Stage I Assessment Report, Volume 2 — Economic Assessment: Kalamazoo River Environment

Final Report

Michigan Department of Environmental Quality,
Michigan Attorney General,
U.S. Fish and Wildlife Service,
and
National Oceanic and Atmospheric Administration

Prepared by:

Stratus Consulting Inc.
PO Box 4059
Boulder, CO 80306-4059
(303) 381-8000

March 15, 2005
SC10093

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1. Introduction

The Director of the Michigan Department of Environmental Quality (MDEQ), the Attorney General of the State of Michigan, and the Secretary of the Interior as represented by the Regional Director of the U.S. Fish and Wildlife Service (U.S. FWS), in coordination with the Secretary of Commerce as represented by the National Oceanic and Atmospheric Administration (NOAA) (collectively referred to as the Trustees), are in the process of assessing damages resulting from injuries to natural resources in the Kalamazoo River Environment (KRE) resulting from releases of hazardous substances into the KRE.[1]

This report presents the methods and results of the Stage I economic assessment of damages resulting from natural resource injuries in the KRE. These injuries have resulted from releases of hazardous substances, which include polychlorinated biphenyls (PCBs), from potentially responsible party (PRP) facilities along Portage Creek and the Kalamazoo River.[2]

The Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended, 42 U.S.C. §§ 9601-75, and the Federal Water Pollution Control Act (Clean Water Act, or CWA), 33 U.S.C. §§ 1251-1387, provide authority for the Trustees to seek such damages. Additionally, the State Trustees have authority to seek damages for the full value of the injuries to natural resources pursuant to Section 20126a(1)(c) of Part 201, Environmental Remediation, of the Natural Resources and Environmental Protection Act (NREPA), MCL § 324.20126, as well as Section 3115(2) of Part 31, Water Resources Protection, of NREPA, MCL § 324.3115(2).

The Trustees followed the U.S. Department of the Interior (DOI) natural resource damage assessment (NRDA) regulations in this Stage I economic assessment [43 CFR § 11.35, 11.82, 11.83, 11.84]. Following these regulations is not mandatory; however, assessments performed in compliance with these regulations have the force and effect of a rebuttable presumption in any

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1. On September 29, 2004, the Michigan Department of Natural Resource (MDNR) was designated to serve as a natural resource co-trustee along with the MDEQ and the Attorney General of the State of Michigan. As of the date of publication of this report, efforts are underway to include the MDNR as a member of the Trustee Council to assure the coordination of future NRDA activities.

2. The U.S. Environmental Protection Agency (EPA) and the State of Michigan identified the following PRPs: Allied Paper, Inc. and its parent company, Millennium Holdings, Inc. (formerly HM Holdings, Inc./Allied Paper Inc., now owned by Lyondell Chemical Company); the Georgia Pacific Corporation; Plainwell, Inc. (successor to Plainwell Paper Inc. and Simpson Plainwell Paper Company); Weyerhaeuser Company; and the Fort James Corporation (formerly James River Company, now owned by Georgia-Pacific) (Blasland, Bouck & Lee, 1992; U.S. District Court, 2000).

administrative or judicial proceeding under CERCLA [42 U.S.C. § 9607(f)(2)(C)]. The DOI regulations also provide a useful context within which the various aspects of the assessment can be evaluated, and therefore have been followed in this document.

This report is part of a multistep process. First, the Trustees conducted a Preassessment Screen (see Michigan Department of Environmental Quality et al., 2000a). Next, the Trustees developed a Stage I Assessment Plan (see Michigan Department of Environmental Quality et al., 2000b). The approaches and methods of this Stage I economic assessment are based on that Assessment Plan. The Trustees designed the Stage I Assessment to develop preliminary conclusions regarding the types and magnitudes of injury and damages resulting from hazardous substance releases into the KRE (see also Michigan Department of Environmental Quality et al., 2005). The Trustees intend the Stage I Assessment to be preliminary, relatively rapid, based primarily on existing data, and highly cost-effective. The Stage I Assessment is based on data known and available to the Trustees through approximately 2003 and on additional information the Trustees were aware of as of the date of this writing. Consequently, while the Stage 1 Assessment is preliminary in nature, it was able to be completed relatively rapidly and is highly cost-effective. The Trustees will use the results of the Stage I Assessment to help define any additional focused work that could be conducted in the next stage and, if appropriate, to help evaluate any potential settlement options. If deemed necessary by the Trustees, the Trustees may conduct a more detailed Stage II Assessment in which the Trustees conduct focused NRDA studies to expand upon the Stage I Assessment. A companion report presents the Trustees' Stage I Injury Assessment Report (Michigan Department of Environmental Quality et al., 2005).

1.1 NRDA Concepts

Certain state and federal agencies that have been designated as Trustees are empowered to obtain compensation from PRPs for damages from injury to, destruction of, or loss of natural resources caused by hazardous substance releases. Trustees must use recovered funds to restore, replace, rehabilitate, or acquire the equivalent of the injured natural resources and their services. In lieu of receiving funds for injuries to natural resources, the Trustees may allow PRPs to implement restoration activities directly.

A measurable adverse change, either long- or short-term, in the chemical or physical quality or the viability of a natural resource resulting from the release of a hazardous substance is known as an *injury* [43 CFR § 11.14(v)]. This report does not discuss the specific scientific nature or extent of natural resource injuries; these can be found in the Stage I Injury Assessment Report (Michigan Department of Environmental Quality et al., 2005). Rather, this report considers natural resource *services,* which are defined in the DOI regulations as the "physical and biological functions performed by the resource, including the human uses of those functions" [43 CFR § 11.14(nn)]. More specifically, this assessment focuses on the human services from natural

resources. Services might include the services members of the public receive from wildlife viewing, recreation, and aesthetics, for example.

The DOI regulations define the measure of damages as *restoration costs* plus, at the discretion of the Trustees, *compensable value for interim losses* [43 CFR § 11.80(b)]. Restoration costs are the costs of restoration actions that restore the injured resources and services to *baseline*, which is the condition that would have existed had the hazardous substance release(s) not occurred [43 CFR §§ 11.80(b), 11.14(e), and 11.14(ll)]. Compensable value for interim losses is the amount of money required to compensate the public for the loss in services provided by the injured natural resources. Compensable value includes the "value of lost public use of the services provided by the injured resources" and can include both past losses and losses that will occur until the injured resources and services are returned to baseline [43 CFR § 11.83(c)(1)]. Thus, the total amount of damages includes both the cost of restoration to baseline and the compensable value for interim losses.

1.2 Public Comment and Information Quality

The Stage I Economic Assessment Report presents the results of the Stage I NRDA that was conducted in accordance with the DOI NRDA regulations as set forth at 43 CFR Part 11.[3] Based upon the results of the Stage I NRDA, the Trustees may augment this evaluation with additional assessment activities to assure the public is appropriately compensated for the lost use of the injured resources. While the Stage I Economic Assessment Report is not subject to a public comment period under state or federal law, the Trustees recognize the benefits of public involvement. Consequently, the Trustees will consider written comments received by April 15, 2005 when planning and undertaking additional assessment activities. Written comments may be submitted to:

Nanette D. Leemon
Michigan Department of Environmental Quality
Compliance and Enforcement Section
Remediation and Redevelopment Division
PO Box 30426
Lansing, MI 48909

3. 43 CFR Part 11 regulations were authored by the DOI, and are referred to as the DOI regulations in this document. Use of these regulations is not required. However, they must be used for the Trustees to gain rebuttable presumption [43 CFR § 11.11].

Information disseminated by federal agencies to the public after October 1, 2002, is subject to information quality guidelines developed by each agency pursuant to Section 515 of Public Law 106-554 that are intended to ensure and maximize the quality of such information (i.e., the objectivity, utility, and integrity of such information). This Economic Assessment Report is an information product covered by information quality guidelines established by NOAA and DOI for this purpose. The information contained herein complies with applicable guidelines.

1.3 Stage I Economic Damages Assessment Approach

As described in the Trustees' Stage I Assessment Plan, the Stage I economic assessment of damages resulting from PCB releases into the KRE consists of two separate components:

1. Assessment of the costs to restore injured resources and their services to baseline condition

2. Assessment of the compensable values for interim losses until the injured resources and services are returned to baseline condition.

The general approach of the Stage I economic damages assessment is to rely primarily on existing data and information, supplemented with newly collected data as necessary and appropriate. Thus, the Stage I economic assessment is not as comprehensive an assessment as described in the DOI NRDA regulations. If necessary, the Trustees may plan and conduct a more comprehensive Stage II economic damages assessment that includes additional site-specific studies.

1.3.1 Approach for estimating costs for restoring injured resources and services to baseline

At this time the Trustees are unable to determine precisely the costs required to restore injured resources and their services to baseline conditions. Changes in the lead agency responsible for the site remedial investigation/feasibility study (RI/FS) and other related delays have extended the schedule for completion of the RI/FS and selection of a remedial action to address KRE PCB contamination. Until a site remedy is selected, the Trustees are unable to define what restoration measures, if any, will be required to restore the injured resources and their services to baseline. The more completely the remedy addresses PCB contamination, the less restoration to restore resources and services will be required. Therefore, this Stage I economic damages assessment does not include an estimate of costs for restoration to baseline. Once a remedy is selected, the Trustees will be able to define the amount and type of restoration required to restore injured resources and their services to baseline, and will then be able to determine restoration costs.

However, the Trustees have begun the process of identifying and selecting natural resource restoration options. First, in the Stage I Assessment Plan the Trustees identified two general types of restoration actions: (1) sediment/soil restoration to eliminate or reduce ongoing exposure of the injured resources to PCBs (in addition to and coordinated with the PCB remedial cleanup), and (2) ecosystem-based restoration, which includes actions that address environmental stressors other than PCBs (e.g., habitat loss and nonpoint source pollution) that result in a loss of services similar to the losses caused by PCB releases.

The Trustees have developed criteria that they plan to use to evaluate potential restoration projects which could enhance or restore natural resources in the KRE. These criteria are based on the factors identified in the DOI regulations [43 CFR § 11.82(d)] and are presented in Chapter 4.

Following the development of the overall restoration framework as described in the Stage I Assessment Plan, the Trustees began soliciting, compiling, and analyzing information on environmental restoration projects that can improve and enhance the KRE natural resource services. State, regional, and local resource agencies, environmental nonprofit groups, and citizen groups provided ideas and specific project proposals for actions that would enhance or restore natural resources in the KRE. These projects have been summarized, categorized, and placed into a database for the Trustees to draw on in the future (see Appendix A).

The Trustees have also begun to identify what kinds of resource restoration actions are most preferred and valued by the public. The Total Value Scoping (TVS) focus groups conducted by the Trustees, described in detail in Chapter 3, provide the Trustees with valuable information about the general categories of potential restoration actions that may be highly valued. This information will be used by the Trustees in identifying and selecting the restoration actions to restore injured resources and services to baseline that provide the most benefit to the public.

The Trustees will continue to coordinate their activities with the ongoing RI/FS and remedy selection process. As that process progresses, the Trustees will re-evaluate their ability to develop more precise Stage I restoration costs. The Trustees will also continue to solicit, compile, and evaluate information on potential restoration projects that could be implemented in the KRE to restore injured resources and services to baseline.

1.3.2 Approach for determining compensable values for interim losses

The Stage I approach for determining compensable values relies on two components: (1) a quantitative estimate of monetized damages resulting from recreational fishing service losses (described in Chapter 2), and (2) a qualitative evaluation of public values and preferences regarding a broader range of service losses (described in Chapter 3). The Trustees also conducted

a preliminary hedonic property value study to determine if the PCB releases into the KRE are having a strong and obvious impact on property values.

At this stage, recreational fishing damages resulting from PCB fish consumption advisories (FCAs) are believed to be the largest and most significant active use damage category for the KRE NRDA. This category is believed to be the largest because recreational fishing typically is one of the most economically significant uses of natural resources in terms of expenditures and number of users. Experience at other sites also suggests that is a major active use category. Moreover, recreational fishing damages are the most easily and accurately quantified given the available information for the site and existing literature on Great Lakes recreational fishing. However, recreational fishing losses from FCAs represent only one service loss category of many that may be occurring in the KRE as a result of the PCB releases (Table 1.1). Therefore, the monetization of damages in this Stage I Assessment, which captures only FCA recreational fishing losses, represents only a portion of the total damages at the site.

Table 1.1. Injured resources and services monetized or addressed qualitatively in the Stage I economic damages assessment

Injured resource	Potentially reduced services	Monetized in Stage I recreational fishing assessment?	Addressed qualitatively in Stage I total value focus groups?
Groundwater	Drinking	No	No
	Agriculture	No	No
	Ecological services	No	No
Surface water	Drinking	No	No
	Water-based recreation	Indirectly/partially	Yes
	Agriculture	No	No
	Aquatic habitat	Indirectly/partially	Yes
	Assimilative capacity[a]	No	Yes
	Ecological services	Indirectly/partially	Yes
Sediments/ floodplains	Habitat	Indirectly/partially	Yes
	Recreation (e.g., camping)	No	Yes
	Assimilative capacity[a]	No	Yes
	Ecological services	Indirectly/partially	Yes
Biological	Recreational fishing	Yes	Yes
	Fish consumption	Yes	Yes
	Recreation (e.g., wildlife viewing, hunting)	No	Yes
	Ecological services	Indirectly/partially	Yes
Geological	Habitat	No	Yes
	Assimilative capacity[a]	No	Yes
	Ecological services	No	Yes

a. The ability of a resource to absorb low levels of contaminants without exceeding standards and without adverse effects to the resource.

As shown in Table 1.1, other service loss categories are addressed in the recreational fishing study (Chapter 2) indirectly and partially, to the extent that anglers are aware of and affected by them. For example, surface water habitat provides ecological services to fish, and therefore surface water ecological service losses are included indirectly in the quantification of recreational fishing losses. However, such services are taken into account only partially in the estimate of recreational fishing damages.

Other selected potential service losses were considered qualitatively through the TVS focus groups described in Chapter 3. The extent to which different categories were addressed in these focus groups is noted in Table 1.1. Not all service categories were addressed. The focus groups discussed only ecological and recreational services, so service categories such as drinking water and agriculture are not explicitly included.

This part of the Stage I Assessment provides information regarding the public's views of natural resource injuries in the KRE and the types of restoration options that could offset the losses resulting from the injuries. The TVS focus groups thus provide information relevant to the value of the broader suite of service losses (beyond recreational fishing losses alone) because they begin to identify the kinds and amount of ecosystem-based restoration activities that are required to offset many service losses caused by PCBs. The qualitative evidence about how the public may value the broader range of services lost, and what could be done to make the public whole without estimating compensable monetary damages for these additional categories, is summarized. The results of the TVS focus groups are important because they provide a link between many of the important biological injuries not addressed by the recreational fishing study and many of the restoration categories that the KRE Trustees anticipate will be most effective for making the public whole.

Finally, the Trustees also conducted a preliminary hedonic property value study as part of the Stage I Assessment. The purpose of the study was to determine if PCB releases into the KRE are having a strong and obvious impact on property values. The study did not find evidence of a substantial effect of PCBs on property values in the KRE.[4] Therefore, no further work on this issue was conducted in the Stage I Assessment.

4. Property values reflect not only the marketable attributes of homes, such as the number of bedrooms or square footage, but also the implicit values of nonmarket amenities and disamenities, such as proximity to a lake or level of contamination. This preliminary study did not detect a discernable impact on property values from PCB contamination in the KRE.

1.4 Summary of Stage I Compensable Value Determination Results

1.4.1 Recreational fishing compensable damages

The computation of compensable recreational fishing damages resulting from PCB FCAs is a major component of this Stage I evaluation. The first method for estimating compensable values for recreational fishing is the benefits transfer approach, which uses unit values from already existing (secondary) valuation studies from the Great Lakes region and elsewhere [43 CFR § 11.83(c)(2)(vi)]. Rather than focusing on collecting new primary valuation data, using data for similar areas and similar types of services and resource injuries results in a cost-effective, first-order estimate of damages. The unit value method requires selecting a unit value per fishing day and multiplying it by the number of fishing days lost or impaired as a result of natural resource injuries.

Because existing estimates of fishing use for the Kalamazoo River are not current, a new recreational angler survey was also conducted in 2001 to estimate the level of current recreational fishing use for the benefits transfer. In addition to obtaining data to estimate aggregate annual use of the river, the survey asked current Kalamazoo River anglers various questions about fishing patterns (e.g., location, frequency), attitudes about fishing the Kalamazoo River, and other socioeconomic variables.

A second, alternative method was also used. A simulation using the Michigan State University (MSU) recreation demand model was conducted to estimate recreational fishing damages resulting from PCB FCAs [43 CFR § 11.83 (c)(2)(iv)]. The MSU model is able to value recreational fishing resources statewide based on observed user behavior as a function of site characteristics (such as site quality) and travel costs.

The estimate of annual recreational fishing damages for the assessment area in 2001 ranges from $221,700 to $324,700. Aggregate damages over time are compounded and discounted following the guidance in the DOI regulations [43 CFR § 11.84(e)]. The present value (in 2003) of past recreational fishing damages from 1981 through 2002 ranges from $9.4 million to $19.8 million. The present value of future interim damages (starting in 2003) varies depending on the remediation scenario for PCB (and FCA) removal. With no cleanup, future damages range from $7.6 million to $10.9 million over a 100-year time horizon. With an intermediate, 40-year cleanup, future damages range from $5.1 million to $7.4 million. With an intensive, 20-year cleanup, future damages range from $3.6 million to $5.1 million. The ranges stem from consideration of alternative assumptions and uncertainty in the benefits transfer, which are required to be considered under the DOI regulations [43 CFR § 11.84(d)].

1.4.2 Total Value Scoping focus groups

The second major component of the Stage I compensable value assessment, the TVS focus groups, is useful for qualitatively evaluating a broader range of service losses and for restoration planning activities. The focus groups take a more comprehensive approach toward addressing multiple service categories simultaneously, such as ecological services and various types of consumptive and nonconsumptive recreation. Focus groups were conducted with the general public based on a short list of potential restoration actions already developed for the KRE by resource managers, which includes a variety of project types that have the potential to restore the range of KRE resources and their services [see 43 CFR § 11.83(b)(1)]. This study was designed to obtain information from the public about its knowledge, attitudes, and preferences for PCB removal and other programs. The results are qualitative only, and quantitative estimates of the monetary damages associated with the broader suite of service losses were not developed in the Stage I Assessment.

To offset service losses on a human-use value-equivalency basis, the correct *scale* of restoration actions, in terms of their types and levels (and subsequently their costs), would have to be determined using a statistical econometric model. While quantitative scaling of restoration programs to obtain value equivalency for losses from PCB contamination is not possible using the Stage I focus group data, rankings and ratings are indicative of the public's intensity of preferences. The focus groups were conducted using new survey instruments with a limited number of people, and, as a result, the findings represent only a preliminary attempt to infuse public preferences into the valuation of a broad range of service losses and the restoration planning process.

The results show clear evidence that residents are aware of and concerned about PCB contamination in the KRE, and that they would like to see those responsible for the PCB releases pay for cleaning it up. While PCB removal is preferred to other types of restoration programs, ecologically based actions such as wetlands restoration or nonpoint source runoff control are the most appealing compensatory restoration actions, on average, to the focus group participants. Recreational facilities are less appealing to them. Focus group respondents indicated that they value a wide variety of services that are impacted by PCBs, other than recreational fishing losses, including ecological services and nonfishing recreation such as beach and bank use.

1.5 Organization of Report

This report is organized as follows:

- Chapter 1 is this introduction, which contains summaries of the two major research efforts in this stage.

- Chapter 2 presents the Stage I estimates of compensable recreational fishing damages resulting from PCB FCA injuries.
- Chapter 3 presents the findings of focus groups exploring the general public's knowledge of and preferences for a variety of improvements to the KRE, including habitat restoration, water quality improvement/protection, recreational access improvements, and PCB cleanup.
- Chapter 4 presents the criteria for evaluating restoration projects that could enhance or restore natural resources in the KRE.

This report also contains six appendices:

- Appendix A contains a summary of potential KRE restoration projects proposed by various state, regional, and local resource agencies; environmental nonprofit groups; citizen groups; and private citizens.
- Appendix B reports the results from a new recreational fishing survey along with aggregate estimates of current (2001) recreational fishing use of the Kalamazoo River. This study is referred to as the Kalamazoo River Recreational Angler (KRRA) study.
- Appendix C presents tables containing current and past fish consumption advisories for various water bodies, including the Kalamazoo River and Lake Michigan.
- Appendix D provides the details of a recreation demand model simulation using the MSU model to obtain an alternative estimate of damages; this appendix was written solely by Dr. Frank Lupi at MSU.
- Appendix E contains all of the written materials for the TVS focus groups.
- Appendix F reports the preliminary opinions of a professional real estate appraiser on whether PCB contamination has had a substantive and measurable impact on property values in the KRE; this appendix was written solely by Steven Ritter, MAI, based on an on-site visit and other information.

2. Recreational Fishing

2.1 Introduction

In this chapter, damages from lost recreational fishing services caused by PCB releases to the Kalamazoo River are quantified. As discussed in Chapter 1, recreational fishing damages constitute an important component of damages, but they are only one component of compensable values for service losses (see Table 1.1). The Stage I Assessment focuses on recreational fishing damages because this component is likely to be a significant portion of the total sum of compensable values and because relatively reliable estimates of this damage category can be readily developed from existing information supplemented with additional site-specific studies. Nevertheless, the estimates reported in this chapter are underestimates of those total losses, because only one type of service loss is valued.

The calculation of recreational fishing damages is based on the following:

- Estimates of actual recreational fishing use on the Kalamazoo River with FCAs in effect. These estimates, described in Section 2.4, were developed primarily from a 1985-1987 Kalamazoo River creel survey by the MDNR and the results of a survey of recreational fishing use, termed the KRRA study, which was conducted by the Trustees in 2001 as part of the Stage I Assessment (see Appendix B).

- Estimates of recreational fishing use on the Kalamazoo River and in Lake Michigan that would have existed if PCBs had not been released and FCAs were not in effect (i.e., fishing use under baseline conditions). These estimates were developed from a combination of the literature on behavioral responses to FCAs and other site characteristics, the results of a Kalamazoo River area survey conducted by the PRPs, a recreational fishing demand model created by researchers at MSU, and a comparison to recreational fishing use on the nearby (and less contaminated) St. Joseph River (Section 2.5).

- The value of the reduced quality of current recreational fishing and the reduced number of recreational fishing days due to PCB contamination and the FCAs. The estimated values of the reduction in fishing days and in fishing quality that result from the PCB FCAs were developed from the available literature.

Estimates of aggregate annual recreational fishing damages are then computed by multiplying the number of affected Kalamazoo River fishing days (encompassing both reduction in quantity and quality) by the corresponding economic value associated with the effect.

2.2 Kalamazoo River Target Species and Fish Consumption Advisories

The deinking, repulping, and use of recycled paper stock led to PCB releases into the Kalamazoo River. An estimated 2.2 to 4.4 million pounds of PCBs were released into the Kalamazoo River (U.S. District Court, 2000).

Releases of PCBs into the Kalamazoo River have resulted in FCAs for the Kalamazoo River and have contributed to the need for FCAs in Lake Michigan. These advisories, which are produced by the Michigan Department of Community Health (MDCH)/MDNR (1977-2001), act as a guide to anglers by recommending how many fish may be eaten safely by the general population and by a special population defined as children and women who are pregnant, nursing, or expect to bear children.[1] These advisories vary by river location and type and size of fish. They include the species commonly sought in the Kalamazoo River (smallmouth bass, walleye, and northern pike) and Lake Michigan (salmon and lake trout). They are more restrictive upstream of Allegan Dam[2] than downstream of the dam (see Figure 2.1).

The central stretch of the Kalamazoo River from Morrow Lake Dam to Allegan Dam is a warm water fishery, and smallmouth bass are the primary target species (James Dexter, MDNR Fisheries Supervisor, personal communication, June 7, 2001). MDNR estimates that in this stretch, 80% of the recreational fishing effort is fishing for smallmouth bass, 15% is for walleye, and 5% is for northern pike (James Dexter, MDNR Fisheries Supervisor, personal communication, June 7, 2001). The KRRA study surveyed 94 Kalamazoo River anglers, primarily between Morrow Lake Dam and Lake Michigan (see Figure 2.1), from May to December 2001 (see Appendix B for further discussion). In the KRRA study, anglers were asked to name the species they were targeting. In this stretch, 11% said they were targeting bass; 22% perch, bluegill, or sunfish; 11% walleye or pike; 11% carp, catfish, or suckers; and 72% "whatever is biting" (percentages sum to more than 100% because anglers could be targeting more than one species). Of the large group who responded, "whatever is biting," the majority in the central stretch were targeting and catching bass, so the breakdowns are roughly consistent across the two sources of data when "whatever is biting" is reallocated as bass.

1. From 1977 to 1983, children are not defined by age in the FCAs. From 1984 to 1987 the advice is for children age 6 and under, and from 1988 to 2000 the advice is for children age 15 and under.

2. Allegan Dam, also known as Caulkins Dam, is the dam that creates Lake Allegan, not to be confused with the dam upstream in the town of Allegan called Allegan City Dam.

Figure 2.1. Kalamazoo River and St. Joseph River.

Since 1979, smallmouth bass have had a "do not eat" restriction for all fish that meet the legal size limits in this stretch,[3] with the exception of 1985-1989, when the smallmouth bass advice was "no more than one meal per week" for the general population and "do not eat" for the special population (of women and children). While smallmouth bass are the most targeted species in this stretch, all other sport species have FCAs as well. The restriction for the other sport species has been "no more than one meal per week" for the general population and "do not eat" for the special population from 1985 to the present. (Tables C.1 and C.2 in Appendix C show the exact advisories by species, size, location, and year for the Kalamazoo River and Lake Michigan.)

Like the central river stretch, the lower Kalamazoo River from Allegan Dam to Saugatuck supports a bass fishery. However this stretch is unique in that it also supports cold water species (trout and salmon). These salmonids enter the river from Lake Michigan to spawn in Kalamazoo tributaries such as the Rabbit River. This migration makes this stretch of river a very popular fishing site, particularly during spring and fall runs. MDNR estimates that in this stretch 60% of the recreational fishing effort is fishing for steelhead (rainbow trout), 20% is for salmon, 15% is for walleye, and 5% is for smallmouth bass (James Dexter, MDNR Fisheries Supervisor, personal communication, June 7, 2001). In the KRRA study, 38% said they were targeting salmon; 3% trout; 7% bass; 16% perch, bluegill, or sunfish; 15% walleye or pike; 18% carp, catfish, or suckers; and 56% "whatever is biting" (percentages add to more than 100% because anglers could be targeting more than one species). Of the large group who responded, "whatever is biting," the majority in the lower stretch were most likely targeting salmon and trout (most of these anglers were interviewed at Allegan Dam, where salmonids congregate), so the breakdowns are consistent across the two sources of data.[4] Assuming all anglers who responded "whatever is biting" are fishing for salmonids, the total targeting these species (rather than warm water species) is 81%.

The FCA restrictions for the lower stretch from Allegan Dam to Saugatuck for warm water species are generally less stringent than those above the dam, with advice being "no more than one meal per week" for the general population and "do not eat" for the special population for legal-sized bass and northern pike. Advisories for salmonids (trout and salmon) for this stretch are the same as those for southern Lake Michigan (described below).

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3. Recreational anglers may only keep fish above a certain length (the legal size limit) defined in the Michigan Fishing Regulations (MDNR, 1999). Therefore the FCAs do not give advice for fish smaller than the legal size limit.

4. This is a congested fishing site. If anglers want to target other species there are more convenient places, but if they prefer targeting salmon this is the optimal spot. This is corroborated by the in-field interviews for the KRRA study.

PCBs released into the Kalamazoo River from paper company facilities have entered Lake Michigan and contribute to the total PCB loadings in Lake Michigan. Thus, a portion of fishing impacts and damages in Lake Michigan from PCB-caused FCAs are attributable to the Kalamazoo River. Lake Michigan advisories vary by species, size, and year, with larger fish having greater restrictions. In Lake Michigan the most important recreational fishing species are salmonids (coho and chinook salmon, and steelhead, brown, and lake trout); in the last 20 years, 80% to 90% of the hours spent in recreational fishing on Lake Michigan were spent targeting salmonids (Rakoczy and Svoboda, 1997). Data from this study on fishing effort by species are not available at the closest creel site to the Kalamazoo River (site 156 at Holland, which includes Saugatuck – see Figure 2.1), but the harvest of salmonids for Lake Michigan breaks down as 45% for coho and chinook salmon, 30% for lake and brown trout, and 25% for steelhead (Rakoczy and Svoboda, 1997, and data from personal communication with G. Rakoczy, MDNR, March 2001).

The advisories for Lake Michigan apply to the Kalamazoo River from Lake Michigan up to Allegan Dam. The Lake Michigan and lower Kalamazoo River advisories for salmonids have varied throughout the years, becoming less restrictive recently. Generally from 1977 to 1995, it was advised that the general population should eat no more than one meal of salmon per week, and that the special population should eat none. More recently this advice was relaxed to advise that the general population eat unlimited amounts and the special population restrict consumption to 6 to 12 meals a year. For lake and brown trout (larger than 23 inches for both species), advice has remained “do not eat” from 1986, when they were first added to the advisory, to the present, and advisories for those less than 23 inches are similar to those for salmon. Steelhead had an advisory from 1977 to 1985 (“no more than one meal a week” for the general population and “do not eat” for the special population) and 1998 to the present (“no more than one meal a week” for steelhead 10 to 18 inches or “no more than one meal a month” for steelhead greater than 18 inches for the special population).

2.3 Behavioral Responses to FCAs

The intent of FCAs is to educate and warn anglers about potential health risks associated with eating fish and to encourage changes in behavior, if and as necessary, to reduce potential health risks. The KRRA study found that 41% of those fishing on the river were aware of FCAs. Most anglers did not eat any of the fish they caught there (72% of all anglers surveyed above Allegan Dam and 48% of all anglers surveyed below). When asked what they most disliked about fishing the Kalamazoo River, 9% said PCBs, although those continuing to fish the Kalamazoo River may be less concerned about the contamination than those who have substituted to other sites.

Another survey conducted in the assessment area (Atkin, 1995) was specifically of anglers who live in eight counties closest to the Kalamazoo River. Of the 690 anglers interviewed, 67% were aware of the FCAs issued by the Michigan Department of Public Health and 25% mentioned the Kalamazoo River specifically. The survey found that 38% of anglers aware of FCAs avoid fishing certain locations because of FCAs (those locations were not specified). These trips are substituted to other sites or activities that would be considered inferior if the Kalamazoo River were not contaminated. Anglers who fish elsewhere are incurring higher travel costs or inferior conditions (than they would enjoy under baseline conditions) because of the substitution. The Atkin study shows a strong response to FCAs, especially in terms of changing fishing location and avoiding fish from waters with FCAs. Other studies of other Great Lakes fishing sites confirm and show a broader picture of the significance of FCAs on angler behavior.

The literature on anglers' behavioral responses to FCAs repeatedly shows that anglers change their behavior in response to FCAs. Table 2.1 reports key results from this literature for Great Lakes locations. In each study the FCAs vary by fish species, and for the studies where more than one site is included, they also vary by location. The behavioral responses to FCAs range from reductions in trip taking to changes in how fish are prepared and cooked. These behavioral changes represent recreational fishing services that have been lost to anglers, so they experience damages. Even anglers who do not change their behavior may experience a reduction in enjoyment of their fishing experience, thus experiencing a loss of services, and therefore may be injured.

Table 2.1. Selected Great Lakes studies of behavioral responses by anglers to FCAs

Study	State, year	Site	Reported behavioral response to FCAs[a]
Atkin, 1995	MI, 1994	All sites in the 8 counties near the Kalamazoo River	Percent of all anglers (in parentheses, percent of anglers who were aware of or had heard of Michigan FCAs) 5% (7%) change type of fish targeted 29% (38%) avoid fishing certain locations 42% (55%) avoid eating all fish from advisory waters 7% (9%) avoid eating certain types of fish from advisory waters 8% (11%) reduced quantity of fish eaten from advisory waters 7% (9%) changed the way fish from these waters is cooked or trimmed
Breffle et al., 1999	WI, 1999	Lower Fox River and Green Bay	For active Lower Fox River/Green Bay anglers 30% spend fewer days fishing 31% change locations fished 23% target different species 45% change the species they keep to eat 47% change the size of fish they keep to eat 45% change the way they clean/prepare fish 25% change the way they cook fish

Table 2.1. Selected Great Lakes studies of behavioral responses by anglers to FCAs (cont.)

Study	State, year	Site	Reported behavioral response to FCAs[a]
Connelly et al., 1990	NY, 1987-1988	New York inland waters and Lake Ontario	Of the 82% aware of health advisories, 61% made a change; of these 61%: 17% take fewer trips 31% change fishing locations 46% change cleaning/cooking methods 51% eat fewer fish from the site 17% eat different species 11% no longer eat fish from the site
Connelly et al., 1992	NY, 1990-1991	All waters of New York	Of the 85% aware of advisories, 50% made a change; of these 50%: 18% take fewer trips 45% change cleaning methods 25% change the size of fish consumed 21% change cooking methods 70% eat less fish from the site 27% eat different species 17% no longer eat fish from the site
Connelly et al., 1996	NY, 1993	Fish caught in Lake Ontario	79% use risk-reducing cleaning methods 42% use risk-reducing cooking methods 32% would eat more fish in the absence of FCAs
Fiore et al., 1989	WI, 1985	Lake Michigan	57% report changing fishing habits and/or fish consumption habits
Hutchison, 1999	WI, 1997	Lower Fox River	64% had made a change; of these 64%: 71% travel to other locations to fish 66% do not eat the fish they catch 18% change frequency of fish consumption 10% target and catch different species 7% change the size of fish they keep 2% clean or prepare fish in different ways
Knuth, 1996	NY portion of Lake Ontario, 1993	Fish caught in Lake Ontario	75% refrain from consuming fish that advisories state should not be consumed 80% do not exceed advisory recommendations
Knuth et al., 1993	IL, IN, OH, KY, PA, WV, 1992	Fish caught in the Ohio River	Of the 83% aware of advisories: 37% take fewer trips 26% change fishing locations 26% change targeted species 23% change cleaning methods 17% change the size of fish consumed 13% change cooking methods 42% eat less fish from the site 13% no longer eat fish from the site

Table 2.1. Selected Great Lakes studies of behavioral responses by anglers to FCAs (cont.)

Study	State, year	Site	Reported behavioral response to FCAs[a]
Silverman, 1990	MI, 1990	All waters of Michigan, including Great Lakes and inland waters	Of the 54% who are aware of the advisories, 92% have modified their behavior; of these 92%: 10% take fewer trips 31% change fishing locations 21% change targeted species 56% change cleaning methods 41% change the size of fish consumed 28% change cooking methods 56% eat less fish from the site 31% eat different species
Vena, 1992	NY, 1990-1991	Fish caught in Lake Ontario	Of the 92% aware of the health advisory, 41% made changes; of these 41%: 16% take fewer trips 30% change fishing locations 20% change targeted species 31% change cleaning methods 53% eat less fish from the site 16% no longer eat fish from the site
West et al., 1989	MI, 1988	Michigan Great Lakes and inland waters	87% were aware of advisories; of these 87%: 76% change cleaning methods 73% change cooking methods 64% eat fewer fish from the site 66% change species fished
West et al., 1993	MI, 1991-1992	Michigan Great Lakes and inland waters	86% change cooking methods (Great Lakes anglers) 80% eat different species (Great Lakes anglers) 46% eat less fish from the site (overall) 27% change cooking methods (overall) 80% are aware of advisories; of these 80%: 75% change cleaning methods

a. Unless otherwise indicated, percentages are for all anglers, not just those aware of FCAs.

The study results listed in Table 2.1 show a broad consistency in the types of behavioral changes, although the specific magnitude of responses to FCAs varies by location, FCA severity, and species.[5] Many of the studies in Table 2.1 cannot be directly compared because some results are

5. Some studies interviewed people who continued to fish at a site, omitting anglers who moved to substitute sites, or interviewed only those anglers who continued to fish in a region, omitting anglers who stopped fishing the region (or potential new anglers who did not start fishing) because of FCAs. As a result, the statistics in Table 2.1 may understate the response of changing where one fishes as a result of the FCAs. Because the results of Table 2.1 are used, in part, to estimate substitution from the Kalamazoo River due to FCAs, use of these results contributes to conservative damage estimates.

reported as percentages of all anglers, some results are reported as percentages of anglers aware of FCAs, and some results are reported as percentages of anglers who are both aware of FCAs and have modified their behavior. The percentage of anglers who are aware of advisories may be directly affected by the population of anglers sampled. For example, awareness of the FCAs for the Kalamazoo River is expected to be much higher for anglers living in Allegan and Kalamazoo counties, where the assessment area is located, than the awareness of these specific FCAs of all Michigan anglers. Therefore, while the percentage of all anglers who have a behavioral response to FCAs can be computed by multiplying the percentage of knowledgeable anglers by the percent of those anglers who change their behavior, in general that is not done.[6] Because the sampled populations vary widely across the studies, there are limitations to how these figures can be compared across studies for any specific behavioral change.

The literature cited in Table 2.1 suggests that the presence of FCAs has resulted in reductions to the number of recreational fishing days taken. Anglers who continue to fish the Kalamazoo River are also affected because the quality of fishing has been reduced. The presence of FCAs may also have discouraged some anglers from fishing at all. For some individuals, the Kalamazoo River may be the only site that they would like to fish because of the convenience of its location. These individuals may return to fishing in the absence of contamination and FCAs; therefore they have experienced service losses and will continue to experience losses until FCAs are removed because they are no longer necessary.

2.4 Estimates of Kalamazoo River Recreational Fishing Use

Sport fishing is a popular recreational activity in Michigan enjoyed by approximately 1.5 million anglers each year. In 1996, resident anglers took about 21 million fishing trips and nonresidents took about 1 million fishing trips in Michigan (U.S. DOI, 1998). The MDNR conducts creel surveys and counts of Michigan fishing activity annually for Lake Michigan and some other popular sites. MDNR surveyed the Kalamazoo River from 1985 to 1987, but has not done so since then. In 2001, the Trustees conducted a new count study and creel survey (the KRRA study is described in detail in Appendix B). The 1985-1987 data and the KRRA study were used to estimate use levels from 1981 to the present.[7]

6. The exception is in Section 2.5, where results from these studies are used loosely to infer the percentage of anglers who substitute to other fishing sites or reduce their total fishing days as a result of contamination.

7. Damages are estimated starting in 1981 because Section 107(f)(1) of CERCLA limits recovery for natural resource damages to cases where the damages and the release of hazardous substances from which such damages resulted have occurred wholly after the enactment of CERCLA on December 11, 1980.

Kalamazoo River

As discussed above, the Kalamazoo River includes two stretches that differ greatly in terms of the type of species sought. In the lower stretch, anglers target cold-water sport fish such as salmon and trout, and these fish are stocked by the state yearly (MDNR, 2000). Anglers can also catch walleye, smallmouth bass, bluegill, and catfish on this stretch. Using data from the Kalamazoo River Basin Fisheries Management Plan (Johnson et al., 1988), from the MDNR 1985, 1986, and 1987 creel surveys for the Kalamazoo River below Lake Allegan Dam, and from personal communication with James Dexter (MDNR Plainwell District, 1993) it is estimated that use levels for the lower stretch ranged from 48,600 to 56,200 fishing days per year in 1985 through 1987 (see Table 2.2).[8] Each year the MDNR conducts creel surveys of inland waters using standard practices of data collection and aggregation methods as discussed in Lockwood (2000). However the Kalamazoo River was included in the yearly creel surveys only in 1985 through 1987. These creel data are the only aggregate use estimates for the Kalamazoo River available from 1985 to 2000 (the KRRA study was conducted in 2001).

In 1994 the MDCH intercepted anglers on the Kalamazoo River to evaluate their exposure to PCBs, DDE, and mercury (MDCH, 2000). Of the 1,060 intercepted, 937 participated in their study. While the study found that Kalamazoo River fish-eaters were likely to have significantly higher residual levels of PCBs in their blood than non-fish-eaters, it did not use a sampling plan to contact anglers, or collect data in such a way that aggregate inferences could be made about use.

The KRRA study estimates that there were 19,416 to 20,193 fishing days on the lower Kalamazoo in 2001.[9] To extrapolate levels between 1987 and 2001, a linear change from the 1985 through 1987 levels to the 2001 levels is assumed for the lower stretch. This is shown in Table 2.2. For the years before 1985 it is assumed that use was constant at the 1985 through 1987 level.

8. If one angler fishes for any part of one day, that is an “angler day.”

9. These figures do not include winter fishing, which is expected to be relatively low. See Appendix B, Section B.5.

Table 2.2. Estimate of fishing days on the Kalamazoo River

Year	1985-1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Central stretch: Morrow Lake Dam to Allegan Dam[a]	4,860 to 5,620	4,652 to 5,363	4,443 to 5,106	4,235 to 4,848	4,533 to 5,091	4,831 to 5,334	5,130 to 5,576	5,428 to 5,819	5,727 to 6,061	6,025 to 6,304	6,323 to 6,547	6,622 to 6,789	6,920 to 7,032	7,219 to 7,274	7,517 to 7,517
Lower stretch: Allegan Dam to Lake Michigan[b]	48,600 to 56,200	46,515 to 53,628	44,431 to 51,056	42,346 to 48,484	40,262 to 45,912	38,177 to 43,340	36,093 to 40,768	34,008 to 38,197	31,923 to 35,625	29,839 to 33,053	27,754 to 30,481	25,670 to 27,909	23,585 to 25,337	21,501 to 22,765	19,416 to 20,193
Total	53,460 to 61,820	51,167 to 58,991	48,874 to 56,162	46,581 to 53,333	44,795 to 51,003	43,009 to 48,674	41,222 to 46,345	39,436 to 44,015	37,650 to 41,686	35,864 to 39,357	34,078 to 37,027	32,292 to 34,698	30,505 to 32,369	28,719 to 30,039	26,933 to 27,710

a. Central stretch use is assumed to be 10% of lower stretch from 1985 to 1990 (from personal communication with James Dexter, MDNR, March 2001), and then is assumed to grow linearly from 1991 to 2001 (a straight line extrapolation between these two endpoints).
b. Lower stretch use is based on 1985-1987 average days for Kalamazoo (Johnson et al., 1988; and from personal communication with James Dexter, MDNR, 1993) with linear growth to the 2001 KRRA estimates (a straight line extrapolation between these two endpoints).

A second-best alternative method of extrapolating the 1985 through 1987 estimates to recent years is to assume that the lower stretch of the Kalamazoo River experienced the same proportional fluctuations in fishing effort as the lower stretch of the nearby St. Joseph River (1985-1987 data are available only for the lower stretches). This method is used to provide additional evidence as groundtruthing for the primary estimate described above. The St. Joseph River can be used as a comparison for several reasons. It has had consistent creel fishing surveys conducted from 1985 to the present. The MDNR sampled the St. Joseph River using the same methods and in the same years (1985 through 1987) as the Kalamazoo River. It is proximate, lying about 48 miles south of the Kalamazoo River. It is also surrounded by a similar-sized population. The Kalamazoo River is closer to in-state population centers such as Kalamazoo, Grand Rapids, Muskegon, Detroit, and Lansing than the St. Joseph River, and the St. Joseph River is closer to Chicago, Illinois, and South Bend, Indiana. These rivers are of roughly similar size with the same species, both drain into Lake Michigan, and both are likely to have experienced about the same weather and climate conditions. Thus it is a similar site to approximate the fluctuations in fishing pressure that the Kalamazoo River most likely experienced.[10] This approach may result in an underestimate of Kalamazoo fishing use since the counties near the Kalamazoo experienced an 11% increase in population from 1985 to 2000, whereas counties near the St. Joseph experienced no increase in population in this same period (U.S. Census Bureau, 2001). Table 2.3 shows the estimates using the St. Joseph River fishing growth for 1985 to 2000. Comparing this to the extrapolation using the creel data, there is a higher range of use levels. For damage calculations, the estimates based on the KRRA survey (shown in Table 2.2) were used, since they are specifically for the assessment area.

The central stretch of the Kalamazoo River, from Morrow Lake Dam to Allegan Dam, receives only a fraction of the use of the lower stretch. It is a warm water fishery that is 49.2 river miles long. While this stretch is believed to be a productive fishery in terms of stock, restrictive FCAs placed on all species of all sizes (as discussed in Section 2.2) may be contributing to the lack of use of this stretch (James Dexter, MDNR, personal communication, March 2001). Use of the central stretch above Allegan Dam increased starting in the early 1990s largely as a result of improvements in the aesthetic quality of the river (James Dexter, MDNR, personal communication, March 2001). Although there continue to be problems with the river's appearance and odor, more anglers returned to the river in the early 1990s as water quality, odor, and appearance improved.

10. There are also several notable differences between the rivers, such as more wetlands and government-owned property surrounding the Kalamazoo River, and greater widths on the St. Joseph River that are more conducive to boating recreation (see Appendix F for further explanation).

Table 2.3. Second-best estimate of fishing days on the lower stretch of the Kalamazoo River (below Allegan Dam to Lake Michigan) based on St. Joseph River growth rate

	1985-1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Fishing days	48,600 to 56,200	41,771 to 48,303	41,771 to 48,303	30,797 to 35,613	30,685 to 35,483	40,059 to 46,323	28,853 to 33,366	41,175 to 47,614	38,953 to 45,045	44,115 to 51,013	43,435 to 50,227	29,645 to 34,280	45,622 to 52,756	43,703 to 50,537

Estimated using data from Kalamazoo River use in 1985-1987. Extrapolated to future years assuming the same fluctuations in fishing pressure as in the St. Joseph River use.

Sources: Johnson et al., 1988; and from personal communication with James Dexter, MDNR, 1993.

Data on aggregate use of the central stretch are available only for 2001 (KRRA). For that reason, professional estimates of the level of use on the central stretch from James Dexter of the MDNR Plainwell office are used. James Dexter has worked in the Kalamazoo River area as a fisheries biologist since the 1980s. He was involved in conducting the 1985-1987 Kalamazoo River creel surveys. He estimates that use of the central stretch has been on average about 20% of the total use in the stretch below Allegan Dam since the early 1990s and was about 10% before that (James Dexter, MDNR, personal communication, March 2001). The KRRA study found that use in the stretch above Allegan Dam is currently about 37% to 39% of the use below the dam, suggesting the central stretch has been increasing in popularity over time. Table 2.2 shows the estimate of use for this central stretch. Here it is assumed that the central stretch had 10% of lower stretch use from 1985 to 1990, and thereafter a linear increase in use to the 2001 estimate from the KRRA is assumed.

Lake Michigan

To estimate the number of Lake Michigan fishing days affected by the PCB contamination from the Kalamazoo River, two assumptions are made to generate different estimates of Lake Michigan losses. For the estimate considered to be most reliable, it is assumed that all fishing days near the Kalamazoo River (based on the Holland creel survey site data) are the only fishing days affected by the Kalamazoo River contamination, because other Great Lakes Areas of Concern are much farther from this creel survey area than is the Kalamazoo River. An average of 22,200[11] Lake Michigan fishing days occur in the Holland creel survey area each year (see Table 2.4).

The second method is a weaker approach. It is assumed that since 2.0% of the recent total PCB loadings into Lake Michigan is estimated to come from the Kalamazoo River (U.S. EPA, 2000), 2.0% of the existing Lake Michigan fishing days are affected by Kalamazoo PCB contamination. This approach requires the assumption that factors contributing to or underlying damages (e.g., use levels, population centers, FCAs) are uniform around Lake Michigan, which obviously is not true. Using the second approach, there would be an average of 13,500 affected Lake Michigan fishing days per year (which is based on 2% of the total Lake Michigan days) between 1985 and 2001. The second estimate of affected Lake Michigan days and total Lake Michigan days is reported in Table 2.4.

11. Average Holland fishing days are derived based on the years 1992-2001 only because Holland data for 1985-1991 do not exist.

Table 2.4. Estimate of fishing days for Lake Michigan area affected by the Kalamazoo River PCB contamination, April through October, 1985-2001

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Holland, MI creel area[a]	40,316	42,447	33,153	25,363	23,551	18,803	20,405	21,633	15,927	31,169	29,162	21,326	24,054	9,790	24,077	23,800	20,851
2.0% of Lake Michigan[b]	20,648	21,739	16,979	12,990	12,062	9,630	10,451	9,217	9,615	6,959	12,975	13,365	13,955	14,711	13,513	13,589	16,323
All of Lake Michigan	1,032,400	1,086,968	848,973	649,505	603,101	481,517	522,532	460,866	480,726	347,966	648,755	668,251	697,769	735,545	675,650	679,437	816,151

a. Holland, MI (site 156) is the closest Lake Michigan creel area to the Kalamazoo River. For 1985 through 1991, Holland data are unavailable. For these years Holland use is approximated by calculating the average ratio of Holland days to total Lake Michigan days for the years for which data are available, and then applying that ratio to total Lake Michigan days from 1985 through 1991.

b. Lake Michigan hours of angler effort were divided by 4.5 hours per trip. This average trip length was calculated from data from 1991-2000 for Lake Michigan sites on the southern east coast. Data from personal communication with G. Rakoczy, MDNR (March 2001).

Sources: 1985-1994 data from Rakoczy and Svoboda (1997); 1995 to 2000 data from personal communication with G. Rakoczy, MDNR (March 2001); 2001 data from personal communication with G. Rakoczy, MDNR (August 2002).

2.5 Estimates of Kalamazoo River Fishing Use in the Absence of FCAs (baseline)

Recreational angling use of the Kalamazoo River and Lake Michigan in the absence of FCAs might be higher than current use for several reasons: (1) existing anglers might substitute fishing days away from other sites to the Kalamazoo River (substituted days); (2) existing anglers might increase their number of fishing days per year, including Kalamazoo River days (foregone days); and (3) new participants who do not currently fish might use the resources for recreational angling. Only the first two categories of "reduced days" are estimated and substituted and foregone days are not distinguished from each other when reduced user days are estimated below.

In Atkin's (1998) survey of Allegan and Kalamazoo County residents, he found that 77% of respondents were concerned about Kalamazoo River contamination and 24% were specifically concerned about contamination effects on fish and fishing. These individuals were not asked if they fish, but of these people concerned about fish and fishing (24%), 57% said the current level of contamination was keeping them from using the Kalamazoo River. This and other evidence discussed below suggests that contamination has reduced the number of recreational angling days on the Kalamazoo River.

To estimate how many more fishing days would be spent fishing the Kalamazoo River in the absence of PCB contamination, estimates from related studies and comparisons to other sites are used. In a 1999 study, Breffle et al. (1999) modeled the effects of changes in FCAs, launch fees, and catch rates in Green Bay on fishing use and values. Green Bay FCAs for consuming smallmouth bass and steelhead currently are "no more than one meal per month." Other species have advisories that vary by fish size, and these advisories are shown in Appendix C (Table C.3). Compared to those for the Kalamazoo River and southern Lake Michigan, the Green Bay advisories are generally less stringent than those for the Kalamazoo River above Allegan Dam and more stringent than those for the Kalamazoo River below Allegan Dam and for southern Lake Michigan. Breffle et al. (1999, In press) found that eliminating FCAs from Green Bay would increase the number of fishing days from 2% to 15% among current Green Bay anglers (the study group).

Other studies have reported the effects on use of a change in angler catch rates, which is loosely relevant even though PCB removal may have no effect on stocks and catch rates of fish. Changes in catch rates are not the same as changes in FCAs, but nonetheless may be useful as indicators of the magnitude of changes in use as a response to a change in an important site characteristic. In Breffle et al. (1999), Green Bay anglers rated the importance (and value) of cleaning up contaminants such as PCBs dramatically higher than increasing angler catch rates. On this basis, the change in use estimated for catch rate increases might be interpreted as a conservative

estimate of the change in use that would result following a significant improvement in FCAs and PCB contamination.

Five of these catch studies along with the Green Bay PCB study are included in Table 2.5 to serve as indicators of the general magnitude of responses to changes in important recreational fishing site characteristics, even though changes in catch rates (and the magnitudes of those changes) are not directly related to FCAs. These studies estimated damages in both categories (substituted and forgone days), and the estimates are generally higher than Breffle et al.'s (1999, In press) estimates of the impact of eliminating FCAs.

Table 2.5. Changes in fishing use from change in conditions

Study	Area	Change modeled	Change
Breffle et al., 1999, In press	Green Bay, WI	Increase in days spent fishing Green Bay from substitution of days fishing from other sites when FCAs are removed	2% to 15%
Morey et al., 1993, 2001	Penobscot River, ME	Increase in total days spent fishing Penobscot River when catch is doubled	34% to 43%
Morey et al., 1995, 2002	Upper Clark Fork Basin, MT	Increase in total days spent fishing upper Clark Fork River when catch is increased 85%	66%
Shaw, 1985; Morey and Shaw, 1990	New York, with multiple, small fishing sites	Increase in total angler days when catch is doubled	10% to 40%

Another basis to approximate the change in user days under baseline conditions is to use the studies in Table 2.1 to obtain the percentage of all anglers (including those not aware of FCAs) who substitute away from contaminated sites (to other sites or other activities), which ranges from 11% to 45%, and the percentage of all anglers who fish less, which ranges from 5% to 37% (see Table 2.1). Atkin (1995) estimated that 29% of all anglers (including those not aware of FCAs) avoid fishing the contaminated sites (by substituting to other locations or fishing less overall). Using that figure and assuming all anglers spend the same number of days, and those who avoid contaminated locations do so for all of their days, an estimate of how much Kalamazoo River user days would increase under baseline conditions is 41%.[12] Again, this method provides only a rough approximation, because the percentage of anglers who avoid a site is a different variable than the percentage of days lost at a site. This discussion is used only as a guide in choosing an appropriate adjustment for lost days.

12. The percentage of anglers who avoid certain locations is 29%, and therefore the percentage who do not avoid certain locations is 71%. Under the strong assumption that all anglers spend the same number of days fishing, and those who avoid contamination do so for all their days, then use is decreased from 100% to 71%. 100 is 41% higher than 71: 100/71 = 1.41.

Another approach uses results from the MSU recreation demand model, which is discussed in detail in Section 2.7 and Appendix D. Application of the MSU recreation demand model to the Kalamazoo River in Kalamazoo and Allegan counties demonstrates that recreational fishing would increase by almost 62% if PCBs had not been released. Further, the 62% increase is a lower-bound estimate because it includes other fishing sites besides the Kalamazoo River that are not improved in the simulation (although the Kalamazoo is the largest fishing site in these counties).[13]

Comparing the recreational fishing use on the Kalamazoo River to use on other Michigan rivers with lower or no FCAs provides another basis of estimating the number of days anglers would spend fishing the Kalamazoo River in the absence of PCB contamination. As discussed in Section 2.4, the St. Joseph and Kalamazoo rivers share some similarities; a major difference is that the St. Joseph River has less restrictive FCAs than the Kalamazoo River (see Appendix C, Table C.4).

While a St. Joseph River comparison is not the basis for selecting a factor to estimate the reduced number of fishing days, it does provide an additional means of evaluating the accuracy of the methods employed. As discussed earlier, in 1985-1987 the MDNR conducted creel surveys on both rivers using the same survey sampling methods. The 1985-1987 levels of use for the lower Kalamazoo River (below Allegan Dam) are compared to those for the St. Joseph River, which is particularly useful for the past. Because the data do not match exactly (months are missing for the Kalamazoo River), two different comparisons are made: one using all available data, and one using only data from the same months of the same years for which use data are available for the lower Kalamazoo River stretch. The former estimate probably provides a more accurate statistic for average use of the St. Joseph River, but the latter may be more useful for a direct comparison with the Kalamazoo River stretch.

The estimate for all months covered by the St. Joseph data is 13% higher per mile than the 1985-1987 levels of use on the Kalamazoo River. The per-mile estimate for only the selected St. Joseph data that conform to the months for which Kalamazoo data are available is 56% higher than 1985-1987 levels of Kalamazoo River use. A significant portion of the difference between the two rivers is expected to be attributable to PCB contamination.

Two estimates for the estimation of lost days are used. The low estimate is 15%, and the high estimate is 50%. The estimates of change in use (reduced days) are uncertain, which leads to a relatively large range in the predictions. Changes of 15% and 50% are in line with other estimates from the literature.

13. When other sites with no improvements are included, they dilute the percentage increase to the injured sites because no increase (or a relatively small increase if sites are complements) is expected for those other sites following cleanup.

Tables 2.6 and 2.7 show the estimates of the reductions in Kalamazoo River days in the central and lower stretches, above and below Allegan Dam, respectively, as a result of FCAs. Four estimates are presented for each stretch. The first two estimates apply the low estimate and the last two apply the high estimate of the percentage increases (under baseline) to the upper and lower bounds of the estimates of current Kalamazoo River fishing days, respectively. These are estimates of the reductions in user days, including both substituted and foregone days.

For the Kalamazoo River below Allegan Dam and for Lake Michigan, there are some years when not all species had FCAs for the general population. In these years, it is assumed that only potential fishing days for those species with advisories are lost. While there were no advisories for the general population, there were advisories for the special population of women and children. Most anglers are male adults and so the "unlimited consumption" advisory would apply to them. However, they may be concerned about the special advisory if they are fishing with family or intending to share meals with their families. If this concern affects the quality of their fishing days, then their damages have been underestimated. For example, in 2001, steelhead and salmon had no advisories for the general population, and they constitute about 80% of the fishing activity.[14] As a result only the estimates of the percentages for the reduced days to the 20% of Kalamazoo River days are applied below Allegan Dam that were affected by advisories. This same approach was applied to each year in the past. For example, in 1992, 75% of Lake Michigan, 40% of lower Kalamazoo River, and 100% of central Kalamazoo River fishing days were spent targeting species with FCAs for the general population, and so the estimates of the percentage of reduced days are applied only to these affected days.

Table 2.8 shows the estimate of the reduction in Lake Michigan fishing days due to FCAs. Substitution may be lower because Great Lakes sites are unique. Lake Michigan fishing also requires a larger investment in equipment than river fishing (e.g., navigating and finding fish in the much larger waterbody requires a much larger boat at a minimum). Therefore Great Lakes anglers who have this equipment may have a lower response to FCAs in terms of the percentage reduction of days, because it is more difficult to substitute away from Lake Michigan. Likewise, anglers who currently do not have suitable equipment for Lake Michigan fishing might not substitute into Lake Michigan if FCAs were removed, at least in the short term. As such, for the estimate of reduced Lake Michigan fishing days due to PCB contamination, only the low estimate of reductions of 15% is used. For 1981-2001, the estimate for the average reduction in the number of Lake Michigan fishing days annually is between 1,600 and 3,100, depending on the total number of days assumed to be currently affected by Kalamazoo River PCB contamination.

14. The KRRA study found that 79% of the anglers below Allegan Dam were fishing for trout, salmon, or "whatever is biting." Dexter (see Section 2.2) estimates that 80% of anglers in this stretch are fishing for trout or salmon.

Table 2.6. Estimated reductions in central Kalamazoo River (Morrow Dam to Allegan Dam) fishing days due to Kalamazoo River FCAs (1981-2001)

Year	Estimate	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
Days fished[a]	Low	4,860	4,860	0	3,888	4,860	4,860	4,860	4,652	4,443	4,235	4,533	4,831	5,130	5,428
	High	5,620	5,620	0	4,496	5,620	5,620	5,620	5,363	5,106	4,848	5,091	5,334	5,576	5,819
Reduction (low; 15%)	Low	729	729	0	583	729	729	729	698	666	635	680	725	769	814
	High	843	843	0	674	843	843	843	804	766	727	764	800	836	873
Reduction (high; 50%)	Low	2,430	2,430	0	1,944	2,430	2,430	2,430	2,326	2,222	2,117	2,267	2,416	2,565	2,714
	High	2,810	2,810	0	2,248	2,810	2,810	2,810	2,681	2,553	2,424	2,546	2,667	2,788	2,909

Table 2.6. Estimated reductions in central Kalamazoo River (Morrow Dam to Allegan Dam) fishing days due to Kalamazoo River FCAs (1981-2001) (cont.)

Year	Estimate	1995	1996	1997	1998	1999	2000	2001
Days fished[a]	Low	5,727	6,025	6,323	6,622	6,920	7,219	7,517
	High	6,061	6,304	6,547	6,789	7,032	7,274	7,517
Reduction (low; 15%)	Low	859	904	949	993	1,038	1,083	1,128
	High	909	946	982	1,018	1,055	1,091	1,128
Reduction (high; 50%)	Low	2,863	3,013	3,162	3,311	3,460	3,609	3,759
	High	3,031	3,152	3,273	3,395	3,516	3,637	3,759

a. Affected number of days fished are from estimates shown in Table 2.2, adjusted to include only those days when the target species had a general population FCA for each year. For example, in 1983 0% of central Kalamazoo fishing days were spent targeting a species that had a general population FCA, and in 1984 it was 80%.

Table 2.7. Estimated reductions in lower Kalamazoo River (downstream of Allegan Dam) fishing days due to Kalamazoo River FCAs (1981-2001)

Year	Estimate	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
Days fished[a]	Low	41,310	41,310	38,880	38,880	41,310	7,290	12,150	11,629	11,108	10,587	10,065	15,271	14,437	13,603
	High	47,770	47,770	44,960	44,960	47,770	8,430	14,050	13,407	12,764	12,121	11,478	17,336	16,307	15,279
Reduction (low; 15%)	Low	6,197	6,197	5,832	5,832	6,197	1,094	1,823	1,744	1,666	1,588	1,510	2,291	2,166	2,040
	High	7,166	7,166	6,744	6,744	7,166	1,265	2,108	2,011	1,915	1,818	1,722	2,600	2,446	2,292
Reduction (high; 50%)	Low	20,655	20,655	19,440	19,440	20,655	3,645	6,075	5,814	5,554	5,293	5,033	7,635	7,219	6,802
	High	23,885	23,885	22,480	22,480	23,885	4,215	7,025	6,704	6,382	6,061	5,739	8,668	8,154	7,639

Table 2.7. Estimated reductions in lower Kalamazoo River (downstream of Allegan Dam) fishing days due to Kalamazoo River FCAs (1981-2001) (cont.)

Year	Estimate	1995	1996	1997	1998	1999	2000	2001
Days fished[a]	Low	6,385	5,968	5,551	5,134	4,717	4,300	3,883
	High	7,125	6,611	6,096	5,582	5,067	4,553	4,039
Reduction (low; 15%)	Low	958	895	833	770	708	645	582
	High	1,069	992	914	837	760	683	606
Reduction (high; 50%)	Low	3,192	2,984	2,775	2,567	2,359	2,150	1,942
	High	3,562	3,305	3,048	2,791	2,534	2,276	2,019

a. Affected number of days fished are from estimates shown in Table 2.2, adjusted to include only those days when the target species had a general population FCA for each year. For example, in 2001 20% of lower Kalamazoo fishing days were spent targeting a species that had a general population FCA, whereas in 1992 it was 40%.

Table 2.8. Estimate of Lake Michigan lost fishing days due to Kalamazoo River PCB contamination (1981-2001)

Days affected by Kalamazoo		1981[a]	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
Lake Michigan days[b]	2.0% of all LM	17,551	20,648	20,648	20,648	20,648	16,305	12,735	9,743	9,047	7,223	7,838	6,913	7,211	5,219
	LM at Holland	34,268	40,316	40,316	40,316	40,316	31,835	24,865	19,023	17,664	14,103	15,304	16,225	11,945	23,377
Lost days (15%)	2.0% of LM	2,633	3,097	3,097	3,097	3,097	2,446	1,910	1,461	1,357	1,083	1,176	1,037	1,082	783
	LM at Holland	5,140	6,047	6,047	6,047	6,047	4,775	3,730	2,853	2,650	2,115	2,296	2,434	1,792	3,507

Table 2.8. Estimate of Lake Michigan lost fishing days due to Kalamazoo River PCB contamination (1981-2001) (cont.)

Days affected by Kalamazoo		1995	1996	1997	1998	1999	2000	2001
Lake Michigan days[b]	2.0% of all LM	9,731	4,010	4,187	4,413	4,054	4,077	4,897
	LM at Holland	21,872	6,398	7,216	2,937	7,223	7,140	6,255
Lost days (15%)	2.0% of LM	1,460	601	628	662	608	611	735
	LM at Holland	3,281	960	1,082	441	1,083	1,071	938

a. Holland data are unavailable from 1981 through 1991. For these years Holland use was approximated by calculating the average ratio of Holland days to total Lake Michigan days for the years for which data are available (1982-2001), and then applying that ratio to total Lake Michigan days from 1981 through 1991. Lake Michigan days from 1981-1984 are assumed to be equal to the 1985 values.

b. Affected number of days fished are from estimates shown in Table 2.4, adjusted to include only those days when the target species had a general-population FCA for each year. For example, in 2001, 30% of Lake Michigan days were spent targeting a species with a general population FCA, whereas in 1988 it was 75%.

2.6 Estimates of Economic Values for Reduced Quantity and Quality of Fishing

In 1996 anglers spent over $1.5 billion on recreational fishing in Michigan (U.S. DOI, 1998). Anglers clearly value their fishing experiences, but figures on total expenditures do not tell us how they value fishing days at specific sites above and beyond their costs. There is a large body of nonmarket economic valuation literature that estimates recreational fishing demand and determines the monetary values anglers place on the different characteristics of fishing. Peer-reviewed literature that is relevant to the reduced value of a fishing day at contaminated sites and to the valuation of lost use at contaminated sites is reviewed below.

Values for reduction in quality of fishing days spent at contaminated sites

This section presents the estimates of consumer surplus per fishing trip or day for reductions in contamination. In this context consumer surplus is defined as anglers' willingness to pay for reductions in contamination (net of fishing costs).

As shown in Table 2.9, the values anglers place on cleaner waters and fish are substantial,[15] but vary across site, type of contamination, levels of contamination, shares of trips affected by FCAs, substitute sites available, and other factors. Several studies value reductions in contamination for Lake Michigan, but none are specific to Michigan rivers. Adjustments have to be made to estimate a range of values to be used in the benefits transfer for this assessment area.

Breffle et al. (1999) estimated the lost value for nine levels of FCAs in Green Bay (see Table 2.9 for description). The value per Green Bay fishing day for the elimination of different levels of FCAs is shown in Table 2.10. Five of these levels are relevant to current FCAs for the Kalamazoo River and southern Lake Michigan. In the central Kalamazoo River, above Allegan Dam, the current FCA on smallmouth bass most closely resembles the Breffle et al. Level 9, and the current FCA on walleye and northern pike most closely resembles Level 3. In the lower Kalamazoo River below Allegan Dam, the current FCA on smallmouth bass most closely resembles Level 3; the current FCA on walleye most closely resembles Level 2; and the current FCAs on steelhead and salmon most closely resemble Level 1 or 2.[16] In southern Lake Michigan, the current FCA on trout most closely resembles Level 5, and the current FCA on steelhead and salmon most closely resembles Level 1. Level 1 (unlimited consumption of all fish) is used as the baseline for all stretches.

15. All values shown are in dollars adjusted to 2001 (2001$).

16. There are FCAs on steelhead and salmon. However, for the general population it is "unlimited consumption" and for the special population it is "once per week or month" depending on the size of fish.

Table 2.9. Selected valuation studies for the reduction of toxins at fishing sites

Authors	Study location	Sample information	Model	Resource change	Value estimates (2001$)[a]
Breffle et al., 1999	Green Bay and Fox River, 1999	647 Green Bay anglers who purchased licenses in 8 WI counties near Green Bay	Combined revealed-stated preference random utility model	Reduction in FCA levels[b] Level 9 to Level 1 Level 5 to Level 1 Level 3 to Level 1 Level 2 to Level 1	 $24 per fishing day $12 per fishing day $5 per fishing day $2 per fishing day
Chen and Cosslett, 1998	Michigan Great Lakes sites	338 one-day salmon fishing trips	Simulated maximum likelihood random parameter probit model	Remove Area of Concern designation at all Michigan Great Lakes sites (total of 14)	$4 to $18 per Great Lakes fishing trip
Hauber and Parsons, 1998	Maine lakes and rivers	143 Maine anglers 2,425 freshwater fishing day trips	Nested logit random utility model (RUM)	Clean up all Maine rivers having FCAs	$2 per trip
Herriges et al., 1999	Wisconsin waters of Great Lakes	240 Great Lakes trout and salmon anglers, and 247 non-Great Lakes anglers (data from Lyke, 1993)	Kuhn-Tucker models	20% reduction in contaminant levels in fish	$11 to $14 per Great Lakes fishing day $81 to $100 per angler per season
Jakus et al., 1997	Reservoirs in middle and eastern Tennessee	368 Tennessee reservoir anglers	Repeated discrete choice RUM (for annual), multinomial logit site-choice model (for per trip)	Remove FCAs from 6 of 14 eastern Tennessee reservoirs Remove FCAs from 2 of 14 middle Tennessee reservoirs	$8 per trip to contaminated site $130 per angler per season $16 per trip to contaminated site $190 per angler per season

Table 2.9. Selected valuation studies for the reduction of toxins at fishing sites (cont.)

Authors	Study location	Sample information	Model	Resource change	Value estimates (2001 dollars)[a]
Jakus et al., 1998	Reservoirs in Tennessee	222 Tennessee reservoir anglers	Multinomial logit site choice model -Valuation considers whether angler knows about advisories	Remove FCAs from 6 of 14 total Tennessee reservoirs	$1 per trip (assumes all anglers know about FCA) $4 per trip (across all anglers, but assuming those who do not know have zero loss)
Lyke, 1993	Wisconsin Great Lakes	274 Great Lakes trout and salmon anglers, and 239 inland anglers	Contingent valuation -Linear logit (LL) -Constant elasticity of substitution (CES)	Eliminate all contaminants that threaten human health in Wisconsin Great Lakes	$4 (LL) to $15 (CES) per Great Lakes fishing day $51 (LL) to $179 (CES) per angler per year
Parsons et al., 1999	Reservoirs in middle Tennessee	143 middle Tennessee reservoir anglers	Various RUMs	Remove FCAs from 2 of 14 middle Tennessee reservoirs	$15 to $16 per trip to contaminated site

a. Estimates of values are for fishing days at the contaminated sites. Where the models estimate the value for all sites (contaminated and uncontaminated), the value was divided by the percentage of the days that are at sites that are contaminated. This calculation is discussed in the text associated with this table.
b. Level 9 = "do not eat" for trout/salmon, walleye, and smallmouth bass; Level 5 = "do not eat" for walleye and "one meal per month" for trout/salmon and smallmouth bass; Level 3 = "one meal per month" for trout/salmon and walleye and "one meal per week" for smallmouth bass; Level 2 = "one meal per week" for trout/salmon and walleye and "unlimited consumption" of smallmouth bass; Level 1 = "unlimited consumption" for all species.

Table 2.10. Value of reduction in quality of existing fishing days from Breffle et al. (1999)

FCA level	FCA level description	Value per Green Bay fishing day to reduce FCAs from listed level to Level 1 (baseline) (2001$)
9	• Yellow perch – Eat no more than 1 meal a month • Trout/salmon – Do not eat • Walleye – Do not eat • Smallmouth bass – Do not eat	$23.52
5	• Yellow perch – Unlimited consumption • Trout/salmon – Eat no more than 1 meal a month • Walleye – Do not eat • Smallmouth bass – Eat no more than 1 meal a month	$12.16
3	• Yellow perch – Unlimited consumption • Trout/salmon – Eat no more than 1 meal a month • Walleye – Eat no more than 1 meal a month • Smallmouth bass – Eat no more than 1 meal a week	$5.27
2	• Yellow perch – Unlimited consumption • Trout/salmon – Eat no more than 1 meal a week • Walleye – Eat no more than 1 meal a week • Smallmouth bass – Unlimited consumption	$1.96
1	• Yellow perch – Unlimited consumption • Trout/salmon – Unlimited consumption • Walleye – Unlimited consumption • Smallmouth bass – Unlimited consumption	$0.00

Chen and Cosslett (1998) used data collected on 338 single-day fishing trips targeting trout or salmon. The choice set includes 41 possible sites in the Michigan waters of the Great Lakes. They estimated three models of fishing demand: a varying parameter multinomial probit model, an independent multinomial logit model, and an independent multinomial probit model. They valued the cleanup of toxic contamination at 14 sites in the Great Lakes waters of Michigan sufficient to remove the designation of Area of Concern by the International Joint Commission.

The values for this cleanup range from $1.29 to $6.08 per trip. These values are applicable to Lake Michigan, but less so to the central Kalamazoo River, which has only warm water species (the lower Kalamazoo River is not relevant either because the salmonids coming up the river have no FCAs for the general population). Values apply to all trips taken in the 41-site region, including those without contamination. The 14 affected sites accounted for 34% of the total sites,

implying a very rough estimate of the value per trip to an affected site of about $4 to $18 [($1.29 to $6.08)/0.34].[17]

Three studies listed in Table 2.9 (Jakus et al., 1997, 1998; Parsons et al., 1999) estimated the value of reducing toxic contamination to the degree that FCAs could be removed from contaminated reservoirs in Tennessee. These studies concentrated on different geographic regions of Tennessee and include both toxic and nontoxic sites. The toxic sites are those with an advisory; they are distinguished by an indicator variable that equals one if an advisory is present and zero if it is not present at the site. The advisories may be for different levels of restrictions, but these levels are not modeled. The models developed are all random utility models, and the population is limited to anglers who use the sites. It should be emphasized that the per-trip values from all of these studies are for trips to all sites modeled, including nontoxic sites. These values do not apply only to the trips taken to the toxic sites.

In Jakus et al. (1997), the value estimated for removing FCAs from 2 toxic sites within a 14-site region is about $2.20 per trip. Because two sites constitute 14% of all 14 sites in the study, a rough first approximation of the per-trip value of cleanup for only the affected sites is $16 ($2.20/0.14).

In Jakus et al. (1998), the values for removing FCAs from 6 toxic sites within a 14-site region are $1.64 from a multinomial logit site-choice model with the assumption that anglers who did not know about FCAs had zero loss, and $8.02 in the same model with the assumption that all anglers knew about FCAs. The 6-site subset represents 43% of the total number of sites, so a rough first approximation of the losses per trip to the contaminated sites ranges from about $4 to $19 [($1.64 to $8.02)/0.43]. The system of reservoirs may be more comparable with the Kalamazoo River than Lake Michigan is because the reservoirs offer smaller waters with similar nontoxic, warm water substitutes.

Lyke (1993) collected data on fishing in Wisconsin in 1989. She used part of the data (surveys returned by 274 anglers who fished the Wisconsin Great Lakes) to develop two contingent valuation models. She estimated that eliminating all contaminants that threaten human health from the Wisconsin Great Lakes would be worth $51.01 to $179.36 per angler per year. Dividing by her sample average of 12.16 Great Lakes fishing days per angler, the values per Great Lakes fishing day range from $4 to $15.

17. This value range ($1.29 to $6.08) is a per-trip value for cleanup that applies to all sites, including ones that are not contaminated. If the value is instead to be assigned only to trips to contaminated sites, which account for 34% of all sites, the values are weighted upward by a factor of 1/0.34.

Herriges et al. (1999) used Lyke's (1993) data from Wisconsin anglers to develop and estimate two utility-theoretic Kuhn-Tucker models of recreation demand.[18] The models value a 20% reduction in toxins at four aggregate Wisconsin Great Lakes sites (Lake Superior, North Lake Michigan, South Lake Michigan, and Green Bay). The models indicate toxins in the Great Lakes significantly reduce the well-being of Wisconsin anglers. Site-specific values are not presented, but the range of values for a 20% reduction in toxins at all four sites is $80.79 to $99.74 per angler per year. For comparison to the other studies, the annual values in Herriges et al. (1999) are divided by the average number of Great Lakes fishing days per angler estimated in that study (7.31) to obtain values per Great Lakes fishing day of $11 to $14.

The Breffle et al. (1999) estimates fall within the range of the other studies discussed above and are used in this benefits transfer because they are specific to the type of change that needs to be valued. They are the best estimates for Lake Michigan damages, but an adjustment will be made to the estimates for the Kalamazoo River because river fisheries generally have lower per day fishing values (and therefore lower absolute values for changes in characteristics) than Great Lakes fisheries.

The middle of the range of per day values for a Great Lakes fishing day falls between $40 and $60, and the middle of the range of per day values for rivers and warm water fisheries falls between $30 and $40 (see Table 2.11, discussed in the next section). This would suggest river values are between two-thirds (40/60) and three-fourths (30/40) those of the Great Lakes. To be conservative, the Breffle et al. (1999) estimates are adjusted by two-thirds before applying them to Kalamazoo River fishing days. Therefore, for the Kalamazoo River, the per fishing day value is $15.68 going from FCA Level 9 to Level 1, $8.10 from Level 5 to Level 1, $3.51 from FCA Level 3 to Level 1, and $1.31 from FCA Level 2 to Level 1 (see Table 2.10 for an explanation of levels). Adjusting for the mix of species and their portion of user days (based on the MDNR and KRRA data discussed earlier), the current value of the loss to existing fishing days is estimated to be $13.25 for the central Kalamazoo River (between Morrow Lake Dam and Allegan Dam),[19] $0.59 for the lower Kalamazoo River (below Allegan Dam),[20] and $2.43 for Lake Michigan.[21] As seen in the calculations in footnotes 20 and 21, the lower Kalamazoo River and Lake Michigan fisheries are dominated by cold water species, and these species have no advisories for the general population. As mentioned earlier, there is an advisory for cold water species for the

18. Other types of models are also estimated, but those models are not utility theoretic and often give implausible results that are not consistent with expectations. However, all estimated models indicate that toxins reduce the amount and quality of recreational fishing services.

19. $15.68 (Level 9) × 80% (smallmouth bass) + $3.51 (Level 3) × 20% (walleye and northern pike).

20. $0 (Level 1) × 80% (steelhead and salmon) + $3.51 (Level 3) × 15% (walleye) + $1.31 (Level 2) × 5% (smallmouth bass).

21. $0 (Level 1) × 70% (steelhead and salmon) + $8.10 (Level 5) × 30% (trout).

Table 2.11. Per-day consumer surplus values for river and Great Lakes recreational fishing (reported in 2001$)

Study	Location	Valuation method	Estimated value
Boyle et al., 1999	Great Lakes bass and salmon fisheries	Meta-analysis (TCM)	$70-$85 per day[a]
	River bass and salmon fisheries	Meta-analysis (TCM)	$32-$46 per day[a]
Charbonneau and Hay, 1984	Bass fisheries nationwide	CVM	$62 per day
	Landlocked salmon fisheries nationwide	CVM	$69 per day
Connelly et al., 1990	New York Great Lakes	CVM	$22 per day
Duffield et al., 1992	Big Hole and Bitterroot rivers, Montana recreational trip by float angler	Dichotomous choice CVM	$72-$130 per day
Herriges et al., 1999	Southern Lake Michigan fishing	Kuhn-Tucker	$99-$108 per day
Kealy and Bishop, 1986	Wisconsin portion of Lake Michigan	TCM	$53 per day
Layman et al., 1996	Gulkana River, Alaska salmon fishing	TCM	$34-$45 per day
Loomis, 1998	Northeast fishing (includes Michigan)	Meta-analysis	$26 per day[b]
Lyke, 1993	Wisconsin Lake Michigan fishing	Multinomial logit TCM	$25 per trip
Menz and Wilton, 1983	New York portion of Lake Ontario	Zonal TCM	$48-$137 per day
	New York portion of St. Lawrence River	Zonal TCM	$81-$155 per day
Milliman et al., 1992	Green Bay yellow perch fishery	Dichotomous choice CVM	$42 per trip
Walsh et al., 1990	Warm water fishing nationwide	Meta-analysis	$40 per day
	Cold water fishing nationwide	Meta-analysis	$52 per day

a. Regression parameters used to predict values were estimated using 286 consumer surplus data points from 15 studies. The estimated values reported here are based on the assumption the travel cost method was applied using data from a mail survey.
b. Combines 40 studies from the Northeast region of the United States.

special population. These calculations are conservative because they do not account for female anglers of childbearing years, children, or those anglers in the general population who may fish or share fish with their families and therefore be concerned with the advisory for special populations.

Values for reductions in fishing days

Anglers may respond to contamination by reducing the number of days they spend at a site, as discussed in Section 2.5. When they choose not to go to a site in response to an injury, they are worse off than if there were no injury. Table 2.11 summarizes studies that value a day of fishing at rivers and Great Lakes sites based on consumer surplus measures (i.e., willingness to pay to spend a day fishing, over and above costs). Most of these studies consider substitution and losses when a site is closed, but in this case, the Kalamazoo River remains open to fishing. However, for those anglers who choose to substitute their fishing activity to other sites, or to forego some days they would have fished the Kalamazoo River, it can be inferred that contamination may be sufficient for them not to consider the Kalamazoo River as an option some or all of the time.

Anglers may choose to go to a substitute site instead of foregoing their day of fishing entirely. In this case they may mitigate some of the loss they experience from not fishing the injured site. Because a model to estimate participation and substitution patterns in the Kalamazoo River fishery or how these behavioral changes are linked to changes in value does not exist, it is not possible to differentiate the changes in use or values of "foregone" versus "substituted" days. The comparison studies in Table 2.11 measured average values across substituted and foregone fishing days; because these studies were conducted with existing anglers, they tend to overemphasize substitution (missing the days foregone by those anglers who have dropped out). Therefore a range of values is considered that is used to estimate the value of a reduction in Kalamazoo River fishing days.

Per day values (2001$)

This section summarizes the literature in Table 2.11. The Kalamazoo River supports both cold- and warm water species (although warm water species have more restrictive advisories) and so studies of the value of a day of fishing for warm and cold water species are discussed below.

Milliman et al. (1992) developed a model of the commercial and recreational yellow perch fisheries in Green Bay. They estimated the value of a perch fishing day to recreationists to be $42 per angler. Using a multinomial logit travel cost model (TCM), Lyke (1993) found the value of a Wisconsin Southern Lake Michigan fishing day to be $25. Herriges et al. (1999) used a subset of the same data to estimate Kuhn-Tucker models of site selection and participation. With the same policy scenario as Lyke, the loss of southern Lake Michigan fishing, they estimated the value of a southern Lake Michigan fishing day to be $99 to $108.

Menz and Wilton (1983) estimated three zonal TCMs for the New York portions of the St. Lawrence River and Lake Ontario. Their estimates vary by the method used and by the county in which the fishing took place. For the St. Lawrence River, their per day estimate of the value of fishing varies between $81 and $155, and for Lake Ontario the value varies between $48 and $137. In this case the value of fishing on the river is higher than on the Great Lakes, because the river is a very large estuarine river. Fishing in this river is likely more comparable to the Great Lakes or ocean bays and estuaries than to most inland waters.

Connelly et al. (1990) estimated the average value of a day of fishing for all inland New York sites (inland river, lakes, estuaries, and Great Lakes) using the contingent valuation method (CVM). They found on average New York anglers were willing to pay $22 per fishing day.

Charbonneau and Hay (1984) used the data from the 1975 U.S. FWS National Survey of Hunting, Fishing and Wildlife Associated Recreation to estimate the value of fishing and hunting for various species. Estimates were derived using CVM. The national average values for a day of bass and land-locked salmon fishing were $62 and $69 per site, respectively.

While several studies of Great Lakes angling values are available, fewer exist for comparable river angling. Duffield et al. (1992) studied the net economic benefits of in-stream flows for the Big Hole and Bitterroot rivers in Montana. Using a dichotomous choice CVM, they calculated the value of a recreational trip for a resident float angler to be $72 for the Bitterroot River and $130 for the Big Hole River. These values are useful because they are for river fishing, but are likely high estimates for the Kalamazoo River, since this area of Montana is renowned for trout and salmon fly fishing and attracts anglers nationwide.

Layman et al. (1996) used a TCM to value fishing on the Gulkana River, a cold water fishing stream in Alaska. The value of a day of fishing was found to be $34-$45. This value is closer to the range found in several meta-analyses of fishing in the Northeast and nationwide. This stream is a popular destination for whitewater rafting, multiday canoe trips, and trout and salmon fishing.

Boyle et al. (1999) designed a meta-analysis of sportfishing values from 70 studies to generate 1,002 per-day and per-trip welfare estimate observations. Per-day welfare estimates were computed by increasing the implicit price of the fishing day at each site to the point that the site was “eliminated” from all respondents’ choice sets. A day of smallmouth bass fishing was estimated to be worth $32 on a river and $70 on a Great Lake, while a day of salmon fishing was estimated to be worth $46 on a river and $85 on a Great Lake.

Walsh et al. (1990) also did a meta-analysis of sportfishing values. They combined travel cost and contingent valuation demand studies from 1968 to 1988 to assess the value of a day of fishing. Using 39 studies they found a mean value of $52 for a day of cold water fishing and

using 23 studies they found a mean value of $40 for a day of warm water fishing. A third meta-analysis by Loomis (1998) combined 40 studies from the Northeast region of the United States; he found a value of $26 per fishing day.

Across the above studies, values for a day of warm water river fishing range from $26 to $65, with most studies averaging $30-$40. Cold-water river and Great Lakes fishing days have higher values, ranging from $34 to $129, with most between $40 and $60.

Incremental travel costs (2001$)

As an alternative, the loss from substituting fishing to other sites can be approximated as the value of the added travel cost to fish at substitute sites instead of the Kalamazoo River. If we assume anglers are substituting from the Kalamazoo River to the St. Joseph, the closest comparable substitute, the difference in round trip travel distance is approximately 30 miles. An estimate of their vehicle operating costs is $10.35 per day, although this would vary by the angler's point of origin. This estimate is calculated using the federal vehicle mileage reimbursement to approximate cost of travel (34.5 cents/mile) multiplied by the extra mileage (30 miles). Including the value of their time (a half-hour of travel at a typical assumption of one-third the average hourly wage rate for Allegan and Kalamazoo counties; the average hourly wage rate is $13.44) increases the total loss to $12.71 per day.

Because an estimate of how many of the lost user days are substituted versus foregone is not available, a value of $20 is applied to both types of reductions in user days for the central and lower Kalamazoo River. This value lies between the range of $30 and $40 in the literature (Table 2.9) and an incremental travel cost estimate of $10.35 or $12.71. For Lake Michigan higher values for lost days are applied. Values for a day of fishing on Lake Michigan and other Great Lakes fishing range from $40 to $60 with only a few outliers (see Table 2.11). As such we use a per-day value of $50 for the damages to anglers who reduce their Lake Michigan user days.

2.7 Results: 2001 Damage Estimates

In this section, damages for a sample year, 2001, are estimated. Damages in other years are estimated in a similar manner, as discussed in Section 2.8. Two approaches are used to compute annual damages for 2001. The first benefits transfer method is based on use estimates in Sections 2.4 and 2.5 and per-day value estimates in Section 2.6. The second is based on the MSU recreation demand model simulation of damages.

2001 damages from reduction in quality of existing fishing days

In the 2001 KRRA study it was estimated there were 19,416 to 20,193 fishing days on the lower Kalamazoo River and 7,517 on the central Kalamazoo River. As discussed above, making adjustments (for species mix and for river versus Great Lakes fishing) to the Breffle et al. (1999) estimates, the damages for the reduction in quality for a day of fishing are estimated to be $13.25 for the central Kalamazoo River, $0.59 for the lower Kalamazoo River, and $2.43 for Lake Michigan. Annual damages for the reduction in quality of Kalamazoo River and Lake Michigan fishing for 2001 are estimated to be from $150,800 to $162,200 (see Table 2.12).

Table 2.12. Annual damages for reduction in quality of existing fishing days and reduction in fishing days on the Kalamazoo River and Lake Michigan (2001$)

	Number of days	Per day value of damages	Damages (2001$)[a]
Quality losses			
Central Kalamazoo River	7,517	$13.25[b]	$99,600
Lower Kalamazoo River	19,416 to 20,193	$0.59[b]	$11,500 to $12,000
Lake Michigan	16,323 to 20,851	$3.51[b]	$39,700 to $50,700
Total quality losses	43,256 to 48,561		$150,800 to $162,200
Reduced fishing days losses			
Central Kalamazoo River	1,128 to 3,759	$20	$22,600 to $75,200
Lower Kalamazoo River	582 to 2,019	$20	$11,600 to $40,400
Lake Michigan	735 to 938	$50	$36,800 to $46,900
Total reduced fishing losses	2,445 to 6,716		$71,000 to $162,500
Quality losses and reduced fishing losses			
All areas	45,701 to 55,277		$221,700 to $324,700

a. Rounded to nearest 100.
b. Figures rounded for presentation.

2001 damages from reduced fishing days

It is estimated that in 2001 from 1,710 to 5,778 fishing days were not taken to the Kalamazoo River and 735 to 938 fishing days were not taken to Lake Michigan because of Kalamazoo River contamination (see Tables 2.6, 2.7, and 2.8). In Section 2.6 the value of a Kalamazoo River fishing day was estimated to be $20 and the value of a Lake Michigan fishing day was estimated to be $50. Therefore the damages from reduced fishing days to the Kalamazoo River and Lake Michigan in 2001 range from $71,000 to $162,500 (see Table 2.12). Total damages from both reduction in quality of existing fishing days and reduced fishing days in 2001 (excluding winter fishing) were between $221,700 and $324,700.

Annual estimate of recreational fishing damages based on MSU model

Another estimate of Kalamazoo River recreational fishing damages can be derived from a simulation using the MSU statewide recreation demand model. This model estimates changes in seasonal use patterns and values from changes in site characteristics such as river quality. The simulation was conducted by Dr. Frank Lupi at MSU, who also contributed to the design of the model. The MSU model is described in Appendix D, along with a detailed description of the analysis and results. Only a summary of the conclusions is provided here.

This simulation is based on an improvement in quality from "secondary quality" to "top quality" for over 74 miles of warm water stream, the length of the PCB-injured stretch of the Kalamazoo River, in Allegan and Kalamazoo counties. The secondary quality designation can be the result of pollution, and absent the PCB contamination, the Kalamazoo River might be designated top quality. The MSU model does not include a quality variable for anadromous stretches of rivers, so the model cannot be used to compute damages for the anadromous fishery. Similarly, because the quality of inland lakes is not included in the MSU model, the length of Lake Allegan is included in the estimate of affected Kalamazoo River miles.

Simulated recreational Kalamazoo River fishing damages to anglers living in Michigan for the April to October season are $442,000 (2001$). As a result, the MSU results support the damage estimates developed based on the benefits transfer approach. The simulated damages exceed the estimated range of $221,700-$324,700 based on benefits transfer, suggesting the latter approach gives conservative estimates. Subsequent computations are based on the benefits transfer method.

2.8 Results: Aggregating Damages over Time

In this section damages are aggregated over time. Past and present damages are estimated in the same manner as for 2001 based on the actual FCAs by year, detailed estimates of use by year, and an assumption of constant values through time; i.e., if a day of fishing is worth $20 (2001$) in 1999, it is also worth $20 (2001$) in 1985 and all other years. This is a simplifying assumption to make the analysis tractable for an estimate based on existing data. Future damages are computed under alternative assumptions of restoration time paths. A 3% real discount rate is used to escalate past damages and discount future damages to 2003.[22] A 3% discount rate is

22. A discount rate accounts for the fact that if a person was paid for the damages that occurred in a past year in that year they could have invested that money and received a return. If they are paid in the current year for a past year's damages, they must also be compensated for that lost interest. Conversely, if they are paid for future damages in the current year, the value for that future year must be discounted to reflect that the payee can invest that payment now and receive a return in the future.

consistent with the average real three-month Treasury bill rates from 1985 through 1999 (Bureau of Economic Analysis, 1998; Federal Reserve, 1999) and is consistent with DOI implementation guidance (U.S. DOI, 1995) for NRDAs under 43 CFR §11.84(e).

The aggregate damages are reported in real 2001$ for all years. Therefore, the estimates account for changes in the purchasing power of money, and reflect the value of 2001 dollars. [The consumer price index (CPI) was used to adjust for inflation.]

Past damages

To estimate damages beginning in 1981 for the reduction in quality of fishing days spent fishing in the assessment area in the past, the same method discussed in Section 2.6 is used to adjust the per-day damage estimates from Breffle et al. (1999) to State of Michigan FCA levels for the Kalamazoo River, specific to each of the past years (see Appendix C for FCA levels through time). These adjusted values are then applied to the estimates of fishing days in past years as shown in Table 2.2. It is assumed that the value of a fishing day has remained constant through these years, and for reductions in past use the values discussed in Section 2.6 are applied to the estimates of reductions in fishing days to the Kalamazoo River and Lake Michigan. Values by category are presented in Table 2.13. Past damages range from $9.4 to $19.8 million.

Table 2.13. Present value (in 2003) of past recreational fishing damages through 2002 (expressed as 2001$)

	Quality losses (millions)	Reduced fishing days losses (millions)	Total damages (millions)[a]
Kalamazoo River			
Past damages (1981-2002)	$2.9 to $3.2	$2.2 to $8.2	$5.1 to $11.4
Lake Michigan			
Past damages (1981-2002)	$1.7 to $3.2	$2.6 to $5.2	$4.4 to $8.4
Kalamazoo River and Lake Michigan			
Past damages (1981-2002)	$4.6 to $6.4	$4.8 to $13.4	$9.4 to $19.8

a. Figures may not sum due to rounding.

Additionally, in 1997 EPA issued a supplementary advisory for the Michigan waters of Lake Michigan. This advisory was more stringent than the advisory issued by the State of Michigan. The estimates herein are based on the Michigan FCA levels. However, for comparison, in 1997 damages to the Lake Michigan fishery calculated under the Michigan FCAs were between $116,000 and $200,000, but using the EPA FCA, they would have been between $260,000 and $448,000. Damages for the Kalamazoo River under the State of Michigan FCA were between $172,000 and $287,000, but using the EPA FCA they would have been between $457,000 and $803,000.

Future damages

Future damages depend on the timeline for recovery. Because the recovery period is not known, for sensitivity analysis three potential remediation scenarios are assumed, as in the Green Bay NRDA (Breffle et al., 1999): no action (100 years), intermediate cleanup (40 years), and intensive cleanup (20 years). Under no action it is assumed the FCAs will remain in place for 100 years, reduced by one level after 50 years and eliminated after 100 years.[23] For the remediation scenarios it is assumed cleanup takes 10 years and then the FCAs are reduced by one level halfway through the remainder of the period.[24] Table 2.14 shows the present value (in 2003) of future damages to the Kalamazoo River and Lake Michigan under the potential cleanup scenarios. Future values for the Kalamazoo River and Lake Michigan range from $7.6 to $10.9 million for no action, $5.1 to $7.4 million for intermediate cleanup, and $3.6 to $5.1 million for intensive cleanup.

Table 2.14. Present value (in 2003) of future recreational fishing damages starting in 2003 (expressed as 2001$)

	Quality losses (millions)	Reduced fishing days losses (millions)	Total damages (millions)
Kalamazoo River			
Future damages with no cleanup recovery (2003-2102)	$3.4	$1.0 to $3.2	$4.4 to $6.7
Future damages with intermediate cleanup (2003-2042)	$2.3	$0.7 to $2.2	$2.9 to $4.5
Future damages with intensive cleanup (2003-2022)	$1.6	$0.4 to $1.5	$2.0 to $3.1
Lake Michigan			
Future damages with no cleanup (2003-2102)	$2.3 to $2.9	$1.0 to $1.3	$3.3 to $4.2
Future damages with intermediate cleanup (2003-2042)	$1.5 to $1.9	$0.7 to $1.0	$2.2 to $2.9
Future damages with intensive cleanup (2003-2022)	$1.1 to $1.4	$0.5 to $0.6	$1.5 to $2.0

23. Reducing FCAs by one level means FCAs of "do not eat" go down one level to "no more than one meal per month," FCAs of "no more than one meal per month" go down to "no more than one meal per week," and FCAs of "no more than one meal per week" go down to "unlimited consumption."

24. Here it is assumed that cleaning up the Kalamazoo River would lead to a reduction in FCAs in the Lake Michigan area affected by PCBs contamination from the Kalamazoo River. This is remotely possible, but unlikely.

Table 2.14. Present value (in 2003) of future recreational fishing damages starting in 2003 (expressed as 2001$) (cont.)

	Quality losses (millions)	Reduced fishing days losses (millions)	Total damages (millions)
Kalamazoo River and Lake Michigan			
Future damages with no cleanup (2003-2102)	$5.7 to $6.3	$2.0 to $4.5	$7.6 to $10.9
Future damages with intermediate cleanup (2003-2042)	$3.8 to $4.2	$1.4 to $3.2	$5.1 to $7.4
Future damages with intensive cleanup (2003-2022)	$2.7 to $3.0	$0.9 to $2.1	$3.6 to $5.1

The present values of all damages (past, present, and future; in 2003) are shown in Table 2.15. Total damages are estimated to be between $17.1 to $30.7 million with no action, $14.6 to $27.3 million with intermediate cleanup, and $13.0 to $24.9 million with intensive cleanup.

Table 2.15. Present value (in 2003) of total (past and future) recreational fishing damages from 1981 forward (expressed as 2001$)

	Quality losses (millions)	Reduced fishing days losses (millions)	Total damages (millions)
Kalamazoo River			
Total damages with no cleanup (1981-2102)	$6.3 to $6.6	$3.1 to $11.5	$9.4 to $18.1
Total damages with intermediate cleanup (1981-2042)	$5.2 to $5.5	$2.8 to $10.5	$8.0 to $15.9
Total damages with intensive cleanup (1981-2022)	$4.5 to $4.8	$2.6 to $9.7	$7.1 to $14.5
Lake Michigan			
Total damages with no cleanup (1981-2102)	$4.0 to $6.1	$3.6 to $6.5	$7.6 to $12.6
Total damages with intermediate cleanup (1981-2042)	$3.2 to $5.2	$3.3 to $6.2	$6.6 to $11.3
Total damages with intensive cleanup (1981-2022)	$2.8 to $4.6	$3.1 to $5.8	$5.9 to $10.4
Kalamazoo River and Lake Michigan			
Total damages with no cleanup (1981-2102)	$10.3 to $12.8	$6.8 to $17.9	$17.1 to $30.7
Total damages with intermediate cleanup (1981-2042)	$8.4 to $10.7	$6.2 to $16.6	$14.6 to $27.3
Total damages with intensive cleanup (1981-2022)	$7.3 to $9.4	$5.7 to $15.5	$13.0 to $24.9

3. Total Value Scoping Focus Groups

3.1 Objective of TVS

The objective of the TVS focus groups was to provide qualitative information on the values people may place on a broad range of service losses (not just recreational fishing). The groups provide information that will be useful for restoration planning, which ultimately will mean identifying projects and their appropriates scales (magnitudes) to make the public whole for all losses. However, the TVS focus groups were not designed to monetize any service losses, nor to provide quantitative information on the scales of value-equivalent restoration projects.

Topics covered in the focus groups included the following:

- What information do individuals have about PCBs in the Kalamazoo River and how do they feel about PCB-caused injuries?
- What understanding and beliefs about PCB cleanup options do individuals have that may affect their feelings about PCB cleanup and tradeoffs among restoration alternatives?
- What understanding, interests, and concerns do people have about possible restoration alternatives?
- What types of information do people seek about PCB injuries and programs for any other restoration options, and how should that information be presented?

Stratus Consulting conducted four focus groups in Kalamazoo, Michigan, on November 6 and 7, 2001, with members of the general public. All written materials for the focus groups are provided in Appendix E.

3.2 Focus Group Development and Implementation

An inventory of potential PCB cleanup and other restoration project proposals for the Kalamazoo River NRDA was developed (see Appendix A). This project list was developed from a review of available documents and from contacts and conversations with individuals in both the public and private sectors from November 2000 through the end of March 2001. In obtaining this information it was emphasized that the intent of the work was to develop as much information as possible about potential restoration needs and opportunities in the Kalamazoo River area. As a result, a large number of potential options were identified to support better informed restoration

decisions in the future. These projects were then grouped into five general categories for discussion in focus groups:

- Improve recreational access and facilities associated with the Kalamazoo River
- Restore and protect wetlands and other natural areas
- Remove PCBs from the Kalamazoo River
- Remove existing sill-level dams from the Kalamazoo River and add a fish ladder to improve fish migration and boating
- Control nonpoint source loadings from urban and agricultural areas (runoff).

All five categories received equal consideration in the focus group materials (i.e., respondents did not know the study was motivated by PCB-caused injuries). Characterization of PCB injuries and the services affected by cleanup and other restoration actions, as presented in the focus group materials, was developed jointly with Trustees and in-house Stratus Consulting natural scientists, and stems from the list of projects in Appendix A.

3.3 Recruitment

Individuals were recruited by telephone to participate in the focus group sessions. The complete telephone recruitment script is included in Appendix E. Individuals were recruited using random digit dialing from areas within approximately ten miles of the Kalamazoo River. Telephone prefixes were identified for all zip codes within this area (some may extend slightly outside of 10 miles) and grouped into three categories: (1) the Kalamazoo metropolitan area, (2) other zip codes above Allegan Dam (referred to locally, and in the focus groups, as “Caulkins” Dam), and (3) other zip codes below Allegan Dam (all the way to Lake Michigan). Sampling quotas were set to equal the population proportions corresponding to the three groups, and individuals were recruited randomly from within these groups.

Respondents were recruited to discuss “a wide variety of programs to enhance the environment and natural resources in the Kalamazoo River valley.” The telephone recruitment included a brief survey that collected information on participation in various recreational activities, attitudes about various issues affecting Michigan, and basic demographic information, including employment.

3.3.1 Response rate

After completing the telephone survey, respondents were invited to participate in one of the focus group sessions, unless they or any household member was employed by the MDNR, the MDEQ, a paper production company (Georgia Pacific, Allied Paper, Plainwell, or Fort James), or any environmental advocacy organization. Seventeen respondents were disqualified for employment reasons.

Several measures were taken to increase participation:

- An informational confirmation letter was sent to all participants, including a detailed map of the focus group site and driving directions
- Individuals were provided with parking permits and informed that they would be given snacks and drinks at the sessions
- Reminder phone calls were made before the sessions
- Participants who did not attend the Wednesday focus group session were contacted and invited to attend a Thursday session; three additional recruits were contacted on Thursday morning and agreed to participate (two actually attended)
- At the end of the session participants were paid $40.

Table 3.1 summarizes the response to the telephone survey and focus group response rates. Of the 105 individuals contacted by telephone, two-thirds agreed to participate in the focus group sessions. Of these, roughly half attended one of the sessions.[1] About one-sixth of those contacted were not invited to participate based on their employment status, and another sixth declined or were unable to participate at the designated times.

1. After the terrorist attacks of September 11, participation rates in focus groups in the fall of 2001 were notably lower nationwide. In another Stratus Consulting study that fall, 20 focus groups were conducted in 10 cities across the United States. The overall average show rate for those recruited was 55.6%. In the Midwest region (Madison, WI) the show rate was 55%. While a lower turnout rate affects the sample size and therefore the statistical confidence in the results, the sample sizes are large enough to make general inferences and to draw general conclusions, and there is no reason to expect bias in the responses.

Table 3.1. Telephone survey response rate

Respondent focus group participation	Number	Percent
Participated in telephone survey and focus group[a]	35	33.3%
Recruited but did not attend focus group	37	35.2%
Not invited to participate[b]	17	16.2%
Declined to participate	16	15.2%
Total	**105**	**100.0%**

a. There was a total of 36 focus group participants. One focus group participant was added during the Wednesday 5:30 p.m. focus group session and did not complete the telephone survey.
b. Of those not invited to participate, 10 were not invited because a household member was employed by an environmental advocacy organization (although this question may have been interpreted as "belonging to" or "supporting" such an organization), three because a household member was employed by a paper company, two because a household member was employed by the MDNR or MDEQ, and two because a household member was employed at DNR/DEQ and an advocacy group or a paper company.

3.3.2 Respondent demographics

Sampling requirements are less rigorous for focus groups than for mail, telephone, or in-person surveys of larger samples, but some attention should still be given to how representative the focus groups are of the underlying population. Table 3.2 provides a comparison of the distribution of age, gender, and household income for all telephone survey respondents. For comparison, sociodemographics for the subgroups of focus group participants and nonparticipants, as well as for the city and county of Kalamazoo, are also reported.

In general, the age and income distributions of the focus group participants and nonparticipants are similar. The age distribution of participants is also similar to that of Kalamazoo County. The focus group participants have incomes that were somewhat lower than the general population. The proportion of males participating in the focus groups was slightly larger than the proportion of males in either the city of Kalamazoo or Kalamazoo County; the group sessions were held at night.

Table 3.2. Sociodemographics of focus group participants, nonparticipants, and Kalamazoo area

	Phone survey respondents	Focus group				
		Participants	Nonparticipants		City	County
Kalamazoo area[a]						
Age						
18-25 years	24.2%	20.0%	26.7%	18-24 years	34.6%	20.1%
26-45 years	35.8%	34.3%	36.7%	25-44 years	33.6%	37.2%
46-65 years	31.6%	34.3%	30.0%	45-64 years	19.1%	27.8%
66-75 years	4.2%	2.9%	5.0%	65-74 years	5.6%	7.7%
Over 75 years	4.2%	8.6%	1.7%	Over 74 years	7.0%	7.3%
Gender						
Male	39.8%	57.1%	29.3%	Male	48.2%	48.3%
Female	60.2%	42.9%	70.7%	Female	51.8%	51.7%
Household income						
Michigan[b]						
Under $24,999	23.4%	22.9%	23.7%		18.6%	
$25,000-$49,999	31.9%	34.3%	30.5%		28.2%	
$50,000-$99,999	30.9%	28.6%	32.2%		36.2%	
Over $100,000	3.2%	2.9%	3.4%		16.9%	
Refused	6.4%	5.7%	6.8%			
Do not know	4.3%	5.7%	3.4%			

a. Age and gender data for Kalamazoo City and County were obtained from the U.S. Census Bureau's (2001) 2000 *Profile of Demographic Characteristics*. The Census age categories are slightly different than those used for this survey.
b. State-level income data from the 2000 Census and state, county, and city-level data from the 1990 Census were obtained from the U.S. Census Bureau's (2002) *American FactFinder* web site (2000 income data for cities and counties is not scheduled to be released until the summer of 2002). In 1990 Kalamazoo County had a median household income of $31,060, slightly higher than Michigan's median household income of $31,020. Kalamazoo City's 1990 median household income was $23,207. This pattern is reflected in the participant responses.

3.4 Implementation

3.4.1 Methods

Groups were led by a moderator (either Rich Bishop of the University of Wisconsin or Jeff Lazo of Stratus Consulting). Sessions were held at 5:30 p.m. and 8:00 p.m. on November 6 and 7, 2001, in a focus group facility on the campus of Western Michigan University in Kalamazoo. Each session lasted about two hours. Table 3.3 shows the number of participants that were recruited for and participated in each focus group. The individual indicated as "no group assigned" arrived late for the assigned session and was asked to complete the written handout materials in the reception area; this provided additional information for analysis without interrupting the flow of a group in progress.

Table 3.3. Recruits and participants by session

	Number of recruits	Number of participants
November 6, 2001 5:30	19	10
November 6, 2001 8:00	18	9
November 7, 2001 5:30	20	11
November 7, 2001 8:00	15	6
No group assigned	1	0
Total	**73**	**36**

3.5 Analysis

3.5.1 Telephone survey: Recreation and attitudes

The tables in this section compare the responses to questions for all focus group participants to nonparticipants. The telephone survey questions on recreational participation and attitudes on issues affecting Michigan were included to examine whether focus group participants were more avid outdoor enthusiasts with preferences different from those of nonparticipants. While these questions were not used to exclude people, they were useful in comparing participants with nonparticipants.

Table 3.4 reports the results from four questions on recreational activity. Respondents were asked whether they had participated in any of several recreational activities since January 1, 2001, including fishing; boating, canoeing, kayaking, sailing, or rowing; watching or photographing birds or other wildlife; and picnicking, walking, or other outdoor recreational activities. The results show that a large majority of the respondents from both groups had

Table 3.4. Participation in outdoor recreational activities since January 1, 2001

Activity	Telephone survey respondents	Focus group		Test for difference between participants and nonparticipants	
		Participants	Nonparticipants		
	Percent participating			z-stat	Significant at $\alpha = 0.05$?
Fishing	28.4%	28.6%	28.4%	0.02	No
Boating	45.1%	34.3%	50.7%	-1.59	No
Bird or wildlife viewing/photography	57.8%	48.6%	62.7%	-1.37	No
Hiking/picnicking	85.3%	91.4%	82.1%	1.26	No
Total number of activities participated in					
0	9.5%	5.7%	11.4%		
1	21.9%	37.1%	14.3%		
2	30.5%	20.0%	35.7%		
3	24.8%	22.9%	25.7%		
4	13.3%	14.3%	12.9%		

participated in at least one outdoor activity. Hiking and picnicking were the most popular activities. A test for significant difference between the recreation participation rates of the focus group participants and nonparticipants indicates that there is no significant difference for any category.

Table 3.5 reports the average response values for each of 10 issues affecting Michigan. A test for significant difference between focus group participants and nonparticipants indicates that there are significant differences for only the categories “improve schools in your area” and “increase local security against terrorism,” where nonparticipants rated both issues as more important than participants did.

Respondents gave the highest average rating to the issue, “clean up PCBs and other toxics that threaten human health and wildlife in the Kalamazoo River Valley” and the lowest average rating to “create more local hiking and biking trails” (although this category still received a 3.31 average rating or higher on a 5-point scale). In general women rated these issues as more important than men did but ranked them in the same order.

In a related question, respondents were asked to identify what they thought was the single most important issue facing Michigan of the 10 issues in Table 3.5. Table 3.6 displays the results ranked in order from participants. The top-ranked issues for both groups tended to be nonenvironmental issues. Cleaning up PCBs was the top-ranked environmental issue for many people in both groups (ranked second by participants, fourth by nonparticipants). Other environmental issues were considered “most important” by relatively few people.

Table 3.5. Results for Question 7: Importance of 10 Michigan issues[a] (1 is "not important at all," 5 is "extremely important")

	Telephone survey respondents		Focus group				Test for difference between participants and nonparticipants	
			Participants		Nonparticipants			
	n	Mean (std. err.)	n	Mean (std. err.)	n	Mean (std. err.)	z-stat	Significant at $\alpha = 0.05$?
Clean up PCBs and other toxics that threaten human health and wildlife in the Kalamazoo River Valley	95	4.41 (0.09)	34	4.26 (0.18)	61	4.49 (0.11)	-1.11	No
Make state and local government more efficient	96	4.14 (0.11)	35	4.11 (0.20)	61	4.15 (0.13)	-0.14	No
Reduce crime in your area	96	4.27 (0.10)	35	4.03 (0.19)	61	4.41 (0.11)	-1.72	No
Encourage economic growth and jobs in your area	96	4.07 (0.11)	35	4.00 (0.20)	61	4.11 (0.13)	-0.47	No
Encourage household recycling	98	3.93 (0.12)	35	3.83 (0.20)	63	3.98 (0.15)	-0.63	No
Improve local roads and highways	96	3.80 (0.11)	35	3.83 (0.20)	61	3.79 (0.13)	0.17	No
Improve schools in your area	93	4.15 (0.10)	33	3.79 (0.21)	60	4.35 (0.11)	-2.40	Yes
Increase local security against terrorism	95	4.00 (0.12)	34	3.53 (0.25)	61	4.26 (0.12)	-2.65	Yes
Preserve and restore wetlands in your area	95	3.69 (0.13)	34	3.53 (0.25)	61	3.79 (0.14)	-0.89	No
Create more local hiking and biking trails	96	3.34 (0.12)	35	3.40 (0.22)	61	3.31 (0.15)	0.33	No

a. Sorted by focus group participants mean importance rating, not by order in which they were asked.

Table 3.6. Respondents' ranking of most important issues facing Michigan[a]

Issues	Phone respondents		Focus group			
			Participants		Nonparticipants	
	% most important	Rank	% most important	Rank	% most important	Rank
Encourage economic growth and jobs in your area	16.8%	2 (tie)	22.9%	1	13.3%	3
Clean up PCBs and other toxics that threaten human health and wildlife in the Kalamazoo River Valley	14.7%	4	20.0%	2	11.7%	4 (tie)
Improve schools in your area	17.9%	1	11.4%	3	21.7%	1 (tie)
Increase local security against terrorism	16.8%	2 (tie)	8.6%	4 (tie)	21.7%	1 (tie)
Reduce crime in your area	9.5%	5	8.6%	4 (tie)	10.0%	6
Create more local hiking and biking trails	4.2%	8	8.6%	6 (tie)	1.7%	9
Encourage household recycling	6.3%	7	8.6%	6 (tie)	5.0%	7
Improve local roads and highways	2.1%	9	5.7%	8 (tie)	0.0%	10
Make state and local government more efficient	9.5%	6	5.7%	8 (tie)	11.7%	4 (tie)
Preserve and restore wetlands in your area	2.1%	10	0.0%	10	3.3%	8

a. Sorted by rank reported by focus group participants, not by order in which they were asked.

3.5.2 Discussion of written focus group handouts

Introduction

Four written handouts were designed to guide individuals through a discussion of the topics. This section discusses each of the handouts, which are in Appendix E. Handout A is an introductory "warmup" question, Handout B asks general questions about the Kalamazoo River, Handout C asks about specific natural resource topics, and Handout D asks about funding. In analyzing the written responses for questions offering a "do not know" response category, the mean value is calculated without the "do not know" responses.

Handout A: Introduction

Handout A is simply a blank sheet that asks the respondent to list a few of the most important environmental issues in the area. An open-ended question such as this is an easy task to get the respondent started in the focus group process while other participants are entering the room. Another purpose of Handout A was to elicit individuals' concerns and issues about the environment before any discussion or prompting. This provides an unbiased perspective on what

environmental issues are important in the area and provides a preliminary understanding of the importance of PCB contamination relative to other issues in the region.

A simple count of the number of times topics were mentioned reveals several common issues. Participants provided 127 comments, and some listed up to eight concerns. Overwhelmingly, "rivers and lakes" was noted as an important environmental issue; 27 comments were about river and lakes (or waterways) or water quality in general with some relation to reducing pollution. Only three of these specifically commented on PCBs, and one commented on paper company wastes. Of these 27 comments, 13 were listed first on an individual's handout. Beyond these 27 comments, 7 more focused on drinking water quality and water conservation.

Twelve comments were made about air pollution (including global warming, which is a result of air emissions), and eight people listed urban sprawl or growth as an issue in the Kalamazoo area. Another eight comments were made about pollution in general terms, and six other comments were more easily categorized as general concerns about toxics.

Eight people entered comments best described as relating to wildlife in the Kalamazoo area. These included concerns about diversity and endangered species (including one suggesting deer population control). An additional five comments specifically listed wetlands as a concern (including one suggesting that perhaps there were too many wetlands). Four people commented on brownfields or "old nonused buildings" as a concern, five commented on groundwater or the water table, and five commented on recycling as a concern.

Thirty-two comments were not easily grouped with those above. These covered topics from asbestos to zebra mussels and included a few "nonenvironmental" issues such as school safety and casinos.

Handout B: The Kalamazoo River and its management

Handout B elicited information from participants on:

- Familiarity with the river
- Activity levels
- Recreational, natural resource, and environmental management actions they believe to be the most important
- Why these actions are important.

The handout contains a combination of closed-ended and open-ended questions. The questions were designed to elicit individuals' existing perspectives and preferences. Participants were shown a map with major cities, creeks, rivers, several dams, recreational areas, and other features before they were asked to answer the questions (see Handout B in Appendix E for the map). The moderators briefly discussed the map, pointing out the direction of river flow and that the Lake Allegan Dam is also called Caulkins Dam.

The first question asks about familiarity with the river in general. Table 3.7 shows frequencies and mean responses. Familiarity is highest for the river stretch near Kalamazoo, where most of the respondents live. Also, respondents tended to rate their familiarity higher for stretches closer to their homes. Responses of "not at all familiar" may be correlated with uncertainty in responses to subsequent questions that follow in the focus group and the reticence to commit to a level of knowledge in advance.

Table 3.7. Familiarity with the Kalamazoo River

B1 **How familiar are you with the following sections of the river?**

	Not at all familiar (1)	Somewhat familiar (2)	Very familiar (3)	Mean	Std. err.
Upstream of Battle Creek	23	9	2	1.38	0.10
Battle Creek to Morrow Lake Dam	19	10	5	1.59	0.13
Morrow Lake Dam to Allegan Dam (Caulkins Dam)	16	10	9	1.80	0.14
Allegan Dam (Caulkins Dam) to Lake Michigan	21	7	6	1.56	0.13

Individuals were then asked another closed-ended question regarding their activity levels in, on, or near the river over the past 5 years. Table 3.8 shows frequencies and mean responses sorted in descending order from most frequent to least frequent. The mean of the responses to this question does not provide a definitive ranking of the activity levels because the response categories are qualitative rather than quantitative. "Nonconsumptive" uses of the river such as walking, biking, jogging, watching birds or wildlife, and stopping to enjoy a view along the river dominate. Fourteen of 35 respondents indicated they used the river for fishing from a boat or shore, and of these only 5 ever ate fish from the river. Only one person indicated that he or she swam in the river.

Table 3.8. Respondent activities in or near the Kalamazoo River[a]

B2 **On average, over the past 5 years, how often have you personally done each of the following activities in or near the Kalamazoo River?**

	Never (1)	Occasionally (less than once a year) (2)	Sometimes (1-10 times a year) (3)	Frequently (11-20 times a year) (4)	Very frequently (20 or more times a year) (5)	Mean	Std. err.
Walking, biking, or jogging	12	6	10	4	3	2.43	0.22
Watching birds or wildlife	12	5	10	5	2	2.41	0.22
Stopping to enjoy a view along the river	10	9	12	1	3	2.37	0.20
Reading about or looking at pictures of the river or the surrounding natural area	9	11	13	1	1	2.26	0.17
Picnicking in a park along the river	13	9	9	2	0	2.00	0.17
Fishing from shore or a boat	21	8	5	1	0	1.60	0.14
Motor boating	24	7	3	0	1	1.49	0.15
Canoeing, kayaking, sailing, or rowing	22	10	3	0	0	1.46	0.11
Eating fish from the river	30	3	2	0	0	1.20	0.09
Swimming in the river	35	0	0	1	0	1.08	0.08

a. Sorted based on mean activity level from most to least frequent.

Question B3 asked individuals what actions, if any, they thought were most important to improve recreational opportunities in or near the Kalamazoo River. A total of 51 written comments were coded into one of five general categories.

The category coded as “recreational access” includes comments about more and better public access sites, including boat ramps, places to put in canoes, and fishing access. The “cleanup” category includes comments on stopping or reducing polluting, cleaning up trash, removing contaminants such as PCBs, cleaning up water so fish are safe to eat and it is safe for swimming, redeveloping abandoned buildings, and enforcing fines for polluting. “Paths and parks” includes comments about renovating existing parks, and providing bike paths, walking trails, and parks and associated facilities. The “information and education” category includes comments on

wanting more information on water quality and the status of the river, wanting more advertising about activities to do around the river, and raising public awareness. The "other" category includes comments on land use restrictions (keep out business and other shops within a radius of a couple of miles and monitor closely any construction along the river bank) and assigning responsibility for solving problems.

Table 3.9 shows the frequencies by comment category. The most frequent comments dealt with issues of cleaning up the river to improve recreational opportunities. Note that the question asked about improvements in recreational opportunities, and the largest number of responses related to cleanup of the river environment. The handout questions had not identified cleanup issues up to this point.

Table 3.9. Coding of open-ended responses to Question B3: "What actions, if any, do you think are most important to improve the recreational opportunities in or near the Kalamazoo River?"

Category	Number of mentions
Access (boat landings, put-ins)	10
Cleanup	20
Paths and parks	12
Information and education	5
Other	4
Total	**51**

Question B4 was an open-ended question asking individuals what actions they thought were most important to improve the natural resources in or near the river. A total of 42 comments were coded into nine categories: pollution control, cleanup, enforcement, habitat preservation or restoration, information and education, paths including more general recreation, shoreline and erosion control, other including land use controls, and do not know. Table 3.10 indicates the frequencies of the mentions by category in decreasing order of frequency. There was no mention of recreational access in response to this question.

The two most common comments related to cleanup of existing pollution and control of pollution. The third most commonly mentioned category related to preserving or restoring wildlife habitat. Some individuals stated that they felt they did not know enough or have enough information to be able to answer this question.

Table 3.10. Coding of open-ended responses to Question B4: "What actions, if any, do you think are most important to improve the natural resources in or near the Kalamazoo River?"

Category	Number of mentions
Cleanup	9
Control pollution	8
Habitat preservation or restoration	5
Information and education	4
Other — including land use controls	4
Enforcement	3
Paths including more general recreation	4
Do not know	3
Shoreline and erosion control	2
Total	**42**

When asked by the moderators whether recreation or environment was more important with respect to Questions B4 and B5, responses varied, with significant numbers favoring ecological improvements over recreational and vice versa. Many participants stated that the two issues are connected: "You can't have good recreation without a clean environment."

Question B5 listed eight natural resource issues related to the Kalamazoo River and asked individuals to indicate whether they were not at all aware, somewhat aware, or very aware of each issue. These issues are largely based on the topics that would be discussed in Handouts C and D. Table 3.11 reports frequencies and mean level of awareness about the eight natural resources topics related to the Kalamazoo River as elicited in Question B5.

Consistent with responses to prior questions and discussion during the focus groups, responses to Question B5 indicated that individuals are most aware of PCBs as an issue for the Kalamazoo River natural resources. Effects of PCBs and other toxic contaminants on fish and wildlife and on people who eat fish from the river ranked first and third, respectively, based on mean responses. The issue of trash and other debris ranked second. People are less aware of issues related to runoff, habitat loss, and shoreline access, and are least aware of shoreline erosion and barriers to fish migration. Thirteen of 36 individuals stated they were not at all aware of the dams and other barriers to fish migration.

As an open-ended probe following Question B5, individuals were asked to write in any other issues regarding the Kalamazoo River natural resources of which they were aware. In general few new topics were raised that had not been covered under the categories from Question B5 and

Table 3.11. Awareness of resource issues[a]

B5 **Below are a list of potential issues regarding the Kalamazoo River natural resources. How aware, if at all, are you with the following issues?**

	Not at all aware (1)	A little aware (2)	Very aware (3)	Mean	Std. err.
Risks to fish and wildlife from PCBs and other toxic contaminants in the river	3	13	20	2.47	0.11
Trash and other debris in the water and on the shorelines	3	14	19	2.44	0.11
Potential effects of PCBs and other toxic contaminants on people who eat fish from the river	4	16	16	2.33	0.11
Effects of municipal and agricultural runoff on water quality (clarity, odor, and safety for human contact)	5	16	15	2.28	0.12
Losses of fish and wildlife habitat (such as wetlands) near the river	8	14	13	2.14	0.13
Limited shore access and facilities for public recreational use	9	16	11	2.06	0.13
Shoreline erosion	7	20	9	2.06	0.11
Dams and other barriers to fish migration	13	19	4	1.75	0.11

a. Sorted based on mean awareness level from most to least.

that were directly relevant to natural resource issues in the Kalamazoo River basin. There was one mention of invasive species and one mention that water levels in the area may have been changing over the years. In addition two individuals mentioned controlling development as a natural resource issue.

Question B6 begins to explore individuals' attitudes toward costs of cleanup, tradeoffs between economic development and natural resource protection, and motivations for preservation. Responses on the first two topics are listed in Table 3.12, and responses about motivation are in Table 3.13. As suggested by responses to the question of cost, individuals seem to fall into two groups, those who generally "somewhat agree" and those who "somewhat disagree" that costs should be considered in choosing how much to cleanup. Only 4 of the 34 responses fell in the neither disagree nor agree response, and only another 9 fell in the strongly disagree or strongly agree. Responses to the second statement fell much more on the side of disagreeing, with 22 of the 35 responses (63%) falling in the strongly or somewhat disagree response categories.

Table 3.12. Attitudes toward costs of cleanup and economic development

B6 **Please rate how strongly you disagree or agree with the following statements.**

	Strongly disagree (1)	Somewhat disagree (2)	Neither disagree nor agree (3)	Somewhat agree (4)	Strongly agree (5)	Mean	Std. err.
Cost should be an important consideration in choosing how much to clean up and restore the natural resources in and near the Kalamazoo River	6	9	4	12	3	2.91	0.22
Sometimes economic development is more important than protecting natural resources	11	11	4	5	4	2.43	0.23

Table 3.13. Motivations for preservation of natural resources

B6 **Please rate how strongly you disagree or agree with the following statements.**

I want the natural resources in and near the Kalamazoo River protected and preserved for:	Strongly disagree (1)	Somewhat disagree (2)	Neither disagree nor agree (3)	Somewhat agree (4)	Strongly agree (5)	Mean	Std. err.
a) My family and me to use and enjoy now	3	1	5	11	14	3.94	0.21
b) My children and grandchildren to be able to use and enjoy	3	0	4	11	16	4.09	0.20
c) Future generations to use and enjoy	2	0	2	10	21	4.37	0.17
d) The benefit of nature, even if nobody uses the natural resources	2	3	0	10	19	4.21	0.21

Table 3.13 shows responses to the four statements focusing on individuals' motivations for protecting and preserving natural resources in the area. Two inferences can be drawn from these responses. First, among the participants, there was strong support for protecting and preserving the natural resource along the Kalamazoo River. Of the 137 total responses across the five response options, only 10 (7%) fell into the strongly disagree category and 4 (3%) in the somewhat disagree category. Second, participants were motivated to support protection and enhancement by both the benefits that people would receive in the near future from use and enjoyment and the benefits that would accrue to future generations and nature more broadly defined.

Looking at responses for particular individuals, only 1 of the 36 respondents agreed more strongly with protecting Kalamazoo River resources for current use than for future generations to use. Twenty-one believed that current use and future use were equally important, and 13 agreed more strongly with preserving the resources for future use than for current use.

In the terminology often used to discuss individuals' motivations for valuing and protecting natural and environmental resources, response option (a) would be considered direct current use; response (b) is for future use, often called a bequest value; response (c) is also future use, but from a more general altruistic motive rather than bequest for family; and (d) is largely an existence value motivation. The strongest motivations for protecting and preserving natural resources in the Kalamazoo River area are for future generations to use and enjoy (c) followed by the existence value motivation (d). Responses to this question strongly indicate that even though there is a significant use value for residents, as indicated by responses under (a), there is potentially an equally large or larger motivation to protect and preserve the resources for the future, both as a bequest and as an existence value.

Handout C: Kalamazoo River actions

Handout C focused on the five natural resource topics for the Kalamazoo River under the following headings:

- Outdoor recreational areas
- Wetlands and other natural areas
- PCBs
- Dams and other barriers to fish migration and boating
- Runoff from cities and farmlands.

The handout briefly introduces each of these topics and then asks a series of questions for later discussion. After the introductory text for each topic individuals were asked, "Before today, how much, if at all, have you seen, heard of, or read about [the topic for that section]?" Participants were then asked, "How important, if at all, is it to you that [action be taken on that topic in order

to reduce or control impacts]?" The quantity of information provided to individuals and the exact layout varied only slightly from topic to topic, and some topics included additional probes on specific issues related to the topic.

Table 3.14 shows response frequencies across all five topics to the question of how much had the respondents seen, heard , or read about the topic. Respondents could answer, "not at all," "very little," "some," or "very much." No one responded, "do not know." Table 3.14 presents the responses in decreasing order of mean level of prior information.

Table 3.14. Prior exposure to information on resource topics[a]

Before today, how much, if at all, have you seen, heard of, or read about . . .

		Not at all (1)	Very little (2)	Some (3)	Very much (4)	Do not know	Mean (excluding do not know)	Std. Err.
C7	. . . PCBs and their impacts in the Kalamazoo River?	0	5	17	14	0	3.25	0.12
C14	. . . water pollution from runoff and its impacts?	2	6	17	11	0	3.03	0.14
C5	. . . the loss of wetlands and natural areas around the Kalamazoo River due to farming and land development?	3	10	16	7	0	2.75	0.15
C8	. . . fish consumption advisories in the Kalamazoo River?	7	7	12	9	0	2.66	0.18
C1	. . . the need to add facilities or acreage at existing parks or to open new parks and access?	5	16	14	1	0	2.31	0.12
C11	. . . these dams and impacts?	12	17	5	2	0	1.92	0.14

a. Sorted based on mean awareness level from most to least.

Individuals have seen and heard the most about PCBs and their impacts, and the results are statistically significantly higher than all other resource topics except water pollution from runoff. Statistical comparisons or average ratings were made on the basis of a standard two-sample test of means, using the computed means and standard errors in Table 3.14. No individual responded

that he or she had not heard of PCBs and their impacts at all. Even though all individuals had heard of PCB impacts, fewer had heard of the fish consumption advisories. After PCBs, people had seen, heard, or read the most about water pollution from runoff. The majority of individuals had heard only very little or some about any potential need for additional recreational facilities. Several individuals had never heard of the issues of the dams and their impacts on the river and its wildlife, and only two individuals had heard "very much" on the topic.

In each of the five sections on natural resource topics, individuals were asked how important, if at all, it was to them for action to be taken to improve conditions. Table 3.15 shows frequencies and means in descending order of overall importance. PCB removal received an average importance rating of 4.11 on the 5-point scale, with 29 of the 36 participants (81%) rating this as "very important" or "extremely important," even though some people made verbal comments about their uncertainty of the efficacy or cost-effectiveness of dredging. Removing PCBs to reduce their impacts on wildlife was followed by wetlands and habitat preservation and runoff pollution control. These three actions were rated statistically significantly higher than the other actions based on a two-sample test of means.

Individuals rated improving recreational opportunities, allowing anadromous fish to migrate further upstream, and removing the three partial dams as least important overall. Question C12 regarding the removal of the three partial dams received the largest number (four) of "do not know" responses of any question regarding how important potential actions were to individuals. Along with the lower revealed awareness of this issue, this suggests that individuals need more information about the ecological and recreational benefits of fish migration, and the importance of dam removal.

In the section on the importance of increasing recreational opportunities along the Kalamazoo River, individuals were asked, "Would you be likely to participate more often in outdoor recreational activities if these improvements were made?" Improvements consisted of adding facilities and acreage at existing parks or opening new parks and access. This question begins to explore whether individuals would make behavioral changes if natural resource improvements were made. Table 3.16 shows the frequencies to this question.

Forty-seven percent indicated that they would be likely to use the river more often for outdoor recreation if more opportunities were made available. One out of six was not sure. These responses suggest that use values are important for individuals and that a lack of access may be causing recreationists to substitute to different sites and activities.

Question C4 in the outdoor recreation section elicited comments on specific topics and locations for recreational improvements. The need for additional trails and paths, including hiking and biking trails, was mentioned most often. Wildlife viewing areas, boat and canoe launches and access, and parks were each mentioned less frequently.

Table 3.15. Importance of natural resource topics[a]

	How important, if at all, is it to you . . .	Not at all important (1)	Slightly important (2)	Moderately important (3)	Very important (4)	Extremely important (5)	Do not know	Mean (excluding do not know)	Std. err.
C9	. . . that PCBs be removed to avoid potential harm to birds, fish, and other wildlife?	0	2	5	16	13	0	4.11	0.14
C6	. . . to acquire, preserve, and restore wetlands and other wildlife habitat near the Kalamazoo River?	0	2	10	12	11	1	3.91	0.16
C15	. . . to control runoff in order to improve water clarity in the Kalamazoo River and reduce excess algae?	0	1	11	17	6	0	3.80	0.13
C2	. . . to increase recreational opportunities along the Kalamazoo River?	2	4	16	12	2	0	3.22	0.15
C13	. . . for trout, salmon, and pike to have a greater ability to migrate by opening a fish ladder and other means?	1	4	20	7	3	1	3.20	0.15
C12	. . . that the rest of the three partial dams be completely removed?	2	3	18	7	2	4	3.13	0.16

a. Sorted based on mean importance level from most to least.

Table 3.16. Behavioral response to recreational improvements

C3	Would you be likely to participate more often in outdoor recreational activities if these improvements were made?	
Go more often	**Go about the same, but enjoy it more**	**Not sure**
17	13	6

In the part of Handout C dealing with PCBs, Question C10 asked individuals how bothered they would be, if at all, if they learned that the effects of PCBs would last for 20 or 100 years into the future. This question begins to explore how individuals would respond to different PCB cleanup efforts leading to different durations of PCB impacts. One hundred more years of PCB impacts may be related to minimal cleanup and natural attenuation. Twenty years may result from an intensive PCB remediation program. Table 3.17 shows frequencies and mean ratings for the responses to Question C10.

Table 3.17. Response to temporal effects of PCBs

C10	How bothered, if at all, would you be if you learned that the effects of PCBs would last for:							
	Not at all bothered (1)	A little bothered (2)	Somewhat bothered (3)	Very bothered(4)	Extremely bothered (5)	Do not know	Mean	Std. err.
20 more years?	0	3	8	13	12	0	3.94	0.16
100 more years?	0	2	4	6	24	0	4.44	0.15

No one responded, “not at all bothered,” and no one responded, “do not know,” for either time frame. A total of 83% responded that they would be “very bothered” or “extremely bothered” by a 100 year time path of PCB impacts. Even with reducing the time to 20 years, 69% are still “very” or “extremely” bothered. While these results suggest that reducing the time frame of PCB effects has beneficial impacts, they also indicate PCB effects during the next 20 years are a major concern.

Following coverage of all five natural resource programs (outdoor recreational areas, wetlands and other natural areas, PCBs, dams and other barriers to fish migration and boating, and runoff from cities and farmlands), Question C16 asked participants to rank the five programs from least important (1) to most important (5). Table 3.18 shows these ranking in descending order of importance. Wetlands and habitat enhancement and PCB removal ranked first and second each, with 21 participants ranking these as the first or second most important issue; they are not statistically different. Runoff control ranked third, followed by recreational park enhancement. Recreation ranked statistically significantly lower than wetlands, PCBs, or runoff (which are not statistically different from each other). Dam removal ranked last, which may reflect that individuals have limited understanding of the issue.

Table 3.18. Ranking of natural resource programs[a]

C16 **Not all actions can be done at once. Based on what you know so far, how would you rank these five programs from least important to most important:**

	Not at all important (1)	Slightly important (2)	Moderately important (3)	Very important (4)	Extremely important (5)	Mean	Std. err.
Wetlands and habitat enhancement	2	4	9	10	11	3.67	0.20
PCB removal	5	5	5	8	13	3.53	0.24
Runoff control	2	10	8	10	6	3.22	0.20
Recreational park enhancement	13	7	4	4	8	2.64	0.27
Dam removal	10	9	10	3	3	2.43	0.21

a. Sorted based on mean importance level from most to least.

Handout D: Funding Kalamazoo River actions

Handout D further explores individuals' relative rankings and ratings of natural resource management priorities along the Kalamazoo River by introducing the concept of funding. Participants were asked how high a priority should be placed on funding a variety of actions. While this question does not elicit willingness to pay or specifically indicate who will bear funding responsibility, it does suggest implicitly that decisions on resource actions involve costs and that fiscal limitations may constrain options to address these issues.

Table 3.19 shows frequencies and mean responses for nine actions related to the five natural resource topics in descending order of mean priority for funding. General cleanup and pollution reduction rated the highest priority. Based on the discussions, the term pollution may have included the concept of PCB cleanup in some respondents' minds. This was followed by research and education related to the river ecosystem, protecting wildlife from PCBs, and removing PCBs to reduce FCAs. The four top actions all average between a "high priority" and a "very high priority." The three pollution/PCB related actions elicited no "very low priority" responses and no "do not know" responses, again suggesting the overall importance of reducing PCBs in the river ecosystem. Removing FCAs rated a "high priority" even though there were relatively few anglers in the focus groups. Rated sixth and seventh, respectively, of the nine

Table 3.19. Funding priorities for natural resource programs

D1 **If money were available, actions could be taken to improve the Kalamazoo River resources. However, there will never be enough money to do everything. Please tell us how high a priority should be placed on each of the following actions.**

	Very low priority (1)	Low priority (2)	High priority (3)	Very high priority (4)	Do not know	Mean (excluding do not know)	Std. err.
Reduce pollution and shoreline trash to improve the aesthetic quality of the river (e.g., odor, water clarity, visible garbage)	0	0	9	27	0	3.75	0.07
Support research and educational programs about the river ecosystem	2	1	7	25	1	3.57	0.14
Protect fish, birds, and wildlife from being harmed by pollution (including PCBs), even if the number of fish, birds, and wildlife is not increased	0	3	10	23	0	3.56	0.11
Remove PCBs so fish consumption advisories could be lifted	0	7	21	8	0	3.03	0.11
Increase the amount of natural habitat near the river	2	5	22	6	1	2.91	0.13
Increase and improve recreational access points and park facilities along the river	2	11	14	8	0	2.80	0.15
Enhance the state recreational and game areas near the river	3	14	13	6	0	2.61	0.15
Reduce barriers to fish migration and boating	3	14	13	6	0	2.61	0.15
Increase the numbers of fish, wildlife, and native plants	3	14	14	4	1	2.54	0.14

topics are improving river access for recreation and enhancing recreational areas. Ecological and pollution actions get much more support for funding.

3.5.3 Impressions from discussions in the focus groups

The focus groups also contributed much information through discussion. However, discussions in focus groups must be interpreted with caution. Often only one or a few participants will be heard on a given subject and one cannot be sure what other people were thinking. Additionally,

there is always the risk that oral statements will be misinterpreted. Still, in addition to providing people's views, concerns, and opinions on survey-like handouts, focus groups offer the opportunity to probe deeper into what people say and to explore issues and ideas that come up spontaneously.

In general, participants in the four focus groups that were conducted in Kalamazoo tended to think about environmental issues in three discrete groups (which was corroborated using factor analysis on responses to Question D1): (1) recreational actions, which include state recreational and game areas; (2) ecological actions, which include increasing wildlife populations, protecting wildlife, increasing habitat, reducing river barriers, and ecosystem education; and (3) pollution actions, which include reducing pollution in general and reducing PCBs to lift FCAs. They tended not to be adamant or overzealous about any one of these or any other particular environmental issues, and with few exceptions, the Kalamazoo River in its present condition did not seem to be central to their daily lives.

Respondents' statements during open-ended discussions revealed a very strong conviction that the Kalamazoo River has a contamination problem, with PCBs being the most significant source. The topics of PCBs often came up spontaneously. While most participants had some information or awareness about PCBs before reading the materials in the handouts, their knowledge about the ecological effects and potential human health risks associated with the chemical was often incomplete. After written comments were completed, a number of people, when questioned further, mentioned PCB cleanup as an environmental issue for the Kalamazoo River.

Several respondents noted that the PCB problem is just one of a number of environmental problems affecting the river, but there was also some vagueness about the sources of the problems. Overall there appears to be a perception that the river is dirty and needs to be cleaned up to improve recreational opportunities. The "dirt" includes PCBs, other toxins, and trash in general. Terms such as "paper mill waste" and "industrial waste" came up repeatedly; a number of respondents knew that PCBs are linked to the paper industry, although some said there are other sources of pollution problems besides the paper industry. A few individuals seemed to be confusing PCBs with other chemicals such as mercury and DDT.

Respondents openly supported the idea that polluters should pay to clean up the pollution they created, but many also believed taxpayers would ultimately bear most of the burden. However, many were uncertain about the effects and effectiveness of dredging or other cleanup methods. While participants were almost universally troubled by the presence of PCBs, many questioned whether cleanup would be effective and successful (and to what degree, relative to the costs of cleanup), and some were worried about collateral damage and making the problem worse. However, if these concerns were allayed, there is no question that a majority of participants would very much like to see the problem addressed.

Several individuals noted the river seemed cleaner than 10 or 20 years ago, but some people said that the river still has an odor. Only one or two participants said they had ever eaten fish from the river, and essentially no interest was expressed in swimming in the river under current conditions. The anglers noted that the fishing has been good, but that they practice catch-and-release fishing, or fish the Kalamazoo River less, because of the fish consumption advisories. As discussed in Chapter 2, there are many studies that show that anglers respond to contamination and FCAs by reducing the number of fish they eat, fishing less, and fishing at cleaner sites.

From a recreational perspective, participants tended to view the Kalamazoo River as an underutilized resource. Some individuals thought it has substantial potential as a recreational resource, especially now as compared to a decade or two ago when the river was much dirtier, but some still are dubious because they remember the past pollution problems.

Several people thought if access and facilities were better, more recreationists would visit and consequently would learn about and support cleaning up the river. However, a larger group felt that further cleanup took priority over enhancing recreational facilities: better environmental conditions are a prerequisite for expanded recreational opportunities. Overall, participants were in agreement that a cleaner environment and good recreation go hand in hand.

Participants showed interest in better access for recreation, more facilities (especially trails), and better information about access. Some access exists, but some individuals said that it was hard to locate and that lengthy stretches do not have good access. Several made specific recommendations for particular access improvements that also showed up in written comments. Several individuals tied these comments to the need to clean up the river if additional access is provided. The Kal-Haven Trail was noted by several individuals as a model for future paths and trails and as a base for expansion to other stretches of the river.

Participants showed a general awareness of the importance of wetlands, although many did not have a complete understanding of the services they provided. For example, some people were unaware of filtration and dilution services performed by wetlands; once someone mentioned these types of services, support for wetlands programs grew within the focus groups. In general, participants were much more in favor of preserving existing wetlands over restoring wetlands that had been drained previously. Some participants voiced reservations about how high a priority wetlands deserve, whereas others thought wetland programs were critically important to the environment of the Kalamazoo River valley.

Because of time constraints, discussion of runoff issues and nonpoint source pollution was limited. Nevertheless, awareness and support for controls were significant. Respondents characterized runoff pollution as an ongoing problem.

Without question, of the topic areas discussed, participants were least informed about sill-level dams. This potentially was reflected in the low levels of interest in and low priority ranking of dam removal. After reading the materials about fish migration and boater access, there was some interest in removal, but also much indifference and some reservations (although no significant opposition to removal). It was not clear whether the participants fully appreciated the service enhancements that would result from dam removal. Awareness was definitely limited regarding the connection between lowering the impoundments and the high PCB concentrations that reside behind them. Further, the implications of PCBs and other contaminants in areas that would be dewatered by dam removal were not fully comprehended.

3.6 TVS Summary

Focus groups are a qualitative research tool. They do not lend themselves to the same sorts of quantitative, detailed generalizations about the public's attitudes, knowledge, and values that one expects from a formal survey, but they can nevertheless be useful in gauging where the public stands in general terms. In this section, conclusions are drawn from the focus groups that should be useful in qualitatively evaluating service losses and in restoration planning under the Kalamazoo River NRDA.

It is clear that area residents are aware of and concerned about PCB contamination in the Kalamazoo River. They have a basic understanding of the problem, although they are not always aware of the details or have the details just right. They are quite troubled by the prospect that PCB effects could last even 20 more years, much less 100 years. Hence they would like to see the problem addressed, provided effective remedial procedures can be employed at reasonable cost. They see remediation as a potential way to benefit themselves, others alive today, future generations, and nature for its own sake. According to verbal comments in focus groups, they would like to see those responsible for the problem pay for cleaning it up.

To the extent that full remediation of contaminated sediments proves infeasible, the area residents are willing to consider other forms of compensatory restoration. Alternatives that seemed to appeal most to the group participants would involve either preservation of and, to a lesser extent, restoration of wetlands and other habitats or control of nonpoint source pollution.

Recreational facilities seemed less promising as a restoration strategy for two reasons. First, there was no general perception that current outdoor recreational facilities are grossly inadequate in quantity or quality. Second, there seemed to be a general feeling that recreational improvements are not very desirable along a river that remains contaminated by PCBs and otherwise degraded. Recreational improvements would be more attractive along a cleaned-up river. Pedestrian and bicycle trails and increased access stood out as possibilities for compensatory restoration.

A case for dam removal would be hardest to make among the alternatives that were considered. Area residents might or might not warm up to the idea if they knew more about it.

In considering restoration strategies, the relatively high priority placed on PCB cleanup needs to be kept in mind. While environment-enhancing actions such as wetlands restoration and runoff control had noteworthy importance rankings and were considered high funding priorities, PCB cleanup generally got as high or higher rankings.

A formal survey of Kalamazoo area residents could help flesh out in much more detail what combinations of PCB remediation and restoration actions would make the public whole. Such a survey would be feasible if it proved desirable in later phases of the NRDA process. The focus groups showed that area residents have the knowledge base about PCB contamination and restoration alternatives needed as a starting point for such a survey. However, gaps in public knowledge and misunderstandings of relevant facts mean that substantial information would have to be effectively supplied to potential survey respondents. This would require careful design and pretesting of the survey materials.

The results from this TVS study are consistent with certain questions on the same topics from another recent general population survey sponsored by paper companies in the Kalamazoo River valley. Not only does this other survey corroborate findings in the TVS study, it also provides useful new information on the knowledge, attitudes, and preferences of residents. A short summary of those results in presented in the next section.

3.7 Atkin General Population Survey Results

Charles Atkin (through the Communications Research Institute in East Lansing, Michigan) conducted a public opinion poll in 1998. This poll consisted of a telephone survey with 38 questions related to environmental issues involving the Kalamazoo River. While no sampling plan or record of the final disposition of telephone calls is available, the data show this study primarily targeted residents of the counties through which the Kalamazoo River runs. Of the 400 people who completed the survey, 384 were from Kalamazoo and Allegan counties, 7 were from St. Joseph County, and the 9 remaining reported no county. The median level of education for respondents was “some college,” the median age was in the 40s, about one-quarter of the sample had children under 10, and men and women were nearly equally represented.

The data and survey form were obtained from Triangle Economic Research in North Carolina. No data codebook was provided, so this analysis reflects the best understanding of the raw data and the questionnaire. The procurement of a codebook might make reanalysis of the data necessary, perhaps leading to different conclusions.

Residents of the counties near the river were aware of its pollution problems. Most (67%) thought the Kalamazoo River is somewhat or very polluted. Only three respondents felt it is very clean (and were terminated from the survey), 16% thought it is somewhat clean,[2] and 17% did not know. When asked what kind of pollution is in the river, about 40% of all respondents mentioned PCBs, chemicals, or toxic waste (14% explicitly mentioned PCBs). Respondents who did not mention one of these categories were prompted with the question, "Do you think there is chemical contamination in the river?" Of the respondents who answered this question, about 83% said they thought there was chemical pollution present. Therefore, overall about 71% of respondents think the Kalamazoo River is polluted with PCBs, chemicals, or toxic waste. Some respondents (30%) also mentioned paper waste polluting the river.

Most respondents think paper mills were responsible for chemical pollution in the Kalamazoo River. When asked who is responsible for this waste, 43% said paper mills/plants, without prompting, and an additional 33% agreed when specifically asked if they think paper mills polluted the river. However, only a very small number of respondents (less than 5%) could specifically name any of the individual paper mills in an open-ended question.

The majority (77%) of residents near the Kalamazoo River are concerned about the possible effects that may result from contamination of the river.[3] The reasons for their concern vary widely, as do their most important concerns. Overall, 58% are concerned about health issues (impure ground or drinking water, contaminated fish, cancer risk, safety of nearby residents, or risk to babies and children); 32% are concerned about hunting and fishing issues (fishing, contaminated fish, hunting, or contaminated waterfowl); and 10% were concerned about other recreational activities (boating, swimming, or tourism).[4]

Those concerned about contamination are more likely to be recreational users (21% of those concerned are users, whereas 14% of the unconcerned are users). Further, those concerned are more likely not to be using the river because of contamination (49% of those concerned are not using the river because of contamination, whereas only 10% of the unconcerned are not using the river for that reason).

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2. Those who think it is somewhat clean may be responding to aesthetic improvements to the Kalamazoo River, brought about by the Clean Water Act, that began to be seen in the early 1990s (James Dexter, MDNR, personal communication, 2002).

3. Note that the way the survey is worded, "contamination" could be interpreted to include all contaminants, not just PCBs.

4. These responses are based on an open-ended question. Note that respondents could report concerns in multiple categories, so percentages do not sum to 100%. This is also true for other questions where multiple responses are possible.

These concerns have affected recreational use patterns on the Kalamazoo River. The current level of contamination is preventing 39% of respondents from using the river. In the year before the survey, only 19% of all the respondents used the river for recreational purposes (9% fished, 11% canoed, boated, or swam, and 6% hiked or participated in other recreational activities). Of the 117 respondents who are specifically concerned about contamination effects on fish and fishing, 49% did not fish the Kalamazoo River in the prior year and 60% said the current level of contamination kept them from using the river. Of the 36 respondents who were concerned about boating and swimming, 81% did not swim or boat on the Kalamazoo River in the prior year, and 58% said the current level of contamination is keeping them from using the river.

Some respondents are also interested in improved access to the Kalamazoo River. When asked if they would be likely to use the river for recreation if additional sections were made more accessible, 29% said yes, 19% said maybe, and 35% said no (18% were not asked because they already use the river). Which "additional sections" would be made accessible is not specified and different respondents may envision different stretches being made more accessible. These stretches could be near to their homes, in a scenic area, or in a less polluted part of the river.

Only 53% of respondents think they know what PCBs are, but 73% believe PCBs are harmful. Most residents (62%) have heard about the FCAs and 34% have full or partial knowledge of which fish pose health risks. Awareness and knowledge are higher for those who use the river. Of those who recreated on the Kalamazoo River in the prior year, 73% had heard of the advisories and 48% had full or partial knowledge of which fish pose health risks. Of those who fished the river in the prior year, 81% had heard of the advisories and 57% had full or partial knowledge of which fish pose health risks.[5]

About half (49%) of all residents think the contaminants in the Kalamazoo River pose a cancer risk (33% do not know and 18% think there is no risk). These proportions are about the same for those who are aware and those who are not aware of the FCAs. Those who are aware and knowledgeable about the FCAs are slightly more likely to think the contamination poses a cancer risk (53% believe it does). While 16% of respondents think the risk is serious, about 27% believe the cancer risk to be "slight" or "mild." Another 6% believe there is a cancer risk, but do not now how serious it is. When asked if PCBs are harmful in an open-ended question, over one-quarter

5. Note the percentage of anglers who are knowledgeable about FCAs is larger here than in the KRRA study described in Chapter 2. This difference reflects the fact that the two studies focused on different populations. Atkin (1998) interviewed residents of eight counties near (or containing) the Kalamazoo River. He asked only about two seasons of fishing that year. From this partial data, only 37 respondents reported fishing. Of these, 81% said they had heard of the FCAs, but the question may have been leading: "Have you heard the advisory warning about eating fish from the Kalamazoo River?" These anglers are also likely to be less avid than the KRRA anglers because the KRRA study was an intercept survey, and the Atkin survey was a random-digit-dial telephone survey. See Appendix B for further discussion.

(27%) said no. Approximately one-third believe they are harmful, but do not know what harm might occur. Another 31% believe PCBs could increase cancer risk. Other categories of potential harm included risk to babies, risk to pregnant women, risk associated with eating contaminated fish or waterfowl, and other health-related and other responses.

Only 19% of respondents feel animals, birds, or amphibians are harmed by the contamination, but the large majority of that group believes the harm is somewhat or very serious. The types of wildlife (i.e., species) some respondents believe to be harmed include frogs, eagles, and, to a lesser degree, mink, muskrats, and other species.

Respondents clearly favor cleaning up the Kalamazoo River. The majority of respondents (71%) think the river should be cleaned up, only 17% feel it should be left alone, and 12% do not know. Moreover 81% of the respondents who fished (and 79% of the respondents who recreated) on the Kalamazoo River in the prior year want to see the river cleaned. Two-thirds of the respondents who said they were not concerned about the effects of the contamination also want to see the river cleaned.

Almost three-fourths (73%) are unaware of any efforts to clean up the river. In an open-ended question for those who had heard of cleanup efforts, the most frequent responses about what is specifically being done include Superfund, government projects, paper company activity, and other cleanup.

Respondents were asked if they were aware of a cleanup under way at Bryant Mill Pond near Portage Creek. Only 30% had heard of any cleanup, and of those, approximately 73% did not know any details about how cleanup would be done. An even smaller number (20%) had heard of plans to clean up paper company landfills in the Kalamazoo area and downriver, and of those, 72% did not know any cleanup details.

Respondents were asked in an open-ended question what type of river cleanup should be undertaken; they could make multiple responses. A number of approaches were mentioned by interviewees, such as stopping new emissions (mentioned by 27% of people who made comments); cleaning up nonchemical pollution along riverbanks, beaches, and wetlands (21%); filtration (3%); and testing (2%). “Whatever it takes” was mentioned by 11%. Comments on oversight, regulations, and research accounted for 20% of all comments. Dredging and removal of PCBs was mentioned over 10 times more frequently than waiting for natural processes to have an effect (21% versus 2%).

The Atkin survey also explored areas that were not covered by the TVS study. The Atkin study asked about where the public obtains information about the river, knowledge about which agencies play a role in remediation, views about potentially responsible parties, and the “reasonable cost” of cleanup.

Almost half of the respondents (49%) get information on pollution problems in the Kalamazoo River from a newspaper. Other sources of information are television, radio, government, and friends and family. The median number of days per week local newscasts are watched on television is three, and the median number of days the local newspaper is read is also three. Over half of respondents (53%) do not think they are getting enough information on Kalamazoo River pollution problems; 36% feel they are getting enough information, and 11% do not know.

Almost half of the respondents do not know which government agencies play a major role in studying and cleaning up the river. EPA was mentioned by 26% of respondents, and the MDNR was mentioned by 22%. Approximately three years before this survey was conducted, the MDNR was split into the MDNR and the MDEQ, so public recognition of the MDEQ may still have been low.

Respondents' general attitudes toward the paper companies tend to be neutral, with a slight tendency to view them unfavorably. The great majority of respondents (over 90%) do not know if the four paper companies identified as potentially responsible for some Kalamazoo River contamination (Allied Paper, Fort James, Georgia Pacific, and Plainwell) have agreed to pay for the cleanup process. When asked if these companies have acted responsibly in handling the problem so far, 44% do not know. Over twice as many respond no (31%) versus those who respond yes (14%), although 11% say the companies have acted somewhat responsibly. Residents were also asked if the different organizations involved in the Kalamazoo River cleanup process are credible sources of information. Government and citizen organizations were rated as "somewhat" to "very" credible, on average, while the paper companies were rated as significantly less credible, falling between "somewhat" and "not" credible. For example, over one-quarter of respondents rated the paper companies as not credible, while only 4% rated the MDNR as not credible and 7% rated EPA as not credible.

Finally, a survey question was asked about the respondent views of a reasonable cost of cleanup, and how many millions of dollars should be spent cleaning up the river. About half do not know. For the other half, the mean response was almost $30 million (with a standard error of the mean of $3.8 million).

3.8 Conclusions

The TVS focus groups were designed to qualitatively evaluate service losses due to PCBs and potential service gains from restoration projects. Results demonstrate that individuals are aware of PCBs, that they value service losses caused by PCBs beyond FCAs, that they are concerned about PCB contamination, and that PCB cleanup is a high priority. Of the other potential restoration actions considered, wetland protection ranked highest, recreational enhancements and dam removal ranked the lowest, and nonpoint source runoff ranked in between.

While the scope and size of the focus groups were small, the results are corroborated by the Atkin (1998) general population survey. The Atkin study reinforces conclusions about awareness of PCBs, the potentially harmful effects on people who eat fish, how to improve natural resources, and the type of cleanup that should be undertaken.

4. Restoration Planning

This chapter describes the Trustees' restoration planning activities in Stage I of the assessment. These Stage I restoration planning activities consist primarily of developing criteria for future selection of projects and compiling information on potential restoration actions for the KRE that are consistent with the DOI NRDA regulations and other applicable state and federal laws.

Restoration actions can include actions to restore, rehabilitate, replace, or acquire the equivalent of the injured resources and services they provide [43 CFR § 11.80(b)]. To the extent that PCBs are causing injuries to natural resources, eliminating or reducing exposure of the injured resources to PCBs can restore the resources to baseline (i.e., the condition they would have been in had the PCB releases not occurred) although interim services during remediation may still be lost. Response actions are expected to reduce PCB exposure, but to the extent that response actions do not fully restore resources to baseline, actions to extract or contain PCB contamination, such as sediment dredging or capping, soil removal or capping, or riverbank stabilization may be considered as part of restoration. Any such actions would be coordinated with the PCB cleanup being planned by the response agencies.

A second type of restoration action that may be taken is ecosystem-based restoration. In the KRE, the different components of the ecosystem are inextricably linked to each other, and the hazardous substances that have been released are one of several ecological stressors on the system. Other stressors such as habitat loss or degradation, alterations in natural hydrologic processes, and nonpoint source pollution can also result in loss of resources or services similar to the losses caused by hazardous substance releases. Any such stressors are taken into account by the Trustees in determining damages for PCB-related injuries to natural resources. In selecting actions to restore natural resources and services injured by PCBs, the Trustees will take into account the interdependencies of multiple resources and services. Ecosystem-based restoration actions can contribute both to restoring injured resources to baseline and to compensating the public for interim losses to their resources.

4.1 Overview of Restoration Planning

The Stage I restoration planning process is depicted in Figure 4.1. First, the Trustees develop a list of potential restoration projects. The list is compiled from projects or ideas developed for the KRE by resource managers, members of community and environmental groups, and private citizens and is presented in Appendix A. Second, the Trustees develop criteria for evaluating restoration projects based on the factors identified in the DOI regulations [43 CFR § 11.82(d)]. The criteria include a set of threshold screening criteria to determine whether potential

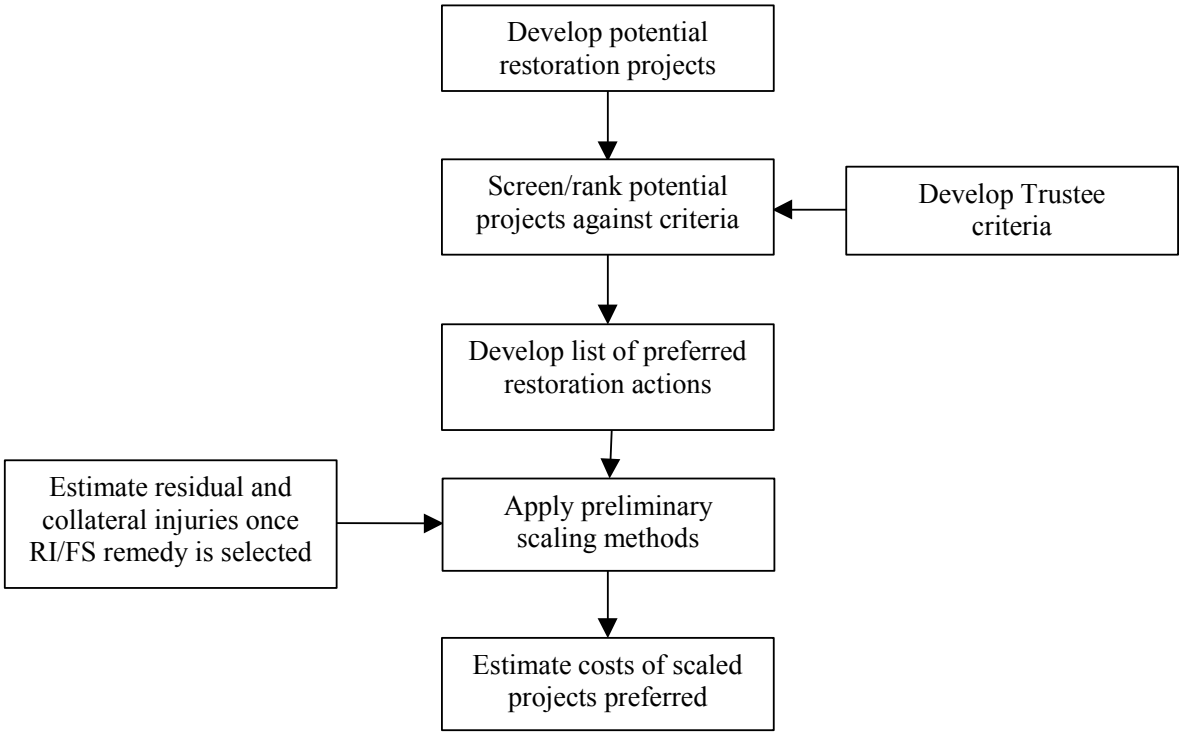

Figure 4.1. Process for identifying, selecting, and costing preferred restoration alternatives.

restoration projects are acceptable. The criteria also evaluate the focus, implementability, and benefits of restoration projects that pass the threshold acceptability criteria.

In the third step in restoration planning, the Trustees apply the criteria to specific potential restoration projects and rank them in a list of preferred projects. Fourth, the trustees scale the preferred alternatives. Scaling is the process of determining the appropriate mix, number, and size of restoration projects necessary to compensate the public for natural resource injuries associated with the site. Fifth, the Trustees estimate the costs of the preferred projects that have been scaled. Finally, the Trustees select which restoration projects to implement.

The scaling and selection of restoration projects are linked to remedial actions to be implemented at the site. EPA has announced that its overall plan for site remedial activities is to first eliminate ongoing sources of PCB contamination, including exposed paper wastes along the river bank, and then address instream sediments (U.S. EPA, 2002). The remediation will begin upstream and proceed downstream on a reach-by-reach or dam-to-dam basis. EPA has not yet determined the type and magnitude of remediation that will be conducted in the KRE. In light of the extended

timeframe anticipated to be necessary to fully implement the response agencies' cleanup plan and the uncertainty concerning the type and scope of remedial actions that will be selected, the Trustees have developed a broad range of restoration alternatives that could be combined with remedial actions. The Trustees anticipate that they will need to select and scale restoration projects for different sections of the river at different times. Once remedial actions have been selected, the Trustees may solicit more specific restoration proposals from the public.

4.2 Criteria for Evaluating Restoration Alternatives

The Trustees have developed criteria that they plan to use to select restoration projects designed to enhance, restore, or replace injured resources and the services they provide. As remedial decisions are made, the Trustees plan to evaluate and rank potential restoration projects using criteria based on factors identified in the DOI regulations [43 CFR §11.82(d)]. The Trustees have incorporated the 10 factors from the DOI regulations into a set of criteria that the Trustees believe are appropriate for the KRE.[1] These criteria were adapted from those developed for the Lower Fox River/Green Bay (Hagler Bailly Services, 1998).

The Trustees will evaluate specific proposals for restoration projects by first screening them using a set of threshold criteria and then ranking them using four sets of evaluation criteria. The four sets of criteria are as follows:

- **Project acceptability.** These screening criteria are evaluated on a pass/fail basis and relate to whether a proposed project is feasible, addresses the resources that were injured, and complies with applicable and relevant laws. A project must meet each of these criteria to be considered further.

- **Project focus**. These evaluation criteria relate to whether the project meets the goals and objectives of the Trustees for restoration of the Kalamazoo River Environment.

- **Project implementation.** These evaluation criteria relate to project implementability, feasibility, and cost-effectiveness.

- **Project benefits.** These evaluation criteria relate to the types, timing, and permanence of benefits provided by the project as related to the types and timing of the resources and services lost and an ecosystem perspective toward restoration.

1. The 10 factors to consider when selecting restoration alternatives as listed in 43 CFR §11.82(d) are listed here numerically followed by the numbers of the corresponding KRE evaluation criteria: (1) A3; (2) I2; (3) I2; (4) I4; (5) B1; (6) I1; (7) F3; (8) A1; (9) F2, I5; and (10) A1.

The evaluation criteria in each of these categories are listed and described in Tables 4.1 through 4.4. Criteria will have different levels of emphasis. In Tables 4.2 through 4.4, general priority weights of higher, medium, and lower (relative to one another in a given category) are shown for the individual evaluation criteria.

Table 4.1. Acceptability criteria for restoration (pass/fail)

Criteria	Description
A1: Complies with applicable and relevant federal, state, local, and tribal laws and regulations.	Project must be legal, likely to receive required permits, and must consider public health, welfare, and the environment.
A2: Addresses resources injured by hazardous substances or services lost because of injuries in the Kalamazoo River Environment.	Projects must restore, rehabilitate, replace, or acquire the equivalent of injured natural resources, as measured by their physical, chemical, or biological properties or their services.
A3: Is technically feasible.	Projects must be likely to meet Trustee objectives within a reasonable period of time.

Table 4.2. Focus criteria for restoration

Criteria	Description	Weight
F1: On-site restoration.	Projects most directly benefiting resources associated with the Kalamazoo River and Portage Creek are preferred over projects with less direct or more distant benefits.	Higher
F2: Addresses/incorporates restoration of "preferred" trust resources and services as evidenced in Trustee mandates and priorities based on law and policy.	Trustee priorities include dynamic floodplain/riverine habitats, wetlands, habitat continuity, water quality, soil/sediment quality, public game/wildlife/recreation areas, threatened and endangered species, native species, important food-web species, recreationally significant species.	Medium
F3: Focuses restoration on resources that are unlikely to be addressed by other programs.	Ecologically valuable restorations that are often omitted from consideration because they need long-term inputs will be favored over quicker, more routine actions typically addressed by other programs.	Lower[a]

a. Restorations requiring long-term inputs will be ranked lower in priority relative to on-site restoration and preferred resources, but will still be favored over quick, routine actions.

Table 4.3. Implementation criteria for restoration

Criteria	Description	Weight
I1: Benefits can be measured for success by evaluation/comparison to baseline.	Projects will be evaluated in terms of whether the benefits can be quantified and the success of the project determined.	Higher
I2: Benefits achieved at reasonable cost (i.e., project is cost-effective).	Project will be evaluated as to whether it will: (a) achieve desired benefits at a reasonable cost; and (b) whether it is cost-effective relative to other projects that could provide the same or similar benefits.	Higher
I3: Uses established, reliable methods/technologies known to have a high probability of success.	Project methodology will be evaluated for likelihood of success. Factors that will be considered include whether the proposed technique is appropriate to the project, whether it has been used before, and whether it has been successful. Projects incorporating wholly experimental methods, research, or unproven technologies will be given lower priority.	Medium
I4: Takes into account completed, planned, or anticipated response actions.	Projects which restore or enhance habitat impacted by response actions will be preferred over those not associated with response actions. Projects proposed in areas likely to be impacted by response actions must be coordinated with response actions to provide cost savings and to take advantage of the availability of mobilized equipment onsite during remediation, if possible, and to avoid damage to the restoration project by any subsequent response actions.	Medium
I5: Takes into account regional planning and federal and state policies.	Projects will be evaluated for consistency with federal and state policies. Projects should also be justified relative to existing regional plans such as species recovery plans and fisheries management plans.	Lower

In addition to using these criteria to rank projects, the Trustees will evaluate the mixture of proposed projects and make selections so that a variety of benefits are achieved which correspond to the types of injuries observed in the KRE. Examples of types of benefits to be achieved include, but are not limited to, elimination of the need for fish consumption advisories; elimination of exceedences of water quality criteria; improvements in the quality of recreational fishing; improvements in the health of fish and benthic invertebrates; improvements in reproduction of bald eagles, mink and other piscivorous wildlife; improvements in hydrology altered by remedial activities; and protection of the KRE from future injuries to habitat or water quality. In the future, the Trustees may use separate requests for proposals for projects that provide different types of benefits or may employ some other mechanism for balancing the mixture of projects so that the range of injuries observed in the KRE is addressed through restoration.

Table 4.4. Benefit criteria for restoration

Criteria	Description	Priority
B1: Provides the greatest scope of ecological, cultural, and economic benefits to the largest area or population.	Projects that benefit more than one injured resource or service will be given priority. Projects that avoid or minimize additional natural resource injury, service loss, or environmental degradation will be given priority.	Higher
B2: Provides benefits not being provided by other restoration projects being implemented/funded under other programs.	Preference is given to projects, or aspects of existing projects, that are not already being implemented or have no planned funding under other programs. Although the Trustees may use restoration planning efforts by other programs, preference is given to projects that would not otherwise be implemented without NRDA restoration funds.	Higher
B3: Aims to achieve environmental equity and environmental justice.	Low-income and ethnic populations (including Native Americans) may suffer from pollution, and sometimes benefit the least from restoration programs. Therefore, a restoration program should not have disproportionate high costs or low benefits to low-income or ethnic populations. Further, where there are specific service injuries to these populations, such as subsistence fishing, restoration programs should target benefits to these populations.	Medium
B4: Maximizes the time over which benefits accrue.	Projects that provide benefits sooner are preferred. Projects that provide longer term benefits are preferred.	Lower

4.3 Proposed Restoration Projects

The Trustees solicited information on environmental restoration projects that might improve and enhance natural resource services in the KRE. State, regional, and local resource agencies, environmental nonprofit groups, citizen groups, and individual citizens provided a range of broad ideas and specific projects, which they consider important for the environment and the public's enjoyment of the environment in the Kalamazoo watershed. The entire list of ideas and proposals is presented in Appendix A.

In reviewing the list, the Trustees screened the proposals based on the acceptability criteria (Table 4.1) and categorized the ideas and proposals that passed this screen into several broad categories based on the types of projects and the benefits they could provide (Table 4.5). The proposals were grouped into three broad classes: habitat restoration, nonpoint source pollution control, and water-related human uses. Across those classes, the proposals were further grouped into ten general categories that were, in some cases, able to be further illustrated with additional subcategories for a total of 24 types of projects.

Table 4.5. Summary of types of restoration projects proposed to Trustees and which meet the acceptability criteria

Category	Subcategory
Habitat restoration	
Enhancement of existing habitat	Restore hydrology and movement of fish in the Kalamazoo River and its tributaries, e.g., removal of dams and restrictive culverts and restoration of meanders
	Removal of waste and fill in floodplain to restore floodplain wetlands, including riparian forests, to pre-disturbance contours
	Softening of shorelines hardened by linear walls or rip-rap
	Enhance habitat in remediated areas by improving contours and structure, establishing native vegetation, or by other means
	Restore wetlands and in-stream habitats
Land acquisition	Acquire riparian land/easements to preserve continuity of the river corridor
	Acquire land/easements to reduce fragmentation and improve/preserve connections among large areas of habitat (e.g., connecting Kalamazoo River corridor with Gun Lake area)
	Acquire land/easements to improve/protect water quality and quantity in the Kalamazoo River
Protect/enhance species	Endangered species programs
	Re-establishment of native communities, e.g., vegetation, freshwater mussels
	Control of exotic species
	Programs to benefit top predators (e.g., raptor nesting platforms)
	Species reintroduction and stocking
Nonpoint source pollution control[a]	
Create riparian buffer zones	
Remove contaminated sediment in tributaries	
Improve land and water use practices	Watershed and land use planning to protect affected resources
	Erosion and stormwater control programs
	Agricultural best management practices
	Education on watershed protection to promote stewardship

Table 4.5. Summary of types of restoration projects proposed to Trustees and which meet the acceptability criteria (cont.)

Category	Subcategory
Water-related human uses	
Create and expand waterfront parks and trails	Expand and create recreational areas to promote enjoyment of the river
	Shoreline improvements for human use, including fishing piers and boat docks/ramps
Improve recreational boating navigation	
Conduct additional studies of affected areas	
Conduct public education programs relating to affected resources	

a. Point source pollution control is not included because it did not meet the criterion of complying with all applicable laws and regulations. Since controlling pollution point sources falls under the purview of other state or federal regulatory programs, it is considered inconsistent with these programs for the NRDA to conduct such actions.

4.4 Conclusions

The Trustees designed the restoration planning process described in this chapter to ensure fidelity to statutory goals, to take advantage of a wide range of practical restoration opportunities, and to allow meaningful public participation. Fidelity to statutory goals is achieved by applying objective criteria, which are rooted in CERCLA, the NRDA regulations, and Trustee agency mandates, to all restoration proposals and ideas. Importantly, criteria constrain restoration opportunities to those which address the public's PCB-caused losses, by returning natural resources and their services to baseline, and by compensating for losses that occur in the interim. In addition, criteria ensure that the Trustees balance competing goals, such as preferences for quick baseline restoration on-site versus cost effectiveness.

A wide range of practical restoration opportunities is achieved by ensuring that as many restoration projects and ideas which address the public's PCB-caused losses are initially included as is practical. In the Stage I restoration planning work, the Trustees sought restoration projects and ideas from diverse sources, including local experts, groups, and organizations with restoration experience; other NRDAs with similar losses and/or restoration opportunities; the PRPs; and the general public. The Trustees do not wish to constrain the initial pool of restoration projects and ideas, thereby ensuring that restoration opportunities are diverse and based on practical experience. By setting objective criteria first, the Trustees can then efficiently evaluate

a wide range of projects. Thus, the Trustees hope to maximize restoration opportunities within the scope of public losses that are being assessed in the NRDA.

The Trustees will seek meaningful public participation by publishing the criteria before choosing the projects, and allowing the public to review the process as a whole. Public participation is also achieved by encouraging public input into the list of projects and ideas to be evaluated with the criteria by the Trustees. In addition, public participation is enhanced through public surveys designed to accurately measure public preferences and values, such as those described in this report. Finally, the Trustees will seek public input on a draft restoration plan developed in connection with any settlement with PRPs or award by the court. Therefore, the public is ensured input on restoration planning that helps to establish Trustee claims, as well as restoration planning to implement actual restorations after claims are resolved.

The Stage I Assessment includes important milestones for restoration planning. The Trustees have proposed for public review an overall process for restoration planning including restoration criteria based on factors identified in the DOI regulation [43 CFR § 11.82(d)], which can be used to evaluate a wide range of restoration projects and ideas. Also, the Trustees have presented initial results for a recreational fishing study and total value focus groups, which are important first steps for scaling the amount of restoration that may be needed. In addition, the Trustees have begun to assemble restoration projects and ideas that can be evaluated with the criteria. In general, these projects focus on habitat restoration, nonpoint source pollution control, and water-related human uses in the KRE.

As information becomes available about the likely amount, type, and timing of cleanup required by the response agencies, the Trustees will be able to predict residual restoration needs, restoration opportunities that can be integrated with cleanup activities, and the amount, type, and timing of restoration that will be required for the entire KRE. The Trustees hope that, ultimately, restoration planning will produce a vision of a restored KRE that can be supported by the Trustees, the PRPs, and the public.

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A. Summary of Potential KRE Restoration Projects

Table A.1. Summary of potential KRE restoration projects

Project description	Source organization
Acquire riparian land parcels along Kalamazoo River to preserve the existing natural corridor and potentially to enhance broader nature corridor development in the area (e.g., look to link with areas like Fort Custer and Gun Lake wilderness areas).	Land Trust Alliance regional director
Determine whether additional restoration activities are warranted in the area around Bryant's Mill pond to enhance the recovery of the natural resources there. Could be considered a "demonstration" restoration project to address the post cleanup conditions likely to exist if other contaminated shore areas are addressed.	Land Trust Alliance regional director
Acquire riparian land parcels along Kalamazoo River to preserve the existing natural corridor.	MDNR – Kalamazoo-Allegan district wildlife supervisor
Control the loading of paper waste into the Kalamazoo (regardless of associated PCB contamination) in order to limit adverse effect on benthic resources and help return sediments to their natural condition.	MDNR – Kalamazoo-Allegan district wildlife supervisor
Remove the three sill-level MDNR controlled dams on the Kalamazoo to restore a free flowing waterway to benefit fishery and recreators.	MDNR – Kalamazoo-Allegan district wildlife supervisor
Provide increased recreational access to the Kalamazoo (ideally after PCB cleanup and access facilities could be linked with infrastructure needed to remove sill level dams, e.g., roads for equipment and staging areas).	MDNR – Kalamazoo-Allegan district wildlife supervisor
Expand and enhance the use of marsh lands adjacent to the Kalamazoo (e.g., increase the number of nesting platforms in the areas for raptors while maintaining the forested aspect of the areas).	MDNR – Kalamazoo-Allegan district wildlife supervisor
Acquire land in the Lake Allegan shoreline area to limit waterside development and to link existing MDNR parcels in the area – have prioritized sites but not formally disclosed (willing seller-willing buyer restrictions and avoid driving up price).	MDNR – Kalamazoo-Allegan district wildlife supervisor
Continue and expand the prairie redevelopment projects currently under way on close to 200 acres in the Augusta Creek area near Kalamazoo.	MDNR – Kalamazoo-Allegan district wildlife supervisor
Enhance the Oak Barrens area (note: mentioned that this is complicated by the presence of wildlife already in the area).	MDNR – Kalamazoo-Allegan district wildlife supervisor
Explore potential conversion of agricultural lands adjacent to area waterways (e.g., buffer conversion) to control non point source pollution loading to the area.	MDNR – Kalamazoo-Allegan district wildlife supervisor
Undertake projects to remove invasive nonnative species in MDNR lands and to restore native vegetation in those areas.	MDNR – Kalamazoo-Allegan district wildlife supervisor
Acquire existing farmlands to create wildlife corridors between existing state game areas, e.g., corridor to link the Allegan and Yankee Springs areas (note the land around these isolated game areas is coming under increasing development pressure from Grand Rapids population).	MDNR – Kalamazoo-Allegan district wildlife supervisor

Table A.1. Summary of potential KRE restoration projects (cont.)

Project description	Source organization
Acquire lands adjoining existing state game and wildlife areas to enhance their potential carrying capacity and potential species diversity.	MDNR – Kalamazoo-Allegan district wildlife supervisor
Remove the three sill-level MDNR controlled dams on the Kalamazoo to restore a free flowing waterway to benefit fishery and recreators.	Private citizen
Incorporate restoration of prairie grass at on site disposal areas that are capped to contain paper waste that is removed and consolidated.	Private citizen
Acquire land along the Kalamazoo River to preserve the existing riverine corridor that serves as a critical migratory bird habitat and as a migratory corridor between the various state game areas (Allegan to Fort Custer and Allegan to Yankee Springs-Barry-Gun Lake).	Private citizen
Acquire land to increase the size of the Allegan State Game area which is under pressure from increased recreational use.	Private citizen
Incorporate features into paper waste excavation, where feasible, that would promote their use by ducks. For example, in areas that are excavated perhaps leave depressions after excavation that could be filled with water and attract ducks. This will benefits the ducks but also will help attract raptor species that prey on ducks such as hawks, falcons, and eagles.	Private citizen
Incorporate features into dam removal projects that would enhance the value of the site to recreators such as sportfishermen or kayakers.	Private citizen
Remove three sill-level MDNR controlled dams on the Kalamazoo to restore a free flowing waterway to benefit fishery resources first; any additional recreator benefits a bonus but should not be primary consideration.	Kalamazoo County Drain Commissioner (elected 11/00) – former county commissioner
Acquire land along the Kalamazoo River to preserve the existing riverine corridor and to prevent development of projects with potentially adverse environmental impacts (e.g., the proposed and approved auto junk yard in the floodplain in Comstock).	Kalamazoo County Drain Commissioner (elected 11/00) – former county commissioner
Address oily contamination in Davis Creek.	Kalamazoo County Drain Commissioner (elected 11/00) – former county commissioner
Clean out sediment backups in Arcadia Sewer focusing on the backups between downtown Kalamazoo and Western Michigan University (WMU).	Kalamazoo County Drain Commissioner

Table A.1. Summary of potential KRE restoration projects (cont.)

Project description	Source organization
Remove the three sill level dams along the Kalamazoo River to restore a free flowing waterway to the Kalamazoo – also consider two additional dams in the area – this is top priority and has been a MDNR objective for a number of years.	MDNR
Acquire property and restore wetlands in floodplain properties along the Kalamazoo.	MDNR
Acquire marsh habitat property at the mouth of the Kalamazoo River where it enters Lake Michigan in Saugatuck, area provides excellent fisheries spawning and rearing sites. Project facilitated because relevant land is under control of one owner. If possible, enhance river access from the site as well.	MDNR
Implement watershed protection projects addressing: erosion control, groundwater protection, and reduction in surface water removals all with goals of improving water quality and to avoid reducing instream flow below critical levels.	MDNR
Acquire floodplain and other lands to establish natural wildlife corridors that would then link the various state wilderness and game areas with each other.	MDNR
Take actions to enhance the colonization and reproduction of freshwater mussels that should be found in the river but are currently lacking.	MDNR
Attempt to remove and subsequently prevent the return of or minimize the spread of aquatic nuisance species (e.g., purple loosestrife and zebra mussels).	MDNR
Develop a trust fund for feasibility investigations and ultimately the restoration of species.	MDNR
Acquire land in upstream part of Kalamazoo geared at conversion of agricultural land to riparian habitat to reduce NPS nutrient and pollutant loads as well as to restore beneficial riparian habitat.	MDNR
Develop public education programs aimed at providing information on the nature and benefits of a fully functioning watershed and of the different types of plants and animals found in the system.	MDNR
Dredge shallow areas behind the present state owned dams to create some diversity in wetlands, by providing some open water shallow pools.	MDNR – Kalamazoo-Allegan district wildlife supervisor
Preserve the existing, and where necessary, restore the natural riparian zone along the Kalamazoo River.	U.S. FWS
Restore freshwater mussel beds in suitable areas of the river once appropriate conditions for success exist.	U.S. FWS
Establish natural wildlife corridors to connect Kalamazoo with Gun Lake and Fort Custer state game areas.	U.S. FWS
Preserve and restore wetland habitat.	U.S. FWS
Reduce nonpoint source pollutant loadings to the river.	U.S. FWS
Increase public recreational access to the river and resources following the recommendations of local wildlife managers.	U.S. FWS

Table A.1. Summary of potential KRE restoration projects (cont.)

Project description	Source organization
Pursue habitat restoration in areas where waste disposal cells are established – for example attempt to restore native prairie grasses on the caps of on-site waste disposal cells that are established.	U.S. FWS
Acquire floodplain and other lands to establish natural wildlife corridors that would then link the various state wilderness and game areas with each other while preserving the current characteristics of the Kalamazoo River corridor.	MDNR – wildlife biologist out of Allegan area, also effective property manager for Allegan state game area
Acquire existing in-holdings in the Allegan state game area to bring the entire area under the control of the MDNR.	MDNR – wildlife biologist out of Allegan area, also effective property manager for Allegan state game area
Acquire lands that provide opportunities for road access to the current MDNR bottomland holdings obtained from Consumers Power along the river between Allegan and Plainwell. These lands currently lack road access and must be visited by boat.	MDNR – wildlife biologist out of Allegan area, also effective property manager for Allegan state game area
Promote remedial alternatives that allow for a free flowing Kalamazoo and avoid creating open areas that could attract currently vulnerable species and increase the predation upon them (e.g., turtles).	MDNR – wildlife biologist out of Allegan area, also effective property manager for Allegan state game area
Undertake a "Battle Creek" type program consisting of a major clean-up, bank protection to reduce erosion, linear parks, and walkways.	CEO Council, Inc.
Recognize and preserve existing habitat before adversely affected by development.	CEO Council, Inc.
Provide for public ownership of property adjoining river (suggested 200 ft width) which is then reserved as green space or for parks.	CEO Council, Inc.
Conduct environmental assessment of the resources in the river area.	CEO Council, Inc.
Expand ordinances that prevent development within the floodplain as in Charleston Township (copy of wetlands protection ordinance attached).	Charleston Township
Consider the purchase of riverfront property for use as a community park.	City of Galesburg
Increase public recreational development along the Kalamazoo in Galesburg – reflects Galesburg residents survey preferences (67% respond Yes, 24% No).	City of Galesburg
Construct a bicycle-pedestrian bridge to cross the river at the site of the old auto bridge that had been removed in Galesburg – incorporate extensions for sitting-fishing areas.	City of Galesburg
Preserve and acquire lands of at least 100 ft adjoining the river in the city of Kalamazoo to accommodate a publicly accessible green space.	City of Kalamazoo – Office of the city manager

Table A.1. Summary of potential KRE restoration projects (cont.)

Project description	Source organization
Develop riverside linear park with viewing areas and access for canoeing and walkways paralleling the river (schematic plan provided).	City of Parchment
Develop a walkway and bridge that would circle Morrow Pond along the telephone company easement and connect with the existing River Oaks Park.	Comstock Township
Increase access and opportunities for recreationalists interested in exploring the Kalamazoo River (e.g., walkways, bike paths, x-county ski trails).	Downtown Kalamazoo Inc.
Explore options for increasing salmonid access up to Battle Creek – requires combination of fish ladders and desired removal of DNR dams – all fisheries projects subject to the addressing of the PCB contamination in the Kalamazoo.	MDNR Fisheries Division
Explore opportunities to expand interactive learning with increased facilities, access, and connectors between local schools and school owned lands adjacent to Kalamazoo River (model after Galesburg River Rams project).	Galesburg/Augusta Community Education
Increase access and opportunities for recreationalists interested in exploring the Kalamazoo River (e.g., walkways, bike paths, x-county ski trails).	James River Corporation
Consider development of a riverside learning platform for use by schoolchildren.	Kalamazoo Central High School
Develop a linear park in Kalamazoo along the river.	Kalamazoo City Parks and Grounds Division
Acquire additional lands to expand the Kalamazoo Nature Center.	Kalamazoo Nature Center
Increase trail access and viewing areas along the Kalamazoo on Kalamazoo Nature Center lands – link where possible with other trails to create a comprehensive trail system.	Kalamazoo Nature Center
Acquire additional lands to expand the Nature Conservancy holdings in Charleston township between Galesburg and August (have a parcel of floodplain forest – waters at the site support a healthy freshwater mussel population).	Michigan Nature Conservancy (E. Lansing office)
Conduct a survey of macro-invertebrates in the Rabbit River to assess its potential for again supporting an active sport fishery based around bass and northern pike.	Private citizen
Explore options for reduction of NPS loading of silt and sediment to the Rabbit River (main tributary to the Kalamazoo). A 319 watershed grant with EPA is in place to evaluate the issue. Benefits would include potential restoration of a once thriving sportfishery for small mouth bass, creek chubs, shiners, and ultimately northern pike.	Private citizen

Table A.1. Summary of potential KRE restoration projects (cont.)

Project description	Source organization
Restore mink populations in the area.	Private citizen
Restore fish habitat and a healthy fishery where PCB contamination is held to 0.05 ppm or lower of PCBs.	Private citizen
Look to enhance recreational boating opportunities with the removal of the dams on the Kalamazoo (exception of Lake Allegan dam) . . . look for opportunities to include white water sections as well.	Private citizen
Removal of the waste along the shores of Lake Allegan (e.g., tires, drums, lawn chairs) to enhance the perception of the river being a "clean" resource.	Private citizen
Increase the amount of deepwater areas in the nearshore part of Lake Allegan by conducting additional dredging if equipment is going to be onsite anyway as part of a remedial action.	Private citizen
Implement the Kalamazoo River Valley Trailway plan to provide non-motorized means of access along the river – would go from Battle Creek to city of Allegan and out to Portage. Envisioned trails would complete links with other existing trail systems already in place.	City of Kalamazoo
Acquire and preserve floodplain forest lands along the Kalamazoo River and its tributaries. Benefits would be helping to ensure the biodiversity of the Great Lakes in general and potential ecological benefits for aquatic species and improved water quality.	The Nature Conservancy, Michigan Chapter
Control the loading of PCBs into the Kalamazoo River and its tributaries.	MDNR
Remove remaining sill level dams on the Kalamazoo to eliminate fish blockages that will improve the local fishery.	MDNR
Undertake habitat restoration projects on the tributaries of the Kalamazoo – have lacked attention as a result of the ongoing PCB contamination but the tributaries could support viable fisheries and in several cases, could potentially support trout fisheries with the cold water flows.	MDNR
Increase public access to the Kalamazoo River and its tributaries, need for access to the Kalamazoo is especially acute in the region between Plainwell and Kalamazoo.	MDNR
Develop fish passage structures for Allegan dam to allow upstream migration of species (e.g., salmonids) currently blocked from these areas (requires assessment of potential impact on existing fishery resources upstream of Allegan dam as a result of creating access, e.g., impact on trout of salmon).	MDNR
Reduce sand and silt loadings from unpaved county roads into the tributaries of the Kalamazoo (e.g., selected paving or development of buffer strips).	MDNR
Address the culverts in tributaries on county roads that currently present a barrier to fish.	MDNR
Develop a public information and education program designed to increase awareness of local waterway resources and increase sense of stewardship and responsibility for these resources.	MDNR

Table A.1. Summary of potential KRE restoration projects (cont.)

Project description	Source organization
Remove all dams on the Kalamazoo with the exception of the one at Lake Allegan.	Private citizen
Remove any PCB contaminated soils and sediments, including floodplains, that would be left following the eventual implementation of a remedy (i.e., ensure all PCB contamination is removed).	Private citizen
Restore wetlands adversely impacted from PCB-related contamination.	Private citizen
Restore eagle populations in the area.	Private citizen
Provide resources necessary for improvement of the lake sturgeon fishery on the Kalamazoo River (e.g., remove dams) – note that the Kalamazoo was given the top rating of "high" in evaluation of suitability of Michigan streams draining into the Great Lakes in terms of its suitability to support a lake sturgeon population in the 1997 Lake Sturgeon Committee report.	U.S. FWS
Provide resources necessary to complete actions outlined in original City of Kalamazoo grant proposal to the Clean Michigan Initiative (CMI) program (original request for $6 million – grant of $2.6 million received).	City of Kalamazoo – Development Manager
Provide funding to continue the remediation and restoration of the former refinery site on Davis Creek. Possible actions could include restoring stream hydrology, restoring native vegetation, and funding the cleanup of the remaining contaminated resources (e.g., terrestrial and aquatic including free product on groundwater) – depending on timing could be considered a SR demonstration project where the funds are used to provide the required match for the Corps to proceed with any actions.	City of Kalamazoo – Development Manager
Continue to establish greenways along the waterfront of the Kalamazoo River and other waterways in the city.	City of Kalamazoo – Development Manager
Improve public access to the Kalamazoo River (e.g., canoe launch).	City of Kalamazoo – Development Manager
Remove remaining sill level dams on the Kalamazoo.	WMU – Environmental Institute director
Eliminate and/or control the loading of PCBs into the waters of the Kalamazoo River.	WMU – Environmental Institute director
Public education and awareness – initiate a graphic design competition to create a Davis Creek Watershed signage.	Davis Creek Watershed Steering Committee
Public education and awareness – install Davis Creek signage at major creek crossings and other appropriate locations.	Davis Creek Watershed Steering Committee
Public education and awareness – stencil urban storm sewer inlets.	Davis Creek Watershed Steering Committee

Table A.1. Summary of potential KRE restoration projects (cont.)

Project description	Source organization
Public education and awareness – prepare and distribute a Davis Creek watershed newsletter for the Davis Creek watershed implementation project.	Davis Creek Watershed Steering Committee
Public education and awareness – promote streambank re-vegetation and bioengineering techniques.	Davis Creek Watershed Steering Committee
Public education and awareness – implement a property owner NPS (nonpoint source) education and on-site assistance program targeted toward industrial, commercial, and concentrated residential properties.	Davis Creek Watershed Steering Committee
Public education and awareness – create a public speakers list of water quality protection and related topics to be made available to public/private organizations seeking program speakers.	Davis Creek Watershed Steering Committee
Public education and awareness – support ongoing community environmental programs which provide water quality benefits (i.e., soil conservation and groundwater protection, household hazardous waste collection, and recycling).	Davis Creek Watershed Steering Committee
Community involvement; effective citizen stewardship – seek to create annual "river" or "watershed" festival similar to the famous Kalamazoo Flower Festival.	Davis Creek Watershed Steering Committee
Community involvement; effective citizen stewardship – expand the Creek Watch Hot Line of the River Partners Program to include periodic meetings with designated liaisons of responsible agencies.	Davis Creek Watershed Steering Committee
Community involvement; effective citizen stewardship – create a self sustaining adopt-a-creek program for Davis Creek.	Davis Creek Watershed Steering Committee
Community involvement; effective citizen stewardship – host in-county workshops and/or conferences on water quality issues.	Davis Creek Watershed Steering Committee
Community involvement; effective citizen stewardship – encourage school districts to incorporate watershed education and an annual watershed appreciation day into the curricula.	Davis Creek Watershed Steering Committee
Community involvement; effective citizen stewardship – assist citizen groups and neighborhood associations in self-directed efforts to engage members in watershed protection.	Davis Creek Watershed Steering Committee
Community involvement; effective citizen stewardship – create an annual Citizen Award program for watershed protection efforts.	Davis Creek Watershed Steering Committee
Watershed master planning and public stewardship – create an empowered interagency committee to further the initiatives of the Davis Creek implementation project.	Davis Creek Watershed Steering Committee
Watershed master planning and public stewardship – initiate integrated engineering re-design of the Davis Creek drainage corridor to creatively mitigate the detrimental effects of the disturbed hydraulics of Davis Creek (i.e., restore natural hydrology of Davis Creek including meanders and vegetation).	Davis Creek Watershed Steering Committee

Table A.1. Summary of potential KRE restoration projects (cont.)

Project description	Source organization
Watershed master planning and public stewardship – develop a long-term data collection strategy for monitoring the Davis Creek watershed.	Davis Creek Watershed Steering Committee
Watershed master planning and public stewardship – seek grant funding to evaluate contaminated groundwater impacts to the water quality of Davis Creek.	Davis Creek Watershed Steering Committee
Watershed master planning and public stewardship – use the Davis Creek Watershed Project as a model with which to encourage similar watershed planning efforts.	Davis Creek Watershed Steering Committee
Municipal storm water management – implement a structured storm drainage system inspection and maintenance program to protect the public's safety, water quality, and the infrastructure investment.	Davis Creek Watershed Steering Committee
Municipal storm water management – initiate an appropriately scaled water quality management program for all municipal storm water drainage systems.	Davis Creek Watershed Steering Committee
Municipal storm water management – seek creative funding mechanism to finance regular drainage system inspection, maintenance, and water quality management programs.	Davis Creek Watershed Steering Committee
Municipal storm water management – pursue cost-shared implementation of site-specific nonpoint source remediation projects through the MDEQ grant funded Davis Creek Implementation Project and other assistance programs.	Davis Creek Watershed Steering Committee
Earth movement, soil erosion and sedimentation control – pursue improved coordination and enhanced enforcement of Act 347 of 1972 Soil Erosion and Sedimentation Control.	Davis Creek Watershed Steering Committee
Earth movement, soil erosion and sedimentation control – assure Act 347 permitting officers possess MDEQ certification and receive annual training.	Davis Creek Watershed Steering Committee
Earth movement, soil erosion and sedimentation control – notify municipal storm water owners/operators of any Act 347 permits issued within their system service areas.	Davis Creek Watershed Steering Committee
Earth movement, soil erosion and sedimentation control – train on-street employees to recognize and report soil erosion control problems.	Davis Creek Watershed Steering Committee
Earth movement, soil erosion and sedimentation control – fund expanded Act 347 monitoring through monthly permit fees adjusted for total area of unstable soils per month.	Davis Creek Watershed Steering Committee
Site development design standards – develop minimum stream corridor setbacks and other critical area site design standards to provide water quality protection.	Davis Creek Watershed Steering Committee
Site development design standards – promote drainage management strategies which consider both the quantity and the quality impacts of storm water runoff.	Davis Creek Watershed Steering Committee
Site development design standards – develop storm water management requirements which encourage on-site management whenever possible.	Davis Creek Watershed Steering Committee

Table A.1. Summary of potential KRE restoration projects (cont.)

Project description	Source organization
Site development design standards – monitor temporary erosion controls concurrent with building construction inspections.	Davis Creek Watershed Steering Committee
Site development design standards – complete dye or other positive testing of waste drains prior to issuing a certificate of occupancy.	Davis Creek Watershed Steering Committee
Land use planning – identify stream corridor environmental features (e.g., flood control, water quality protection, habitat) to be protected through local land use planning.	Davis Creek Watershed Steering Committee
Land use planning – protect significant features through local land development standards.	Davis Creek Watershed Steering Committee
Land use planning – preserve urban stream corridor greenways.	Davis Creek Watershed Steering Committee
Intergovernmental cooperation and coordination – restrict environmental high-risk land use activities from locating in critical watershed areas.	Davis Creek Watershed Steering Committee
Intergovernmental cooperation and coordination – seek to implement the community retention basins recommended in the Olmsted-Davis Creek Drainage Study.	Davis Creek Watershed Steering Committee
Intergovernmental cooperation and coordination – initiate dialogue and establish working liaisons among the ten local agencies with Act 347 permitting authority.	Davis Creek Watershed Steering Committee
Intergovernmental cooperation and coordination – provide public trash/litter containers at high pedestrian traffic locations along the creek.	Davis Creek Watershed Steering Committee
Intergovernmental cooperation and coordination – initiate coordinated interjurisdictional development of model ordinances for stream corridor land use; drainage, construction details for stream crossings, roadways, and parking lots; NPS nuisance pollution; and guides for street sweeping, roadway deicing, etc.	Davis Creek Watershed Steering Committee
Remediation of contaminated sites; urban redevelopment; and sustainable growth – establish a local governmental liaison group to coordinate local involvement in state/federal led environmental cleanups.	Davis Creek Watershed Steering Committee
Remediation of contaminated sites; urban redevelopment; and sustainable growth – seek to reconstruct natural riparian conditions concurrently with any brown field redevelopment.	Davis Creek Watershed Steering Committee
Remediation of contaminated sites; urban redevelopment; and sustainable growth – seek removal of trapped sediment and dismantle the Davis Creek dam at Lakeside.	Davis Creek Watershed Steering Committee
Remediation of contaminated sites; urban redevelopment; and sustainable growth – establish training certification programs for bulk chemical users, similar to certification required for restricted use pesticides.	Davis Creek Watershed Steering Committee

Table A.1. Summary of potential KRE restoration projects (cont.)

Project description	Source organization
Site development design standards – restrict new, potentially significant NPS polluting facilities (e.g., industrial/commercial sites, parking lots) from conveying runoff directly to a water body.	Davis Creek Watershed Steering Committee
Site development design standards – provide public authority or other legal arrangements to assure long-term maintenance of privately installed storm water management systems.	Davis Creek Watershed Steering Committee
Establish wildlife corridors linking existing game areas to the Kalamazoo River (e.g., develop a wildlife corridor along Augusta Creek.	MSU – Kellogg Biological Station (professor with emphasis on aquatic system ecology)
Acquire existing lands with unique natural resource features for preservation and enhancement (e.g., use Nature Conservancy, Southwest Michigan Land Conservancy, and Michigan Natural Features Inventory information as a guide for acquisition targets).	MSU – Kellogg Biological Station (professor with emphasis on aquatic system ecology)
Implement any remaining activities from the Master Plan for the Lakeside Refinery Site / Davis Creek which look to turn the former refinery site into an area emphasizing passive recreation and restoration of natural habitats to the area.	Prepared for Davis Creek Watershed Steering Committee
Ensure complete removal of PCB contaminated sediments and soil deposits from the wetlands and floodplains in the assessment area.	Kalamazoo River Protection Association
Undertake means to increase the populations of all species adversely affected by the PCB contamination (e.g., fish, eagles, mink).	Kalamazoo River Protection Association
Removal of dams along Portage Creek and Kalamazoo River to restore free flowing waterways to benefit fishery and recreational users.	Kalamazoo River Protection Association
Increase the depth of Lake Allegan and all the navigational channels and marinas downstream of the Kalamazoo River – conduct after cleanup operations are completed.	Kalamazoo River Protection Association
Acquire lands to protect existing habitat and to create green spaces and wildlife migration corridor.	Kalamazoo River Protection Association
Implement best management practices (BMPs) to reduce NPS loads of sediment and other pollutants to waterways from agricultural lands (BMPs such as buffer strips, grassed waterways, conservation tillage, animal waste storage structures).	Allegan County Soil and Water Conservation District
Acquire lands to preserve and protect existing habitat and riparian corridor along the Kalamazoo River (i.e., prevent riverfront development that is likely if the PCB contamination issue can be adequately addressed).	Private citizen

Table A.1. Summary of potential KRE restoration projects (cont.)

Project description	Source organization
Acquire lands along tributaries to the Kalamazoo to preserve and protect existing habitat.	Private citizen
Examine opportunities to use NRDA restoration funds to set up a revolving fund to purchase tradable pollution permits under the trading regime that is to be set up on the Kalamazoo River – could also use funds for direct purchase and retirement of the permits.	Private citizen
Implement BMPs to reduce NPS loads of sediment and other pollutants to waterways from agricultural lands (BMPs such as buffer strips, grassed waterways, conservation tillage, animal waste storage structures).	Private citizen
Examine opportunity to establish watershed-based working groups or organizations that would be comprised of local government officials with current authority to oversee land use and land management – perspective is problems are dealt with at primarily the local or state level so a cohesive strategy for a watershed is hard to develop and/or implement.	Private citizen
Develop a wildlife corridor around Augusta Creek that would preserve its existing wetlands and riparian zone prior to the encroachment of human activity and structures.	Augusta Creek Watershed Association (Augusta)
Protect/restore northern pike spawning habitat with metal weirs designed to exclude carp that would disrupt the emergent vegetation (little sign of success in field studies in Green Bay, WI, e.g., algae builds up on weirs reducing wave action in enclosure which stimulates additional algae growth).	Wisconsin Department of Natural Resources
Restore pooled wetland and tributary stream northern pike spawning and rearing habitat through elimination of "perched" culverts and other impediments that restrict access to spawning/rearing sites, and active habitat restoration such as reshaping roadside ditches and providing hydrologic buffers with conversion of agricultural lands to wetlands, shallow scrapes and development of water control structures and supplemental sources for spawning/rearing areas.	Wisconsin Department of Natural Resources
Lower part of Kalamazoo is a designated natural river which requires a 300 ft buffer from the bank for new structures- model for upper Kalamazoo potentially.	MDNR
Lower part of Kalamazoo is a designated natural river which requires a 50 ft buffer of natural vegetation on private land (150 ft on public land) with some provisions for cutting to maintain views and remove dead vegetation – model for upper Kalamazoo potentially.	MDNR
Remove PCB waste plus paper waste and all dam implements and then remove the dam structures entirely.	Kalamazoo River Watershed Council
Establish safe portages until the dams are removed.	Kalamazoo River Watershed Council

Table A.1. Summary of potential KRE restoration projects (cont.)

Project description	Source organization
If dams are not removed, introduce ways for wildlife to migrate up/downstream (i.e., fish ladders).	Kalamazoo River Watershed Council
Establish a 300-500 ft setback for all development on the Kalamazoo to establish/protect a riparian corridor.	Kalamazoo River Watershed Council
Restrict agriculture and animal use within a 500 ft distance from river edge.	Kalamazoo River Watershed Council
Increase public awareness of and opportunities for continued education on the functioning and role of the Kalamazoo River ecology.	Kalamazoo River Watershed Council
Revisit zoning along the river to establish designated places for new development and to clear standards for what will be allowed in locations and how it should look.	Kalamazoo River Watershed Council
Purchase conservation easements along existing undeveloped tracts of the river, perhaps in proximity of proposed trailway.	Kalamazoo River Watershed Council
Purchase properties adjacent to the river with existing, non-conforming (i.e., undesirable) uses.	Kalamazoo River Watershed Council
Assure sufficient contiguous wetlands of high quality to support the Kalamazoo River fishery.	Kalamazoo River Watershed Council
As river is cleaned of PCBs harvest contaminated fish and plant/transplant fish free from PCBs.	Kalamazoo River Watershed Council
Re-establish a thriving eagle population.	Kalamazoo River Watershed Council
Promote purchases and donations and offering agreements to landowners who agree to limit sale for development of riverfront (see this is similar to the conservation easement proposal).	Kalamazoo River Watershed Council
Buy back lands near (and within – in section titled remove inholdings) public holdings then remove the extensive two track systems.	Kalamazoo River Watershed Council
Encourage sale or donation of private lands to Nature Conservancies.	Kalamazoo River Watershed Council
Teach farmers and animal growers new and better ways to control runoff (i.e., look to increase awareness and implementation of Best Management Practices among the farming and livestock communities).	Kalamazoo River Watershed Council
Create farm fences to prevent livestock wastes in river and also to prevent the animals from getting into the river (example of a specific BMP for controlling NPS – also helps limit streambank erosion).	Kalamazoo River Watershed Council

Table A.1. Summary of potential KRE restoration projects (cont.)

Project description	Source organization
Promote residential rain gardens and ground water infiltration as opposed to stormwater flows; commercial rain gardens (check vs. the EPA's existing stormwater regulations that were being implemented at this time and that communities were looking for funding for – e.g., settlement and recharge ponds).	Kalamazoo River Watershed Council
Limit use of salt on roads and around facilities (e.g., apartment buildings and on college campuses).	Kalamazoo River Watershed Council
Parking lots and other indirect discharges must be identified and retrofitted with swirl technology.	Kalamazoo River Watershed Council
Construct wetland wastewater treatment plants.	Kalamazoo River Watershed Council
Encourage and facilitate residential, commercial, and industrial grey water systems.	Kalamazoo River Watershed Council
Explore options for water quality and discharge trading systems, development of TMDLs.	Kalamazoo River Watershed Council
Promote habitat restoration in urban areas by use of creative landscaping, as at the University of Washington.	Kalamazoo River Watershed Council
Link land (i.e., habitat corridors with planned or proposed bicycle corridors – wider bike easements).	Kalamazoo River Watershed Council
Increase efforts for education and implementation to increase the amount of prairie restoration in the area – for example look at controlled burns and establishment of the large contiguous tracts needed to make the restoration work.	Kalamazoo River Watershed Council
Remove existing steel cladding of PCB removal sites along the river and avoid the use of similar cladding at future sites.	Kalamazoo River Watershed Council
Improve the number and safety of boat launch (currently canoe and kayak) sites and increase the management at existing put-in sites to limit the informal creep of the sites and the accompanying erosion.	Kalamazoo River Watershed Council
Ensure river trail way for access on land and along water.	Kalamazoo River Watershed Council
Improve rural road crossings to prevent salt runoff during snow falls and remove the trash and debris build up along bridges and loading areas.	Kalamazoo River Watershed Council
Acquire lands for preservation, habitat, and recreation.	Kalamazoo River Watershed Council

Table A.1. Summary of potential KRE restoration projects (cont.)

Project description	Source organization
Acquire lands for canoe launch sites and primitive camping.	Kalamazoo River Watershed Council
Restore existing sites for habitat uses – Bryant Mill Pond PCB cleanup area.	Kalamazoo River Watershed Council
Promote bike pathways and parks between major cities – bring Portage Trailway to the river and link it with the Kal Haven and other trailways.	Kalamazoo River Watershed Council
Create riparian buffers to improve fish habitat (additional benefit of controlling NPS pollution loading).	Kalamazoo River Watershed Council
Purchase existing pollution credits and retire them (check on status of the TMDL Agreement for the Kalamazoo River).	Kalamazoo River Watershed Council
Remove non-native species of nuisance plants.	Kalamazoo River Watershed Council
Evaluate impact of county drains on the river including its pollutant and sediment loading and the impact high flow drains have on river scouring.	Kalamazoo River Watershed Council
Install passageways under roads to enable/facilitate animal movement.	Kalamazoo River Watershed Council
Encourage brownfield development as an alternative to control sprawl from development.	Kalamazoo River Watershed Council

B. 2001 Kalamazoo River Recreational Angler Study

Executive Summary

The Kalamazoo River Recreational Angler (KRRA) study was conducted for two reasons: (1) to obtain a current estimate of fishing use on the river, and (2) to conduct angler interviews of anglers who fish the river. This executive summary presents the most important results and conclusions of the KRRA study.

The KRRA study was implemented using a random on-site sampling procedure between May 27, 2001, and December 9, 2001. Aggregate use was estimated by weighting observed counts that were taken at 32 observation points by one survey agent during a randomly drawn subset of the total number of possible sampling periods. A correction based on external data was made for spring fishing outside of the sampling period. Two sampling methods were used for Allegan Dam, a popular and unique fishing site, because of the number of anadromous fish that congregate there.

Angler days were estimated for three reaches of the Kalamazoo River: upper – the confluence of Battle Creek to the waters above Morrow Lake Dam in Kalamazoo; central – the waters below Morrow Lake Dam through Lake Allegan (i.e., above Allegan Dam); and lower – the waters below Allegan Dam through Saugatuck Harbor. The upper reach is not part of the Kalamazoo River NRDA assessment area and received only about 8% of the total sampling time; estimates for this reach have low confidence. The angler day estimates are presented in Table S.1.

Table S.1. Estimated angler days on the reaches of the KRRA study (spring through fall)

KRRA study reach	Estimated annual number of angler days
Upper Kalamazoo	1,745
Central Kalamazoo	7,517
Lower Kalamazoo	19,416-20,193
All reaches	28,678-29,455

The angler interview was conducted with 94 predominantly shore anglers. The survey included 12 questions that collected information about the angler, the level of fishing activity and preferences, attitudes, and knowledge of FCAs. A summary of the results is provided below:

- A great deal of use occurs at Allegan Dam, and 59% of all angler interviews were conducted there.
- The majority of Kalamazoo River anglers are local residents (69% reported being residents of Allegan or Kalamazoo counties, which contain the KRE Superfund site).
- Anglers in the lower reach below Allegan Dam are more likely to be targeting specific species, anadromous species in particular, than anglers above the dam.
- Most Kalamazoo River anglers had not fished other sites in the two weeks previous to the interview.
- The single greatest dislike about the Kalamazoo River of central and lower reach anglers is visible pollution (e.g., paper waste, oil, trash).

Over half of interviewed anglers on the central and lower reaches either did not know about the PCB-caused FCAs or were uncertain of their content. Nonetheless, most anglers do not keep fish to eat; on average, only 3% of fish caught in the assessment area are eaten, which may reflect the sequencing of survey questions (see Appendix B, Section B.6). The popularity of catch-and-release may stem from FCAs and anglers' latent knowledge of FCAs.

B.1 Introduction

The primary purpose of the KRRA study was to obtain current estimates of total angler use of the Kalamazoo River within the NRDA area. Before this survey, the most recent estimate of angler use on the Kalamazoo River was obtained by a 1985-1987 survey that did not incorporate stretches of the river located upstream of Allegan Dam (also known locally as "Caulkins"), omitting the most contaminated stretch upstream of this dam. The KRRA study consisted of two elements: (1) a count of recreational anglers, both onshore and in boats; and (2) an on-site survey of recreational anglers that collected information on their level of fishing activity, preferences, attitudes, and knowledge of fish consumption advisories on the Kalamazoo River.

This appendix summarizes the design, implementation, and results of the KRRA count study and a summary of the angler interview responses.

B.2 Design of the KRRA Study

The KRRA study took place between May 27, 2001, and December 9, 2001, and encompassed the stretch of the Kalamazoo River from the Battle Creek River to the Kalamazoo River's confluence with Lake Michigan.[1] Predetermined weighting guided the selection of reaches for sampling and the allocation of sampling periods between weekdays and weekends, and the assignment of sampling periods within those categories (e.g., reaches and times of day) was randomized. The following subsections provide information on the selection of reaches for the individual sampling periods, the selection of observation locations, and the survey schedule.

B.2.1 Selection of reaches and observation locations for sampling

The KRRA study was designed so each sampling period would provide a record of angler use and preference information within a distinct reach of the Kalamazoo River from Battle Creek to Lake Michigan. To accomplish this, this stretch of the Kalamazoo River was divided into the following three reaches: upper – the confluence of the Battle Creek River with the Kalamazoo River to the waters above Morrow Lake Dam in Kalamazoo; central – the waters below Morrow Lake Dam through Lake Allegan (i.e., above Allegan Dam); and lower – the waters below Allegan Dam through Saugatuck Harbor (see Figure B.1). In addition, sampling recorded angler use and preferences only at Allegan Dam from September 10 through December 9 for the fall steelhead run.

1. This schedule misses the spring season and the popular steelhead run that accompanies it. The KRRA study adjusts for this omission using state data from 1986.

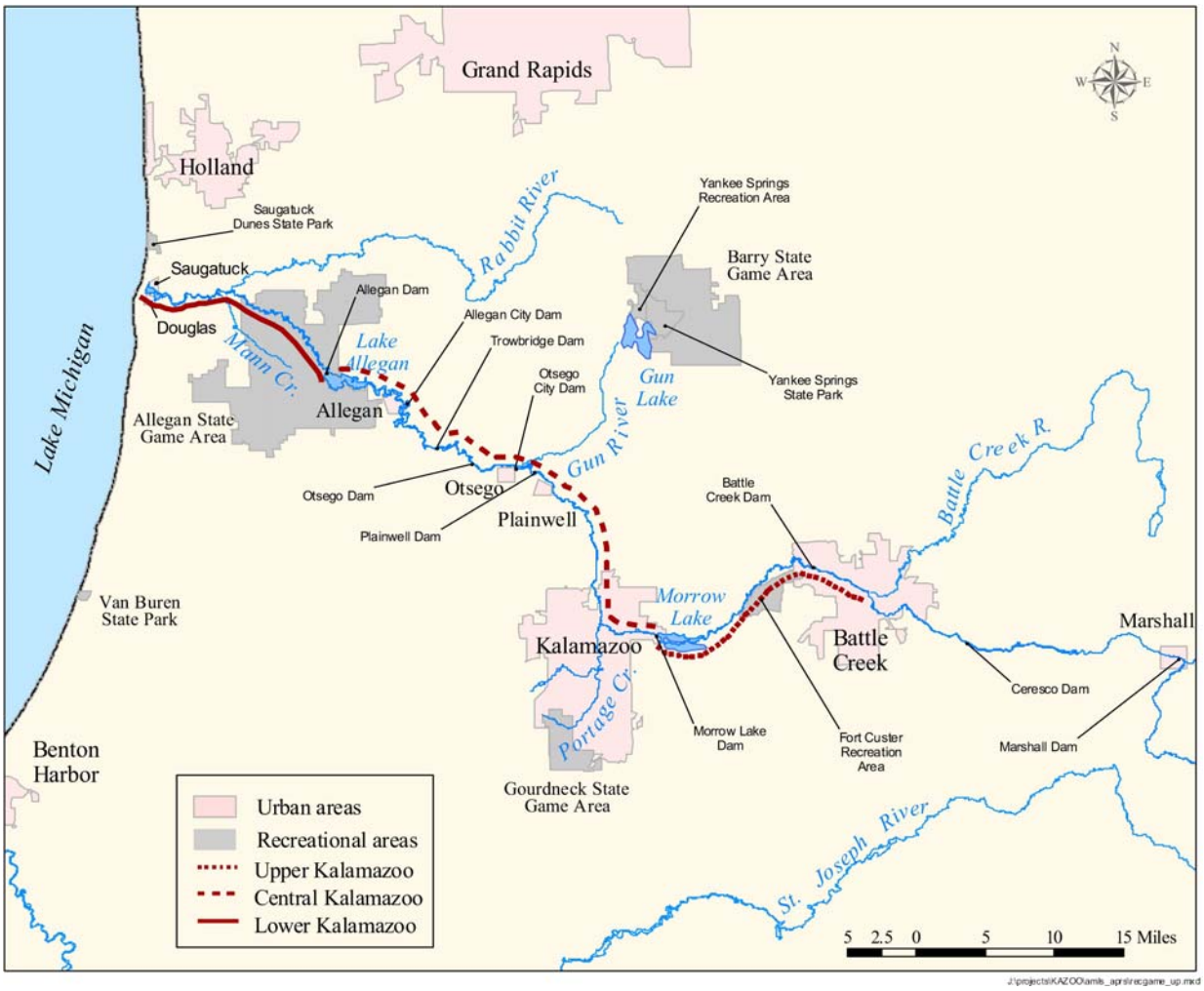

Figure B.1. Kalamazoo River.

The release of PCBs into the Kalamazoo River and into Portage Creek, a Kalamazoo River tributary that drains into the Kalamazoo River in the city of Kalamazoo below Morrow Lake Dam, has resulted in FCAs in the central and lower reaches of the Kalamazoo River (State of Michigan, 2001). The FCAs within the central reach are the most restrictive, recommending that males age 15 and older and women beyond childbearing age not eat any carp, catfish, suckers, or largemouth or smallmouth bass, and limit their cumulative consumption of other species to one meal a week. Women of childbearing age and all children less than 15 years old are advised to avoid consumption of any fish caught within the central reach.

In the lower reach, carp, catfish, and northern pike have "do not eat any" advisories for all individuals. Similarly, largemouth and smallmouth bass have a "do not eat any" advisory for women of childbearing age and children and an advisory of not more than "one meal per week" for adult males and women beyond childbearing age (State of Michigan, 2001). For all other species in the lower reach, adult males and women beyond childbearing age can enjoy unlimited consumption while women of childbearing age and children should limit themselves to no more than one meal per month (State of Michigan, 2001).

In addition to the differences in FCAs, the reaches defined for the KRRA study reflect other differences in this stretch of the Kalamazoo River. Most important, Allegan Dam, the dividing line between the central and lower reaches, is currently an impassible barrier for anadromous species (e.g., salmon, steelhead). As a result, the lower reach has a different fish assemblage and pool of potential target species for anglers than the central and upper reaches. In addition, extensive public access for fishing off Allegan Dam provides angling opportunities in the lower reach not available in the central and upper reaches.

Counts of recreational anglers and angler interviews were completed at a series of fishing access sites and observation locations identified in a pretesting period. Within a reach, these locations were selected based on a combination of observed angler use and views of the river so that the entire length of the reach could be observed by visiting all the locations in a reach (i.e., from each observation location, there was overlap in the river and shoreline to the next observation location).[2] The observation locations used for the KRRA study and the identification number assigned to each location (numbers increase within a reach moving downstream; latitude and longitude for each location are also provided) are presented in Table B.1 (nonconsecutive numbering in the central reach locations reflects the elimination of initially identified locations used during the pretesting).

This stretch of the Kalamazoo River is presented in Figure B.1. The break points between the reaches in the KRRA study and several of the other locations are noted.

2. The Kalamazoo River can be viewed when in transit between points, so angler counts were continued from the road. Angling activity does not occur strictly at observation points; in the count summaries in this appendix, fishing pressure by observation point is based on the closest observation point.

Table B.1. KRRA study observation and intercept locations by reach

Upper Kalamazoo River		Central Kalamazoo River		Lower Kalamazoo River	
Site I.D.	**Site name (latitude, longitude)**	**Site I.D.**	**Site name (latitude, longitude)**	**Site I.D.**	**Site name (latitude, longitude)**
101	S. Wattles Park (42.31736, -85.19048)	201	Morrow Dam (42.28307, -85.49486)	301	Allegan Dam/Caulkins Bridge (42.56368, -85.95452)
102	37 Trail (42.33792, -85.23277)	202	Morrow Lake (42.28304, -85.47196)	302	650 Area (42.58887, -85.97250)
103	2 River Junction (42.35650, -85.29937)	203	Morrow Park (42.28618, -85.51370)	303	Swan Creek Marsh (42.59295, -85.98213)
104	96 Bend (42.33527, -85.34485)	204	Wenke Park (42.28628, -85.53078)	304	Marsh Public Access (42.60225, -85.98788)
105	97 Area (42.33288, -85.34971)	205	Mills Bridge (42.29366, -85.56625)	305	Big Daily Bayou (42.61586, -86.00494)
106	Trailer Park Bend (42.28825, -85.40706)	206	Verburg Park (42.30333, -85.57175)	306	22 Junction (42.62832, -86.02756)
107	Gales Bridge (42.28048, -85.42897)	207	Mosel Bridge (42.31791, -85.57386)	307	Rabbit River Access (42.66047, -86.07248)
		208	Parchment Park (42.33242, -85.58307)	308	RR Junction (42.64197, -86.06841)
		209	D. Ave (Gravel Pit) (42.37602, -85.57877)	309	New Richmond (42.65203, -86.10703)
		210	Plainwell Dam (42.45560, -85.66933)	310	130th Access (42.63891, -86.16289)
		211	Otsego Dam (42.45874, -85.73365)	311	Douglas Bayou (42.64099, -86.19819)
		212	Trowbridge Dam (42.46548, -85.74763)		
		219	Monroe Rd. Bend (42.53810, -85.88293)		
		220	Lake Allegan (42.54706, -85.90763)		

Note: Nonconsecutive numbering in the central reach observation locations reflects the elimination of initially identified locations used during the pretesting.

B.2.2 Development of the KRRA study sampling schedule

The KRRA study sampling schedule includes the following features:

- The general schedule was four five-hour-long sampling periods per week (in the late fall some weeks included only three sampling periods); during a sampling period, the survey agent would conduct angler counts and angler interviews in only one reach (upper, central, or lower)
- During each sampling period, the survey agent visited each observation location in a given reach once and only once
- Weekdays and weekends received differential treatment (holidays are treated as weekends even if they fall on a weekday)
- A roughly equal allocation of sampling periods between weekends-holidays and weekdays was made (equal allocation was maintained in all weeks with four scheduled sampling periods)
- Sampling periods were randomly allocated across days and times within the weekday and weekend-holiday categories
- One survey agent was used for the entire study.

The KRRA study was conducted in two phases. The first phase (Phase I), from May 27 through September 9, incorporated three possible sampling periods per day: 6 a.m. to 11 a.m. (morning); 11 a.m. to 4 p.m. (afternoon); and 4 p.m. to 9 p.m. (evening). The second phase (Phase II), from September 10 through December 9, had only two possible sampling periods because of the reduction in available daylight hours: 8 a.m. to 1 p.m. and 1 p.m. to 6 p.m.[3] In addition, during Phase II, some sampling periods focused solely on recording the angling activity and preferences of anglers at Allegan Dam/Caulkins Bridge to record the anticipated increase in angler activity that coincides with the fall steelhead run.

The proportion of sampling periods conducted in each of the survey reaches by phase of the KRRA study is presented in Table B.2.

3. The division of the KRRA study into two phases reflects solely the restriction in sampling opportunities that resulted from the reduction in daylight hours as the study proceeded from summer to fall and early winter, as opposed to discrete changes in the characteristics of Kalamazoo River angling.

Table B.2. Final KRRA study reach sampling distribution

Survey subreach	Phase I (May 28 through September 9)	Phase II (September 10 through December 9)
Upper[a]	9.8%	5.9%
Central	44.3%	26.5%
Lower	45.9%	20.6%
Allegan Dam only	–[b]	47.1%

a. Because PCB-caused FCAs do not apply to the upper reach it was de-emphasized in the sampling plan.
b. In Phase I, there were no Allegan-Dam-only sampling periods; the Phase II sampling periods were scheduled to coincide with the fall steelhead salmon run.

Within a given week, the two weekend sampling periods were chosen at random over Saturday and Sunday, as were the sampling period times. Weekday sampling periods were determined by selecting two days at random from an equally weighted distribution of the weekdays for the first week of the sampling season (days "a" and "b"). In each subsequent week, the weekdays for the sampling periods were selected by advancing the day "a" sampling by one day and by moving the day "b" sampling back one day. An example of how this worked is provided in Table B.3.[4]

Table B.3. Example selection of weekday sampling periods for the KRRA study

Day "a" sampling periods		Day "b" sampling periods	
Week	Weekday	Week	Weekday
1	Tuesday	1	Friday
2	Wednesday	2	Thursday
3	Thursday	3	Wednesday

The selection of time of day for the weekday and weekend sampling periods in Phase I of the KRRA study was made at random for each of the days from an equally weighted distribution of the three available times. The direction of travel, either upstream or downstream, was also selected randomly for each sampling period. In Phase II of the study, restrictions in the field agent's availability limited the weekday sampling times as shown in Table B.4, although the weekend sampling period times were still selected at random.[5]

4. In a few cases, day "a" and day "b" were the same. Two sampling periods were scheduled for those days, where the times of day were selected randomly.

5. The sampling design and methods used in this study are standard (see Kish, 1965; Cochran, 1977). Similar methods were used in a recent study to count California beach users (see Chapman and Hanemann, 2000).

Table B.4. Weekday sampling period times for Phase II of the KRRA study

Weekday	Available survey shift
Monday	Morning
Tuesday	Afternoon
Wednesday	Morning
Thursday	Afternoon
Friday	Afternoon

B.3 Implementation of the KRRA Study

The distribution of completed sampling periods by phase, observation location, and time and type of day is presented as counts and as percentages in Tables B.5 and B.6 for Phase I and Phase II of the KRRA study, respectively.

Tables B.5 and B.6 reflect the previously discussed distribution of sampling periods among the reaches for each phase of the KRRA study. Most notably, this results in a proportional reduction in the number of sampling periods in the central section in Phase II relative to Phase I so that increased Allegan Dam visits could be completed. This transition was appropriate in developing the sampling schedule because there is a shift in fishing activity to the Allegan Dam area in the fall that coincides with the seasonal steelhead run. Since the survey agent usually could visit all the observation locations within a reach during a sampling period, the angler count data provides a complete record for the reaches when they were visited.

There is a disproportionately large number of afternoon shifts for the central stretch in Phase I as a result of the randomization program. To have run the program repeatedly to obtain more even proportions would have interfered with the randomization process. The aggregation (weighting) procedure presented in Section B.5 takes account of the fact that there were relatively more afternoon shifts completed. The large number of afternoon sampling periods will not cause a bias; in fact, one would expect the estimates of afternoon angling to be more precise. To the extent that more angling occurs in the sampled reaches during the afternoon, this may be a benefit to the study.

Table B.5. KRRA study Phase I: Number of possible sampling periods and number of completed visits

	Weekday			Weekend			All		
Sampling period option	**Morning**	**Afternoon**	**Evening**	**Morning**	**Afternoon**	**Evening**	**Morning**	**Afternoon**	**Evening**
Possible sampling periods[a]	72	72	72	33	33	33	105	105	105
Upper Kalamazoo									
Number of completed sampling periods	2	0	0	1	1	2	3	1	2
Possible sampling periods completed (%)	2.8%	0.0%	0.0%	3.0%	3.0%	6.1%	2.9%	1.0%	1.9%
Central Kalamazoo[b]									
Number of completed sampling periods	1	9	4	2	10	1	3	19	5
Possible sampling periods completed (%)	1.4%	12.5%	5.6%	6.1%	30.3%	3.0%	2.9%	18.1%	4.8%
Lower Kalamazoo[c]									
Number of completed sampling periods	4	6	4	3	5	6	7	11	10
Possible sampling periods completed (%)	5.6%	8.3%	5.6%	9.1%	15.2%	18.2%	6.7%	10.5%	9.5%

a. Phase I lasted 15 weeks (May 28 through September 9, 2001). During this time there were three holidays (Memorial Day, 4th of July, and Labor Day) that fell on weekdays. These days are considered weekend days in the KRRA study. As a result the total number of weekdays is 72 = (15 × 5) – 3, and the total number of weekend days is 33 = (15 × 2) + 3.

b. In a few instances, not all of the observation locations were visited during a given sampling period, due to extenuating circumstances such as severe weather. In these cases, the sampling periods were only "partially" completed. Only three visits were made to the Plainwell Dam, Otsego Dam, Trowbridge Dam, Monroe Rd. bend, and Lake Allegan sites (site ids = 210, 211, 212, 219, 220, respectively) in the weekday evening sampling time period; only eight visits were made to the Otsego Dam (site id = 211) and Trowbridge Dam (site id = 212) in the weekday afternoon period; and no visits were made to the Otsego Dam and Trowbridge Dam sites in the weekend evening time period. As a result, the percentage of possible visits completed is 4.2% for the affected weekday evening sites, 11.1% for the Otsego and Trowbridge Dam sites in the weekday afternoon, and 0.0% for these same two sites for the weekend evening.

c. In a few instances, not all of the observation locations were visited during a given sampling period, due to extenuating circumstances such as severe weather. In these cases, the sampling periods were only "partially" completed. Only five visits were made to the Douglas Bayou site (site id = 311) in the weekday afternoon sampling time period. As a result, the percentage of possible visits completed is 6.9% for this site at this time.

Table B.6. KRRA study Phase II: Number of possible sampling periods and number of completed visits

	Weekday		Weekend		All	
Sampling period option	**Morning**	**Afternoon**	**Morning**	**Afternoon**	**Morning**	**Afternoon**
Possible sampling periods[a]	64	64	27	27	91	91
Upper Kalamazoo						
Number of completed sampling periods	0	1	1	0	1	1
Possible sampling periods completed (%)	0.0%	1.6%	3.7%	0.0%	1.1%	1.1%
Central Kalamazoo						
Number of completed sampling periods	3	5	1	0	4	5
Possible sampling periods completed (%)	4.7%	7.8%	3.7%	0.0%	4.4%	5.5%
Lower Kalamazoo						
Number of completed sampling periods (Allegan Dam only)	1	3	4	8	5	11
Possible sampling periods completed (%) (Allegan Dam only)	1.6%	4.7%	14.8%	29.6%	5.5%	12.1%
Number of completed sampling periods (Allegan Dam as part of reach sampling)[b]	4	4	2	1	6	5
Possible sampling periods completed (%) (Allegan Dam as part of reach sampling)	6.3%	6.3%	7.4%	3.7%	6.6%	5.5%
Number of completed sampling periods (all other lower reach sites)	2	1	2	2	4	3
Possible sampling periods completed (%)	3.1%	1.6%	7.4%	7.4%	4.4%	3.3%

a. Phase II lasted 13 weeks (September 10 through December 9, 2001). During this time there was one holiday (Thanksgiving) that fell on a weekday (sampling was not done on the Friday following Thanksgiving). This is considered a weekend day in the KRRA study. As a result the total number of weekdays is $64 = (13 \times 5) - 1$, and the total number of weekend days is $27 = (13 \times 2) + 1$.

b. The number of sampling periods completed to the Allegan Dam site as part of reach sampling is different from the remaining sites in the lower Kalamazoo reach because part way through Phase II the survey agent was directed to include the Allegan Dam location in sampling periods to the central Kalamazoo reach as well as the regularly scheduled (starting October 18) lower Kalamazoo reach sampling trips.

B.4 Raw Angler Counts

During a sampling period, the survey agent counted all visible shore and boat anglers at each observation location, and attempted to interview all accessible anglers.[6] Tables B.7 and B.8 present the results of the sampling in terms of the number of observed anglers by observation location in Phase I and Phase II of the KRRA study, respectively.[7]

Tables B.7 and B.8 together show that 1,124 anglers were observed during the KRRA study: 438 (39%) during Phase I and 686 (61%) during Phase II. The higher totals in Phase II are consistent with *a priori* expectations of the increased sampling emphasis on the popular Allegan Dam location and the expected increase in angler activity in conjunction with the fall steelhead run.

A second conclusion from Tables B.7 and B.8 is that angling activity along the surveyed reaches of the Kalamazoo River is clearly not evenly distributed across the observation locations. For example, in the central and lower reaches, no anglers were ever observed, despite over 30 sampling periods, at two of the observation locations: Morrow Dam and RR Junction.

Table B.9 provides information on the three observation locations with the highest totals for observed anglers within each reach, including the total percentage of observed anglers in each phase of the KRRA study that were seen at each of these locations.

Table B.10 provides additional information on the distribution of the observed anglers based on their fishing mode (i.e., boat or shore). Table B.10 shows that boating anglers constitute a significant portion of the total angler count in the KRRA study (29%). As expected, the percentage of anglers in boats is higher during Phase I, which corresponds with the summer months. A surprising result in this table is the share of boat anglers that were observed in the central reach (50% over both phases), given conversations with local resource managers that portrayed the area as having limited boat access. While most of the observed boat angling was at Lake Allegan (62% of all observations), boat anglers were observed at 6 of the 13 fished observation locations within the central reach.

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6. To be counted as a boat angler, an individual had to have visible fishing gear. Otherwise, he or she would be counted as a recreational boater.

7. Locations and times that were not sampled in the upper reach, identified as “not surveyed” in Tables B.7 and B.8, do not contribute to aggregate use estimates in the next section. This underestimate applies only to the upper reach, which is not in the assessment area, was not a main focus of the KRRA study, and received less than 10% of the total sampling time. The upper reach estimates have low confidence in general, but serve to indicate that little fishing occurs there.

Table B.7. Anglers (shore and boat) observed during Phase I of the KRRA study

Site I.D.	Observation location	Weekday			Weekend			All			Share of all anglers in Phase I observed at site
		Morning	Afternoon	Evening	Morning	Afternoon	Evening	Morning	Afternoon	Evening	
Upper Kalamazoo											
101	S. Wattles Park	3	Not surveyed	Not surveyed	0	0	0	3	0	0	1%
102	37 Trail	0	Not surveyed	Not surveyed	0	0	0	0	0	0	0%
103	2 River Junction	0	Not surveyed	Not surveyed	0	3	2	0	3	2	1%
104	96 Bend	0	Not surveyed	Not surveyed	0	0	0	0	0	0	0%
105	97 Area	0	Not surveyed	Not surveyed	0	0	0	0	0	0	0%
106	Trailer Park Bend	0	Not surveyed	Not surveyed	0	0	0	0	0	0	0%
107	Gales Bridge	0	Not surveyed	Not surveyed	0	0	0	0	0	0	0%
Upper Kalamazoo total		**3**	**Not surveyed**	**Not surveyed**	**0**	**3**	**2**	**3**	**3**	**2**	**2%**
Central Kalamazoo											
201	Morrow Dam	0	0	0	0	0	0	0	0	0	0%
202	Morrow Lake	0	3	9	1	9	1	1	12	10	5%
203	Morrow Park	0	0	0	0	1	0	0	1	0	0%

Table B.7. Anglers (shore and boat) observed during Phase I of the KRRA study (cont.)

Site I.D.	Observation location	Weekday			Weekend			All			Share of all anglers in Phase I observed at site
		Morning	After-noon	Evening	Morning	After-noon	Evening	Morning	After-noon	Evening	
Central Kalamazoo (cont.)											
204	Wenke Park	0	4	2	0	3	0	0	7	2	2%
205	Mills Bridge	0	0	1	0	0	0	0	0	1	0%
206	Verburg Park	0	0	0	0	1	0	0	1	0	0%
207	Mosel Bridge	0	0	0	1	0	0	1	0	0	0%
208	Parchment Park	0	1	0	0	0	2	0	1	2	1%
209	D. Ave (Gravel Pit)	0	8	1	0	5	0	0	13	1	3%
210	Plainwell Dam	0	4	0	0	4	3	0	8	3	3%
211	Otsego Dam	0	0	2	1	3	Not surveyed	1	3	2	1%
212	Trowbridge Dam	0	0	2	0	1	Not surveyed	0	1	2	1%
219	Monroe Rd. Bend	0	3	3	1	1	0	1	4	3	2%
220	Lake Allegan	1	26	3	7	27	1	8	53	4	15%
Central Kalamazoo total		**1**	**49**	**23**	**11**	**55**	**7**	**12**	**104**	**30**	**33%**
Lower Kalamazoo											
301	Allegan Dam/ Caulkins Bridge	10	15	18	18	25	18	28	40	36	24%
302	650 Area	0	0	0	0	0	0	0	0	0	0%
303	Swan Creek Marsh	0	1	1	0	2	1	0	3	2	1%

Table B.7. Anglers (shore and boat) observed during Phase I of the KRRA study (cont.)

Site I.D.	Observation location	Weekday			Weekend			All			Share of all anglers in Phase I observed at site
		Morning	Afternoon	Evening	Morning	Afternoon	Evening	Morning	Afternoon	Evening	
Lower Kalamazoo (cont.)											
304	Marsh Public Access	2	5	1	0	3	0	2	8	1	3%
305	Big Daily Bayou	1	6	0	0	2	4	1	8	4	3%
306	22 Junction	0	0	7	0	1	0	0	1	7	2%
307	Rabbit River Access	4	6	2	0	3	3	4	9	5	4%
308	RR Junction	0	0	0	0	0	0	0	0	0	0%
309	New Richmond	2	21	5	6	0	6	8	21	11	9%
310	130th Access	0	6	0	4	11	6	4	17	6	6%
311	Douglas Bayou	0	39	3	10	3	3	10	42	6	13%
Lower Kalamazoo total		**19**	**99**	**37**	**38**	**50**	**41**	**57**	**149**	**78**	**65%**
Total across all sites		**23**	**148**	**60**	**49**	**108**	**50**	**72**	**256**	**110**	**100%**
Total sampling periods		**7**	**15**	**8**	**6**	**16**	**9**	**13**	**31**	**17**	
Average anglers per visit		**3.3**	**9.9**	**7.5**	**9.2**	**6.8**	**5.6**	**5.5**	**8.3**	**6.5**	

Table B.8. Anglers (shore and boat) observed during Phase II of the KRRA study

Site I.D.	Observation location	Weekday		Weekend		All		Share of all anglers in Phase II observed at site
		Morning	Afternoon	Morning	Afternoon	Morning	Afternoon	
Upper Kalamazoo								
101	S. Wattles Park	Not surveyed	2	0	Not surveyed	0	2	0%
102	37 Trail	Not surveyed	0	0	Not surveyed	0	0	0%
103	2 River Junction	Not surveyed	0	0	Not surveyed	0	0	0%
104	96 Bend	Not surveyed	1	0	Not surveyed	0	1	0%
105	97 Area	Not surveyed	0	0	Not surveyed	0	0	0%
106	Trailer Park Bend	Not surveyed	0	0	Not surveyed	0	0	0%
107	Gales Bridge	Not surveyed	0	2	Not surveyed	2	0	0%
Upper Kalamazoo total		**Not surveyed**	**3**	**2**	**Not surveyed**	**2**	**3**	**1%**
Central Kalamazoo								
201	Morrow Dam	0	0	0	Not surveyed	0	0	0%
202	Morrow Lake	2	5	1	Not surveyed	3	5	1%
203	Morrow Park	0	0	0	Not surveyed	0	0	0%
204	Wenke Park	0	0	0	Not surveyed	0	0	0%
205	Mills Bridge	0	0	0	Not surveyed	0	0	0%
206	Verburg Park	1	0	0	Not surveyed	1	0	0%
207	Mosel Bridge	0	0	0	Not surveyed	0	0	0%
208	Parchment Park	4	0	0	Not surveyed	4	0	1%
209	D. Ave (Gravel Pit)	2	2	0	Not surveyed	2	2	1%
210	Plainwell Dam	0	3	0	Not surveyed	0	3	0%
211	Otsego Dam	0	2	0	Not surveyed	0	2	0%
212	Trowbridge Dam	0	0	0	Not surveyed	0	0	0%
219	Monroe Rd. Bend	1	0	0	Not surveyed	1	0	0%
220	Lake Allegan	6	9	4	Not surveyed	10	9	3%
Central Kalamazoo total		**16**	**21**	**5**	**Not surveyed**	**21**	**21**	**6%**

Table B.8. Anglers (shore and boat) observed during Phase II of the KRRA study (cont.)

Site I.D.	Observation location	Weekday		Weekend		All		Share of all anglers in Phase II observed at site
		Morning	Afternoon	Morning	Afternoon	Morning	Afternoon	
Lower Kalamazoo								
301	Allegan-Dam-only visit	5	58	123	185	128	243	54%
301	Allegan Dam as part of reach surveys	51	56	58	15	109	71	26%
302	650 Area	0	0	4	0	4	0	1%
303	Swan Creek Marsh	0	2	0	0	0	2	0%
304	Marsh Public Access	0	0	1	0	1	0	0%
305	Big Daily Bayou	4	4	6	0	10	4	2%
306	22 Junction	1	0	1	0	2	0	0%
307	Rabbit River Access	4	0	5	1	9	1	1%
308	RR Junction	0	0	0	0	0	0	0%
309	New Richmond	6	5	3	9	9	14	3%
310	130th Access	0	0	0	0	0	0	0%
311	Douglas Bayou	4	7	9	12	13	19	5%
Lower Kalamazoo total		**75**	**132**	**210**	**222**	**285**	**354**	**93%**
Total across all sites		**91**	**156**	**217**	**222**	**308**	**378**	**100%**
Total sampling periods[a]		**6**	**10**	**8**	**10**	**14**	**20**	
Average anglers per visit		**15.2**	**15.6**	**27.1**	**22.2**	**22.0**	**18.9**	

a. The total number of sampling periods is calculated as the sum of the visits for the upper, central, and lower reaches plus those sampling periods that focused solely on the Allegan Dam site (see Table B.6). Because of the extra visits to the Allegan Dam site associated with sampling periods to the central reach, the average anglers per visit results presented above have an upward bias because these extra trips are not accounted for and because of the popularity of the Allegan Dam site.

Table B.9. KRRA frequently fished locations

Location name	Site I.D.	KRRA study reach	Percentage of Phase I anglers across all reaches	Percentage of Phase II anglers across all reaches
Lake Allegan	220	Central	15%	3%
Allegan Dam/ Caulkins Bridge	301	Lower	24%	80%
Douglas Bayou	311	Lower	13%	5%
Total			**52%**	**88%**

Table B.10. Mode of observed anglers by angling location, phase, and reach

KRRA study reach	Boat anglers	Shore anglers	Percentage of reach anglers in boats	Percentage of reach anglers on shore
Phase I				
Upper	0	8	0%	100%
Central	82	64	56%	44%
Lower	110	174	39%	61%
All reaches	192	246	44%	56%
Phase II				
Upper	0	5	0%	100%
Central	12	30	29%	71%
Lower	119	520	19%	81%
All reaches	131	555	19%	81%
Phase I and Phase II				
Upper	0	13	0%	100%
Central	94	94	50%	50%
Lower	229	694	25%	75%
All reaches	323	801	29%	71%

B.5 Aggregate Angler Days

The count of observed anglers in each phase of the KRRA study provides the starting point for estimating the total aggregate level of angling activity measured in angler days that took place during the KRRA study.[8] From this starting point, separate adjustment factors are developed for the count of observed anglers for each phase to address the following sampling issues[9]:

1. Only a portion of the total number of possible sampling periods was covered by the survey agent.

2. On any given sampling period, some anglers were not observed because each observation location was visited once, allowing anglers to arrive at a location after the survey agent had completed her visit or to leave before her arrival.

Adjusting the counts of observed anglers in response to the first sampling issue is straightforward and requires multiplying the observed counts at a location, distinguished by phase, type of day, and sampling time, by an adjustment factor equal to the inverse of the percentage of trips completed to observation locations out of the total possible number of sampling periods (see Tables B.5 and B.6 for these percentages).[10]

This adjustment increases angler counts by a factor of roughly 11.5 for Phase I and 9.6 for Phase II. To simplify the reporting, the adjusted counts by location have been aggregated by reach and sampling time in Table B.11 (counts for Allegan-Dam-only sampling periods in Phase II are reported separately).

The counts of anglers in Table B.11 represent only the first adjustment in estimating total angler use during the KRRA study. The final estimate is obtained after accounting for the fact that the survey agent did not observe the entire reach for the entire duration of a sampling period.

The second set of adjustment factors incorporates information from the KRRA study's angler intercept results. Separate adjustment factors are calculated by reach (upper and central receive the same adjustment) for the weekday and weekend counts in each phase of the KRRA study consistent with the aggregation in Table B.11.

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8. If one angler fishes for any part of one day, that is an "angler day."

9. Separate adjustment factors are required for each phase of the KRRA study because of the difference in the number of sampling periods in each phase and the addition of the sampling periods that focused only on Allegan Dam in Phase II.

10. For example, if 20 anglers were observed at a location that was visited 6 out of a possible 60 times (10%), the adjusted angler count for the location would be 200 (i.e., 20 × [1/0.10]).

Table B.11. KRRA study angler counts after adjustment for portion of possible sampling periods covered

Phase I

Reach	Weekday morning	Weekday afternoon	Weekday evening	Weekday total	Weekend morning	Weekend afternoon	Weekend evening	Weekend total
Upper	108	Not surveyed	Not surveyed	108	Not surveyed	99	33	132
Central	72	392	474	938	182	182	231	594
Lower	342	1,282	666	2,290	418	330	226	974
Total all reaches				3,336	Total all reaches			1,700

Phase II

Reach	Weekday morning	Weekday afternoon	Weekday total	Weekend morning	Weekend afternoon	Weekend total
Upper	Not surveyed	192	192	54	Not surveyed	54
Central	341	269	610	135	Not surveyed	135
Lower	1,424	2,048	3,472	1,175	702	1,877
Allegan-Dam-only	320	1,237	1,557	830	624	1,445
Total all reaches			5,831	Total all reaches		3,521

For a given sampling period, the likelihood of an angler being observed is based on the amount of time the angler is fishing as a proportion of the total duration of the sampling period for the whole reach. Intuitively, the longer the angler is fishing, the more likely it is the survey agent will observe the angler as the survey agent makes the round through all the observation points within the reach.

Suppose for the sake of simplicity and illustration that the length of the sampling period is two hours, and all anglers report a fishing duration of one half hour. Because the duration of an angler's visit is 25% of the duration of the sampling period (30 minutes/120 minutes), it is inferred that on average anglers have a one in four chance of being observed by repeated visits conducted on different days during the two-hour sampling period. On average, the survey agent will miss 75% of the anglers, because they only fish for a portion of the sampling period. Thus, the weight to be used for observed anglers is a factor of four, the reciprocal of the likelihood of observing an angler (1/0.25).

Generally, let T = the length of the sampling period, and t_i be the fishing duration of angler i. The likelihood of observing angler i is t_i/T, and an estimate of the adjustment factor for aggregation based only on angler i's data is the reciprocal of this expression, T/t_i. Estimates of t_i are reported

from numerous anglers from the on-site angler interview (Question 5). The variable t_i is the total time anglers reported for their fishing visits. T in all cases is equal to 5 hours. The mean of the expression T/t_i over i is used as the weight (adjustment factor), as reported in Table B.12:

$$W = \overline{\left[\frac{T}{t_i}\right]} = T \times \frac{\sum_{i=1}^{N}\left[\frac{1}{t_i}\right]}{N}. \qquad \text{(B.1)}$$

The adjustment factors are therefore the inverse of the ratio of the harmonic mean of fishing time to the duration of the sampling period (R. Tourangeau, Director of the Joint Program of Survey Methodology, University of Maryland, personal communication, January 29, 2004).[11]

The interim adjusted counts in Table B.11 by phase and type of day are multiplied by the adjustment factors in Table B.12, with the exception of the interim counts in Table B.11 for the sampling periods at Allegan Dam.

The counts for Allegan Dam in Table B.11 are not adjusted using this approach because the survey agent was able to record all of the anglers who were at the site during the sampling period because she was stationed there. As a result it would be inappropriate to apply this type of adjustment, which is designed to account for anglers missed because the survey agent visited each observation location only once during a sampling period. Instead, the Allegan Dam counts reported in Table B.11 were increased by multiplying by an adjustment factor equal to the actual length of each sampling period (5 hours) divided by the time actually spent at Allegan Dam on these shifts (3 hours). The resulting adjustment factor of 1.67 accounts for the fact that not all the time in the sampling period was spent on site at Allegan Dam but that, while the agent was there, no Allegan Dam anglers were missed.[12]

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11. The harmonic mean is the number of observations of a variable, divided by the sum of the reciprocals of that variable. When this weighting method has been applied in the literature, it is described in terms of the harmonic mean [see Tourangeau and Ruser, 1999; see also Dixon and Chapman (1980) for another application using the harmonic mean], but the computations here are equivalent. Both the arithmetic and harmonic means of t are reported in Table B.12. As an aside, the harmonic mean is less than the arithmetic mean because the harmonic mean is much less sensitive to outlier observations. The adjustment factors are based on the mean of the inverse of angler fishing time, not the mean of fishing time (see Equation B.1), so the harmonic mean of fishing time is the appropriate statistic.

12. This factor is appropriate assuming fishing start and stop times are random and, based on the survey information, the length of the average fishing day is short relative to the length of a sampling period. Also, note that these Allegan Dam sampling periods are not part of lower-reach sampling, so anglers fishing at or near other lower observation points are not of concern.

Table B.12. Adjustment factors to account for anglers missed during sampling periods

	Phase I		Phase II	
	Weekday	**Weekend**	**Weekday**	**Weekend**
Arithmetic mean of expected duration of fishing visits (hours)	2.30	2.33	2.07	2.30
Harmonic mean of expected duration of fishing visits (hours)	1.79	1.81	1.85	1.69
Central and upper reach adjustment factors				
Sampling period duration in central and upper reaches (hours)	5.00	5.00	5.00	5.00
Harmonic mean of time spent fishing divided by sampling period duration in central and upper reaches (hours)	0.36	0.36	0.37	0.34
Adjustment factor	2.79	2.77	2.70	2.96
Lower reach adjustment factors				
Sampling period duration in lower reach visits (hours)	5.00	5.00	5.00	5.00
Sampling period duration for Allegan Dam only visits (hours)	3.00	3.00	3.00	3.00
Harmonic mean of time spent fishing divided by sampling period duration in lower reach (hours)	0.60	0.60	0.62	0.56
Adjustment factor	1.68	1.66	1.62	1.78

Some figures are rounded for presentation.

The resulting final estimates of angler days on the reaches incorporated in the KRRA study are presented in Table B.13. Note that because of the two sampling methods for Allegan Dam, there is a range for the lower reach.

Table B.13 presents a final angling estimate of roughly 21,900 to 22,400 angler days on the surveyed reaches of the Kalamazoo River during the KRRA study. Of this total, roughly 66% of the days (i.e., 14,200-14,700 days) are estimated to occur in the lower Kalamazoo River reach, which is consistent with expectations because of the ease of access and congregation of desirable recreational angling species (e.g., salmon, steelhead) in this reach.[13]

13. The range in estimates is driven by the two sampling methods for Allegan Dam. This count study was designed to provide order-of-magnitude estimates of the level of use. The smaller scale of this study, with only one survey agent and a small percentage of total possible sampling periods covered, contributes to a wider range of uncertainty in the estimates. The larger estimate is based on weights derived from data collected at all observation points; Allegan Dam is a unique site, and the turnover rate may be different from other, less-popular sites. Further, the weights are based on a limited amount of data, so there is uncertainty in the weights as well. In a more intensive study, the two estimates would be expected to converge. Because FCAs are milder below Allegan Dam, and apply only to warm-water fishing days (see Chapter 2), the difference in the use estimates below the dam is less significant with respect to the damage estimates.

Table B.13. Estimated angler days during the KRRA study

KRRA study reaches	Phase I		Phase II	
	Weekday	Weekend	Weekday	Weekend
Upper Kalamazoo	302	365	518	160
Central Kalamazoo	2,621	1,643	1,646	400
Lower Kalamazoo	3,839	1,616	5,445-5,621	3,336-3,648
Total all reaches	6,762	3,625	7,609-7,785	3,896-4,208
Total all reaches all phases	**21,892-22,380**			
Figures may not sum to totals due to rounding.				

The KRRA study covered 197 days, or 54% of the year. However, extrapolating to annual use is complicated by the fact that fishing effort is not equally distributed over the year, especially in the winter months, when the weather limits the number of attractive locations and the number of possible days to fish.

The KRRA study effectively covered the summer and fall fishing seasons, leaving the winter and spring unaccounted. Available information from a 1986 creel survey conducted at Allegan Dam (J. Wesley, MDNR Fisheries Division, personal communication, 2002) showed that visits to the location in the spring were 59% of those in the fall.[14] Assuming that this is reflective of all the reaches in the KRRA survey, the Phase II aggregate counts, which effectively represent the fall season, are inflated by 1.59 (i.e., an additional 59%) to account for spring visits. Despite the knowledge that fishing does occur at locations along the surveyed reaches of the Kalamazoo River in winter, notably for walleye downstream of Allegan and Trowbridge Dams (J. Wesley, MDNR Fisheries Division, personal communication, 2002), no adjustment was incorporated for the winter season because of a lack of information on which to base any adjustment factors.

Table B.14 presents the estimated angler days for spring through fall for each reach of the KRRA study incorporating the annual adjustment factor described above while maintaining a range of estimates for the lower reach to reflect the differences in the estimating approaches.

As presented in Table B.14, incorporating the spring adjustment provides an estimate of between 28,700 and 29,500 angler days from spring through fall on the reaches of the Kalamazoo River included in the KRRA study.

14. In this study, spring includes March, April, and May (and therefore ends just as the sampling began), and fall includes September through December (and so matches the Phase II period closely).

Table B.14. Estimated angler days spent fishing in the reaches of the KRRA study (spring through fall)

KRRA study reach	Estimated number of angler days
Upper Kalamazoo	1,745
Central Kalamazoo	7,517
Lower Kalamazoo	19,416-20,193
All reaches	28,678-29,455

B.6 Results of the KRRA Angler Interview

The angler interviews of the KRRA study were implemented during the same sampling periods as the counts of anglers. Efforts were made to interview all reasonably accessible anglers at locations that did not involve entering posted private property. Over the course of the KRRA study, 94 angler intercepts were completed (59 in Phase I and 35 in Phase II). A copy of the survey questionnaire administered by the survey agent is included as Figure B.2.

Of the completed interviews, seven anglers were interviewed more than once. The responses to all interviews are considered to have been completed within the KRRA study period because much of the collected information is specific to the actual angling event rather than the angler. The responses from the repeat group to questions about angling preferences may cause a slight bias as a result, but the impact should be minimal.

Summaries of the angler interview results are presented in Tables B.15 though B.33, following the order of the survey questions in Figure B.2. These tables appear at the end of this section.

From among the various findings in the intercept data, the following are of special interest or worthy of special note.

- Of the 94 completed surveys, 55 (59%) were completed at Allegan Dam (see Table B.16). As a result, responses to questions that are not broken out by reach are heavily influenced by these responses. At the same time, the total number of responses from anglers interviewed in the lower reach is not disproportionate to the final distribution of angling days during the study (77% of survey responses versus 79% of estimated angling days).

KALAMAZOO RIVER ANGLER INTERCEPT SURVEY

ID#_____
DATE: ____/_____/2001 **TIME**: _____ am / pm **DAY OF WEEK**: M T W Th F Sa Su
River Stretch: 1 = Upper 2 = Central 3 = Lower **Site Code #:**_____
Rain/Bad Weather: 0 No 1 Yes **Angler Type:** 0 Shore 1 Boat

HELLO, MY NAME IS HEATHER. I'M WORKING WITH THE U.S. FISH AND WILDLIFE SERVICE TO COLLECT INFORMATION ABOUT FISHING, INCLUDING THIS PART OF THE KALAMAZOO RIVER.

#1 **COULD I ASK YOU A FEW SHORT QUESTIONS ABOUT YOUR FISHING** ? 0 – No 1 - Yes

#2 **HAVE I INTERVIEWED YOU BEFORE TODAY**? 0 = No 1 = Yes (If YES When? _____)

#3 **WE WOULD LIKE TO KNOW HOW FAR ANGLERS TRAVEL TO FISH THE KALAMAZOO RIVER. CAN WE HAVE YOUR HOME TOWN AND ZIPCODE?** City: _____ Zip Code: _____

#4 **WHAT PRIMARY SPECIES ARE YOU TARGETING? (circle all that are mentioned)**
a) Trout b) Salmon c) Walleye / Pike d)Perch / Bluegill / Sunfish
e) Bass f) Carp-Catfish-Sucker g) Whatever is biting h) Other _____

#5 **HOW LONG HAVE YOU BEEN FISHING AT THIS SITE TODAY?** _____hrs _____ mins

#6 **HOW MUCH LONGER DO YOU EXPECT TO BE FISHING HERE TODAY?** _____hrs _____ mins

#7 **HOW MANY ANGLERS ARE IN YOUR PARTY TODAY, INCLUDING YOURSELF?** _____ # anglers

#8 **<u>INCLUDING TODAY</u>, HOW MANY DAYS HAVE YOU FISHED IN THE PAST TWO WEEKS EITHER HERE OR ANYWHERE ELSE?** _____ Days
HOW MANY OF THESE DAYS FISHING WERE TO:
- The Kalamazoo River from Battle Creek to above Morrow Dam _____ Days
- The Kalamazoo River from below Morrow Dam to above Caulkins Dam (including Lake Allegan) _____ Days
- The Kalamazoo River from below Caulkins Dam to Lake Michigan _____ Days
- Kalamazoo River tributaries (e.g., Rabbit River, Gun River, Battle Creek) ___|___|___ Days
- Other site(s) (if mentioned _____) ___|__ Days

#9 **(Central and Lower reaches only – Morrow Pond to Lake Michigan).**
THINKING ABOUT THE KALAMAZOO RIVER BETWEEN MORROW POND AND LAKE MICHIGAN ARE THERE THINGS THAT YOU PARTICULARLY LIKE OR DISLIKE ABOUT FISHING HERE (for both circle # and add comments)?

Like 1 = Convenience / Close to home
2 = Uncongested
3 = Good Accessibility (e.g., boat launches

Dislike 21 = Consumption restriction
22 = PCBs
23 = Other visible pollution (e.g., paper waste, oil, trash)
24 = Limited access/facilities

Other Like =_____ Other Dislike =_____

#10 **ARE YOU AWARE OF ANY ADVISORIES OR RESTRICTIONS ON FISH CONSUMPTION FOR THIS STRETCH OF RIVER**?
0 = No
1 = Yes ----------> What do you understand the advisory in this stretch of the river to be?
9 = Thinks so, but uncertain _____

#11 **OVER THE PAST 12 MONTHS, ABOUT WHAT PERCENTAGE OF THE FISH THAT YOU CAUGHT ON THE KALAMAZOO AND COULD HAVE KEPT, WERE KEPT FOR EATING, EITHER BY YOURSELF OR OTHERS?**
None 10% 20% 30% 40% Half 60% 70% 80% 90% All (circle closest percent)

#12 **TO BETTER MANAGE THE KALAMAZOO RIVER, WE MAY WANT TO CONTACT YOU BY MAIL OR PHONE. WOULD YOU BE WILLING TO HELP?**
0 No --> Thank respondent for taking the time to complete the questions. <<*TERMINATE INTERVIEW*>>
1 Yes --> Add name, address, city, zip code, telephone number on separate record sheet.

INTERVIEWER ADD FOLLOWING INFORMATION ABOUT RESPONDENT:
GENDER: 0 = Male 1 = Female **AGE Group:** 0 = Youth 1 = Adult 2 = Senior
DOES THE ANGLER POSSESS ANY FISH? 0= None visible 1 = Yes
COMMENTS:

Figure B.2. Kalamazoo river angler interview.

- Results presented from intercepts conducted in the upper reach of the KRRA study must be viewed and interpreted with caution as a result of the limited size of the respondent pool (three angler intercepts, see Table B.16).

- The survey responses come disproportionately from shore anglers relative to boat anglers (see Table B.18) compared to the counts of observed anglers (see Table B.10).

While 29% of the observed anglers in the KRRA study were in boats (Table B.10), only 12% of the completed interviews were from boat anglers. This result was anticipated and is largely unavoidable in this type of survey given the difficulty in interviewing boat anglers with a shore-based survey agent. Adjustments that attempt to account for this discrepancy were not developed.

- A majority of the anglers are local residents (Table B.19).

About 68% of the respondents report living in a city or town within Allegan (Allegan, Fennville, Pullman, and Saugatuck) or Kalamazoo (Galesburg, Kalamazoo, and Portage) counties, the principal counties containing the reaches included in the KRRA study. Many of the remaining respondents come from counties adjacent to these counties.

- Anglers in the lower reach are more likely to be targeting specific species than are anglers in the other reaches (see Table B.21).

A higher percentage of anglers surveyed in the lower reach report targeting a specific species than do anglers surveyed in the central reach, as reflected in the percentage of respondents who responded affirmatively when questioned if they were interested in "whatever bites." This result can also be seen in the high percentage of lower reach respondents who reported targeting salmon. This result is expected given the fish assemblage potentially available in the lower reach. Specifically, because Allegan Dam represents an impassible barrier to anadromous species (e.g., salmon and steelhead), these fish end up congregating below the dam, making it a desirable fishing location, especially when combined with the existing public access opportunities.

- Most Kalamazoo River anglers had not fished other sites in the past two weeks at the time of the interview (see Table B.24).

Table B.24 shows that most of the interviewed anglers reported no fishing days within the previous two weeks at any other nearby rivers and lakes, although the table also shows that a significant number of these anglers took multiple fishing days within the two-week period (almost all of which were to the Kalamazoo River). Most notably, the group of nearby locations includes the Rabbit River, which is unique for the area because it is a Class I trout stream. This finding suggests there is a group of anglers that consistently chooses to fish the surveyed reaches

of the Kalamazoo River. However, a two-week period is short and allows few opportunities to visit other sites. Further, during any one period of time, anglers may focus on one particular site.

- The single greatest dislike about the Kalamazoo River of central and lower reach anglers is visible pollution (e.g., paper waste, oil, trash – see Table B.26).

Interviewed anglers in the central and lower reaches of the KRRA study were approximately three times more likely to cite visible pollution as their greatest annoyance while angling than to cite PCB contamination. This suggests that, among active anglers, addressing the PCB contamination may not be the first priority in terms of improvements that could be made to improve fishing conditions. However, this finding does not address the extent to which the PCB contamination may have driven other anglers away from these reaches of the Kalamazoo River altogether.

- The majority of the interviewed anglers report little knowledge about the PCB-caused FCAs on the central and lower reaches of the Kalamazoo River (see Table B.28).

Table B.28 shows that in the central and lower reaches of the KRRA study, over half of the interviewed anglers either did not know about the PCB-caused FCAs or were uncertain of their content. That this is the case in the central reach is of concern, given the severity of the FCAs in this reach, and the efforts that have been and continue to be taken to inform the angling public.

Two other studies show awareness to be considerably higher, but those results must be qualified, as they are not directly comparable to this finding. Atkin (1995), first mentioned in Table 2.1, reports that over two-thirds of anglers in the eight counties surrounding the Kalamazoo River are aware of Michigan FCAs, but only 25% mentioned the Kalamazoo River in an open-ended question about specific sites. Also, the Atkin fishing log data for anglers are incomplete for the year, and consequently it is not possible to determine who had fished the Kalamazoo River over the past year, or how frequently they have fished there. It is likely many of these anglers had substituted away from the Kalamazoo River, reflecting a higher awareness of FCAs. Atkin (1998) reports that 81% of anglers who had fished the Kalamazoo River in the past year were aware of Kalamazoo River FCAs (and 57% had full or partial knowledge of the kinds of fish posing the most risk). However, this figure is based on a small sample size (37 anglers) and a leading question: “Have you heard the advisory warning about eating fish from the Kalamazoo River?” This question also follows other questions discussing Kalamazoo River contamination. Finally, while these anglers are Kalamazoo River anglers, they are likely to be less avid about Kalamazoo River fishing than those intercepted in the KRRA study, because those who are more avid are more likely to be intercepted. The Atkin (1998) study was based on a random telephone survey.

- The low percentage of fish caught that are kept and eaten may reflect a latent knowledge of FCAs (see Tables B.29 and B.30).

In the central reach of the KRRA study, where the PCB consumption advisories are most restrictive, on average only 3% of fish that are caught are eaten. Thirteen of the 18 respondents (72%) in this reach replied that they do not eat any of their catch, and the maximum response was that 20% of the catch was eaten. In contrast, on average 15% of the catch in the lower reach was reported to be eaten, with under half of the 73 respondents replying that they ate none of their catch. However, these lower reach statistics are more difficult to interpret with regard to effective compliance with the FCAs because the consumption restrictions are less severe relative to the central reach, particularly with regard to the popular anadromous species.

It is unclear why so few people report keeping many fish to eat, given the low-to-moderate awareness of FCAs. When the survey agent followed up with individuals who were unaware of the FCAs, but still do not keep many fish, several said they were catch-and-release anglers who do not fish for food. Others may be underreporting how many fish they keep because of the sequencing of the survey questions (this question is immediately preceded by a question about FCAs, suggesting that eating fish is not a good idea), or they may be underreporting their knowledge of FCAs. It is not expected that the small numbers of fish kept and eaten is the result of bag limits or minimum size restrictions because of how the question was posed (i.e., "caught and could have kept").

The FCAs in the lower reach include no restrictions for adult males and women beyond childbearing years and a one meal per month restriction for everyone else on the consumption of salmon, which is the most highly targeted species among anglers in this reach (see Table B.21).

Table B.15. Day of interview

Type of day	Frequency	Percent
Weekday	42	45%
Weekend	52	55%

Table B.16. Location of interview

Site I.D.	Site name	Frequency	Percent
101	S. Wattles Park	1	1.1%
103	2 River Junction	1	1.1%
107	Gales Bridge	1	1.1%
202	Morrow Lake	4	4.3%
208	Parchment Park	2	2.1%
209	D. Ave (Gravel Pit)	1	1.1%
210	Plainwell Dam	1	1.1%
211	Otsego Dam	3	3.2%
212	Trowbridge Dam	1	1.1%
219	Monroe Rd. Bend	4	4.3%
220	Lake Allegan	3	3.2%
301	Allegan Dam/ Caulkins Bridge	55	58.5%
303	Swan Creek Marsh	1	1.1%
304	Marsh Public Access	2	2.1%
305	Big Daily Bayou	2	2.2%
307	Rabbit River Access	3	3.2%
309	New Richmond	6	6.4%
310	130th Access	2	2.1%
311	Douglas Bayou	1	1.1%

Figures may not sum to 100% due to rounding.

Table B.17. Rain/bad weather

Was it raining/bad weather for interview?	Frequency	Percent
No	94	100%
Yes[a]	0	0%

a. Although no angler interviews were conducted during bad weather, the survey agent reported bad weather on 18% of all survey shifts. Of the total anglers observed, only 8% were fishing during bad weather. They were not interviewed either because they were inaccessible or because of the weather.

Table B.18. Angler type

Type of angler	Frequency	Percent
Shore	83	88%
Boat	11	12%

Table B.19. Angler's city of residence

City of angler residence	Frequency	Percent
Allegan	19	20.2%
Alto	2	2.1%
Battle Creek	4	4.3%
Bellwood, IL	1	1.1%
Cadillac	1	1.1%
Chicago, IL	1	1.1%
Covert	2	2.1%
Delton	1	1.1%
Fennville	12	12.8%
Flint	1	1.1%
Galesburg	1	1.1%
Grand Rapids	4	4.3%
Hastings	2	2.1%
Holland	2	2.1%
Kalamazoo	12	12.8%
Paw Paw	1	1.1%
Portage	2	2.1%
Pullman	15	16.0%
Rochester	1	1.1%
Saugatuck	3	3.2%
Schaumburg, IL	1	1.1%
South Haven	5	5.3%
Unspecified	1	1.1%

Figures may not sum to 100% due to rounding.

Table B.20. Prior interview for this survey

Have you been interviewed previously for this survey?	Frequency	Percentage
No	87	92%
Yes	7	8%

Table B.21. Number of respondents targeting each species[a]

Species targeted	Upper		Central		Lower	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
Trout	0	0%	0	0%	2	3%
Salmon	1	33%	0	0%	28	38%
Walleye/pike	0	0%	2	11%	11	15%
Perch/bluegill/sunfish	0	0%	4	22%	12	16%
Bass	2	67%	2	11%	5	7%
Carp/catfish/sucker	0	0%	2	11%	13	18%
Whatever is biting	3	100%	13	72%	41	56%

a. Number of times each species was mentioned as targeted; individual respondents can target more than one species per trip so totals may not equal 100%.

Table B.22. Number of anglers in party

Number of anglers in party	Upper		Central		Lower	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
1	1	33%	12	67%	42	58%
2	2	67%	6	33%	20	27%
3	0	0%	0	0%	7	10%
4	0	0%	0	0%	4	5%

Table B.23. Days spent fishing in past 2 weeks, including the day of the interview

Days spent fishing in past two weeks	Upper		Central		Lower		All	
	Frequency	%	Frequency	%	Frequency	%	Frequency	%
1	1	33%	10	56%	16	22%	27	29%
2	1	33%	2	11%	16	22%	19	20%
3	0	0%	3	17%	9	12%	12	13%
4	1	33%	2	11%	17	23%	20	21%
5	0	0%	0	0%	2	3%	2	2%
6	0	0%	0	0%	5	7%	5	5%
7	0	0%	0	0%	3	4%	3	3%
8	0	0%	0	0%	0	0%	0	0%
9	0	0%	1	6%	2	3%	3	3%
10	0	0%	0	0%	0	0%	0	0%
11	0	0%	0	0%	1	1%	1	1%
12	0	0%	0	0%	0	0%	0	0%
13	0	0%	0	0%	0	0%	0	0%
14	0	0%	0	0%	2	3%	2	2%

Table B.24. Days spent fishing in other locations in past 2 weeks[a]

Days fished at other rivers/lakes in past two weeks	Rabbit River		Gun River		Muskegon Lake		Duck Lake	
	Frequency	%	Frequency	%	Frequency	%	Frequency	%
0[b]	90	96%	92	98%	93	99%	93	99%
1	1	1%	2	2%	1	1%	1	1%
2	1	1%	0	0%	0	0%	0	0%
3	2	2%	0	0%	0	0%	0	0%

a. 0 fishing days reported for Battle Creek.
b. For example, 90 anglers reported they had not fished the Rabbit River in the last two weeks (but four had, at least once), 92 reported they had not fished the Gun River in the last two weeks (but two had, one time each), and so forth.

Table B.25. Attractive features of angling location (listed options)

Things you particularly like about fishing here (listed options)[a]	Upper		Central		Lower	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
Convenience	2	67%	12	67%	32	44%
Uncongested	1	33%	3	17%	14	19%
Accessibility	0	0%	4	22%	16	22%

a. Respondents can provide more than one response or no response so totals may not equal 100%.

Table B.26. Things you particularly dislike about fishing here (listed options)

Unattractive features of the location (listed options)[a]	Upper		Central		Lower	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
Consumption restriction	0	0%	0	0%	0	0%
PCBs	0	0%	2	11%	6	8%
Other visible pollution	0	0%	5	28%	18	25%
Limited access	0	0%	0	0%	1	1%

a. Respondents can provide more than one response or no response so totals may not equal 100%.

Table B.27. Other likes and dislikes (open-ended)

Reach[a]	Likes	Dislikes
Central	Nice area to fish No snakes, quiet location	Near neighborhoods Snakes Traffic near lake (x2)
Lower	Good fishing site (x3) Many fish (x4) Nice area (x2) Diverse fish Not chaotic as Allegan Dam Peaceful at times Water is shallow	Crowded (x9) Can be rowdy (x2) Dirty water Not enough catches (x2) Lot of snags (x2) People for steelhead run River's reputation Too much traffic Stairs along dam dangerous

a. No other responses were received from anglers interviewed in the upper reach of the KRRA study.

Table B.28. Are you aware of advisories for this stretch of river?

	Upper		Central		Lower		All	
	Frequency	%	Frequency	%	Frequency	%	Frequency	%
Yes	3	100%	7	39%	29	40%	39	41%
No	0	0%	8	44%	27	37%	35	37%
Uncertain	0	0%	3	17%	17	23%	20	21%

Figures may not sum to 100% due to rounding.

Table B.29. What do you understand the advisory in this stretch to be (open-ended)?

Upper
Do not eat bass and bottom feeders.
Fishermen receive information with license – do not eat most fish.
Central
A person can only eat certain numbers of certain types of fish.
Eat once per week.
If you're male, you can eat bass twice a week, avoid others.
It is safe to not eat the fish.
Only bottomfeeders, not bass.
Only eat particular species.
Women and children do not eat the fish.
You are not supposed to eat fish anywhere in the river.
Lower
I know the fish consume PCBs in river.
Allowed to eat some, others will make you sick.
Aware of FCAs.
Cannot eat carp or catfish.
Do not eat any fish.
Do not eat bass, bottom feeders only.
Do not eat catfish.
Do not eat certain types.
Do not eat them.
Eat a few kinds of fish only a couple times a week.
Eat catfish and bottomfeeders only – once a week.

Table B.29. What do you understand the advisory in this stretch to be (open-ended) (cont.)?

Lower (cont.)
Eat fish once a month.
Eat fish once to a few times each week depending on fish.
Eat once a month – only some fish.
Eat one fish a week.
Eat the fish once a week.
Heard and read about FCAs.
Heard of contaminated fish in river.
Many fish you are not allowed to eat.
Men can eat specific types of fish.
Men only eat a few each week, women and children do not eat.
Men eat small amounts – women and children cannot eat fish.
Not sure.
Only eat bass.
Only certain types.
Nasty water – salmon do not live in water – free to eat.
Some fish are dangerous to eat – catfish.
Stay away from bass, eat bottomfeeders.
There are many types you cannot eat.
Understand FCAs.
Watch types you eat – can only eat on occasion.
Water is polluted, not all fish are safe to eat.
Only certain fish, certain times per month.

Table B.30. Distribution of responses for percentage of fish caught that are eaten

Reach	Percentage of fish caught that are eaten	Frequency	Percent of total responses in reach
All reaches combined	0%	49	52%
	5%	3	3%
	10%	20	21%
	20%	9	10%
	30%	3	3%
	40%	2	2%
	50%	3	3%
	100%	5	5%
Upper Kalamazoo	0%	1	33%
	20%	1	33%
	30%	1	33%
Central Kalamazoo	0%	13	72%
	5%	1	6%
	10%	3	17%
	20%	1	6%
Lower Kalamazoo	0%	35	48%
	5%	2	3%
	10%	17	23%
	20%	7	10%
	30%	2	3%
	40%	2	3%
	50%	3	4%
	100%	5	7%

Table B.31. Average percentage of fish caught that are eaten

Reach	Number of responses	Average percentage of fish caught that are eaten
All reaches combined	94	13%
Upper Kalamazoo	3	17%
Central Kalamazoo	18	3%
Lower Kalamazoo	73	15%

Table B.32. Angler age group

	Frequency	Percent
Youth	5	5%
Adult	78	83%
Senior	11	11%

Figures may not sum to 100% due to rounding.

Table B.33. Angler gender

	Frequency	Percent
Male	77	82%
Female	17	18%

C. Fish Consumption Advisories

Table C.1. State of Michigan fish consumption advisories for the Kalamazoo River 1977-2001[a, b]

Species	Size	'77 to '78[c]	'79 to '82	'83	'84[d]	'85 to '86	'87 to '89	'90 to '93	'94 to '95	'96	'97	'98 to '01
Kalamazoo River from Battle Creek to Morrow Pond Dam												
Carp	All				▼/◆		◆	◆	◆	◆	◆	◆
Catfish	All				▼/◆							
Suckers	All				▼/◆							
Largemouth bass	All				▼/◆							
Kalamazoo River from Morrow Pond Dam to Allegan Dam (including Portage Creek)[d]												
Carp	All		◆	◆	▼/◆	◆	◆	◆	◆	◆	◆	◆
Catfish	All		◆		▼/◆	◆	◆	◆	◆	◆	◆	◆
Suckers	All		◆	◆	▼/◆	◆	◆	◆	◆	◆	◆	◆
Largemouth bass	All		◆		▼/◆	◆	◆	◆	◆	◆		
	140-300										◆	◆
Smallmouth bass	All		◆			▼/◆	▼/◆	◆	◆	◆		
	140-300										◆	◆
All other species			◆			▼/◆	▼/◆	▼/◆	▼/◆	▼/◆	▼/◆	▼/◆
All species in Portage Creek[e]			◆	◆								
Kalamazoo River below Allegan Dam (Allegan Dam to Saugatauk)												
Carp	All		◆	◆	▼/◆	◆	◆	◆	◆	◆	◆	◆
Catfish	All		◆		▼/◆	◆	◆	◆	◆	◆	◆	◆
Suckers	All		◆	◆	▼/◆	◆	◆					
Largemouth bass	All		◆		▼/◆	◆	◆		▼/◆	◆		
	140-300										▼/◆	▼/◆
	> 150							▼/◆				
Smallmouth bass	All		◆			▼/◆	▼/◆		▼/◆	◆		
	140-300										▼/◆	▼/◆
	> 150							▼/◆				
Northern pike	All		◆			▼/◆	▼/◆		◆	◆		
	≥ 220										◆	◆
	200-250							▼/◆				
	> 250							◆				
All other species	All		◆			▼/◆	▼/◆					▲/■

Table C.1. State of Michigan fish consumption advisories for the Kalamazoo River 1977-2001 (cont.)[a, b]

◆ = No consumption.
▼ = Limit consumption to 1 meal (½ pound) per week.
■ = Limit consumption to 1 meal (½ pound) per month.
▲ = Unlimited consumption.

a. If there is only one symbol it is the advice for the whole population. When two symbols are shown, the first is the advice for the "General Population" and the second is the advice for "children and women who are pregnant, nursing, or expect to bear children." From 1977 to 1983 children are not defined by age, from 1984 to 1987 the advice is for children age 6 and under, and from 1988 to 2000 the advice is for children age 15 and under.
b. PCB is the only substance identified as a key contaminant/factor responsible for the advisories for 1979 to 1981 and 1989 to 2000. From 1982 to 1988 the contaminant of concern was not identified by waterbody in the advisory, instead a preamble said that the listed "locations contained one or more chemicals at levels of public health concern." Potential contaminants listed were mercury, PCB, PPB, DDT, dieldrin, chlordane, toxaphene and dioxins.
c. From 1977 to 1978 Kalamazoo River was not included in the advisory.
d. In 1984, the advice was for the Kalamazoo River and Portage Creek, with no distinction as to the stretch.
e. From 1979 to 1983 there is a separate advisory for "all other species" in Portage Creek, thereafter Portage Creek species are included in the Kalamazoo River from Morrow Pond Dam to Allegan Dam advisory.
Source: MDCH/MDNR (1977-2001).

Table C.2. State of Michigan fish consumption advisories for the Lake Michigan, south of Frankfort 1977-2001[a, b]

Species	Size	'77 to '81	'82 to '85	'86	'87 to '91	'92 to '94	'95	'96	'97[c]	'98	'99 to '01
Brown trout	All		▼/◆	◆							
	100-220				▼/◆	▼/◆			▲	▲/■	▲/■
	≥ 220				▼/◆	▼/◆			◆	◆	◆
	> 230				◆	◆	◆	◆			
Carp	All		▼/◆	◆	◆	◆	◆	◆	◆	◆	◆
Catfish	All		▼/◆	▼/◆	◆	◆	◆	◆	◆	◆	◆
Chinook salmon	All	▼/◆	▼/◆								
	100-260									▲/■	▲/■
	≥ 260			▼/◆						▲/■	▲/❖
	210-320				▼/◆	▼/◆					
	> 320				◆	◆	▼/◆				
Coho salmon	All	▼/◆	▼/◆								
	100-300									▲/■	▲/■
	> 260				▼/◆	▼/◆					
	≥ 300									▲/❖	▲/❖
Lake trout	All	▼/◆	▼/◆								
	100-180								▲	▲/■	▲/■
	180-220								▼/◆	▼/■	▼/■
	≥ 220								◆	◆	◆
	200-230				▼/◆	▼/◆	▼/◆	▼/◆			
	> 230				◆	◆	◆	◆			
	≤ 25			▼/◆							
	> 250			◆							
Rainbow trout/ steelhead	All	▼/◆	▼/◆								
	100-180									▲/▼	▲/▼
	≥ 180									▲/■	▲/■
Smelt	60-140									▲/▼	▲/▼
Sturgeon	≥ 300								◆	◆	◆
Walleye	140-180									▲/▼	▲/▼
	180-220								▲	▲/■	▲/■
	220-260					▼/■	▼/■	▼/■	▼/■	▼/■	▼/■
	≥ 260					▼/■	▼/■	▼/■	▼/■	▼/❖	▼/❖

Table C.2. State of Michigan fish consumption advisories for the Lake Michigan, south of Frankfort 1977-2001 (cont.)[a, b]

Species	Size	'77 to '81	'82 to '85	'86	'87 to 91	'92 to '94	'95	'96	'97[c]	'98	'99 to '01
Whitefish	All		▼/◆	▼/◆							
	60-180								▲	▲/▼	▲/■
	180-220								▲	▲/■	▲/■
	≥ 220								◆	◆	◆
	> 230					◆	◆	◆			
Yellow perch	All										
	60-80									▲/▼	▲
	80-220									▲/▼	▲/▼

◆ = No consumption.
❖ = Limit consumption to 6 meals (½ pound) per year.
■ = Limit consumption to 1 meal (½ pound) per month.
▼ = Limit consumption to 1 meal (½ pound) per week.
▲ = Unlimited consumption.

a. If there is only one symbol it is the advice for the whole population. When two symbols are shown, the first is the advice for the general population and the second is the advice for "children and women who are pregnant, nursing, or expect to bear children." From 1977 to 1983 children are not defined by age, from 1984 to 1987 the advice is for children age 6 and under, and from 1988 to 2000 the advice is for children age 15 and under.

b. Key contaminants/factors responsible for the advisory:

From 1982 to 1988 the contaminant of concern was not identified by waterbody or species in the advisory, instead a preamble said that listed "locations contained one or more chemicals at levels of public health concern." Potential contaminants listed were mercury, PCB, PPB, DDT, dieldrin, chlordane, toxaphene and dioxins. In 1992 the three contaminants listed for Lake Michigan were PCB, mercury and chlordane, they were not attributed by species. Attribution specific to years and species are listed below (the order in which the contaminants are listed indicates their relative contribution to the advisory).

- Chinook and coho salmon — the key contaminants listed were mercury and PCB from 1977 to 1981, and PCB from 1989 to 2000.
- Lake trout — the key contaminants listed were PCB and DDT from 1977 to 1981, PCB from 1989 to 1991, and 1993 to 1994, chlordane from 1995 to 1996 and PCB and chlordane from 1987 to 2000.
- Rainbow trout/steelhead — the key contaminant listed was PCB from 1977 to 1981 and 1989 to 2000.
- Brown trout, carp, and catfish — the key contaminant listed was PCB from 1989 to 2000.
- Walleye — the key contaminants listed were mercury from 1993 to 1997, PCB and mercury in 1998, and mercury, PCB, and dioxin from 1999 to 2000.
- Whitefish — the key contaminants listed were chlordane from 1993 to 1997, PCB and chlordane in 1998, and PCB, chlordane, and dioxin from 1999 to 2000.
- Smelt and yellow perch — the key contaminant listed was PCB from 1997 to 2000.
- Sturgeon — the key contaminants listed were PCB from 1997 to 1998 and PCB, chlordane, DDT, and dioxin from 1999 to 2000.

c. In 1997 EPA issued FCAs for the Michigan waters of Lake Michigan. These FCAs were more stringent, but were not used in our primary estimate of damages in that single year.

Table C.3. 1998 Wisconsin FCAs for Green Bay[a]

	One meal a week	One meal a month	One meal every 2 months	Do not eat
Brown trout		< 170	170-280	> 280
Carp				All sizes
Channel catfish				All sizes
Chinook salmon		< 300	> 300	
Northern pike	< 220	> 220		
Rainbow trout		All sizes		
Smallmouth bass		All sizes		
Walleye		< 170	170-260	> 260
White bass				All sizes
Whitefish			All sizes	
White sucker		All sizes		
Yellow perch	All sizes			

a. Including tributaries up to the first dam or barrier.

Source: Breffle et al., 1999.

Table C.4. State of Michigan fish consumption advisories for the St. Joseph River 1977-2000[a, b]

Species	Size	1977 to 1981[c]	1982 to 1988	1989 to 1996	1997	1998 to 2000
St. Joseph River below Berrien Springs						
Carp	All		◆	▼/◆	▼/◆	▼/◆
Smallmouth bass	140-300					▲/■
Walleye	≥ 140					▲/▼
St. Joseph River above Berrien Springs, Berrien County (including Chapin Lake)[d]						
Carp	All				▼/◆	▼/◆
Smallmouth bass	140-300					▲/■
St. Joseph River, St. Joseph County						
Walleye	≥ 140					▲/▼
Union Lake (St. Joseph River, Branch County)						
Carp	All					▲/▼
Catfish	All					▲/▼

◆ = No consumption.
■ = Limit consumption to 1 meal (½ pound) per month.
▼ = Limit consumption to 1 meal (½ pound) per week.
▲ = Unlimited consumption.

a. If there is only one symbol it is the advice for the whole population. When two symbols are shown, the first is the advice for the general population and the second is the advice for "children and women who are pregnant, nursing, or expect to bear children." From 1977 to 1983 children are not defined by age, from 1984 to 1987 the advice is for children age 6 and under, and from 1988 to 2000 the advice is for children age 15 and under.
b. PCB is the only substance identified as a key contaminant/factor responsible for the advisories for 1989 to 2000. From 1982 to 1988 the contaminant of concern was not identified by waterbody in the advisory, instead a preamble said that listed "locations contained one or more chemicals at levels of public health concern." Potential contaminants listed were mercury, PCB, PPB, DDT, dieldrin, chlordane, toxaphene, and dioxins.
c. St. Joseph river was not included in the advisory from 1977 to 1981.
d. Additionally, for Chapin Lake follow general advice for mercury (no more than one meal per week), since there has been no site-specific testing.

D. Recreational Angling Benefits of Improved Quality on Kalamazoo River, Michigan

Prepared by Frank Lupi, PhD, Michigan State University

Recreational Angling Benefits of Improved Quality on Kalamazoo River, Michigan

Frank Lupi, Ph.D.
Department of Agricultural Economics and
Department of Fisheries and Wildlife
Michigan State University
East Lansing MI 48823

August 2, 2002

This report summarizes a simulation of the effects of an increase in river quality for 74.05 miles of river in Kalamazoo and Allegan Counties, Michigan. The simulation is based on the Michigan Recreational Angling Demand Model, a large-scale application of the economic technique referred to as the travel cost method. The model was developed at Michigan State University with funding by the Michigan Department of Environmental Quality and Michigan Department of Natural Resources, as reported in Hoehn *et al* and Lupi *et al*. For brevity, I refer to the model as the "MSU model."

The MSU model is a type of travel cost model referred to as a repeated random utility model (RUM). RUMs use data on individual trips and statistical techniques to explain anglers' fishing site choices and relate these choices to the costs and characteristics of alternative fishing sites. It is through this linkage that RUMs can be used to value changes in site characteristics such as river quality. Since possible fishing destinations differ in their travel costs and characteristics, anglers must make a trade-offs between travel costs and site characteristics. The RUM approach assumes that anglers pick the site that they consider to be best. Anglers' choices reveal their relative preferences for site characteristics and travel costs, i.e., the anglers' willingness to trade costs (or money) for site characteristics. As a repeated RUM, the MSU model estimates seasonal participation as well as site choices.

The MSU model uses data describing where and how often anglers go fishing in Michigan that was collected in an extensive telephone panel survey that followed over 2,000 anglers during the course of the 1994-95 fishing year. The panel members were recruited from the general population of Michigan residents and interviewed using computer assisted telephone interviewing. The structure of the MSU model reflects the broad array of fishing opportunities available to the state's anglers. In the MSU repeated RUM, trips are differentiated by trip durations (single versus multiple day trips), by water body fished at (Great Lakes, inland lakes, rivers/streams), and by species targeted ("warm" species such as bass, perch and walleye, versus cold species such as salmon and trout). Thus, for both single and multiple day trip types, seven distinct fishing activities are separately classified in the MSU model: Great Lakes warm, Great Lakes cold, inland lake warm, inland lake cold, river and stream warm, river and stream cold, and river anadromous runs. For inland lake warm and cold fishing sites, destination sites are

defined at the county level. For Great Lakes warm and Great Lakes cold fishing types, destination sites are defined by the stretch of Great Lake shoreline within a county.

For river and stream fishing, fishing destinations are distinguished according to the three types of species that can be targeted on a fishing trip: warm species, non-anadromous cold species, and anadromous species. Anadromous run refers to Great Lakes trout and salmon on migratory runs up or down-stream. These species types constitute the three river and stream fishery types that enter the model. Destinations within the river and stream fishery types are defined as the counties in Michigan which contain river fishing opportunities for that species type. In the MSU model, fishing trips of the "river and stream warm" type are related to the number of miles of river within a county that are classified as top and as secondary quality. This variable and trip type will be affected by the simulations discussed below. Rivers miles classified as "top quality" support good self-sustaining stocks of desirable game fish. "Secondary quality" river miles contain populations of game fish, but game fish populations are appreciably limited by such factors as pollution, competition, or inadequate natural production.

In a repeated RUM such as the MSU model, the season is divided into a series of choice occasions. In each occasion, anglers decide whether to take a trip, and if so, where to fish. In all, the Michigan model contains over 850 distinct fishing opportunities in each choice occasion, and this set of opportunities is available for over 60 occasions for each sampled angler in the model. Moreover, the model contains about 80 parameters that were statistically estimated. While the entire statistical model is used in the simulations discussed below, it is worth noting that the key parameters in the simulation (travel costs and the river quality classifications) are all significantly different from zero at $p>0.011$ or higher.

Model Simulation

This section describes the policy simulation examined using the MSU model. In the river and stream warm-water fishing trip type, river quality improvements were simulated by changing the stream quality variables from second quality to top quality for 74.05 miles of the Kalamazoo River. Specifically,

- In the river and stream warm-water fishing trip type, 58.47 miles of river in Allegan County were changed from second quality to top quality.
- In the river and stream warm-water fishing trip type, 15.58 miles of river in Kalamazoo County were changed from second quality to top quality.
- No changes were made at any other counties.
- No changes were made in any of the six other fishing trip types (i.e., no changes in Great Lakes warm, Great Lakes cold, inland lakes warm, inland lakes cold, river/stream cold, or anadromous run).

Estimated total statewide use value to resident anglers for the April to October season for the specified warm river miles changing from second to top quality as estimated by the model simulation run is $368,351 per year in 1994 dollars. The U.S. Bureau of Labor Statistics' CPI calculator (http://www.bls.gov/cpi) yields a conversion factor of 1.2 to convert 1994 dollars into 2001 dollars. Thus, in 2001 dollars, the estimated value from the MSU model is $442,021.

Estimated trip changes: For the simulated change in warm-water river quality, the model predicts that the river and stream warm-water fishing in Allegan and Kalamazoo Counties increases by 50.9% for fishing trips and by 61.8% for user days. Table 1 presents these results as well as some more detailed information. The largest percentage increases are seen in Allegan County which includes Lake Allegan and which has 58.47 of the 74.05 warm-river miles that improve under the simulation scenario.

Table 1. MSU Model estimates of changes in river and stream warm-water fishing trips at Allegan and Kalamazoo Counties for the simulated increase in river quality.

	County	Change in river-warm trips
Single Day, River-Warm, Trips	**Allegan**	67.9%
	Kalamazoo	13.6%
Multiple Day, River-Warm, Trips	**Allegan**	142.7%
	Kalamazoo	26.4%
River-Warm User Days*	**Allegan**	90.9%
	Kalamazoo	16.9%
Total River-Warm Trips	**Allegan and Kalamazoo**	50.9%
Total River-Warm User Days*	**Allegan and Kalamazoo**	61.8%

* User days calculated by multiplying multiple day trips by 3.85, the average length of multiple day trip, and adding single day trips.

Scope of results:

The estimates reported in this report are for the anglers and season represented in the MSU model. The following points highlight some fishing trips and people that may have benefits that are outside the scope of the model:

- Model results apply to the period of April 1 through October 31. Thus, any trips outside this season are not included in the estimated annual values from the MSU model.
- Model results only apply to trips where the purpose was primarily for fishing.
- Model results do not apply to any fishing trips by non-residents of Michigan.
- Model results do not include anglers below the age of 18.
- The model can only estimate use-values associated with recreational angling.

Sources of uncertainty for simulation results:

There are many possible sources of uncertainty associated with using the MSU model to estimate natural resource damages at the Kalamazoo River. For one, the degree to which the simulated change in river quality reflects the damages at the Kalamazoo River affects the results. Simulated changes reported here only affect the river and stream warm fishing trip types – all other trip types that may experience a change in quality are not captured by these estimates. Another factor that may be a source of uncertainty is that the sites are defined at the county level and may not correspond perfectly with the affected river areas. In any such travel cost model, valuation results for specific sites are affected by the degree to which the model fits those sites – the estimated model may over or under-estimate actual warm-river fishing trips to the affected counties which will have a similar effect on the estimated values. A related issue is that the MSU model is based on fishing behavior from 1994 and current and future behavior patterns may shift. As is true with any travel cost model, variations in the measurement of travel cost and other variables will affect the estimated trip and value predictions.

References:

Hoehn, John P., Theodore Tomasi, Frank Lupi, and Heng Z. Chen, *An Economic Model for Valuing Recreational Angling Resources in Michigan*, Report submitted to the Michigan Department of Environmental Quality and Michigan Department of Natural Resources, Department of Agricultural Economics, Michigan State University, December 1996.

Lupi, Frank, John P. Hoehn, Heng Z. Chen and Theodore Tomasi, "The Michigan Recreational Angling Demand Model," *Agricultural Economics Staff Paper* 97-58, Department of Agricultural Economics, Michigan State University, January, 1998.

E. Focus Group Materials

E.1 Recruitment Screener

E.2 Example Recruitment Letter and Map

E.3 Handouts

- Handout A
- Handout B
- Handout C
- Handout D

E. Focus Group Materials

E.1 Recruitment Screener

My name is **[fill in]** and I am from Discovery Research Group. We are conducting a brief survey about natural resources and environmental issues in your area. This is not a marketing or sales call. The survey will only take a few minutes.

1. Are you 18 years of age or older? *(Circle one number)*
- **1** 18 or more years of age **-----> *Go to Q3***
- **2** Less than 18 years **-----> *Go to Q2***

2. Is there someone in your household I may speak to who is 18 years of age or older?
- **1** No **----->** *THANK AND TERMINATE*
- **2** Yes **-----> *Have that person put on the phone — Repeat above introductory information and continue***

The next questions ask whether you have participated in certain recreational activities since January 1st of this year. ***(emphasize)***

3. Since January 1, 2001, have you gone fishing?
- **1** Yes
- **2** No
- **3** Don't know

4. Have you gone boating, canoeing, kayaking, sailing, or rowing?
- **1** Yes
- **2** No
- **3** Don't know

5. Have you watched or photographed birds or wildlife?
- **1** Yes
- **2** No
- **3** Don't know

6. Have you picnicked, walked, or participated in other outdoor recreational activities?
- **1** Yes
- **2** No
- **3** Don't know

7. In this question, I'd like to get your opinion on some issues affecting Michigan and your area. I am going to read 10 actions that could be taken in your area. Tell me how important to you, if at all, each action is. Please use a 5-point scale where 1 is "Not at all important," 2 is "Slightly important," 3 is "Moderately important," 4 is "Very Important," and 5 is "Extremely important." How important to you is it to . . .

	Not at all important	Slightly important	Moderately important	Very important	Extremely important	Not sure	Most important
Make state and local government more efficient	1	2	3	4	5	9	A
Improve schools in your area	1	2	3	4	5	9	B
Preserve and restore wetlands in your area	1	2	3	4	5	9	C
Improve local roads and highways	1	2	3	4	5	9	D
Encourage economic growth and jobs in your area	1	2	3	4	5	9	E
Clean up PCBs and other toxics that threaten human health and wildlife in the Kalamazoo River valley	1	2	3	4	5	9	F
Encourage household recycling	1	2	3	4	5	9	G
Create more local hiking and biking trails	1	2	3	4	5	9	H
Reduce crime in your area	1	2	3	4	5	9	I
Increase local security against terrorism	1	2	3	4	5	9	J

[INTERVIEWER: CIRCLE ONE APPROPRIATE LETTER A-J IN THE LAST COLUMN ASSOCIATED WITH THE RESPONDENT'S HIGHEST NUMBER/MOST IMPORTANT ACTION FROM QUESTION 7. IF 2 OR MORE ACTIONS ARE TIED FOR MOST IMPORTANT ASK "Which of these actions is most important to you?" **— CIRCLE APPROPRIATE LETTER A-J]**

8. Do you, or does anyone in your household, work for the State of Michigan?

1 Yes, ***Which department?*** _____ ---> If Department of Natural Resources or Department of Environmental Quality, *TERMINATE AFTER Q15*

2 No

9. Do you, or does anyone in your household, work for industry?

1 Yes, ***Which company?*** _____ ---> If Georgia Pacific, Allied Paper, Plainwell, or Fort James, *TERMINATE AFTER Q15*

2 No

10. Do you, or does anyone in your household, work for an environmental advocacy organization? *TERMINATE AFTER Q15*

1 Yes
2 No

11. Which category best describes your age? *(Read list and circle the number that applies)*

1 18-25 years
2 26-45 years
3 46-65 years
4 66-75 years -----> | *NO MORE THAN 20% OF TOTAL RECRUITS FROM*
5 Over 75 years -----> | *THESE TWO CATEGORIES*

12. Which of the following categories best describes your total annual household income in 2000?

1 Under $24,999
2 $25,000-$49,999
3 $50,000-$99,999
4 $100,000 or more
88 Don't know
99 Refused/confidential

13. Including yourself, how many members in your household are in each age group? (*If none please write 0.*)

_____ Under 18 _____ 18 to 35 _____ 36 to 60 _____ Over 60

14. Last month, were you employed for pay or profit? (*Circle all that apply.*)

1 Yes Which category best describes your employment status?

1 Full time
2 Part time

2 No Which category best describes you?
1 Student
2 Retired
3 Homemaker
4 Looking for work
5 Other (please specify _____)

15. INTERVIEWER RECORD GENDER (Based on Voice):
1 Male
2 Female
3 Can't tell

IF Q8, Q9, OR Q10 IS "TERMINATE AFTER Q15," ***THANK AND TERMINATE***

RECRUITMENT

As part of this study, we are holding a small group discussion with people like you to get a better understanding of public preferences regarding a wide variety of programs to enhance the environment and natural resources in the Kalamazoo River valley. Because we realize your time is valuable, we are offering you $40 to thank you for coming and sharing your opinions with us. These discussions will be held at Western Michigan University on Wednesday November 7th and Thursday November 8th at 5:30 p.m. and 8:00 p.m.

16. The discussion will take 1 ½ to 2 hours. Would one of these dates and times work out for you?

1 **Yes----->** Which date and time?**:**_____ ***Go to Q17***

2 **No------>** Can we keep your name and phone number and call you for a similar future focus group?

Name: _____

Phone #: _____

THANK AND TERMINATE

17. We will send you a letter to remind you of the date, time, location of the discussion group, and directions on how to get to the facility. Could I get your name and address to send the materials?

Name: _____

Street: _____

City: _____

Zip code: _____

Daytime telephone: (____) _____-_____

Evening telephone: (____) _____-_____

Because informational packets will be passed out at the meeting, please remember to bring your glasses if you need them for reading. Since space is limited we ask that only one person from each household attend. Also, this facility does NOT have child care.

- ***5:30 group to be provided with sandwiches and beverages***
- ***8:00 group to be provided with a light snack and beverages***

Thank you. We look forward to meeting you.

Answers to Common Questions

Q: I'm too busy.
A: We understand your time is valuable. This survey takes less than 5 minutes to complete.

Q: Who is Discovery Research Group?
A: Discovery Research Group is a professional survey research firm hired to assist with this study.

Q: How did you get my name?
A: Your name was randomly selected from listed telephone numbers of people who live in Michigan.

Q: Who is sponsoring this study?
A: This study is being done for the State of Michigan.

Q: What agency in Michigan?
A: I don't know. We are a professional survey firm hired to implement the survey. To make sure we and respondents are not in any way influenced or biased, we have not been told any more about what agency or individual this project is for other than natural resources management and environmental policy planning.

Q: What are the results being used for?
A: For natural resource management and environmental policy planning in Michigan.

Q: Does this have anything to do with the Superfund business on the Kalamazoo River or actions against local paper companies? (or other similar questions)
A: The results will be used for natural resource management and environmental policy planning. I was not informed of any more specific purpose for the study.

Q: Do you really want to hear from me? I don't know much about natural resources or the environment in this area, or what should be done.
A: The survey does not require special knowledge. We just collect information about <u>your</u> opinions about natural resources and the environment. To obtain input representing <u>all</u> people in your area, it is important to have a sample that includes the opinions of people like you.

Q: Is this confidential? I don't want my information provided to someone else.
A: The information you provide will be used only to understand the views of people in your area. As a professional survey firm, we are committed to protecting your confidentiality to the maximum extent permitted by law.

Q: Why do you need my address?
A: Your address is only used to mail you a letter confirming the date and time of your group and to send you information on where the meeting room is and how to get there. Your address will not be used for, or given to, anyone for any marketing or sales purposes.

Q: Where is Western Michigan University?
A: Western Michigan University is in Kalamazoo. We will send you a map and directions in a reminder letter.

If respondent is not satisfied with these answers, please say "That is all the information I have about this study. If you need more information I can arrange to have you speak to one of my supervisors."

E. Focus Group Materials

E.2 Example Recruitment Letter and Map

[**DATE**], 2001

Dear [**NAME**],

Thank you for agreeing to come to our focus group. Your participation in this study is very important. You are one of a small number of people from your area who have been invited to participate, and we are counting on your attendance.

The interview will take place at Western Michigan University, Haworth College of Business, Schneider Hall. The group will be on **Thursday, November 8** at 5:30 p.m. The session will last approximately 2 hours. Please arrive 5 to 10 minutes early. We know your time is valuable and are offering you $40 for your help.

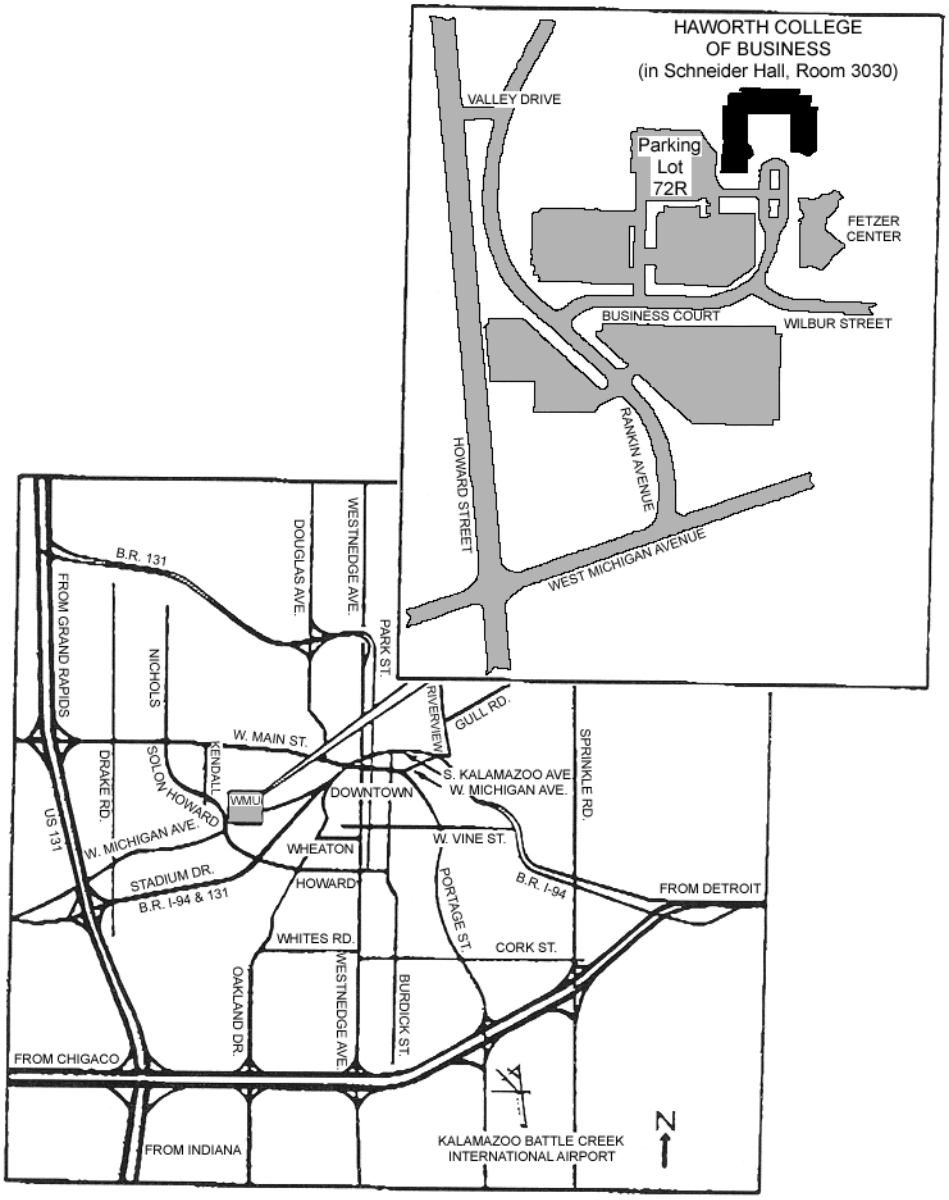
Space in our meeting room is limited and child care is not available. Therefore we request that only the designated person from your household come to the interview session. In addition to the interview, we will be asking your reactions to some written materials. Therefore, if you need glasses for reading, be sure to bring them with you.

Sandwiches and beverages will be provided.

Enclosed is a map with directions to the Western Michigan University — Haworth College of Business. Your group will meet in Schneider Hall. Once inside Schneider Hall, go up a flight of stairs. Immediately on your left is room 3020, which you need to go through to get to Room 3030. The focus group will take place in Room 3030. Signs will be placed to help you find the room. **Please be sure to hang the enclosed parking pass on your rearview mirror when you park for your group**. If you have any questions regarding these directions or the study, please call [**DRG CONTACT**]. Thank you in advance for your participation in this important study.

Sincerely,

[DRG CONTACT]



Western Michigan University
Haworth College of Business

Directions:

From I-94 Detroit (East) and Chicago (West): At Exit #75, turn north onto Oakland Drive, drive 2.7 miles; turn left onto Howard Street, go 1.1 miles; turn right onto West Michigan Avenue. Turn left at the second street, Rankin Avenue, then turn right onto Business Court. Turn left at the first street and drive straight into the Haworth College of Business parking area, Lot 72R.

From US 131 (North) Grand Rapids, Muskegon: At Exit #36A, turn east onto Stadium Drive, drive 2.2 miles to Howard Street, turn left and go 0.6 miles; turn right onto West Michigan Avenue. Turn left at the second street, Rankin Avenue, then right onto Business Court. Turn left at the first street and drive straight into the Haworth College of Business parking area, Lot 72R.

From M-43 North of Kalamazoo: Follow westbound M-43 through downtown Kalamazoo (Gull Road — Riverview Avenue — East Michigan Avenue — Kalamazoo Avenue — West Main Street) until reaching Solon Street (the fourth traffic light after Kalamazoo Avenue merges with West Main Street and becomes two-way traffic, near Kalamazoo College). Turn left onto Solon and drive south 0.5 miles where Solon turns into Howard Street. At the light turn left onto West Michigan Avenue. Turn left at the second street, Rankin Avenue, then right onto Business Court. Turn left at the first street and drive straight into the Haworth College of Business parking area, Lot 72R.

From M-43 West of Kalamazoo: Drive easterly past US 131 and after 1.9 miles, turn right on Solon Avenue and drive south 0.5 miles where Solon turns into Howard Street. At the light turn left onto West Michigan Avenue. Turn left at the second street, Rankin Avenue, then right onto Business Court. Turn left at the first street and drive straight into the Haworth College of Business parking area, Lot 72R.

From Downtown Kalamazoo: Drive westerly on Stadium Drive (Business Route 131). At Howard Street turn right and drive 0.6 miles; at the light turn right onto West Michigan Avenue. Turn left at the second street, Rankin Avenue, then right onto Business Court. Turn left at the first street and drive straight into the Haworth College of Business parking area, Lot 72R.

E. Focus Group Materials

E.3 Handouts

- Handout A
- Handout B
- Handout C
- Handout D

First name: _____

INTRODUCTION

Please list three or four of the most important environmental issues in your area.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

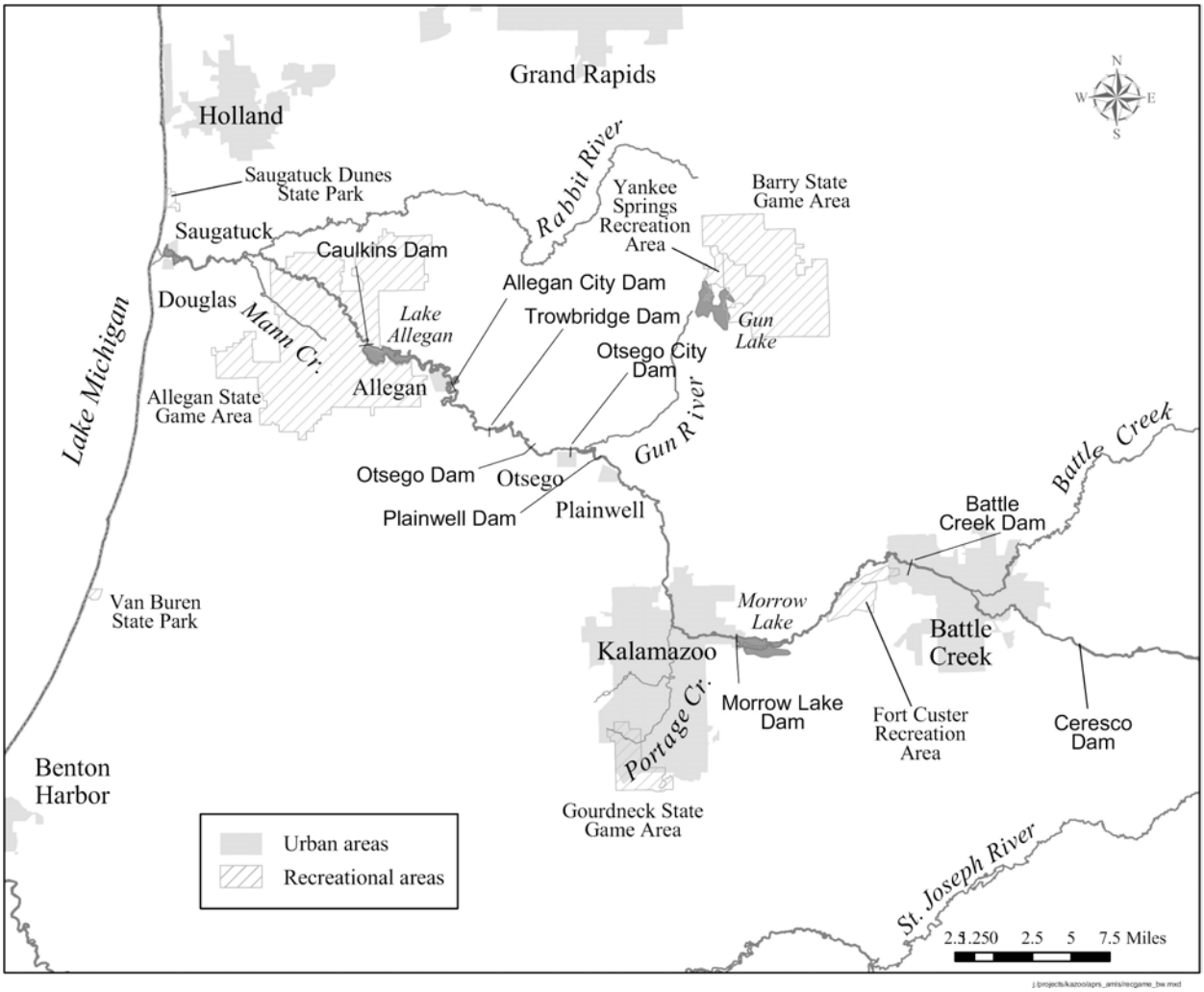
_____

(Please Wait for Further Instructions to Continue.)

First name: _____

THE KALAMAZOO RIVER AND ITS MANAGEMENT

In this focus group we want to learn more about your interest in and experiences with natural resources in and along the Kalamazoo River from Battle Creek to Lake Michigan, and to hear your opinions about options to improve these natural resources. When we refer to the Kalamazoo River, we mean the river itself and the lands near the river, including the shoreline, wetlands, and other natural areas near the river.



B1 **How familiar are you with the following sections of the river? (See map)**
(Circle one for each item.)

	Not at all familiar	Somewhat familiar	Very familiar
Upstream of Battle Creek	1	2	3
Battle Creek to Morrow Lake Dam	1	2	3
Morrow Lake Dam to Caulkins Dam (Lake Allegan Dam)	1	2	3
Caulkins Dam to Lake Michigan	1	2	3

B2 **On average, over the past 5 years, how often have you personally done each of the following activities in or near the Kalamazoo River?**
(Circle one for each item.)

	Never	Occasionally (less than once a year)	Sometimes (1-10 times a year)	Frequently (11-20 times a year)	Very frequently (20 or more times a year)
Fishing from shore or a boat	1	2	3	4	5
Eating fish from the river	1	2	3	4	5
Motor boating	1	2	3	4	5
Canoeing, kayaking, sailing, or rowing	1	2	3	4	5
Watching birds or wildlife	1	2	3	4	5
Walking, biking, or jogging	1	2	3	4	5
Picnicking in a park along the river	1	2	3	4	5
Stopping to enjoy a view along the river	1	2	3	4	5
Swimming in the river	1	2	3	4	5
Reading about or looking at pictures of the river or the surrounding natural area	1	2	3	4	5

B3 **What actions, if any, do you think are most important to improve the recreational opportunities in or near the Kalamazoo River?**

_____

_____

_____

_____

_____

_____

B4 **What actions, if any, do you think are most important to improve the natural resources in or near the Kalamazoo River?**

_____

_____

_____

_____

_____

_____

B5 **Below are a list of potential issues regarding the Kalamazoo River natural resources. How aware, if at all, are you with the following issues?**
(Circle one for each item.)

	Not at all aware	A little aware	Very aware
Dams and other barriers to fish migration	1	2	3
Limited shore access and facilities for public recreational use	1	2	3
Potential effects of PCBs and other toxic contaminants on people who eat fish from the river	1	2	3
Risks to fish and wildlife from PCBs and other toxic contaminants in the river	1	2	3
Effects of municipal and agricultural runoff on water quality (clarity, odor, and safety for human contact)	1	2	3
Losses of fish and wildlife habitat (such as wetlands) near the river	1	2	3
Trash and other debris in the water and on the shorelines	1	2	3
Shoreline erosion	1	2	3

What other issues regarding the Kalamazoo River natural resources are you aware of?

_____

_____

_____

B6 **Please rate how strongly you disagree or agree with the following statements.**
(Circle one for each item.)

	Strongly disagree	Somewhat disagree	Neither disagree nor agree	Somewhat agree	Strongly agree
Cost should be an important consideration in choosing how much to clean up and restore the natural resources in and near the Kalamazoo River	**1**	**2**	**3**	**4**	**5**
Sometimes economic development is more important than protecting natural resources	**1**	**2**	**3**	**4**	**5**
I want the natural resources in and near the Kalamazoo River protected and preserved for: ***(see below)***					
a) My family and me to use and enjoy now	**1**	**2**	**3**	**4**	**5**
b) My children and grandchildren to be able to use and enjoy	**1**	**2**	**3**	**4**	**5**
c) Future generations to use and enjoy	**1**	**2**	**3**	**4**	**5**
d) The benefit of nature, even if nobody uses the natural resources	**1**	**2**	**3**	**4**	**5**

First name: _____

KALAMAZOO RIVER ACTIONS

We are going to discuss various natural resource topics for the Kalamazoo River:

- Outdoor recreational areas
- Wetlands and other natural areas
- PCBs (polychlorinated biphenyls)
- Dams and other barriers to fish migration and boating
- Runoff from cities and farmlands

This handout will briefly introduce each of these topics and ask a few questions for later discussions.

A number of issues related to these topics exist, and actions to address these issues cannot all be done at once. We want to gain input from the public about what actions you feel are most important.

(Please Turn to the Next Page and Continue.)

OUTDOOR RECREATIONAL AREAS

Several state parks, county parks, city parks, game areas, and recreation areas are located near the Kalamazoo River.

- These parks include a variety of facilities such as picnic grounds, campgrounds, scenic overlooks, piers, boat ramps, and biking and hiking trails.
- To meet the current and future recreational needs of area residents, programs have been proposed to (1) add facilities or acreage at existing parks and (2) to open new parks and river access.

C1 **Before today, how much, if at all, have you seen, heard of, or read about the need to add facilities or acreage at existing parks or to open new parks and access?** (*Circle the number of your answer.*)

Not at all	Very little	Some	Very much	Don't know
1	2	3	4	8

C2 **How important, if at all, is it to you to increase recreational opportunities along the Kalamazoo River?** (*Circle the number of your answer.*)

Not at all important	Slightly important	Moderately important	Very important	Extremely important	Don't know
1	2	3	4	5	8

C3 **Would you be likely to participate more often in outdoor recreational activities if these improvements were made?** (*Circle the number of your answer.*)

1 Go more often

2 Go about the same, but enjoy it more

3 Not sure

C4 **Please provide any brief comments about the types of recreational improvements you would prefer, and the stretches of river that would most benefit from improvements.**

_____

_____

WETLANDS AND OTHER NATURAL AREAS

Wetlands and other natural areas in and around the Kalamazoo River are important to fish and wildlife. Wetlands provide spawning and nursery habitats for fish of the Kalamazoo River. Wetlands and other natural areas also provide habitats and food for many bird species, including song birds, ducks, geese, and eagles. Other wildlife such as deer, muskrat, and mink also use natural areas for habitat. Wetlands support many plant species that cannot grow in other areas, and they can reduce flooding and improve water quality.

C5 **Before today, how much, if at all, have you seen, heard of, or read about the loss of wetlands and natural areas around the Kalamazoo River due to farming and land development?**
(*Circle the number of your answer.*)

Not at all	Very little	Some	Very much	Don't know
1	2	3	4	8

C6 **Protecting and increasing wetlands and other natural areas would support nearly proportional increases in the populations of the plants, birds, and fish species associated with those habitats. 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, if at all, is it to you to acquire, preserve, and restore wetlands and other wildlife habitat near the Kalamazoo River? (*Circle the number of your answer.*)

Not at all important	Slightly important	Moderately important	Very important	Extremely important	Don't know
1	2	3	4	5	8

PCBs

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

- PCBs released into the Kalamazoo River have accumulated in the sediments, banks, and floodplains of the river in and downstream of the city of Kalamazoo. Some PCBs have been carried by the river into Lake Michigan.
- PCBs remain in the environment for a long time. They get into fish, birds, and other wildlife through the food chain.

C7 **Before today, how much, if at all, have you seen, heard of, or read about PCBs and their impacts in the Kalamazoo River?** (*Circle the number of your answer.*)

Not at all	Very Little	Some	Very much	Don't know
1	2	3	4	8

C8 Because of PCBs, the State of Michigan has issued consumption advisories for all fish in the Kalamazoo River (including all tributaries up to the first dam) below Morrow Lake Dam. The fish consumption advisories recommend how often a meal of fish may be safely eaten. Eating more fish than is recommended may increase a woman's risk of bearing children with learning disabilities and slow development. Eating fish in excess of recommended amounts also increases the risk of cancer. The advisories recommend:

- Between Morrow Lake Dam and Caulkins Dam (Lake Allegan Dam):
  - *For women of childbearing age and children under 16*: no consumption of any fish.
  - *For all others*: (1) no consumption of any bass, carp, or catfish; and (2) no more than one meal per week of all other species.
- Between Caulkins Dam and Lake Michigan:
  - *For women of childbearing age and children under 16*: (1) no consumption of any bass, carp, catfish, or northern pike; and (2) no more than one meal per month of all other species.
  - *For all others*: (1) no consumption of carp, catfish, and large pike; (2) eat no more than one meal per week of large bass; and (3) no advisory for all other species.

Before today, how much, if at all, have you seen, heard, or read about fish consumption advisories in the Kalamazoo River? (*Circle the number of your answer.*)

Not at all	Very little	Some	Very much	Don't know
1	2	3	4	8

C9 PCBs can cause harm to fish and wildlife in and near the Kalamazoo River. Some fish may develop cancerous liver tumors, and birds and sensitive wildlife such as mink may have increased reproductive failure.

Even though PCBs harm wildlife, it may be the case that PCBs have not caused a decrease in the total number of fish, birds, and other wildlife that inhabit the area. This is because the PCB effects may not be severe enough to cause population reductions, because wildlife can migrate into and out of the area, and because other factors influence wildlife populations.

How important, if at all, is it to you that PCBs be removed to avoid potential harm to birds, fish, and other wildlife? (*Circle the number of your answer.*)

Not at all important	Slightly important	Moderately important	Very important	Extremely important	Don't know
1	2	3	4	5	8

C10 How long fish consumption advisories and risks to fish, birds, and other wildlife in the Kalamazoo River environment will continue depends on how much cleanup is done. If nothing is done, the effects of PCBs may last for as long as 100 years, or even longer. PCB cleanup can shorten the time required for PCBs to be at levels safe for humans, fish, and wildlife.

How bothered, if at all, would you be if you learned that the effects of PCBs would last for: *(Circle the number of your answer for each item.)*

	Not at all bothered	A little bothered	Somewhat bothered	Very bothered	Extremely bothered	Don't know
20 more years	1	2	3	4	5	8
100 more years	1	2	3	4	5	8

DAMS AND OTHER BARRIERS TO FISH MIGRATION AND BOATING

The top portions of three dams, Plainwell, Otsego, and Trowbridge, have been torn down to sill level, which means only the bases of the dams remain with water flowing over them. However, even the remains of these three dams continue to act as barriers to fish and boaters. Removal of the rest of these partial dams has been proposed. This would enhance fish habitat and migration between the cities of Plainwell and Allegan. It would also allow boaters to move up and down the river more freely.

C11 **Before today, how much, if at all, have you seen, heard of, or read about these dams and impacts?** (*Circle the number of your answer.*)

Not at all	Very little	Some	Very much	Don't know
1	2	3	4	8

C12 **How important, if at all, is it to you that the rest of the three partial dams be completely removed?** (*Circle the number of your answer.*)

Not at all important	Slightly important	Moderately important	Very important	Extremely important	Don't know
1	2	3	4	5	8

C13 Opening a fish ladder at Caulkins Dam (Lake Allegan Dam) has been proposed. This would allow trout and salmon from the Great Lakes to migrate upstream to Lake Allegan, enhancing recreational opportunities. Other things could also be done to enhance fish migration. For example, culverts under roads could be modified to allow northern pike to have easier access to tributaries.

How important, if at all, is it to you for trout, salmon, and pike to have a greater ability to migrate by opening a fish ladder and other means?
(*Circle the number of your answer.*)

Not at all important	Slightly important	Moderately important	Very important	Extremely important	Don't know
1	2	3	4	5	8

RUNOFF FROM CITIES AND FARMLAND

Runoff from farms, highways, construction sites, and residential and urban neighborhoods carries sediments, animal waste, fertilizers, and pesticides into the Kalamazoo River and its tributaries.

- Runoff reduces water clarity, which makes the water look less appealing and also reduces the light that reaches underwater plants, thus reducing aquatic habitat.
- Runoff chemicals stimulate algae growth that can look and smell bad.
- Populations of sport fish such as smallmouth bass may be smaller and carp populations may be larger than they would be otherwise.
- Runoff pollution can be reduced by decreasing erosion; controlling farm, urban, and residential wastes; fencing livestock away from streams; paving and regrading rural roads; and other measures.
- Runoff is **not** a significant source of PCBs in the Kalamazoo River and does not affect the quality of your drinking water.

C14 **Before today, how much, if at all, have you seen, heard of, or read about water pollution from runoff and its impacts?** (*Circle the number of your answer.*)

Not at all	Very little	Some	Very much	Don't know
1	2	3	4	8

C15 **How important, if at all, is it to you to control runoff in order to improve water clarity in the Kalamazoo River and reduce excess algae?**
(*Circle the number of your answer.*)

Not at all important	Slightly important	Moderately important	Very important	Extremely important	Don't know
1	2	3	4	5	8

SUMMARY

C16 **Not all actions can be done at once. Based on what you know so far, how would you rank these five programs from least important to most important:**
1 = least important, 5 = most important

Recreational park enhancement …… _____

Wetlands and habitat enhancement…_____

PCB removal……..._____

Dam removal……. _____

Runoff control……... _____

First name: _____

FUNDING KALAMAZOO RIVER ACTIONS

D1 **If money were available, actions could be taken to improve the Kalamazoo River resources. However, there will never be enough money to do everything. Please tell us how high a priority should be placed on each of the following actions. If you want to include other actions, you may do so under "other" at the end of the question.**

	Very low priority	Low priority	High priority	Very high priority	Don't know
Increase the numbers of fish, wildlife, and native plants	**1**	**2**	**3**	**4**	**8**
Increase the amount of natural habitat near the river	**1**	**2**	**3**	**4**	**8**
Reduce pollution and shoreline trash to improve the aesthetic quality of the river (e.g., odor, water clarity, visible garbage)	**1**	**2**	**3**	**4**	**8**
Protect fish, birds, and wildlife from being harmed by pollution (including PCBs), even if the number of fish, birds, and wildlife is not increased	**1**	**2**	**3**	**4**	**8**
Remove PCBs so fish consumption advisories could be lifted	**1**	**2**	**3**	**4**	**8**
Increase and improve recreational access points and park facilities along the river	**1**	**2**	**3**	**4**	**8**
Enhance the state recreational and game areas near the river	**1**	**2**	**3**	**4**	**8**
Reduce barriers to fish migration and boating	**1**	**2**	**3**	**4**	**8**
Support research and educational programs about the river ecosystem	**1**	**2**	**3**	**4**	**8**
Other (*Specify*)_____ _____	**1**	**2**	**3**	**4**	**8**
Other (*Specify*)_____ _____	**1**	**2**	**3**	**4**	**8**

F. The Kalamazoo River NRDA Property Appraisal Analysis

Prepared by Ritter Appraisals, Inc.

RITTER APPRAISALS, INC.

Real Estate Appraisers

Lawrence E. Ritter, SRA
Steven L. Ritter, MAI

2118 Royal Street
Harrisonville, MO 64701

STRA JS
MAR 22 2002
Received
CONSULTING

September 21, 2001

Dr. William Breffle
Stratus Consulting
P.O. Box 4059
1881 Ninth Street, Suite 201
Boulder, Colorado 80302

RE: Kalamazoo Project - Summary of the results of a preliminary market study of the impact of paper waste contaminants in the Kalamazoo River on property values along the Kalamazoo River basin.

Dear Dr. Breffle:

As per our discussion and agreement, I have completed a preliminary market study of the impact of contaminants in the Kalamazoo River on property values along the Kalamazoo River basin. This report is intended to comply with Standard 4 and Standard 5 (Real Property Appraisal Consulting) of the Uniform Standards for Professional Appraisal Practice (USPAP). Please note, a certification for this market study is attached to this letter. Following is a summary of the study.

INTENDED USER AND USE OF THE STUDY

The intended users and clients of this report are Dr. William Breffle, Stratus Consulting, United States Department of the Interior Fish and Wildlife Service, and the State of Michigan. Use of this report by any other party is prohibited.

The intended use of this report is for the sole purpose of determining if there is any anecdotal evidence that property values, particularly residential property values, along the Kalamazoo River have been adversely affected by the known paper waste contamination contained therein. Any other use of this report is prohibited.

PURPOSE OF THE STUDY

The purpose of the market study is to determine if sufficient anecdotal evidence exists to warrant a future, more intensive market study of the impact of paper waste contamination in the Kalamazoo River on property values, particularly residential property values, along the Kalamazoo River.

MARKET VALUE DEFINITION

"Value" as referred to in this report is synonymous with "Market Value." Market value is defined as follows:

E-mail: steven@ritterappraisals.com
Web Site: www.ritterappraisals.com

Telephone: 816-380-5158
Fax: 816-380-6949

Market value is the amount in cash, or on terms reasonably equivalent to cash, for which in all probability the property would have sold on the effective date of the appraisal [market study], after a reasonable exposure time on the open competitive market, from a willing and reasonably knowledgeable seller to a willing and reasonably knowledgeable buyer, with neither acting under any compulsion to buy or sell, giving due consideration to all available economic uses of the property at the time of the appraisal [market study]. (Uniform Appraisal Standards for Federal Land Acquisitions, 2000, Page 17)

SUBJECT OF THE STUDY

The property type that is the focus of this market study is real property adjacent to the Kalamazoo River, particularly residential real property, in the Kalamazoo River basin from the city of Kalamazoo to its confluence at Lake Michigan (an approximate distance of 80 miles).

EFFECTIVE DATE OF THE STUDY

The effective date of this market study is September 21, 2001, which is also the date of this report. Fieldwork for the study was conducted on September 18, 2001 through September 21, 2001.

SCOPE OF WORK

As requested by the client, this report is a preliminary market study and limited in scope. The opinions described in this report are not intended to be conclusive and the reader is warned that the reliability of this report may be impacted by its limited nature.

Preliminary data collection for the study involved gathering and reviewing demographic data for the region and information specifically regarding the contamination in the Kalamazoo River. Sources of demographic data include but are not limited to Census Data, Kalamazoo County, Allegan County, city of Kalamazoo, Greater Kalamazoo Association of Realtors, etc. Sources for information regarding contamination and a history of the contamination include but are not limited to Stratus Consulting, United States Environmental Protection Agency (EPA), Michigan Department of Environmental Quality (MDEQ), Kalamazoo Gazette, Kalamazoo River Watershed Public Advisory Council, etc.

The next step in the study was to conduct an on-site inspection of the area and the subject of the study, the Kalamazoo River. Due to the large area of the subject, inspection of the river was completed by a charter flight of the river beginning at Marshall and flying west/northwesterly to Lake Michigan. Other areas inspected during the flight were Gull Lake, the Lake Michigan shoreline from Holland to St. Joseph, the St. Joseph River basin from St. Joseph to Three Rivers, and Portage Creek from Portage to its confluence at the Kalamazoo River. Additional inspections of the Kalamazoo River basin were made from the ground where public roads intersect the river. Ground inspections were made in Kalamazoo, Plainwell, Otsego, Allegan, and Lake Allegan. As part of the property inspection, the consultant also considered development trends and land uses along the Kalamazoo River and other areas inspected.

Data research was qualitative in nature and primarily focused on interviews with persons familiar with the local market. Sources of data include but are not limited to area realtors, real estate appraisers, county equalization staff, city and county planners, officials with MDEQ, homeowners association officers, etc. Approximately 20 individuals having one of the above occupations were interviewed.

A limited amount of quantitative data was gathered from the local Multiple Listing Service (MLS). Quantitative data focused on residential lot sales around Lake Allegan and other similar, comparable lakes in Kalamazoo County and Allegan County because lake lot sales data had the greatest availability and the least amount of variables that impact value.

RESULT OF THE STUDY

Inspection of the Kalamazoo River by flight from Marshall to its confluence at Lake Michigan revealed typical land use patterns and development trends as would be expected along a stream or river. The land uses upstream from the city of Kalamazoo are similar to the land uses downstream from the city of Kalamazoo. Urban core areas typically contain commercial and industrial land uses. The outlying urban areas contain some residential development and the land between urban areas is typically a mixture of agricultural land and recreational land (wildlife refuges) with scattered farmsteads and rural homesites appearing adjacent to the river.

Development patterns along the St. Joseph River were found to be similar. However, the consultant did note a significantly greater amount of residential development along the St. Joseph River compared to the Kalamazoo River. The urban areas along the St. Joseph River contain a significantly larger amount of residential development. This is believed to be due to two factors.

First, the St. Joseph River is significantly larger than the Kalamazoo River. The areas of the St. Joseph River that contain more intensive residential development are large enough to accommodate recreational boating and water sports such as water skiing. The majority of the Kalamazoo River is a narrow shallow channel and limited to canoeing only. Those areas of the St. Joseph River with a narrow shallow channel contain limited residential development. In addition, those areas of the Kalamazoo River capable of supporting recreational boating, such as Lake Allegan and areas near Saugatuck, contain comparable residential development.

Second, the St. Joseph River is within closer proximity to Chicago. Many of the buyers for property along the St. Joseph River are from Chicago searching for a weekend cabin or second home. As the St. Joseph River is closer to Chicago, a major metropolitan area, it would be expected to have superior demand and more intensive development.

Inspection of the subject from ground and air, for the most part, revealed a scenic setting and the consultant noted no visible evidence of contamination. Vegetation is green along the river and the water is clear. As view is an important component of any residential property, the views along the river are aesthetically pleasing and rated good.

Most individuals interviewed about the river were skeptical that a measurable negative impact on property values along the Kalamazoo River could be found.

In fact, many individuals had strong opinions that there was not a negative impact on property values along the river. Common reasons why they would not expect a negative effect on property values as a result of the contamination include the following:

1. Demand for waterfront property has been very strong in recent years. Any property that contains some type of water frontage typically sells at a premium.

2. There is a limited amount of land available for improvements along the river. Much of the unimproved land adjacent to the river is either in the floodplain of the river or government owned as a wildlife refuge. Therefore, upland adjacent to the river that is privately owned is of a very limited supply.

3. The Kalamazoo River is no longer visibly contaminated. It offers a scenic view and as the pollution cannot be visibly seen at present, there is less of a perceived risk. Prior to the 1970s, the river was visibly polluted. However, currently there are few to no visible signs of pollution. Therefore, as the appearance of the river has greatly improved, people perceive the water quality as having greatly improved.

4. Many buyers of waterfront property are from the Chicago area and may be unaware of any contamination hazard.

5. Lake Allegan is a 1,500+ acre lake and will accommodate recreational boating. There is a limited supply of large lakes in the area.

Realtors interviewed indicated that they had lost sales along the river after potential buyers found out about the contamination or fish advisory, but indicated that the marketing times for riverfront property were typical and riverfront property sells at a premium. The consultant collected MLS sale data on 44 improved residential sales having frontage on the Kalamazoo River. The sales contain an average marketing time of 82 days with the overall range being 1 day to 201 days. This is a typical expected marketing time for property in the subject area. Nearly all of the sales were advertised emphasizing the riverfront amenity.

One realtor indicated lots fronting Lake Allegan with access to the lake typically sell in the $40,000 to $70,000 price range and second tier lots sell in the $20,000 price range. This relationship indicates a distinct advantage for waterfront property in the Kalamazoo River basin.

In the last few years, there have been three new residential developments on Lake Allegan that have been successful. The new plats containing lakefront lots sell out fairly quickly. Wildwood Shores is one of the recent plats and sold out of lakefront lots in approximately two years. Home prices are also fairly strong along the lake. One realtor noted that there are some $300,000 to $400,000 homes being built along Lake Allegan with typical lakefront improved homes being in the $200,000+ price range. According to the Greater Kalamazoo Association of Realtors, out of 4,125 residential sales scattered throughout the area, the average sale price was $127,282 per residential unit and the median sale price was $111,750 per residential unit.

In addition to the interviews summarized above, the consultant gathered MLS data on Lake Allegan lot sales and other lakes in the area not affected by the Kalamazoo River pollution. The consultant selected lake lot sales because data was readily available through MLS and because there are less characteristics that could influence value other than contamination. Following is a summary of the lot sale data.

Lake Lot Sale Summary

MLS #	Body of Water	Date	DOM	Lot Area	WtrFrnt	Sale Price	Price/SF	Price/FF
9915253	Lake Allegan	09/99	81	27,286′	113′	$51,000	$1.87	$451
9905465	Lake Allegan	04/99	1	42,844′	86′	52,500	1.23	610
9812442	Lake Allegan	01/99	224	47,633′	134′	62,900	1.32	469
2005943	Lake Allegan	07/00	93	24,000′	120′	58,500	2.44	488
2029266	Lake Allegan	12/00	6	18,383′	111′	55,000	2.99	496
9907279	Lake Allegan	04/99	5	52,404′	135′	55,000	1.05	407
9920289	Lake Allegan	07/99	1	9,000′	60′	33,500	3.72	558
2023093	Lake Allegan	10/00	12	12,000′	60′	33,500	2.79	558
9831920	Lake Allegan	01/99	18	12,000′	60′	33,500	2.79	558
2103610	Lake Allegan	06/01	42	12,845′	72′	38,000	2.96	528
9907328	Lake Allegan	09/99	172	26,358′	74′	42,500	1.61	574
9913116	Lake Allegan	07/99	15	13,718′	100′	45,000	3.28	450
2015035	Lake Allegan	06/00	12	26,992′	112′	48,000	1.78	429
9917059	Lake Allegan	08/99	1	40,976′	126′	49,900	1.22	396
14 Sale Average.....			**49**	**26,174′**	**97′**	**$47,057**	**$2.22**	**$498**
2019268	Upper Scott	06/01	337	53,235′	105′	$22,000	$0.41	$210
2107682	Upper Scott	05/01	44	120,560′	110′	29,900	0.25	272
2111756	Minkler Lake	06/01	30	87,120′	225′	69,900	0.80	311
2012757	Scott Lake	06/01	89	5,000′	50′	30,000	6.00	600
2109130	Miner Lake	05/01	25	87,120′	300′	200,000	2.30	667
9914145	Hutchins Lake	12/00	495	313,632′	189′	140,000	0.45	741
9905968	Wetmore Lake	02/00	324	27,600′	120′	43,000	1.56	358
7 Sale Average.....			**192**	**99,181′**	**157′**	**$76,400**	**$1.68**	**$451**

Among the data above, there appears to be the most correlation between sale price and water feet of water frontage. The sale price per waterfront foot provides a fairly consistent range in indicated values. The average sale price per waterfront foot for Lake Allegan lots was $498. The average sale price per waterfront foot for other area lakes was $451. Therefore, the data suggests that there are no adverse conditions affecting the value of the Lake Allegan properties.

CONCLUSIONS

Based on the data gathered during this limited scope market study, it appears unlikely that an adverse impact on property values along the Kalamazoo River basin could be measured. Therefore, a more in-depth market study is not warranted.

Thank you for the opportunity to be of service to you. If you have any additional questions on the matter, please call me.

Sincerely,

Steven L. Ritter

STATE OF MISSOURI
STEVEN LAWRENCE RITTER
No. RA 002684
GENERAL
CERTIFIED REAL ESTATE APPRAISER

CERTIFICATION

I certify that, to the best of my knowledge and belief:

- the statements of fact contained in this report are true and correct.
- the reported analyses, opinions, and conclusions are limited only by the reported assumptions and limiting conditions, and are my personal, impartial, and unbiased professional analyses, opinions, conclusions, and recommendations.
- I have no present or prospective interest in the property that is the subject of this report, and I have no personal interest with respect to the parties involved.
- I have no bias with respect to any property that is the subject of this report or to the parties involved with this assignment.
- my engagement in this assignment was not contingent upon developing or reporting predetermined results.
- my compensation for completing this assignment is not contingent upon the development or reporting of a predetermined value or direction in value that favors the cause of the client, the amount of the value opinion, the attainment of a stipulated result, or the occurrence of a subsequent event directly related to the intended use of this appraisal.
- my analysis, opinions, and conclusions were developed, and this report has been prepared, in conformity with the Uniform Standards of Professional Appraisal Practice.
- I have made a personal inspection of the property that is the subject of this report.
- no one provided significant real property appraisal or appraisal consulting assistance to the person signing this certification.
- the reported analyses, opinions, and conclusions were developed, and this report has been prepared, in conformity with the requirements of the Code of Professional Ethics and the Standards of Professional Appraisal Practice of the Appraisal Institute. As of the effective date of this report, I have completed the requirements of the continuing education program of the Appraisal Institute.
- the use of this report is subject to the requirements of the Appraisal Institute relating to review by its duly authorized representatives.

Consultant	September 21, 2001 **Date of Value Estimate**