Wisconsin Department of Natural Resources
101 South Webster Street
Madison, Wisconsin 53707

Northeast Regional Headquarters
1125 North Military Avenue
Green Bay, Wisconsin 54307

United States Environmental Protection Agency
Region 5
77 West Jackson Blvd.
Chicago, IL 60604

Record of Decision
Operable Units 3, 4, and 5
Lower Fox River and Green Bay, Wisconsin

Record of Decision
Responsiveness Summary

June 2003

Record of Decision
Operable Units 3, 4, and 5

Lower Fox River and Green Bay Site
Wisconsin

June 2003

SUPERFUND RECORD OF DECISION (ROD)
for Operable Units 3, 4, and 5
Wisconsin DNR and U.S. EPA
Lower Fox River and Green Bay
Brown, Door, Marinette, Oconto, Outagamie, Kewaunee, and Winnebago Counties, Wisconsin, and
Delta and Menominee Counties, Michigan
CERCLIS ID: WID000195481
June 2003

Table of Contents

TABLES

FIGURES

APPENDICES

LIST OF ACRONYMS AND ABBREVIATIONS

°F	degrees Fahrenheit
µg/kg	micrograms per kilogram
µg/kg-BW/day	micrograms per kilogram of body weight per day
µg/L	micrograms per liter
API/NCR	Appleton Papers, Inc./NCR Corp.
ARAR	applicable or relevant and appropriate requirement
BLRA	Baseline Human Health and Ecological Risk Assessment
BTAG	Biological Technical Assistance Group
CAD	confined aquatic disposal
CDF	confined disposal facility
CDI	chronic daily intake
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
cfs	cubic feet per second
CIP	Community Involvement Plan
COC	chemical of concern
COPC	chemical of potential concern
CSF	cancer slope factor
CT	central tendency
CTE	central tendency exposure
CWAC	Clean Water Action Council
cy	cubic yard
DHFS	Department of Health and Family Services (Wisconsin)
DDD	dichlorodiphenyldichloroethane
DDE	dichlorodiphenylene
DDT	dichlorodiphenyltrichloroethane
DO	dissolved oxygen
EPA	United States Environmental Protection Agency
ERA	Ecological Risk Assessment
ESD	Explanation of Significant Difference
FRDB	Fox River Database
FRFood	Fox River Food Chain Model
FRG	Fox River Group
FS	Feasibility Study
GBFood	Green Bay Food Chain Model
GBMBS	Green Bay Mass Balance Study
GBTOXe	Enhanced Green Bay PCB Transport Model (an enhanced version of GBTOX, a water quality model)
GLNPO	Great Lakes National Program Office
HHRA	Human Health Risk Assessment
HI	hazard index
HQ	hazard quotient
IRIS	Integrated Risk Information System
kg	kilogram
LLBdM	Little Lake Butte des Morts
LMMBS	Lake Michigan Mass Balance Study
LOAEC	Lowest Observed Adverse Effects Concentration
LOAEL	Lowest Observed Adverse Effects Level
mg/kg	milligrams per kilogram
mg/kg-day	milligrams per kilogram per day
mg/L	milligrams per liter
MNR	Monitored Natural Recovery
NAS	National Academy of Sciences
NCP	National Contingency Plan
NCR	National Cash Register Company (now NCR Corporation)
ng/L	nanograms per liter
NHPA	National Historic Preservation Act

NOAA	National Oceanic and Atmospheric Administration
NOAEC	No Observed Adverse Effects Concentration
NOAEL	No Observed Adverse Effects Level
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
NR	Natural Resources (in reference to that part of the WAC that presents NR rules)
NRC	National Research Council
NRDA	Natural Resource Damage Assessment
OSHA	Occupational Safety and Health Administration
OSWER	Office of Solid Waste and Emergency Response
OU	Operable Unit
PAL	preventive action limit
PCB	polychlorinated biphenyl
POTW	publicly owned treatment works
ppb	parts per billion
ppm	parts per million
ppt	parts per trillion
PRP	potentially responsible party
RAL	remedial action level
RAO	remedial action objective
RAP	Remedial Action Plan
RCRA	Resource Conservation and Recovery Act
RfD	reference dose
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
RME	reasonable maximum exposure
ROD	Record of Decision
SARA	Superfund Amendments and Reauthorization Act
SITE	Superfund Innovative Technology Evaluation
SLRA	Screening Level Risk Assessment
SMDP	Scientific Management Decision Point
SMU	Sediment Management Unit
SQT	sediment quality threshold
SWAC	surface-weighted average concentration
TAG	Technical Assistance Grant
TBC	to be considered
TEF	toxic equivalency factor
TEL	threshold exposure limit
TMDL	total maximum daily load
TRV	toxicity reference value
TSCA	Toxic Substances Control Act
UCL	upper confidence limit
USACE	United States Army Corps of Engineers
USC	United States Code
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
WAC	Wisconsin Administrative Code
WDNR	Wisconsin Department of Natural Resources
WDOT	Wisconsin Department of Transportation
wLFRM	whole Lower Fox River Model
WPDES	Wisconsin Pollutant Discharge Elimination System
WQS	Water Quality Standard

EXECUTIVE SUMMARY
Record of Decision (ROD) for Operable Units 3, 4, and 5 Wisconsin DNR and U.S. EPA

The Lower Fox River and Green Bay Site ("the Site") includes an approximately 39-mile stretch of the Lower Fox River (referred to herein as "the River") as well as the Bay of Green Bay (referred to herein as "the Bay"). The River portion of the Site extends from the outlet of Lake Winnebago and continues downstream to the mouth of the River at Green Bay, Wisconsin. The Bay portion of the Site includes all of Green Bay from the City of Green Bay to the point where Green Bay enters Lake Michigan. A Record of Decision (ROD) for Operable Units (OUs) 1 and 2 of the River was released by the Wisconsin Department of Natural Resources (WDNR) and United States Environmental Protection Agency (EPA) on January 7, 2003. This ROD covers OU 3, OU 4, and OU 5 and addresses some of the human health and ecological risks posed to people and ecological receptors associated with polychlorinated biphenyls (PCBs) that have been released to the Site. Presently these PCBs reside primarily in the sediment in the River and in the Bay, and this ROD outlines a remedial plan to address a certain portion of PCB-contaminated sediment.

For ease of management and administration, as well as because of similar features and characteristics, the Site has been divided into certain discrete areas: the River has been divided into Operable Units 1 through 4 and the Bay constitutes Operable Unit 5. These Operable Units are as follows:

Operable Unit 1 – Little Lake Butte des Morts
Operable Unit 2 – Appleton to Little Rapids
Operable Unit 3 – Little Rapids to De Pere
Operable Unit 4 – De Pere to Green Bay (in some documents, Green Bay Zone 1)
Operable Unit 5 – Green Bay

This ROD selects a remedial action for OUs 3, 4, and 5, and is complementary to the ROD addressing Operable Units 1 and 2, which was released in January 2003. This ROD completes the remedial decision-making process for the entire Site. Significant public comments on the Proposed Plan concerning OUs 3, 4, and 5 were considered in preparation of this ROD.

For many years, a large number of paper mills have been and continue to be concentrated along the River. Some of these mills operated de-inking facilities in connection with the recycling of paper. Others manufactured carbonless copy paper. In both the de-inking operations and the manufacturing of carbonless copy paper, these mills handled PCBs, which were used in the emulsion that coated carbonless copy paper. In the de-inking process and in the manufacturing process, PCBs were released from the mills to the River directly or after passing through local water treatment works. PCBs have a tendency to adhere to sediment and they have contaminated the River sediment. In addition, the PCBs and contaminated sediment were carried downriver and released into the Bay.

Presently, it is estimated that OU 3 contains approximately 1,250 kilograms (kg) (2,750 pounds) of PCBs in 3,030,100 cubic yards (cy) of sediment. This ROD provides for the removal by dredging 586,800 cy of contaminated sediment containing 1,111 kg (2,444 pounds) of PCBs from Operable Unit 3. In addition, this ROD calls for the removal of Deposit DD from OU 2 as part of the OU 3 remedy. Deposit DD adds approximately 9,000 cy of contaminated sediment and 31 kg (68 pounds) of PCB mass to the OU 3 project. It is estimated that OU 4 contains approximately 26,650 kg (58,620 pounds) of PCBs in 8,491,400 cy of sediment. This ROD provides for the removal by dredging 5,880,000 cy of contaminated sediment containing 26,433 kg (58,150 pounds) of PCBs from OU 4. This ROD provides for the removal of about 56 percent of all contaminated sediment from OUs 3 and 4, removing 6.5 million cy out of approximately 11.6 million cy of contaminated sediment.

The dredged material will be "dewatered" and taken to a landfill for permanent disposal. This ROD establishes an "action level" of 1 part per million (ppm) for this cleanup effort. In other words, any sediment found in Operable Unit 3 or 4 which has a concentration of PCBs of 1 ppm or greater will be targeted for removal. The goal of the remedial action in Operable Units 3 and 4 is to reach a surface-weighted average concentration (SWAC) of approximately 0.25 ppm after dredging is completed. Current estimates are that the removal of the contaminated sediment above 1 ppm will result in a SWAC of 0.26 ppm for OU 3 and a SWAC of 0.16 ppm for OU 4. Reducing the concentration of PCBs in Operable Units 3 and 4 to this SWAC level or below will dramatically reduce the risks to human health and ecological receptors. Following implementation of the remedy, monitoring of these OUs will take place. This monitoring will address natural processes such as degradation, dispersion, and burial of contaminant concentrations and will examine various media.

Operable Unit 5 has a selected remedy of Monitored Natural Recovery (MNR) with continued institutional controls. MNR includes the monitoring of processes such as degradation, dispersion, and burial of contaminant concentrations to the point where the contaminants are no longer of concern. In OU 5, it does not appear that burial or degradation are significant factors in the recovery of Green Bay. However, remediation of the River will reduce loading from the River into Green Bay and should contribute to the recovery of the Bay. The MNR alternative for OU 5 includes a monitoring program for measuring PCB levels in various media (e.g., water, sediment, tissue, etc.). Monitoring would continue until acceptable levels of PCBs are reached in sediment, surface water, and fish tissue. In response to comments on the proposed remedy for OU 5, additional sampling will take place near the mouth of the River. Evaluation of the sample results may lead to further dredging in OU 5 near the River mouth.

A monitoring program for OUs 3 through 5 will also be developed to effectively measure achievement of and progress toward the Site's remedial action objectives. These monitoring plans will be placed in information repositories for the Site (including Administrative Record locations) for public review

The estimated cost for the remedial action in Operable Units 3 and 4 is $284 million; for Operable Unit 5, the estimated cost is $39.6 million.

Declaration for the Record of Decision (ROD) for Operable Units 3, 4, and 5 Wisconsin DNR and U.S. EPA

Lower Fox River and Green Bay
Brown, Door, Marinette, Oconto, Outagamie, Kewaunee, and Winnebago Counties, Wisconsin, and
Delta and Menominee Counties, Michigan
CERCLIS ID: WID000195481
June 2003

Part 1: Declaration for the Record of Decision

The Lower Fox River and Green Bay Site ("the Site") includes an approximately 39-mile section of the Lower Fox River (referred to herein as "the River"), from Lake Winnebago downriver to the mouth of the River, and all of Green Bay (referred to herein as "the Bay"); the Site totals approximately 2,700 square miles in area. This stretch of the River and Bay flows through or borders Brown, Door, Kewaunee, Marinette, Oconto, Outagamie, and Winnebago Counties in Wisconsin and Delta and Menominee Counties in Michigan. The Site has been divided into discrete areas referred to as Operable Units (OUs). The River portion of the Site comprises OU 1 through OU 4, and the Bay portion of the Site is designated OU 5 for purposes of Site management. The OUs were selected based, in part, on stretches of the River having similar features and characteristics, as well as for ease of Site management and administration. OU 1 (Little Lake Butte des Morts) encompasses the area from the Lake Winnebago outlet to the Appleton dam. OU 2 (Appleton to Little Rapids) is the area from the Appleton dam to the Little Rapids dam. OU 3 (Little Rapids to De Pere) is the area from the Little Rapids dam to the De Pere dam. OU 4 (De Pere to Green Bay) is the area from the De Pere dam to the mouth of the River at Green Bay. OU 5 is the bay of Green Bay.

This Record of Decision (ROD) addresses the risks to people and ecological receptors associated with polychlorinated biphenyls (PCBs) in OUs 3, 4, and 5. PCBs, the primary risk driver, are contained in sediment deposits located in the River and the Bay. The implementation of the remedy selected in this ROD will result in reduced risks to humans and ecological receptors living in and near the Site.

With the exception of continuing releases of PCBs from contaminated sediment, it is believed that the original PCB sources are now essentially controlled. PCBs in the River resulted from historical discharges, primarily related to the manufacturing and recycling of carbonless copy paper.

STATEMENT OF BASIS AND PURPOSE

By agreement with the United States Environmental Protection Agency (EPA), the Wisconsin Department of Natural Resources (WDNR) is the "lead agency" with respect to the Site. EPA has funded the WDNR through a cooperative agreement to prepare a Remedial Investigation and Feasibility Study (RI/FS) and this ROD.

This decision document was developed by WDNR for OUs 3, 4, and 5 of the Site, pursuant to WDNR's authority under Chapter 292, Wisconsin Statutes. EPA has concurred in and has adopted this ROD for the Site, as provided for in 40 Code of Federal Regulations (CFR) § 300.515(e).

This decision document presents the selected remedy for OUs 3, 4, and 5 of the Site and was written in accordance with the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA) as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA) and, to the extent practicable, with the National Oil and Hazardous Substances Pollution Contingency Plan ("National Contingency Plan" or NCP), 40 CFR Part 300. This decision is based on information contained in the Administrative Record for this Site. This ROD is consistent with the findings of the National Academy of Sciences' (NAS) National Research Council report entitled "A Risk Management Strategy for PCB-Contaminated Sediments" and with EPA policy.

ASSESSMENT OF THE SITE

The response action selected in this ROD is necessary to protect the public health, safety, and welfare or the environment from an imminent and substantial endangerment from actual or threatened releases of hazardous substances into the environment.

DESCRIPTION OF THE SELECTED REMEDY

The objectives of the response actions for this Site are to protect public health, safety, and welfare and the environment and to comply with applicable federal and state laws. The selected remedy specifies response actions that will address PCB-contaminated sediment in OUs 3, 4, and 5. The WDNR and EPA ("the Agencies") believe the remedial actions outlined in this ROD, if properly implemented, will address contaminated sediment in OUs 3, 4, and 5 and will protect human health, safety, and welfare and the environment to the extent practicable. Among the goals for the selected remedy are the removal of fish consumption advisories, the protection of the fish and wildlife that use the River and Bay, and reduction of the transport of PCBs from the River to the Bay.

The major components of the selected remedy include:

- Removal of an estimated 6,475,800 cubic yards (cy) of contaminated sediment containing over 27,575 kilograms (kg) or 60,660 pounds of PCBs from OUs 3 and 4 using environmental dredging techniques that minimize adverse environmental impacts. The selected remedy calls for dewatering the dredged sediment and disposing of it at a new off-site licensed disposal facility, not yet constructed, to be located in the Fox River Valley. Dredge water will be treated prior to discharge. In conducting the design of this remedy, WDNR and EPA may utilize vitrification of dredged contaminated sediment as an alternative to off-site disposal at a licensed facility if this is determined to be practicable and cost-effective. If vitrification is proposed, the Agencies will inform the public and seek public input.

- Monitored Natural Recovery (MNR) of the residual PCB contamination remaining in dredged areas and undisturbed areas until the concentrations of PCBs in fish tissue are reduced to an acceptable level. Fish consumption advisories and fishing restrictions will remain in place until acceptable PCB levels are achieved.

- The use of Monitored Natural Recovery for OU 5.

- A long-term monitoring program covering various media (e.g., water, tissue, and sediment) throughout OUs 3, 4, and 5 to determine the effectiveness of the remedy. A final long-term monitoring plan will be developed as part of the remedial design phase.

STATUTORY DETERMINATIONS

The selected remedy meets the requirements for remedial actions set forth in Section 121 of CERCLA, 42 United States Code (USC) § 9621. It is protective of human health and the environment, complies with federal and state applicable or relevant and appropriate requirements, and is cost-effective. The selected remedy utilizes permanent solutions and alternative treatment technologies to the maximum extent practicable. It does not completely satisfy the statutory preference for treatment as a principal element of the remedy, because PCB-contaminated sediment may not be treated prior to disposal.

With respect to the portions of the River addressed in this ROD, some PCB concentrations create a risk in the range of 10^{-3} or more, thus "qualifying" those sediments to be a principal threat waste. The preference for treatment applies to these particular sediments. However, it would be wholly impracticable to closely identify, isolate, and treat these principal threat wastes in a manner different from the other PCB sediment identified for removal and disposal. Typical dredging technology that may be employed may not be capable of distinguishing among such fine gradations of PCB concentrations. Nevertheless, at the conclusion of the OUs 3 and 4 remedy, the principal threat wastes will have been removed from OUs 3 and 4 and deposited in a landfill. In so doing, the mobility of the principal threat wastes will have been greatly reduced. Also, dredge water will be treated prior to discharge.

Because the selected remedy will result in hazardous substances remaining on the Site above levels that allow unlimited use and unrestricted exposure, a statutory review will be conducted every 5 years after initiation of remedial action to ensure that the remedy is, or will be, protective of human health and the environment. Once all remedial action objectives have been met, a 5-year review will no longer be needed.

DATA CERTIFICATION CHECKLIST

The following information is in the Declaration for the Record of Decision. Additional information is in the Administrative Record file for this Site.

- Chemicals of concern and their respective concentrations – Sections 6 and 8
- Baseline risk presented by the chemicals of concern – Section 8
- Cleanup levels established for the chemical of concern and the basis for these levels – Section 13.3
- How source materials constituting principal threats are addressed – Section 12
- Surface water and land use assumptions used in the baseline risk assessments and ROD – Sections 7 and 8
- Potential land and groundwater uses that will be available at the Site as a result of the Selected Remedy – Section 7
- Estimated capital, operation and maintenance, and total present-worth costs and the time to implement each of the various remedial alternatives – Sections 11 and 13.2
- Key factors that led to selecting the remedy (i.e., best balance of tradeoffs with respect to the balancing and modifying criteria) – Sections 11 and 14

6/30/03
Date

[signature]
Bruce Baker, Deputy Administrator
Water Division
Wisconsin DNR

By signing this ROD, U.S. EPA Region 5 concurs with the selected remedy.

6/30/03

Date

Wm. E. Muno

William E. Muno, Director
Superfund Division
U.S. EPA – Region 5

Declaration for the Record of Decision (ROD) for Operable Units 3, 4, and 5 Wisconsin DNR and U.S. EPA

Lower Fox River and Green Bay
Brown, Door, Marinette, Oconto, Outagamie, Kewaunee, and Winnebago Counties, Wisconsin, and
Delta and Menominee Counties, Michigan
CERCLIS ID: WID000195481
June 2003

Part 2: Superfund Record of Decision

1 SITE NAME, LOCATION, AND BRIEF DESCRIPTION

1.1 Site Name and Location

The Lower Fox River and Green Bay Site ("the Site") is located in northeast Wisconsin in Brown, Door, Marinette, Oconto, Outagamie, Kewaunee, and Winnebago Counties and in the eastern portion of the Upper Peninsula of Michigan in Delta and Menominee Counties. The Lower Fox River (referred to herein as "the River") flows northeast from Lake Winnebago for 39 miles, where it discharges into Green Bay (referred to herein as "the Bay"). The Bay is approximately 119 miles long and is an average of 23 miles wide (Figures 1-1 and 1-2).

The Site has been divided into five discrete Operable Units (OUs) by the Wisconsin Department of Natural Resources (WDNR) and the United States Environmental Protection Agency (EPA). For purposes of the Remedial Investigation and Feasibility Study (RI/FS), the River was divided into four OUs. An OU is a geographical area designated for the purpose of analyzing and implementing remedial actions. OUs are defined on the basis of similar features and characteristics (e.g., physical and geographic properties and characteristics developed in previous investigations) and for ease of Site management and administration. The River and the Bay OUs are:

- OU 1 – Little Lake Butte des Morts
- OU 2 – Appleton to Little Rapids
- OU 3 – Little Rapids to De Pere
- OU 4 – De Pere to Green Bay (referred to in some documents as Green Bay Zone 1)
- OU 5 – Green Bay

The Bay is a single OU and has been divided into four major zones (i.e., zones 2, 3A, 3B, and 4).

This Record of Decision (ROD) addresses Operable Units 3, 4, and 5. For OUs 3 and 4, active remediation (dredging, dewatering, and off-site disposal) of in-place sediment has been selected. The remediation of OU 3 is to include the dredging of Deposit DD from OU 2. Remediation of OU 4 will include dredging by the mouth of the River. For OU 5, a monitoring program has been selected to evaluate the effectiveness of natural processes that are expected to reduce risk over time. Risk reduction will occur more quickly in OUs 3 and 4 because of the active remediation of those Operable Units. The remedial activity may include a small amount of remediation in the Bay. It is expected that the active remediation in OU 1, OU 3, and OU 4 may contribute to a faster remediation in the Bay.

The remedial action selected herein is to remove and isolate or otherwise ameliorate the threats to human health and the environment in OUs 3 through 5 caused by the release of polychlorinated biphenyls (PCBs) into the River. While the release of PCBs to the environment occurred between 1954 and the late 1970s, the PCB contamination in the sediment continues to act as a source to the water, biota, and air.

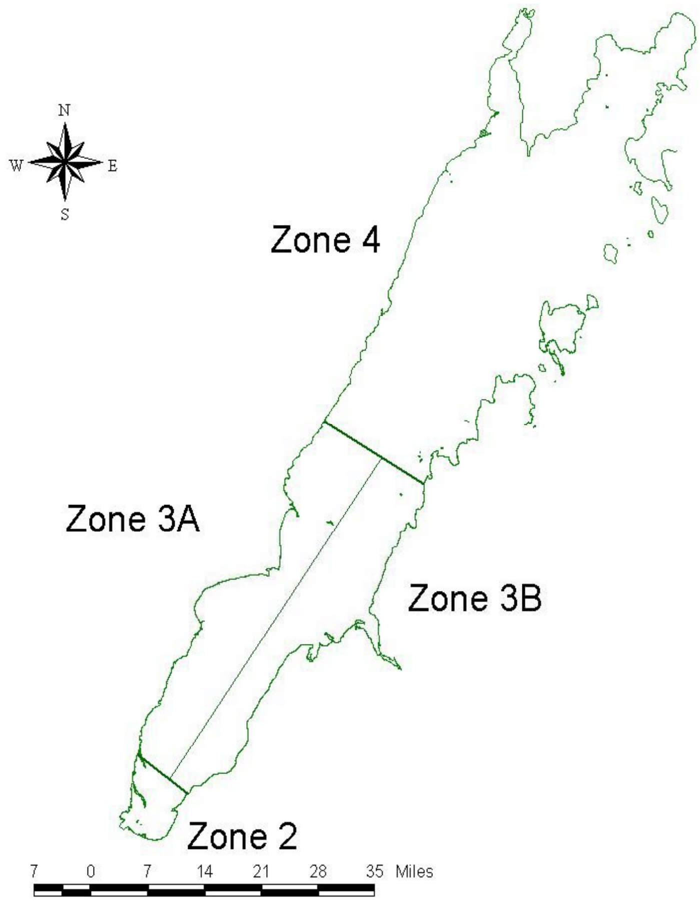
1.2 Brief Description

The study area comprises two distinctly different water bodies, the River and Lake Michigan's Green Bay (Figures 1-1 and 1-2). The River flows northeast approximately 39 miles from Lake Winnebago to the River mouth at the southern end of the Bay. The Bay's watershed drains approximately 15,625 square miles. Two-thirds of the Bay basin is in Wisconsin; the remaining one-third is in Michigan's Upper Peninsula.

Figure 1-1 Lower Fox River PCB-Contaminated Sediment Deposits and Operable Units

The River is the primary tributary to the Bay, draining approximately 6,330 square miles. The River's elevation drops approximately 168 feet between Lake Winnebago and the Bay. Twelve dams and 17 locks accommodate this elevation change and allow navigation between Lake Winnebago and the Bay. While the entire River and southern Bay has a federally authorized navigation channel and is navigable by recreational boats, the Rapide Croche lock is permanently closed to restrict upstream migration of the sea lamprey.

Figure 1-2 Green Bay Zones



The River is generally less than 1,000 feet wide over much of its length and is up to approximately 20 feet deep in some areas. Where the River widens significantly, the depth generally decreases to less than 10 feet and, in the case of Little Lake Butte des Morts (LLBdM), water depths range between 2 and 5 feet except in the main channel. The main channel of the River ranges from approximately 6 to 20 feet in depth.

Since 1918, flow in the River has been monitored at the Rapide Croche dam, midway between Lake Winnebago and the River mouth. Mean annual discharge is approximately 4,237 cubic feet per second (cfs). The recorded maximum daily discharge of 24,000 cfs occurred on April 18, 1952; the minimum daily discharge of 138 cfs occurred on August 2, 1936.

OU 3 is identified primarily as the river reach from the Little Rapids dam to the De Pere dam and extends a distance of approximately 6 miles. This reach includes sediment deposits EE through HH. For operational reasons, sediment Deposit DD, which is located in OU 2 immediately upstream of the Little Rapids dam, is also included with OU 3 for remedy consideration. OU 4 extends from the De Pere dam to the River's mouth at Green Bay, a distance of approximately 7 miles, and includes Sediment Management Units (SMUs) 20 through 115. OU 5 is Green Bay, which is roughly 119 miles long by 23 miles wide, and includes zones 2, 3A, 3B, and 4.

1.3 Lead Agency

The WDNR is the lead agency for this project. EPA has worked jointly with WDNR in the development of this ROD and concurs with and has adopted the decision described herein. Through a cooperative agreement, the EPA has funded WDNR to prepare the Site RI/FS and baseline risk assessment, as well as this ROD.

2 SITE HISTORY AND ENFORCEMENT ACTIVITIES

2.1 Site History

The Fox River Valley is one of the largest urbanized regions in the state of Wisconsin, with a population of approximately 400,000. The Fox River Valley has a significant concentration of pulp and paper industries, with 20 mills located along or near the River. This is one of the largest concentrations of paper mills in the world. Other important regional industries include metal working, printing, food and beverages, textiles, leather goods, wood products, and chemicals. In addition to heavy industrial land uses, the region also supports a mixture of agricultural, residential, light industrial, and conservancy uses, as well as wetlands. For investigative purposes, the Site is defined as the 39 river miles of the River and Bay to a line that extends between Washington Island, Wisconsin, and the Garden Peninsula of Michigan.

Problems related to water quality have been noted and measured in the River and lower Green Bay almost since the area was settled. Water quality studies were initiated in the early 1900s and have been conducted almost annually since. Between the early 1930s and mid-1970s, the population of desirable fish and other aquatic organisms in the system was poor. Recorded fish kills and the increasing predominance of organisms able to tolerate highly polluted conditions were found throughout the Lower Fox River and lower Green Bay. Few people used the River or lower Green Bay for recreation because of the poor water quality and the lack of a sport fishery. During this same time period, dissolved oxygen (DO) levels were often very low (2 milligrams per liter [mg/L] or less). The poor water quality was attributed to many sources, such as the effluent discharged from pulp and paper mills and municipal sewage treatment plants.

Over time, in large part because of the federal Clean Water Act (1972), improved waste treatment systems began operation. As part of this effort, WDNR developed and implemented a Waste Load Allocation system to regulate the discharge of oxygen-demanding pollutants from wastewater treatment plants. Fish and aquatic life in the River and Bay have responded dramatically to the improved water quality conditions. Fishery surveys conducted from 1973 to the present indicate a sharp increase in the sport-fish population. Species sensitive to water quality, such as lake trout, which were absent since the late 1800s or early 1900s, have been found in the River since 1977. These improvements resulted in large part from a substantial reduction in organic wastes discharged into the River.

With the return of sport fishery, human use of the River and Bay has also returned. Recognizing concerns about potential health impacts of PCBs in the environment and their bioaccumulative properties, WDNR began routinely monitoring contamination in fish in the early 1970s. Significantly elevated levels of PCBs were detected in all species of fish and all OUs. Measured concentrations of PCBs in fish were (and remain) above levels that have been shown to be harmful to human health. As a result, fish consumption advisories for the Site were first issued in 1976 and 1977 by WDNR and the State of Michigan, respectively. Fish consumption advisories remain in effect today. WDNR has continued to collect data on contaminant concentrations in fish tissue since that time.

2.1.1 PCB Use in the Lower Fox River Valley

The principal source of PCBs in the River and Bay is the manufacture and recycling of carbonless copy paper. The former National Cash Register Company (NCR) is credited with inventing carbonless copy paper. The method used microcapsules of a waxy material to enclose a colorless dye dissolved in PCBs. This material was manufactured as an emulsion and could be coated onto the back of a sheet of paper. A second reactive coating was then applied to the front of a second sheet of paper. When the two sheets were joined, an impact on the front sheet would rupture the microcapsules and allow the dye to react with the coating on the second sheet, leaving an identical image.

PCB discharges to the River resulted from the production and recycling of carbonless copy paper made with PCB-containing coating emulsions. The manufacture of carbonless paper using the PCB-containing emulsion began in the Fox River Valley in 1954 and continued until 1971. The production of carbonless copy paper increased during the 1950s and 1960s; by 1971, approximately 7.5 percent of all office forms were printed on carbonless copy paper. With the increased production of carbonless copy paper, PCBs began to appear also in many types of paper products made using recycled carbonless copy paper. As documented in an EPA report, nearly all paper products contained detectable levels of PCBs by the late 1960s. During this time period, other Fox River Valley paper mills also began recycling wastepaper laden with PCBs. Evidence of PCBs in paper products includes studies conducted by the Institute of Paper Chemistry to determine the rate at which PCBs migrated from paper container materials to the food products contained in them.

The production of carbonless copy paper was discontinued after 1971 because of increased concern about PCBs in the environment. Technical Memorandum 2d estimates that during the period of use (1954 through 1971),13.6 million kilograms (kg) (30 million pounds) of emulsion were used in the production of carbonless copy paper produced in the Fox River Valley. PCBs were released into the River in discharge water from several facilities. Conservative estimates made from analyzing purchase, manufacturing, and discharge records have shown that approximately 313,600 kg (690,000 pounds) of PCBs were released to the River environment during this time. Ninety-eight percent of the total PCBs released into the River had been released by the end of 1971. Ceasing production of carbonless copy paper and implementing the wastewater control measures put in place by the Clean Water Act were effective in eliminating point sources. No major non-point sources, such as PCB-contaminated groundwater plumes, are known to exist from any of the potentially responsible parties' (PRPs') properties.

2.2 Actions to Date

To date, seven companies have been identified as PRPs with respect to the PCB contamination and formally notified of such by the governmental agencies. These companies are Appleton Paper Company, NCR, P.H. Glatfelter Company, Georgia Pacific (formerly Fort James), WTMI (formerly Wisconsin Tissue), Riverside Paper Co., and U.S. Paper Co. This group is commonly referred to as the Fox River Group (FRG).

The EPA's proposed inclusion of the Site on the National Priorities List (NPL), a list of the nation's hazardous waste sites eligible for investigation and cleanup under the federal Superfund program, defines the Site as the Lower Fox River from the outlet of Lake Winnebago to a point in Green Bay 27 miles from the River mouth. That Site is officially called the Fox River NRDA PCB Releases Site in the proposed NPL listing. However, for the purpose of the RI/FS, the Proposed Remedial Action Plan ("Proposed Plan"), and this ROD, the Site includes the 39 miles of the Lower Fox River and all of Green Bay. The federal trustees conducting a

Natural Resource Damage Assessment (NRDA) have defined the Site somewhat differently to include the Lower Fox River, all of Green Bay, and nearby areas of Lake Michigan.

In 1994, the United States Department of the Interior acting through the United States Fish and Wildlife Service (USFWS), the National Oceanic and Atmospheric Administration (NOAA) of the Department of Commerce, the Menominee Indian Tribe of Wisconsin, and the Oneida Tribe of Indians of Wisconsin initiated an NRDA for the Site. The state, federal, and tribal trustees are working together to determine what is necessary to address natural resource injuries caused to date by releases of PCBs. This process is separate from, but related to, the remediation discussed in this document.

In January 1997, the WDNR and the FRG signed an agreement dedicating $10 million to fund demonstration projects on the River and other work to evaluate various methods of restoration. This collaborative effort, however, was not completely successful and did not resolve technical issues as initially hoped. At about this same time, the USFWS issued a formal Notice of Intent to sue the paper companies. In June 1997, the EPA announced its intent to list the River and portions of the Bay on the NPL. The state indicated its opposition to listing the River as a Superfund site. Federal, state, and tribal officials subsequently signed an agreement on July 11, 1997, to share their resources in developing a comprehensive cleanup and restoration plan for the River and the Bay. The EPA formally proposed listing of the Site to the NPL in the Federal Register on July 28, 1998.

In October 1997, the FRG submitted an offer to conduct an RI/FS on the River. An RI/FS is the first step in the federal process initiated by EPA to assess current health risks and evaluate potential remediation methods. Following unsuccessful attempts to negotiate this work activity with the FRG, the EPA delegated the lead role for the Site to the WDNR and helped craft a scope of work and cooperative agreement for completing the RI/FS with the WDNR. The WDNR, EPA, USFWS, NOAA, and the Menominee and Oneida Tribes worked in close cooperation to guide, review, and issue the RI/FS.

In February 1999, the WDNR released a draft RI/FS for public review and comment. The draft RI/FS was released to solicit public comment early in the planning process, to better evaluate public acceptance, and to assist the WDNR and EPA in selecting a cleanup alternative having the greatest public acceptance. Comments were received from other governmental agencies, the public, environmental groups, and private-sector corporations. These comments were used to revise and refine the scope of work that led to the RI/FS and Proposed Plan released for public comment in October 2001. Comments received from the PRPs, the public, and independent peer review committees were incorporated into the final RI/FS. In January 2003, the ROD for OUs 1 and 2 was released. That ROD called for active remediation in OU 1 and Monitored Natural Recovery in OU 2.

2.2.1 Documentation of Residual PCB Levels

With the finding that PCBs released into the River were appearing at levels harmful to human health and the environment, several cooperative efforts were initiated to document residual PCBs in the sediment and the fate, transport, and risks of PCBs within the Site. Two mass balance studies were conducted: the Green Bay Mass Balance Study and the Lake Michigan Mass Balance Study, discussed below.

Green Bay Mass Balance Study

In 1989/90, following recommendations made in the Green Bay Remedial Action Plan, the EPA and WDNR began a comprehensive program of sampling sediment, water, and biota in the River and Bay for use in the Green Bay Mass Balance Study (GBMBS).

The GBMBS was a pilot project to test the feasibility of using a mass balance approach for assessing the sources and fates of toxic pollutants spreading throughout the food chain. The objectives of the GBMBS were to:

1. Inventory and map PCB mass and contaminated sediment volume.

2. Calculate PCB fluxes into and out of the River and Bay by evaluating Lake Winnebago, point sources, landfills, groundwater, atmospheric contributions, and sediment resuspension.

3. Increase understanding of the physical, chemical, and biological processes that affect PCB fluxes.

4. Develop, calibrate, and validate computer models for the River and Bay systems.

5. Conduct predictive simulations using computer models to assist in assessing specific management scenarios and selecting specific remedial actions.

The GBMBS confirmed that the primary source (more than 95 percent) of the PCBs moving within the River is the River sediment itself. The contribution of PCBs from wastewater discharges, landfills, groundwater, and the atmosphere is relatively insignificant in comparison to the PCBs originating from the sediment. Furthermore, the GBMBS showed that PCBs released from the sediment were directly linked to the levels of PCBs measured throughout the biological food chain, including fish, birds, and mammals that depend on the River for food.

Inventory and mapping activities showed that PCBs are distributed throughout the entire River. Thirty-five discrete sediment deposits were identified between Lake Winnebago and the De Pere dam. One relatively large, continuous sediment deposit exists downstream of the De Pere dam. Water column sampling indicated that the water entering the River from Lake Winnebago contains relatively low PCB concentrations. However, upon exposure to the contaminated river sediment in Little Lake Butte des Morts, water in the River exceeds state water quality standards. During the GBMBS, the lowest water column concentration (5 nanograms per liter [ng/L]) of PCBs measured in any River sample still exceeded the state water quality standard by a factor of more than 1,500.

As expected, water column concentrations also increased as River flow increased and PCBs attached to River sediment were resuspended into the water column. These higher flows resulted in PCB concentrations that exceeded standards by a factor of almost 40,000. The GBMBS also documented that more than 60 percent of PCB transport occurs during the relatively short time that River flows are above normal. Movement of PCBs in the water column extends throughout the Bay, with some PCBs from the River ultimately entering Lake Michigan proper. The GBMBS also documented that a considerable amount of PCBs is lost to the atmosphere from the surface of the water in the River and Bay.

Lake Michigan Mass Balance Study

The EPA's Great Lakes National Program Office (GLNPO) initiated a similar mass balance study for all of Lake Michigan, the Lake Michigan Mass Balance Study (LMMBS). To accomplish the objectives of this study, which were similar to those of the GBMBS but on a larger scale, pollutant loading (including PCBs) from 11 major tributaries flowing into Lake Michigan was measured. The Lake Michigan Tributary Monitoring Program confirmed the magnitude and significance of the River contribution to pollutant loading in Lake Michigan. It is estimated that on a daily basis, up to 70 percent of the PCBs entering Lake Michigan via its tributaries are from the River.

2.2.2 The Fox River Coalition

In 1993, a group of paper mills approached the WDNR to establish a cooperative process for resolving the contaminated sediment issue. The outcome was formation of the Fox River Coalition, a private-public partnership of area businesses, state and local officials, environmentalists, and others committed to improving the quality of the River. The Coalition focused on the technical, financial, and administrative issues that would need to be resolved to achieve a whole River cleanup.

The Coalition's first project was an RI/FS of several sediment deposits upstream of the De Pere dam. The sediment deposits targeted for the Coalition's RI/FS were selected after all the deposits had been prioritized based on their threat and contribution to the contaminant problems. Previous studies of the River had focused only on the nature and extent of contamination. The Coalition's RI/FS first confirmed the nature and extent of the contamination within each deposit, then evaluated remedial technologies for cleaning up two of the deposits.

The Coalition also undertook a project to more thoroughly inventory and map sediment contamination in the River downstream of the De Pere dam, collecting sediment cores from 113 locations. The sampling was completed in 1995 with technical and funding assistance from both the WDNR and EPA. The resulting data led to a revised estimate of PCB mass and the volume of contaminated sediment in this River reach. The expanded database also made it possible to prioritize areas of sediment contamination, much as had previously been done for areas upstream of the De Pere dam.

Following completion of the Coalition's RI/FS for the upstream sites, the Coalition selected Deposit N as an appropriate site for a pilot project to evaluate remedial design issues. The primary objectives were to determine requirements for implementing a cleanup project and to generate site-specific information about cleanup costs. Although the Coalition initiated the effort, the WDNR, with funding from the EPA, was responsible for implementing the Deposit N pilot project.

2.2.3 Demonstration Projects

Deposits N and O

In 1998 and 1999, the WDNR and EPA-GLNPO sponsored a project to remove PCB-contaminated sediment from Deposit N in the River. This project was successful at meeting its primary objective by demonstrating that dredging of PCB-contaminated sediment can be performed in an environmentally safe and cost-effective manner. Other benefits of the project included the opportunity for public outreach and education on the subject of environmental dredging, as well as the actual removal of PCBs from the River system. Deposit N, located near Little Chute and Kimberly, Wisconsin, covered approximately 3 acres and contained about

11,000 cubic yards (cy) of sediment. PCB concentrations were as high as 186 milligrams per kilogram (mg/kg). Of the 11,000 cy in Deposit N, about 65 percent of the volume was targeted for removal.

Approximately 8,200 cy of sediment were removed, generating 6,500 tons of dewatered sediment that contained 112 total pounds of PCBs. The total included about 1,000 cy of sediment from Deposit O, another contaminated sediment deposit adjacent to Deposit N. Monitoring data showed that the River was protected during the dredging and that wastewater discharged back to the River complied with all permit conditions. The project met the design specifications for the removal, such as the volume of sediment removed, sediment tonnage, and allowed thickness of residual sediment. It should be noted that the project's goals were to test and meet the design specifications and focus on PCB mass removal, not to achieve a concentration-based cleanup, i.e., removal of all PCB-contaminated sediment above a certain cleanup level. A cost analysis of this project indicated that a significant portion of the funds was expended in pioneering efforts associated with the first PCB cleanup project on the River, for the winter construction necessary to meet an accelerated schedule, and for late season work in 1998.

Fox River Group Demonstration Project (SMU 56/57)

As part of the January 1997 agreement between the FRG and the State of Wisconsin, the FRG agreed to make available a total of $10 million for a number of projects. One of these was a sediment remediation project for which the objective was to design, implement, and monitor a project downstream of the De Pere dam. The project was intended to yield important information about large-scale sediment restoration projects in the River. The project, as described in the agreement, had a pre-defined financial limit of $8 million.

The FRG and WDNR agreed on Sediment Management Units 56 and 57 (SMU 56/57) as the project site. Contractors and consultants, under contract to the FRG, designed and implemented the project. Dredging at SMU 56/57 began on August 30, 1999. Dewatered sediment was trucked to a landfill owned and operated by Fort James Corporation (now Georgia Pacific). Because of cold weather and ice, dredging ceased on December 15, 1999, after approximately 31,350 cy of contaminated sediment containing more than 636 kg (1,400 pounds) of PCBs were removed from the River.

At the time this project was halted for the first year, SMU 56/57 had not met the project's dredging objective, which was removal of 80,000 cy of material. The result was that unacceptably high concentrations of PCBs in surface sediment were present in portions of the dredged area. Despite this, the project provided instructive experience concerning hydraulic dredging. Building on the successes of the project, Fort James (now Georgia Pacific) worked cooperatively with the WDNR and EPA in the spring of 2000 to complete the SMU 56/57 project. (See a description of this enforcement agreement in Section 2.3, below.) The sediment volume targeted for removal in 2000 was 50,000 cy.

The additional volume of sediment removed from SMU 56/57 in 2000 was 50,316 cy; following dewatering, the material was transported to the same Fort James landfill. Approximately 304 kg (670 pounds) of PCBs were removed from SMU 56/57 during the 2000 project phase. Overall, the 1999 and 2000 efforts at SMU 56/57 resulted in the removal of approximately 940 kg (2,070 pounds) of PCBs from the River. The 2000 project phase met all goals set forth in the Administrative Order By Consent and also met or exceeded the project's operational goals for removal rates, dredge slurry solids, filter cake solids, and production rates set forth for the original 1999 FRG project.

2.2.4 Green Bay White Perch Analysis

In response to requests from parties interested in expanding commercial harvest of white perch from Green Bay, the WDNR undertook a study in 2001 and 2002 to examine whether PCB concentrations in white perch vary by location in Green Bay, by season, or by length of the fish. This was a more extensive examination of PCB concentrations than the WDNR typically conducts when issuing fish consumption advisories.

White perch, which are not native to Green Bay, were first discovered in the Bay in 1988. As part of the fish advisory monitoring program, skin-on white perch fillets were analyzed for PCBs in 1992, 1994, and 1996 because of the growing presence of the species in the Bay. These early analyses showed that the fish contained more than 2 parts per million (ppm, or mg/kg, representing mg PCBs per kg of fish tissue) of PCBs in skin-on fillets. Based on this work, the WDNR and the Wisconsin Department of Health and Family Services (DHFS) issued a sport-fish consumption advisory recommending that individuals eat no more than six meals of white perch each year from Green Bay or the Lower Fox River (below the De Pere dam). Present sport-fishing regulations have no bag limit or size limit for white perch in Green Bay. The upper limit for PCBs in fish for sale in commercial markets under U.S. Food and Drug Administration rules is 2 ppm. WDNR and DHFS fish consumption advisories for PCBs are based on fish tissue concentrations ranging from less than 0.05 ppm (no-limit-on-consumption advisory) to 2 ppm (do-not-eat advisory).

Sport-fish consumption advisories have been established to inform people how much fish from contaminated waters can be safely eaten. The number of recommended meals that a person may safely eat is based upon the average for a given fish size, species, and location. Fish with PCB concentrations of more than 1.9 mg/kg in their skin-on fillet fall into the "Do Not Eat" category, while there are no advisories for fish with body burdens of less than 0.05 mg/kg PCBs. Advisories are reevaluated and revised when new data are available and changed when warranted.

White perch samples were collected during 2001 and 2002 for analysis as individuals to determine whether PCB concentrations in white perch fillets vary by location in the Bay, by season, and by length of the fish. Individual fish were selected for PCB analysis as the collections were completed. In total, skin-on fillets from 145 individual fish were analyzed for PCB concentrations. The fish analyzed in 2001–2002 ranged in size from 6.1 to 13.0 inches. PCB concentrations in skin-on fillets ranged from 0.13 ppm to a high value of 2.2 ppm. Only three out of 145 individual fish contained PCBs equal to or greater than the 2 ppm standard.

The following relationships were determined to be significant for white perch with skin-on fillets.

- PCB concentration is moderately associated with fat and less so with length and weight. Fattier fish tend to have higher concentrations of PCBs. Length and weight are highly correlated measures of the condition of the fish.

- PCB concentrations in the white perch fillets differed significantly by collection location. Adjusted PCB concentrations in fish collected from the southernmost Bay were significantly higher than concentrations in fish collected from the northern Bay. This is not unexpected, because the River is the major source of PCBs to the Bay.

- PCB concentrations differed significantly by season of collection. Fish collected in the spring had the highest PCB concentrations, followed by fish collected in the fall, and then fish collected in the summer.

Based on this study, the following conclusions were reached:

- Based on the most recent data, the sport-fish consumption advisory will remain at six meals per year.

- The 2001–2002 data suggest that PCBs in white perch fillets reflect the location in which the fish were collected and also the season. To minimize the chance of harvesting an individual fish with a PCB concentration that exceeds 2 ppm, fish should be taken from the northern portion of Green Bay. In addition, the study suggests that fishing during the summer months may minimize the chance of harvesting an individual fish with a PCB concentration that exceeds 2 ppm. However, the seasonal pattern observed in 2001–2002 may not hold true in the future.

- The levels of PCBs and fat in white perch may vary with abundance of white perch, growth rates, and food availability and type, as well as with short-term and long-term changes in PCB exposure. Any of these factors may change in future years and future concentrations cannot be predicted from the 2001–2002 data. Future monitoring is needed.

More information is available from the WDNR's Fisheries Management website at: http://www.dnr.state.wi.us/org/water/fhp/fish/pubs/whiteperch.pdf.

2.3 Enforcement Activities

The work on SMU 56/57 described above was conducted from July to November 2000 under an Administrative Order By Consent (Docket No. V-W-00-C-596) that was entered into by Fort James, the EPA, and the State of Wisconsin. Under its terms, Fort James funded and managed the project in 2000 with oversight from both the WDNR and EPA.

An interim Consent Decree settlement was also reached with Appleton Papers/NCR (API/NCR); the Decree was entered by the Court on December 10, 2001. Under this agreement, API/NCR agrees to provide up to $10 million a year for each of 4 years ($40 million in total) for both remediation and restoration work under the natural resource damage process. The determination of which remedial or restoration projects to fund rests solely with the Intergovernmental Partnership. In return, the Intergovernmental Partnership agrees not to order API/NCR to perform remediation or restoration work on the River for the 4-year life of the agreement.

On January 29, 2003, the WDNR and EPA, along with Georgia Pacific Corporation (formerly Fort James Corporation) signed an agreed administrative order under which Georgia Pacific agreed to provide $4 million toward certain characterization and contaminant delineation work, anticipated primarily in the OU 4 area.

3 COMMUNITY PARTICIPATION

3.1 Public Participation

Community/public participation activities were conducted to support selection of the remedy in accordance with the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) § 117 and the National Contingency Plan (NCP) § 300.430(f)(3).

More than 100 people were interviewed in late 1998 and early 1999 to support development of the Site's Community Involvement Plan (CIP). Residents, tribal members, elected officials, business organizations, local health staff, and environmental groups from the affected communities discussed their concerns; those discussions are documented in the CIP. In addition, an extensive profile of each municipality and reservation, as well as a history of the River, was completed for the CIP. The CIP was placed in the information repositories for the Site in 2001.

The information repositories are located at the Appleton Public Library, Oshkosh Public Library, Brown County Library in Green Bay, Door County Library in Sturgeon Bay, and Oneida Community Library. Five additional locations (the Kaukauna, Little Chute, Neenah, De Pere, and Wrightstown Public Libraries) maintain a fact sheet file, although they are no longer information repositories.

The EPA awarded a $50,000 Technical Assistance Grant (TAG) to the Clean Water Action Council (CWAC) in 1999, another $50,000 grant was provided in 2001, and another $50,000 grant was provided in 2003. The council has used its TAG to inform the community about the Lower Fox River investigations. To fulfill its obligations, the CWAC developed a website, printed flyers and bumper stickers, paid for newspaper advertisements, and paid technical advisors to review EPA- and WDNR-generated documents.

The WDNR and EPA held numerous public meetings and availability sessions beginning in the summer of 1997 to explain how and why the Site was proposed for the NPL (i.e., Superfund listing). In February 1999, a draft RI/FS (which did not identify a specific selected remedy) was released with a 45-day public comment period, which was later extended an additional 60 days. Prior to and after the release of the draft RI/FS, the WDNR and EPA provided for extensive community and public participation and kept residents, local government officials, environmental organizations, and other interest groups apprised of the steps in the process. Well-attended public meetings, small group discussions, meetings and presentations for local officials, and informal open houses continued through 2001.

The public meetings and availability of the Proposed Plan were announced to the public at a press conference on October 5, 2001, and received extensive television, radio, and newspaper coverage. The draft RI/FS and Proposed Plan were formally presented at public meetings held on October 29, 2001, in Appleton and October 30, 2001, in Green Bay. Additionally, the WDNR and EPA mailed meeting reminders and summaries of the Proposed Plan to the 10,000 names on the Fox River mailing list. Press releases pertaining to the Proposed Plan, the comment period, and the public meetings were sent to newspapers and television and radio stations throughout the Fox River Valley. Display advertisements announcing the Proposed Plan, comment period, and public meetings were also placed in Green Bay and Appleton newspapers. The presentations and question-and-answer sessions at the public meetings, as well as all public comments taken at the meetings, were recorded and transcribed. The written transcripts of the public meetings are available in the information repositories, the Administrative Record, and on the WDNR Lower Fox River web page (http://www.dnr.state.wi.us/org/water/wm/lowerfox/index.html).

More than 20 public meetings and availability sessions have been held regarding the project. Among the topics on which these meetings focused are cleanup and restoration activities, the status of pilot projects, fish consumption advisories, and the February 1999 draft RI/FS released by the WDNR. Additionally, over 15 small group and one-on-one interview sessions have been held. Project staff have also made more than 60 presentations to interested organizations and groups. In addition, the WDNR, EPA, and their intergovernmental partners publish a bimonthly newsletter, the *Fox River Current*, which is mailed to over 10,000 addresses. To date, more than 25 issues of the *Fox River Current* have been published.

Copies of the various supporting reports and the Proposed Plan were made available to the public during a public comment period that began on October 5, 2001, and concluded on January 22, 2002. (Originally, the comment period was for 60 days, ending on December 7, 2001, but it was extended until January 22, 2002. The announcement of this extension was published through newspaper advertisements and news releases on October 25, 2001.) Approximately 4,800 written comments were received via letter, fax, and e-mail. A copy of the Responsiveness Summary for comments that pertain to OU 3, OU 4, and OU 5 is attached to this ROD. Additionally, many comments were addressed in the Responsiveness Summary attached to the ROD issued for OU 1 and OU 2; a number of those comments and responses also pertain to OU 3, OU 4, and OU 5.

Newspaper advertisements announcing the availability of the plan and its supporting documents were placed in the *Green Bay Press Gazette* and the *Appleton Post Crescent*, and a brief summary of the plan was placed in the information repositories. The Proposed Plan, the RI/FS, and other supporting documents containing information upon which the proposed alternative was based were also made available on the Internet at http://www.dnr.state.wi.us/org/water/wm/lowerfox/index.html and at the EPA Region 5 website at http://www.epa.gov/region5/. All documents were also available as part of the Administrative Record housed at WDNR offices in Madison, Wisconsin, and Green Bay, Wisconsin, and at the EPA Region 5 office in Chicago, Illinois.

Following the release of the ROD for OUs 1 and 2, the WDNR and EPA held a public information meeting on January 29, 2003, in Appleton, Wisconsin.

Information Repositories and Administrative Records

Copies of the ROD for OUs 3, 4, and 5 and the associated Responsiveness Summary, as well as other documents related to the Lower Fox River cleanup, are available in reference sections of the following libraries:

- *Appleton Public Library*
  225 N. Oneida Street
  Appleton, Wisconsin
  (920) 832-6170
- *Brown County Library*
  515 Pine Street
  Green Bay, Wisconsin
  (920) 448-4381, Ext. 394
- *Door County Library*
  104 S. Fourth Street
  Sturgeon Bay, Wisconsin
  (920) 743-6578
- *Oneida Community Library*
  201 Elm Street
  Oneida, Wisconsin
  (920) 869-2210
- *Oshkosh Public Library*
  106 Washington Avenue
  Oshkosh, Wisconsin
  (920) 236-5200

An Administrative Record containing detailed information upon which the selection of the cleanup plan was based is available at the WDNR Lower Fox River Basin Team Office, 801 E. Walnut Street, Green Bay; at the WDNR Bureau for Remediation and Redevelopment Office, 3rd Floor, 101 S. Webster Street, Madison; and at the EPA Records Center, 7th Floor, 77 W. Jackson Boulevard, Chicago, Illinois.

4 SCOPE AND ROLE OF RESPONSE ACTION

As with many Superfund sites, the problems at the Site are complex. As a result, the WDNR and EPA organized the Site into five OUs as described in Section 1.1.

The Proposed Plan, issued in October 2001, recommended a remedy for each of the five Operable Units at the Site. In January 2003, the WDNR and EPA released the ROD for OUs 1 and 2. At this time, the WDNR and EPA are issuing a ROD for OUs 3 and 4 in the River and OU 5, Green Bay. With the issuance of this ROD, the WDNR and EPA have completed issuing a final remedial decision for the entire Site.

The primary objective of this ROD is to select the remedy that will address the risks to human health and the environment resulting from PCBs in the in-place sediment of OUs 3 and 4 in the River and OU 5, Green Bay. PCB concentrations remain elevated in River sediment, in the water column, and in the fish. Removal of the PCB-contaminated sediment will result in reduced PCB concentrations in fish tissue, thereby accelerating the reduction of future human health and ecological risks. In addition, by addressing the sediment, the remediation will control the most critical source of PCBs to the water column, which contributes to fish tissue concentrations and transports PCBs into downstream reaches of the River, Green Bay, and eventually to Lake Michigan.

This ROD builds upon work already accomplished (the cleanup actions in deposits N and O and in SMU 56/57, described in Section 2.2.3) and the remedial work to be accomplished in OUs 1 and 2 (as described in the ROD for OUs 1 and 2). Together with the OU 1 and OU 2 ROD, this ROD completes remedial decision making for the entire Site.

5 PEER REVIEW

To ensure the credibility of the scientific work conducted during the RI/FS, the EPA conducted two forms of peer involvement: peer input and peer review. Peer input was conducted through internal WDNR and EPA reviews, as well as reviews by other agencies and tribes. More formal peer review was also conducted, in accordance with EPA guidance outlined in the *Peer Review Handbook* (dated December 1998, updated December 2000). The peer review, which focused on some of the major scientific findings that form the basis for this decision, was conducted by independent experts who were unaffiliated with the EPA, WDNR, FRG, or other Site stakeholders.

Two separate EPA-sponsored peer review panels were convened, one to consider the Remedial Investigation (RI), the other to consider the Feasibility Study (FS). Each panel conducted an independent review by three panel members, with technical and administrative support from an EPA contractor. The EPA contractor was responsible for convening the panels, consistent with the “charge” (a request to address specific questions) given by the EPA for the panel review. The peer review was undertaken without influence by the EPA, WDNR, FRG, or other interested parties to provide an independent analysis of and comment on key documents and issues related to the development of a proposed remedy. Specifically, the panels were asked to evaluate:

- The adequacy of the data considered in the 1999 draft RI relative to quality and quantity (RI Panel).
- Natural recovery and environmental transformation, i.e., biological breakdown of PCBs (FS Panel). Natural recovery was defined by the panel as naturally occurring physical, chemical, or biological processes that reduce the risks associated with contaminants in sediment over time.

Each peer review panel was asked to address specific questions (the “charge”) regarding the report being reviewed, including key controversial issues identified by the EPA. The RI and FS Panels issued reports dated October 7, 1999, and September 28, 1999, respectively.

The following summarizes the major findings of the panels:

- The data are adequate to determine the distribution of contaminants (i.e., it can be decided where cleanups should take place) if all data sources are considered (i.e., the RI does not provide a complete compilation of all data).

- The data from all available sources are adequate to support identification and selection of a remedy for those technologies (for example, dredging and capping) that have been used on a large scale at other, similar sites. The data are insufficient for developing *in-situ* bio-technologies that may be applicable to the Site.

- Substantial improvements or additions to the existing data set are not indicated.

- The draft FS should more fully evaluate natural recovery of sediments as a remedial alternative in comparison with other remedial options.

- The technical basis of the natural recovery analysis needs to be described in more detail to permit a review of the methodology used and to assess confidence in natural recovery predictions.

In the 2001 draft RI/FS and the Proposed Plan, the WDNR and EPA considered the recommendations by the peer review panels and, on that basis, made modifications to the draft documents upon which the Proposed Plan was based.

In addition to EPA-sponsored peer reviews, the FRG sponsored peer reviews that were technically consistent with EPA peer review policy, although they may not have conformed to all aspects of the peer review process and documentation. These reviews consisted of the following analysis for the River:

- Fate and transport and bio-uptake modeling evaluations by the WDNR and FRG
- Human health and ecological risk assessments by the WDNR and FRG

Recommendations arising from both the EPA- and FRG-sponsored peer reviews were considered and incorporated into the 2001 draft RI/FS, which was a significant part of the basis for the Proposed Plan.

6 SITE CHARACTERISTICS

6.1 Conceptual Site Model

The conceptual site model for the Site describes the source-to-receptor succession in simple terms and identifies the major contamination sources (discussed in Section 2.1.1), contaminant release mechanisms, secondary sources, pathways, and receptors of concern. Figures 6-1, 6-2, 6-3, and 6-4 show both human health (Figure 6-1) and ecological (Figures 6-2, 6-3, and 6-4) conceptual site models. The design of field investigations and of the human health and ecological risk assessments reflect the basic components of the conceptual site model.

The conceptual site model shows that historical PCB releases were from paper manufacturing and paper recycling facilities that discharged wastewater into the River. Current wastewater releases are considered insignificant. The historical discharges created contaminated sediment "hot spots" — areas where PCBs are concentrated. These contaminated sediment hot spots contribute to the overall PCB load in the River and the Bay.

Once introduced into the River, the PCBs adhere to sediment, with some fraction being carried in the water column. Physical, chemical, and biological release mechanisms allow PCBs in the sediment to become available for redistribution and a source of PCB contamination to the water column. Unless the PCB-contaminated sediment is managed or remediated in some manner, the sediment will continue to release PCB contamination to the water column through these mechanisms. Biological release mechanisms include biotic decomposition, which allows contaminants to cycle through the pelagial, aquatic, and benthic food chains. Physical release mechanisms include boat scour, ice rafting, and bioturbation, which are not easily modeled. In addition, scour from water flowing over sediment during high-flow events will continue to redistribute sediment and reexpose contaminants.

Generally, PCB-laden sediment is not sequestered or stable, because the River is a dynamic system with varying energy regimes. At times, some PCB-contaminated sediment is buried by deposition of cleaner sediment, but in other places and at other times, contaminants are redistributed. This redistribution may be local or more regional, depending on the energy of flow events and/or the physical type or size of the sediment particles. The redistributed sediment releases contamination to the water column. High-flow events (e.g., floods) further increase the bioavailability of contaminants to organisms in the water column. Although scour during high-flow events is an important release mechanism, PCBs in the surface water are also routinely observed during periods of lower flows (see the water column discussion in Section 6.2.3).

The conceptual site model shows that the fish ingestion pathway is a completed exposure route for the Site. Receptors include humans (such as anglers and their families), piscivorous (that is, fish-eating) fish, piscivorous birds (including threatened and endangered species), and mammals. Additional information on the human and ecological receptor populations is provided in Section 8 of this ROD, which summarizes the Site risks.

Figure 6-1 Human Health Conceptual Site Model for the River and Bay

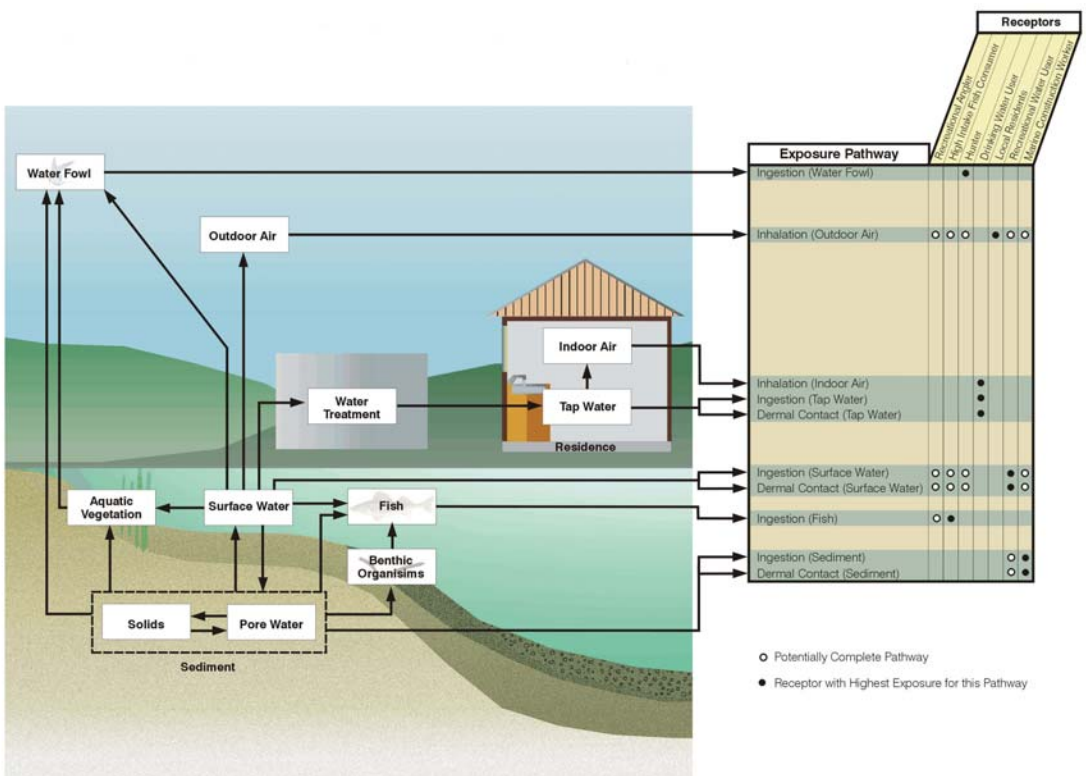


Figure 6-2 Ecological Conceptual Site Model for OU 3

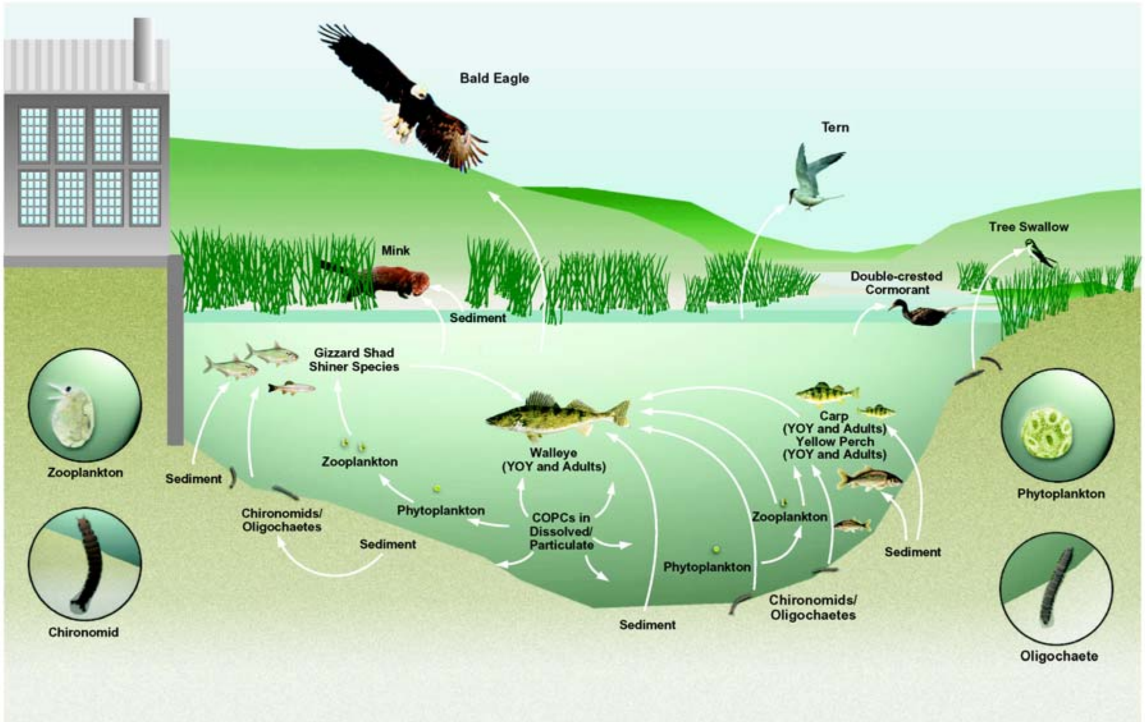


Figure 6-3 Ecological Conceptual Site Model for OU 4 and OU 5 – Zone 2

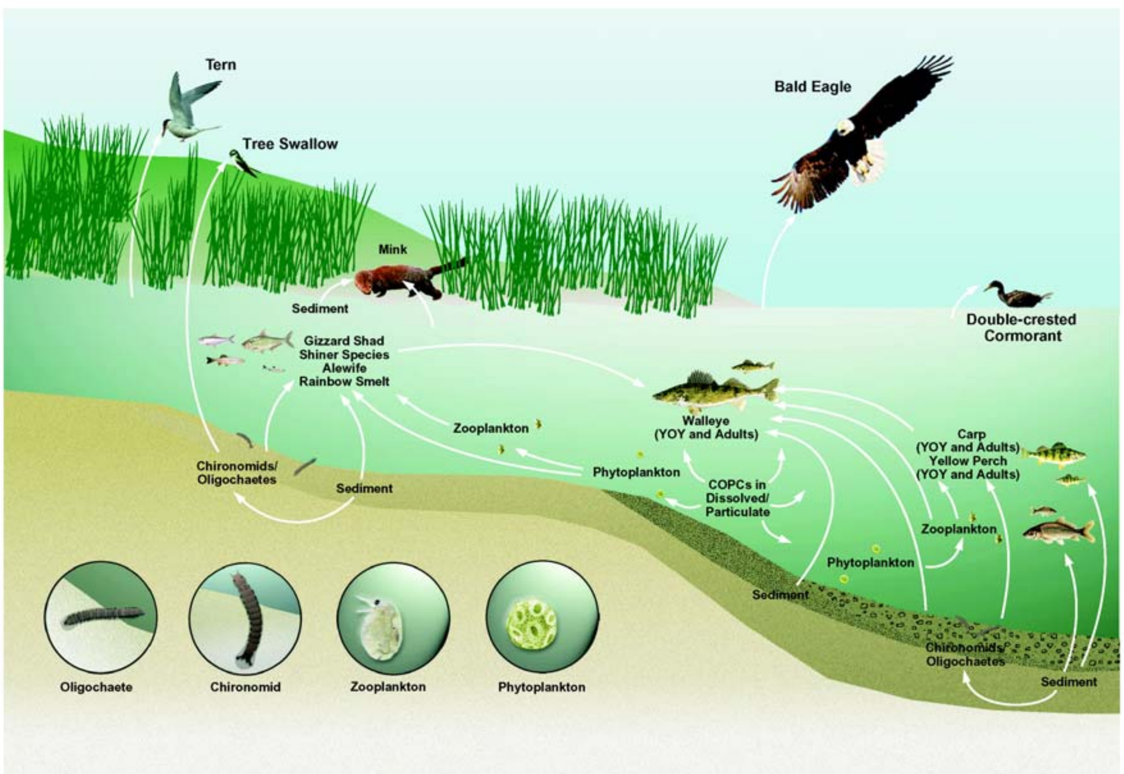
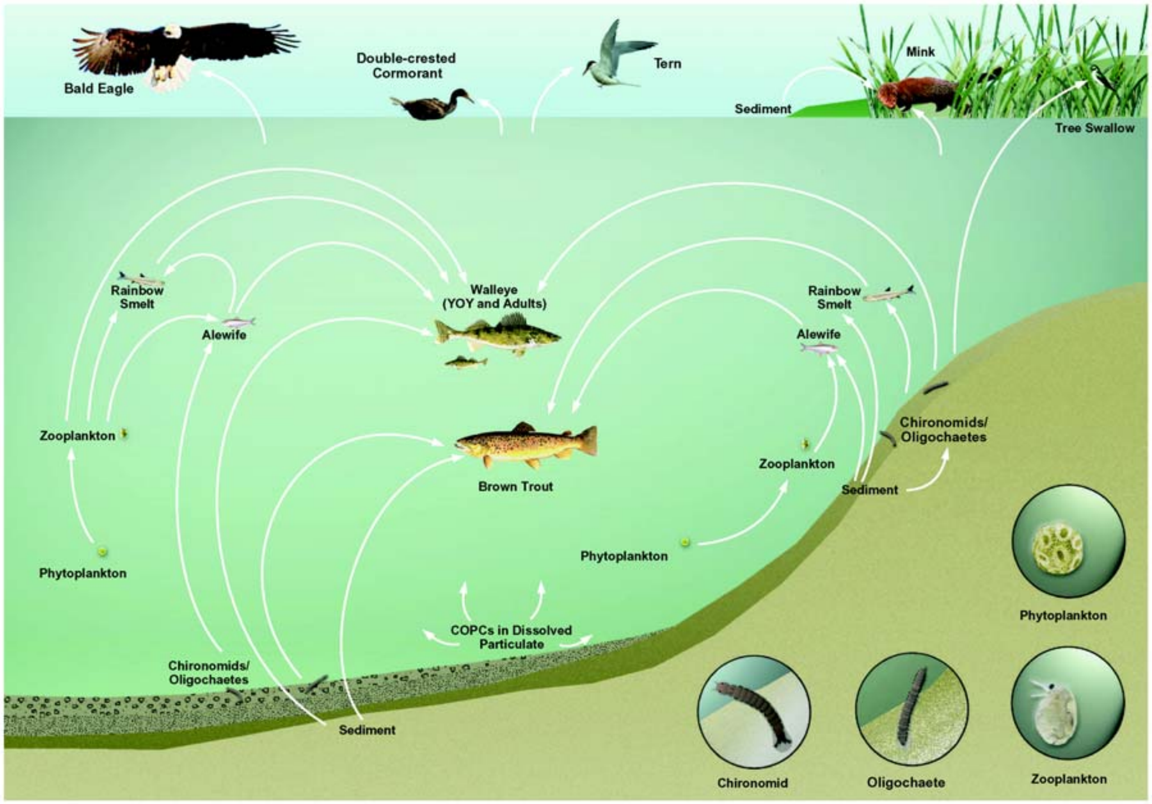


Figure 6-4 Ecological Conceptual Site Model for OU 5 Zones 3A, 3B, and 4



6.2 Results of the Remedial Investigation

6.2.1 Site Overview

The Lower Fox River is a large freshwater river. Green Bay is a large freshwater body of water, roughly 119 miles long with an average width of 23 miles. The southern end of the Bay is a warm water estuary with shallow depths, while the northern half is deeper and has cold water more typical of Lake Michigan. The River and Bay have been contaminated with PCBs for nearly 50 years. The contaminated portions of the River have variations in hydrology and riverbed geology, creating a complex environmental setting. Within this setting, there are varying levels of PCB contamination.

6.2.2 Summary of Sampling Results

The RI/FS evaluated data from numerous prior investigations, some of which had been conducted as early as 1971. These data have been incorporated into a single Fox River Database (FRDB), which is available at the WDNR's Lower Fox River web page (http://www.dnr.state.wi.us/org/water/wm/lowerfox/index.html). The current database contains more than 580,000 analytical records captured since 1971, including every substantial data collection activity from 1989 to the time of the release of this ROD. The FRDB covers analysis of samples of sediment, water, air, and biota (e.g., fish and wildlife tissues). Data received as part of the comments on the Proposed Plan have been added to the database.

6.2.3 Nature of Contamination

Based upon the investigations conducted for this project, it was determined that PCBs are the primary risk driver, and PCB contamination was therefore studied in the RI/FS. PCBs consist of a group of 209 distinct chemical compounds, known as congeners, that contain one to ten chlorine atoms attached to a biphenyl molecule, with the generic formula of $C12H_{(10-x)}Cl_x$, where x is an integer from 1 to 10. PCBs are grouped based on the number of chlorine atoms present (homologous groups). For example, monochlorobiphenyls contain one chlorine atom, dichlorobiphenyls contain two chlorine atoms, and trichlorobiphenyls contain three chlorine atoms. Some PCB congeners are structurally and toxicologically similar to another highly toxic group of compounds known as dioxin. These PCB compounds are sometimes called “dioxin-like” PCBs.

Commercially manufactured PCBs consisted of complex mixtures of congeners that were known under various trade names and marketed under the general trade name “Aroclors.” Approximately 140 to 150 different congeners have been identified in the various commercial Aroclors; about 60 to 90 different congeners were present in each individual Aroclor.

The PCBs used by paper manufacturing facilities on the River in the production of carbonless copy paper from 1954 to 1971 consisted largely of the Aroclor identified as “1242.” Carbonless copy paper produced during this time contained approximately 3.4 percent PCBs by weight.

Other chemicals of potential concern (COPCs) (for example, mercury, lead, arsenic, dieldrin, DDT/DDE/DDD, furan, and dioxin) are also present at the Site. However, these non-PCB contaminants are not significant risk drivers because of their relatively low concentrations. Additionally, some of the other COPCs identified in sediment have fate and transport properties similar to those of PCBs and are generally co-located with PCBs. For this reason, a remedy that effectively addresses PCB exposure will also address the other COPCs (which pose less risk) in the sediment.

Sources

Approximately 20 paper mills are located along the portion of the River included in the Site. Of these companies, six engaged in the production or de-inking of carbonless copy paper containing PCBs and, as a result, discharged PCBs to the River. It is estimated that the wastewater discharged by the paper mills, either directly or indirectly (i.e., through publicly owned treatment works), released an estimated 313,260 kg (690,000 pounds) of PCBs into the River.

Contaminated Media

Sediment

Much of the volume of PCBs discharged into the River has already been transported throughout the Site and is now concentrated in sediment within specific areas. In general, the upper three River reaches can be characterized as having discrete soft sediment deposits within inter-deposit areas (areas between deposits with little or no soft sediment). In contrast, the last River reach from De Pere to Green Bay is essentially one large, continuous soft sediment deposit. Because there were several points of PCB discharge along the entire length of the River, PCB concentrations and mass distributions are highly variable. Table 6-1 summarizes the distribution of PCBs within the sediment of OUs 3, 4, and 5. (Also see Tables 8-1 through 8-6 in Section 8 of this ROD, which summarize PCB contaminant concentration data for OUs 3, 4, and 5.)

Table 6-1 PCB Distribution in the Lower Fox River OUs 3, 4, and 5

River Reaches	Sediment Volume (cy)	PCB Mass (kg)
OU 3 – Little Rapids to De Pere	3,030,100	1,250
OU 4 – De Pere to Green Bay	8,491,400	26,650
OU 5 – Green Bay*	815,210,000	69,330

* The Green Bay mass and volume estimates are from the RI. Please see *White Paper No. 18 – Evaluation of an Alternative Approach of Calculating Mass, Sediment Volume, and Surface Concentrations in Operable Unit 5, Green Bay,* and *White Paper No. 19 – Estimates of PCB Mass, Sediment Volume, and Surface Sediment Concentrations in Operable Unit 5, Green Bay Using an Alternative Approach* for a complete discussion of Green Bay mass and volume estimates.

Transport of PCBs in the Fox River and Green Bay

Contaminant fate and transport in the River and Bay are largely a function of deposition, suspension, and redeposition of the chemicals of concern (COCs) that are bound to sediment particles. The organic COCs (PCBs, pesticides) adhere to organic material in the sediment. The ultimate fate and transport of these organic compounds depend significantly on the rate of flow and water velocities through the River and Bay. During high-flow events such as storms and spring snowmelt, more sediment becomes suspended and transported downstream. High-flow events occur approximately 15 to 20 percent of the time, but can transport more than 50 to 60 percent of the PCB mass that annually moves over the De Pere dam and into the Bay. Other modes of contaminant transport, such as volatilization, atmospheric deposition, and point source discharges, are negligible when compared to this sediment resuspension.

Changes in Sediment Bed Elevation

The River is an alluvial river that exhibits significant changes in bed elevations over time in response to changing volumes of flow during annual, seasonal, and storm events; changes in sediment load; and changes in its base level, which is determined by Lake Michigan. Sediment in the riverbed is dynamic and does not function as discrete layers. Sediment movement in the River is in marked contrast to the sediment dynamics found in a large, quiescent body of water, such as deep lakes or the deeper portions of the Bay.

Scouring of the sediment bed plays a significant role in the quantity of sediment and contaminants transported through the River system. In its comments on the 1999 draft RI/FS, the FRG commented that less than 1 inch of sediment would be resuspended from the riverbed as a result of a 100-year storm event. In response to that comment, the WDNR and EPA investigated changes in sediment bed elevation for the De Pere to Green Bay River reach (OU 4). This work, entitled *Technical Memorandum 2g of the Model Documentation Report*, is relevant to OU 4 and informative regarding movement of River sediments generally. (Technical Memorandum 2g was completed by a group called the FRG/WDNR Model Evaluation Workgroup as part of the 1997 agreement between the FRG and WDNR. The EPA made further evaluations that were consistent with changes documented in Technical Memorandum 2g; see *White Paper No. 3 – Fox River Bathymetric Survey Analysis*, released with the Lower Fox River and Green Bay ROD for OUs 1 and 2.) Monitoring indicates that the River is both erosional and depositional over time, reflecting the fact that the hydrodynamics of the River are very complex. These same results indicate that in the absence of continued point sources contributing PCBs to the system, the continued presence of PCBs in the Lower Fox River is the result of erosion, transport, and redeposition of PCB-contaminated sediment.

These analyses indicate that changes in sediment bed elevation occur in the River over both short- and long-term time frames. Changes in sediment bed elevation were observed both across the channel and downstream profiles, and these changes show little continuity. Since River flows have not significantly changed in recent years, the complexity of the changes in sediment bed elevation reflects the prevailing hydrologic and sediment conditions that occurred over a 22-year period from 1977 through 2000. However, it should be noted that lake levels are at historically low levels and additional declines are projected over the long term. Therefore, the potential for erosion and scour may increase, particularly during large storm events.

The wide range of these discharges and sediment loads continuously reshapes the River sediment bed. Short-term changes (e.g., annual and subannual) in average net sediment bed elevations range from a decrease or scour of over 11 inches to an increase or deposition of over 14 inches. Long-term changes (e.g., over several years) in average net elevations range from a decrease of more than 39 inches to an increase of nearly 17 inches. These documented changes are well supported by sediment volume calculations made by the United States Army Corps of Engineers (USACE) from pre- and post-dredge surveys of sediment bed elevations, as well as by the results of an analysis by the United States Geological Survey (USGS) of bed surveys performed at intermediate time scales (e.g., 8 months to 45 months).

Surveys of the River bottom conducted by several different groups show significant changes in sediment bed elevation. On average, sediment bed elevation data from throughout the De Pere to Green Bay Reach suggest that this River reach is a net depositional zone. It should be noted that during the survey period, there were no large storm events of a 10-year or greater magnitude. It is unknown what the scour would be during larger events.

The Potential for Natural Biodegradation of PCBs

Responding to comments received from the EPA's peer review panel concerning natural recovery, the viability of natural degradation as a potential remedial action for the sediment-bound PCBs in the River and Bay was evaluated and set forth in Appendix F of the Lower Fox River and Green Bay FS.

In summary, two basic degradation processes, anaerobic (without oxygen) and aerobic (in the presence of oxygen), must occur to completely decompose PCBs. Based on evidence in the literature, anaerobic PCB degradation was demonstrated to have occurred under field conditions at almost all the sites studied. However, a reduction in PCB concentrations through anaerobic processes is site-dependent. In the Lower Fox River, University of Wisconsin researchers found only a 10 percent reduction that could be attributed to anaerobic degradation processes in deposits with average PCB concentrations greater than 30 mg/kg. More important, no PCB reductions resulting from anaerobic processes could be accounted for in deposits with average concentrations less than 30 mg/kg.

Other active treatment options might promote dechlorination of the sediment, making the PCBs more amenable to biological destruction. However, a pilot-scale experiment conducted at the Sheboygan River, another site with PCB-contaminated sediment, yielded inconclusive results regarding the viability of enhanced biodegradation. In that study, PCB-contaminated sediment was removed from the river and placed into a specially engineered treatment facility. The sediment was seeded with microorganisms and nutrients, and the sediment was manipulated between aerobic and anaerobic conditions to optimize biological degradation. Even under these conditions, the data were insufficient to conclude that PCB decomposition was enhanced.

Effects of Time

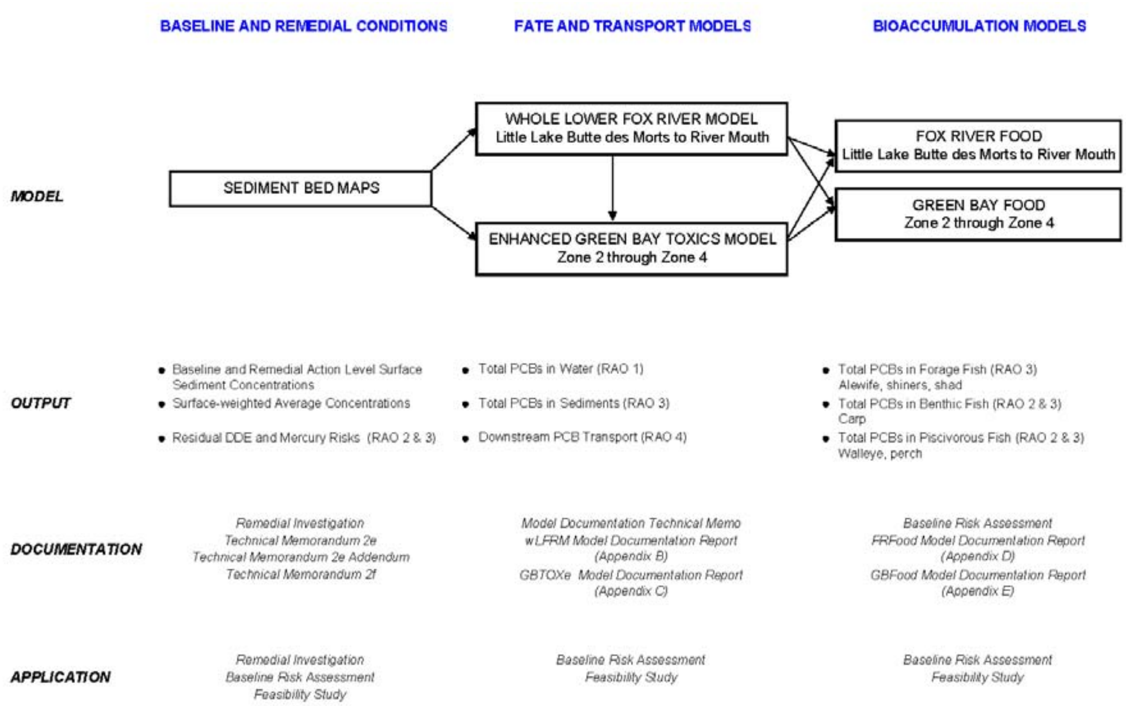
The FRDB includes test results for sediment, water, and tissue samples collected since 1971. During the 1970s, after the use of PCBs in the manufacture of carbonless copy paper had ceased, PCB concentrations in fish tissue showed significantly declining concentrations. Since the mid-1980s, however, changes in PCB levels in fish have slowed, remained constant, or, in some cases, increased. The Time Trends Analysis (see Appendix B to the Remedial Investigation and *White Paper No. 1 – Time Trends Analysis,* December 2002, released with the Lower Fox River and Green Bay ROD for OUs 1 and 2) conducted as part of the RI suggests that the rate of change in PCB concentrations in fish has slowed to unacceptable levels in certain cases or, in some cases, has stabilized and shows no change at all.

Trends in PCB concentrations in the surface layer (i.e., top 4 inches) of River sediment are not consistent, but concentrations generally appear to be decreasing over time as more PCB mass is transported downstream. However, the Time Trends Analysis showed that concentrations in the subsurface sediments do not appear to be declining. This indicates that a considerable amount of PCB mass remains within the sediments of the River. Any changes made to the current lock and dam configuration on the River could result in increased scour and resuspension of those underlying sediments, which could in turn result in increases in PCB concentrations in fish tissue. In addition, soil eroded from the watershed mixes with and may further dilute PCB concentrations in the sediment.

<u>Modeling Effort for the Lower Fox River and Green Bay</u>

Four interrelated models were used in the RI/FS to simulate the fate and transport of PCBs in the River and the Bay (Figure 6-5). The models are mathematical representations of the transport and transfer of PCBs between the sediment, the water, and uptake into the River and Bay food webs. The models are intended not only to provide information on the fate and transport of PCBs in an unremediated river system, but also to compare the potential remedial alternatives detailed in the FS. Although the models tend to estimate concentrations lower than the concentrations actually observed in the River, the relative differences predicted by the models are considered to be reliable.

Figure 6-5 Relationship of Models Used for Risk Projections in the Lower Fox River and Green Bay



The modeling effort included:

- Bed mapping of the River and Bay to define sediment thickness, sediment physical properties (such as total organic carbon and bulk density), and total PCB concentrations
- Use of the whole Lower Fox River Model (wLFRM) to simulate the movement of PCBs in the water column and sediment of the River from Little Lake Butte des Morts to the mouth of the River at Green Bay
- Use of the Fox River Food Chain Model (FRFood) to simulate the uptake and accumulation of PCBs in the aquatic food chain in the River using model results from wLFRM
- Use of the Enhanced Green Bay PCB Transport Model (GBTOXe) to simulate the movement of PCBs in the water column and sediment of Green Bay from the mouth of the Lower Fox River to Lake Michigan, including loading rates to Green Bay based on model results from wLFRM
- Use of the Green Bay Food Chain Model (GBFood) to simulate the uptake and accumulation of PCBs in the aquatic food chain in the lowest reach of the Lower Fox River and in Green Bay

Bed mapping provided the foundation for the modeling inputs. Total PCB concentrations in surface sediment for the baseline and action levels serve as inputs to wLFRM and GBTOXe. This model projects total PCB concentrations in water and sediment. The output from this model is in turn used in the bioaccumulation models, FRFood and GBFood, to project whole fish tissue concentrations of PCBs (see Figures 6-2 to 6-4). The output from all of the models is then compared to the remedial action levels specified in the FS. This information is used in the FS to estimate the length of time it would take for a receptor to achieve the acceptable fish tissue concentration in response to a given action level.

Taken together, these models provide a method for evaluating the long-term effects of different remedial alternatives and different action levels on PCB concentrations in water, sediment, and aquatic biota in the River and Bay. The models are then used to predict PCB concentrations in the aquatic environment over a 100-year period under different remedial alternatives and action levels. The modeling results are discussed in the FS and a more detailed discussion on modeling can be found in the Model Documentation Report. A complete copy of that report is available on the WDNR's Lower Fox River web page, which can be accessed at http://www.dnr.state.wi.us/org/water/wm/lowerfox/index.html.

In summary, in the RI/FS the Agencies evaluated PCB contamination at the Site using a number of tools. These tools included geochemical analyses of the water and sediment, "time trends" (i.e., statistical) analyses, analysis of biological monitoring data, and synthesis of the data by the application of a set of complex mathematical (i.e., computer) models. PCB physical/chemical transport and fate and PCB bioaccumulation models were applied to predict future levels of PCBs in the River and Bay sediment, water, and fish, as discussed below.

Water Column

The dominant current PCB source to the water column is sediment. Average River surface water total concentrations are 54.6 parts per trillion (ppt), with particulates and dissolved concentrations 40.0 ppt and 14.6 ppt, respectively. There are significant seasonal variations, particularly when the water temperature drops below 40 degrees Fahrenheit (°F). For example, during the winter months of December 1994 and February 1995, total PCB concentrations dropped to about 10 percent of their average concentration. See Tables 8-1 through 8-6 in Section 8 of this ROD for data on surface water PCB concentrations for OU 3, OU 4, and OU 5.

Fish and Other Biota

PCB concentrations in fish result from a fish's exposure to PCBs in water and surface sediment through an aquatic food chain and/or a benthic food chain. The WDNR continues to collect and analyze fish tissue data from locations in the River and the Bay. See Tables 8-1 through 8-6 in Section 8 of this ROD for data on fish (walleye) PCB concentrations for OU 3, OU 4, and OU 5.

A wide variety of fish and other species have been collected and analyzed for the River and the Bay from 1971 to present. In general, these data suggest concentrations in biota have declined, although the rate of decline varies depending upon the location and time. However, it is important to note that this does not appear to be true for all cases. For certain fish species evaluated as part of the Time Trends Analysis, it appears that the rate of change in fish PCB concentrations has slowed to unacceptable levels in certain cases or, in some cases, has stabilized and shows no change at all.

Air

PCBs can enter the air via volatilization from PCB-contaminated water and soil, although volatilization of PCBs is generally considered to be limited. Air monitoring during the 1999 SMU 56/57 dredging project demonstrated that volatilization of PCBs does not pose a significant risk to humans or wildlife. Based on previous modeling, PCB loading to the Lower Fox River and Green Bay from atmospheric sources is relatively small, estimated to be a maximum of 5 kg (11 pounds) to the River and 35 kg (77 pounds) to Green Bay.

7 CURRENT AND POTENTIAL FUTURE SITE AND RESOURCE USES

As one of Wisconsin's great rivers, the Lower Fox River has played and will continue to play a major role in the history, culture, and economy of the area. Current and reasonably anticipated future land and surface water uses are described below.

7.1 Current and Reasonably Anticipated Future Land Uses

Current land use includes a variety of residential, commercial, agricultural, and industrial activities. Other uses of land along the River and Bay include recreational areas such as parks and woodlands. Future uses of the River and lands surrounding the River are expected to remain consistent with present uses. At this time, no changes in future land use are known, nor are any new uses expected. Table 7-1 summarizes current land uses for OUs 3, 4, and 5, which pass through and border on Brown, Door, Kewaunee, Marinette, Oconto, Outagamie, and Winnebago Counties in Wisconsin and Delta and Menominee Counties in Michigan.

Table 7-1 Predominant Land Uses by Operable Unit

Operable Unit	Predominant Land Uses
OU 3 – Little Rapids to De Pere	Agricultural, residential
OU 4 – De Pere to Green Bay	Residential, industrial, commercial, agricultural, and commercial
OU 5 – Green Bay	Residential, industrial, commercial, agricultural, and commercial

7.2 Surface Water Uses

Human uses of the surface waters of the River and Bay range from the industrial and commercial to the residential and recreational. In addition, surface waters of the River and Bay fill important ecological functions. These uses are briefly described below.

- **Industrial and Commercial:** Uses include electrical power generation, paper mills and related production facilities, heavy and light manufacturing, as well as other industrial and commercial activities.

- **Residential/Domestic:** Because of historical problems in the River, the main water supply sources for human consumption in the areas surrounding OUs 3, 4, and 5 are Lake Michigan and groundwater, not the River. The River is not presently used as a primary source of drinking water source by municipalities.

- **Recreation:** The River and Bay support a variety of water-based recreational activities, including sport fishing, waterfowl hunting, swimming, and boating, both power and non-power. Tourism is popular and important to the local economy.

- **Ecological Resources:** The River and Bay support many species of birds (such as tree swallow, Forster's and common tern, double-crested cormorants, and bald eagles), fish (such as rainbow smelt, alewife, gizzard shad, shiner, yellow perch, carp, brown trout, and walleye), and mammals (for example, mink), including 16 species of state or federally listed threatened or endangered species.

  The River also provides diverse habitats for all trophic levels of the River and Bay ecosystem. Plants, plankton, aquatic invertebrates, fish, amphibians, reptiles, birds, and mammals use the River for feeding, reproduction, and shelter. In addition to the aquatic communities associated with the River, animals living in wetlands, floodplains, and upland communities are also dependent on the River. Both federal and state freshwater wetlands exist in the River region, providing valuable habitat.

8 SUMMARY OF SITE RISKS[1]

Baseline human health and ecological risk assessments were conducted to evaluate the potential for current and future impacts of site-related contaminants on receptors visiting, utilizing, or inhabiting the River and the Bay. The Baseline Human Health and Ecological Risk Assessment (BLRA) for the Lower Fox River and Green Bay was prepared as a companion document to the RI/FS and was finalized in December 2002.

In the BLRA's Human Health Risk Assessment (HHRA), cancer risks and noncancer health hazards were evaluated for the River and Bay. In the BLRA's Ecological Risk Assessment (ERA), ecological risks were evaluated for the River and Bay.

The BLRA concluded that:

- Human health and ecological receptors are at risk in each Operable Unit.

[1] Publication details for references cited in this section can be found in the BLRA and/or RI/FS documents, which appear in the Administrative Record and are also available in the information repositories.

- Fish consumption is the exposure pathway presenting the greatest level of risk for human and ecological receptors.
- The primary contaminant of concern is PCBs.

8.1 Identification of Chemicals of Concern

More than 75 chemicals of potential concern (COPCs) were identified in the Screening Level Risk Assessment (SLRA) conducted to evaluate which chemicals in the system pose the greatest degree of risk to people and ecological receptors. COPCs identified for the Lower Fox River included metals, PCBs, dioxins, pesticides, and polycyclic aromatic hydrocarbons. Based on a further review of the COPCs in fish tissue, the Agencies, along with the Biological Technical Assistance Group (BTAG), made a determination that only the following eight COPCs should be carried forward into the BLRA: PCBs (total and/or Aroclor 1242), dioxins, furans, DDT/DDE/DDD, dieldrin, arsenic, lead, and mercury. The rationale supporting this decision is documented in Appendix A to the BLRA.

Human health and ecological risks associated with those eight COPCs were evaluated in the BLRA. It was concluded that all the COPCs posed risk to at least one receptor group in at least one reach or zone of the River or Bay; however, only PCBs, DDE, and mercury posed risk to all receptors (both human and ecological) in all areas evaluated. Of those, PCBs were the primary chemical of concern (COC). As a result of this process, only PCBs, DDE, and mercury were carried forward for evaluation in the FS as COCs.

PCB Health Effects

Studies on the human health effects and risks associated with exposure to PCBs, including from fish consumption, show:

- *Neurobehavioral and developmental problems, such as impaired responsiveness, short-term memory problems, and reduced mental abilities in the infants and children of mothers exposed to PCBs prior to and during pregnancy (Jacobson, 1984, 1985, 1990; Koopman, 1996; Huisman, 1995; Lonkey, 1996; Rogan, 1985).*
- *Three times the chance of having lower IQ scores; twice the chance of lagging at least 2 years behind in reading comprehension; short-term and long-term memory effects and difficulties paying attention (Jacobson, 1996).*
- *Increased risk of cancer and immune system effects among the general population and workers producing PCB capacitors (Bertazzi, 1987; Brown, 1987; Sinks, 1991; Svensson, 1984; Rothman, 1997).*

Because of the potential health impacts, fish consumption advisories have been in place since 1976 for both the Lower Fox River and Green Bay. These advisories, published regularly by the Wisconsin Department of Natural Resources, warn residents to limit or eliminate locally caught fish (for example, carp and catfish) from their diets. The advisories also provide tips on how to properly clean and cook fish to reduce the risk of PCB exposure.

8.2 Human Health Risk Assessment

8.2.1 Summary of Site Risks

The site-specific HHRA evaluated both cancer risks and noncancer health hazards from exposure to PCBs and other COCs in the Site, as documented in the RI/FS. This discussion emphasizes cancer risks and noncancer health hazards due to PCBs in the River and Bay that exceed the EPA's goals for protection. For cancer effects, regulatory decisions are made ranging from incremental risk levels of one in a million (10^{-6}) to one in 10,000 (10^{-4}). For noncancer effects, a hazard index (HI) of 1 is the most frequent basis for risk management decisions. Cancer risks and noncancer hazard indices in the Bay were calculated to be generally similar to those in the River. For fish consumption, the cancer risks and noncancer hazard indices in the River and Bay are above the EPA's levels of concern for fish consumption, while other exposure media presented significantly lower risks.

Consistent with Superfund policy and guidance, the HHRA is a baseline risk assessment and therefore assumes no actions (e.g., remediation) to control or mitigate hazardous substance releases and no institutional controls, such as the fish consumption advisories and fishing restrictions that are currently in place, intended to control exposure to hazardous substances. As part of the baseline HHRA, cancer risks and noncancer hazard indices were calculated based on an estimate of the reasonable maximum exposure (RME) expected to occur under current and future conditions at the Site. The RME is defined as an upper end exposure that is reasonably expected to occur at a site. The HHRA also estimated cancer risks and noncancer hazard indices based on central tendency (CT), or average, exposures at the Site.

For both the RME and CT exposures, upper-bound and average concentrations of COCs in fish and other exposure media were determined. The HHRA also included a focused evaluation of exposure only to PCBs through the fish ingestion pathway. The following discussion summarizes the HHRA with respect to the basic steps of the Superfund HHRA process: (1) data collection and analysis, (2) exposure assessment, (3) toxicity assessment, and (4) risk characterization.

8.2.2 Data Collection and Analysis

The baseline HHRA utilized documents relating to the nature and extent of PCB contamination at the Site developed as part of the RI/FS. These RI/FS documents provide both current and projected future concentrations of PCBs in source media, including air, fish, sediments, and River water. To calculate cancer risks and noncancer hazard indices, the information on concentrations in these media (Tables 8-1 to 8-6) is combined with other information on exposure (see Section 8.2.3) and toxicity (see Section 8.2.4).

Table 8-1 Summary of PCB Data and Medium-Specific Human Exposure Point Concentrations for OU 3

<table>
<tr><th rowspan="2">Exposure Point</th><th rowspan="2" colspan="2">Chemical of Concern</th><th colspan="2">Concentration Detected</th><th rowspan="2">Frequency of Detection</th><th rowspan="2">Exposure Point Concentration</th><th rowspan="2">Statistical Measure</th></tr>
<tr><th>Min.</th><th>Max.</th></tr>
<tr><td>Sediments</td><td colspan="2">Total PCBs</td><td>0.003 ppm</td><td>54.0 ppm</td><td>542/652</td><td>2.1 ppm</td><td>mean</td></tr>
<tr><td rowspan="2">Surface Water Direct Contact</td><td rowspan="2">Total PCBs</td><td>particulate</td><td>0.2 ng/L</td><td>96.3 ng/L</td><td>94/98</td><td>29.9 ng/L</td><td rowspan="2">mean</td></tr>
<tr><td>dissolved</td><td>0.2 ng/L</td><td>27.6 ng/L</td><td>97/98</td><td>11.3 ng/L</td></tr>
<tr><td>Fish Tissue (walleye)</td><td colspan="2">Total PCBs</td><td>0.4 ppm</td><td>2.80 ppm</td><td>47/48</td><td>0.5 ppm</td><td>mean</td></tr>
</table>

Notes:
ng/L – nanograms per liter (ppt)
ppm – parts per million
Data Sources:
Concentrations and detections for sediments – RI Table 5-1.
Concentrations and detections for surface water – RI Table 5-16.
Concentrations and detections for fish tissue (walleye) – BLRA Table 5-76.
Exposure point concentration for sediments – BLRA Table 5-33.
Exposure point concentration for surface water – RI Table 5-16.
Exposure point concentration for fish tissue (walleye) – BLRA Table 5-76.

Table 8-2 Summary of PCB Data and Medium-Specific Human Exposure Point Concentrations for OU 4

Exposure Point	Chemical of Concern		Concentration Detected Min.	Concentration Detected Max.	Frequency of Detection	Exposure Point Concentration	Statistical Measure
Sediments	Total PCBs		0.0004 ppm	710.0 ppm	947/1023	2.959 ppm	mean
Surface Water Direct Contact	Total PCBs	particulate	1.4 ng/L	149 ng/L	129/143	44.2 ng/L	mean
		dissolved	2.4 ng/L	45.0 ng/L	142/143	16.6 ng/L	
Fish Tissue* (walleye)	Total PCBs		0.1 ppm	4.6 ppm	124/125	1.3 ppm	mean

Notes:
ng/L – nanograms per liter (ppt)
ppm – parts per million
* Fish concentration data from De Pere to Green Bay (OU 4) and Green Bay Zone 2 are combined.
Data Sources:
Concentrations and detections for sediments – RI Table 5-1.
Concentrations and detections for surface water – RI Table 5-16.
Concentrations and detections for fish tissue (walleye) – BLRA Table 5-76.
Exposure point concentration for sediments – BLRA Table 5-34.
Exposure point concentration for surface water – RI Table 5-16.
Exposure point concentration for fish tissue (walleye) – BLRA Table 5-76.

Table 8-3 Summary of PCB Data and Medium-Specific Human Exposure Point Concentrations for OU 5, Zone 2

Exposure Point	Chemical of Concern		Concentration Detected Min.	Concentration Detected Max.	Frequency of Detection	Exposure Point Concentration	Statistical Measure
Sediments	Total PCBs		0.015 ppm	0.8 ppm	48/49	0.212 ppm*	Mean
Surface Water Direct Contact	Total PCBs	particulate	1.3 ng/L	91.7 ng/L	71/71	13.0 ng/L	Mean
		dissolved	1 ng/L	13.7 ng/L	63/63	4.8 ng/L	
Fish Tissue** (walleye)	Total PCBs		0.1 ppm	4.6 ppm	124/125	1.3 ppm	Mean

Notes:
ng/L – nanograms per liter (ppt)
ppm – parts per million
* Concentration is the mean for all Green Bay zones.
** Fish concentration data from De Pere to Green Bay (OU 4) and Green Bay Zone 2 are combined.
Data Sources:
Concentrations and detections for sediments – RI Table 5-1.
Concentrations and detections for surface water – RI Table 5-16.
Concentrations and detections for fish tissue (walleye) – BLRA Table 5-76.
Exposure point concentration for sediments – BLRA Table 5-35.
Exposure point concentration for surface water – RI Table 5-16.
Exposure point concentration for fish tissue (walleye) – BLRA Table 5-76.

Table 8-4 Summary of PCB Data and Medium-Specific Human Exposure Point Concentrations for OU 5, Zone 3A

Exposure Point	Chemical of Concern		Concentration Detected Min.	Concentration Detected Max.	Frequency of Detection	Exposure Point Concentration	Statistical Measure
Sediments	Total PCBs		0.004 ppm	1.0 ppm	157/180	0.212 ppm*	mean
Surface Water Direct Contact	Total PCBs	particulate	0.22 ng/L	16.9 ng/L	61/66	2.8 ng/L	mean
		dissolved	0.48 ng/L	5.1 ng/L	60/60	1.6 ng/L	
Fish Tissue (walleye)	Total PCBs		0.16 ppm	5.5 ppm	15/15	1.7 ppm	mean

Notes:
ng/L – nanograms per liter (ppt)
ppm – parts per million
* Concentration is the mean for all Green Bay zones.
Data Sources:
Concentrations and detections for sediments – RI Table 5-1.
Concentrations and detections for surface water – RI Table 5-16.
Concentrations and detections for fish tissue (walleye) – BLRA Table 5-78.
Exposure point concentration for sediments – BLRA Table 5-35.
Exposure point concentration for surface water – RI Table 5-16.
Exposure point concentration for fish tissue (walleye) – BLRA Table 5-78.

Table 8-5 Summary of PCB Data and Medium-Specific Human Exposure Point Concentrations for OU 5, Zone 3B

Exposure Point	Chemical of Concern		Concentration Detected Min.	Concentration Detected Max.	Frequency of Detection	Exposure Point Concentration	Statistical Measure
Sediments	Total PCBs		0.002 ppm	1.3 ppm	418/424	0.212 ppm*	mean
Surface Water Direct Contact	Total PCBs	particulate	0.29 ng/L	9.4 ng/L	40/45	2.2. ng/L	mean
		dissolved	0.5 ng/L	3.9 ng/L	40/40	1.4 ng/L	
Fish Tissue (walleye)	Total PCBs		0.5 ppm	8.1 ppm	23/23	2.5 ppm	mean

Notes:
ng/L – nanograms per liter (ppt)
ppm – parts per million
* Concentration is the mean for all Green Bay zones.
Data Sources:
Concentrations and detections for sediments – RI Table 5-1.
Concentrations and detections for surface water – RI Table 5-16.
Concentrations and detections for fish tissue (walleye) – BLRA Table 5-78.
Exposure point concentration for sediments – BLRA Table 5-35.
Exposure point concentration for surface water – RI Table 5-16.
Exposure point concentration for fish tissue (walleye) – BLRA Table 5-78.

Table 8-6 Summary of PCB Data and Medium-Specific Human Exposure Point Concentrations for OU 5, Zone 4

Exposure Point	Chemical of Concern		Concentration Detected		Frequency of Detection	Exposure Point Concentration	Statistical Measure
			Min.	Max.			
Sediments	Total PCBs		0.001 ppm	0.8 ppm	199/203	0.212 ppm*	mean
Surface Water Direct Contact	Total PCBs	particulate	0.1 ng/L	2.4 ng/L	66/86	0.9 ng/L	mean
		dissolved	0.3 ng/L	1.3 ng/L	66/66	0.6 ng/L	
Fish Tissue (walleye)	Total PCBs		0.1 ppm	3.5 ppm	30/30	0.7 ppm	mean

Notes:
ng/L – nanograms per liter (ppt)
ppm – parts per million
* Concentration is the mean for all Green Bay zones.
Data Sources:
Concentrations and detections for sediments – RI Table 5-1.
Concentrations and detections for surface water – RI Table 5-16.
Concentrations and detections for fish tissue (walleye) – BLRA Table 5-78.
Exposure point concentration for sediments – BLRA Table 5-35.
Exposure point concentration for surface water – RI Table 5-16.
Exposure point concentration for fish tissue (walleye) – BLRA Table 5-78.

Fish at the Site have been collected by the WDNR for approximately 35 years and fish advisories have been in effect since 1976. Fish samples have been analyzed for PCBs (both total PCBs and selected congeners), dioxins/furans (specifically, 2,3,7,8-TCDD and 2,3,7,8-TCDF), the pesticide DDT (dichlorodiphenyltrichloroethane) and its metabolites (DDD and DDE), the pesticide dieldrin, arsenic, lead, and mercury. The non-PCB contaminants were found to present substantially less risk than the risk presented by PCBs. Additionally, some of the other contaminants identified in sediment have fate and transport properties similar to those of PCBs and are generally co-located with PCBs. For this reason, a remedy that effectively addresses PCB exposure will also address the other COCs (that pose less risk) in the sediment. This is also the basis for including only PCBs in the focused risk assessment.

The conceptual site model identifies potential receptors for COCs and exposure pathways. As discussed above, determination of PCB exposure provides a sound basis for characterizing significant human health risks at the Site. Estimates of the exposures allow a quantitative risk evaluation. This was done for source media including fish, sediment, and drinking/River water. Most Site risks were determined to relate to fish consumption, with only minimal risk associated with other potential exposures (e.g., inhalation, direct contact). This is the basis for including only the fish ingestion pathway in the focused risk assessment.

The quantitative risk calculations for the fish consumption pathway were based on wet-weight PCB concentrations in fish fillets, as generated by the WDNR's bioaccumulation models, Fox River Food (FRFood) and Green Bay Food (GBFood). The fillet represents the portion of the fish most commonly consumed. The fish exposures were derived by weighting the model output by reported angler preference for species consumption (i.e., weighting the modeled PCB concentrations in fish to reflect the species caught and consumed by anglers) and by averaging over location within the study area.

8.2.3 Exposure Assessment

The exposure assessment evaluates exposure pathways by which people are or can be exposed to the COCs in different media (e.g., fish, water, and sediment). Factors relating to the exposure assessment include, but are not limited to, the concentrations that people are or can be exposed to and the potential frequency and duration of exposure.

Conceptual Site Model

Human exposure to PCBs through consumption of fish presented the greatest risk. Other human exposure pathways evaluated in the baseline HHRA presented significantly less risk; these pathways include ingestion of and dermal contact with sediments and water and inhalation of indoor and outdoor air. The human health conceptual site model is shown on Figure 6-1.

Exposed Populations

Recreational anglers and high-intake (i.e., subsistence) fish consumers are the most likely population to have significant PCB exposures. This group consists of approximately 136,000 individuals who have fishing licenses in counties adjacent to the River and Bay. Populations that may have portions of their members engaged in subsistence fishing include Native Americans and Hmong (Laotians), estimated to include 5,000 individuals and their families. Sensitive populations that were quantitatively evaluated include highly exposed (i.e., subsistence) anglers and their families, as well as young children who consume fish. Infants of mothers who ingest fish that are exposed *in utero* and/or through consumption of breast milk are of concern, and these exposures were evaluated qualitatively. With respect to subsistence or highly exposed angler populations in Wisconsin, review of the literature suggests that these populations are likely to be adequately represented in the HHRA. With respect to infants (less than 1 year old), exposure to PCBs *in utero* and via ingestion of breast milk are known exposure routes that pose risks to fetal development in the infant. Several ongoing studies are determining whether it is possible to develop quantitative relationships between fetal/infant PCB exposure and developmental effects. Standard EPA default factors were used for angler body weight (e.g., 72 kg [159 pounds] for an adult).

Fish Ingestion Rate

Several fish consumption surveys were used to evaluate fish intake rates for both recreational and high-intake fish consumers. Specific studies included West et al. (1989, 1993) conducted in Michigan; Fiore et al. (1989) conducted in Wisconsin; Hutchinson and Kraft conducted in Wisconsin (1994), and Hutchinson (1999) conducted in Wisconsin. The RME fish ingestion rate for recreational anglers was determined to be 59 grams per day from the West et al. studies, while 81 grams per day was determined to be the RME for high-intake fishers using the findings from Hutchinson and Kraft (1994). For average or central tendency exposures (CTE) of recreational anglers, a fish intake of 15 grams per day was used based on the average of results from West et al. (1989) and West et al. (1993). For CTE high–intake anglers, a fish intake of 21 grams per day was used based on Hutchinson and Kraft (1994).

Exposure Duration

To derive both RME and CTE exposures, average levels of PCBs in fish (all fish or subgroups such as walleyes) were applied. Fish data from 1989 onward was used in the risk analyses. Values of 30 years for the CTE and 50 years for the RME scenarios were established based on

EPA published estimates of the years persons live in the River and Bay area. For young children, an exposure duration of 7 years was applied.

PCB Cooking Loss

PCB losses during cooking were assumed to be 50 percent, based on studies reported in the literature. Potential PCB loss mechanisms include removing skin and fat, draining cooking fluids from the fish, and grilling to allow oil to drip away from the fish.

Probabilistic Analysis

In addition to the point estimate (i.e., deterministic) analyses, a probabilistic analysis was performed to provide a range of estimates of the cancer risks and noncancer health hazards associated with the fish ingestion pathway. The probabilistic analysis helps to evaluate variability in exposure parameters (e.g., differences within a population's fish ingestion rates, number of years anglers are exposed, body weight, etc.) and uncertainty (i.e., lack of complete knowledge about specific variables). The deterministic risk analyses using point estimates to generate RMEs and risks were found to compare favorably to findings from the probabilistic approach.

8.2.4 Toxicity

The toxicity assessment determines the types of adverse health effects associated with PCB exposures and the relationship between the magnitude of exposure (dose) and severity of adverse effects (response). Potential health effects for PCBs include the risk of developing cancer over a lifetime. Other noncancer health effects, such as changes in the normal functions of organs within the body (e.g., changes in the effectiveness of the immune system), are also associated with PCB exposure. Some of the 209 PCB congeners are considered to be structurally and mechanistically similar to dioxin and exert dioxin-like effects. The WDNR and EPA have concluded that the use of EPA-derived toxicity criteria is appropriate for the human health risk assessment. These values were developed according to standard methodologies and, therefore, present a relative measure of the potential for adverse effects. Both the cancer slope factor (CSF) and the reference dose (RfD) that were used in the BLRA were also used by the EPA in the Hudson River Risk Assessment, where PCBs were also the primary contaminant of concern. In defense of these values, the EPA prepared papers on PCB Carcinogenicity and Non-Cancer Toxicity as part of EPA work on the Hudson River.

Sources of Toxicity Information

The HHRA used the current consensus toxicity values for PCBs from EPA's Integrated Risk Information System (IRIS) in evaluating the cancer risk and noncancer health effects of PCBs. IRIS provides the primary database of chemical-specific toxicity information used in Superfund risk assessments. More recent toxicity data are provided in Appendix B of the BLRA. These data do not change the EPA's use of IRIS values. For the dioxin-like PCBs, the HHRA used toxicity information for dioxin (2,3,7,8-TCDD) provided in EPA's 1997 Health Effects Assessment Summary Tables coupled with toxic equivalency factors (TEFs) specific to each congener.

Cancer

The EPA has determined that PCBs cause cancer in animals and probably cause cancer in humans (B2 classification or likely to cause cancer in humans). The EPA's CSFs for PCBs represent plausible upper-bound estimates, which means that the EPA is reasonably confident that the actual cancer risks will not exceed the estimated risks calculated using the CSFs. For exposure to total PCBs in fish, sediment, or particulate exposure media, the CSF of 2 (milligrams per kilogram per day [mg/kg-day])$^{-1}$ was used (BLRA Table 5-40). For exposure to total PCBs in water or vapors, a CSF of 0.4 (mg/kg-day)$^{-1}$ was used. For the dioxin-like PCBs, the CSFs were based on toxic equivalency to 2,3,7,8-TCDD.

Noncancer Health Effects

Serious noncancer health effects have been observed in animals exposed to PCBs. Studies of rhesus monkeys exposed through ingestion of PCBs (i.e., Aroclors 1016 and 1254) indicate a reduced ability to fight infection and reduced birth weight in offspring exposed *in utero*. Studies of noncancer health effects, including neurobehavioral effects observed in children of mothers who consume PCB-contaminated fish, were summarized in the BLRA and are being evaluated by the EPA as part of the Agency's IRIS process. The toxicity assessment is an evaluation of the chronic (e.g., 7 years or more) adverse health effects from exposure to PCBs. The chronic RfD represents an estimate (with uncertainty spanning an order of magnitude or greater) of a daily exposure level for the human population, including sensitive populations (e.g., children), that is likely to be without an appreciable risk of deleterious effects during a lifetime. Chemical exposures exceeding the RfD do not predict specific disease. For oral exposure to total PCBs, the oral RfD for Aroclor 1254 of 2×10^{-5} mg/kg-day was used (BLRA Table 5-41). For the dermal exposure to total PCBs, a dermal RfD was extrapolated from the oral RfD for Aroclor 1254. Inhalation exposures were not evaluated for noncancer health effects.

8.2.5 Risk Characterization

This final step in the HHRA combines the exposure and toxicity information to provide a quantitative assessment of Site risks. Exposures are evaluated based on the potential incremental risk for developing cancer and the potential for noncancer health hazards.

8.2.6 Cancer Risks

Cancer risk is expressed as an incremental probability of an individual developing cancer over a lifetime as a result of exposure to a carcinogen. For example, a 10^{-4} cancer risk means a one in 10,000 excess cancer risk, or an increased risk of an individual developing cancer of one in 10,000 as a result of exposure to site contaminants under the conditions used in the exposure assessment. Under Superfund, acceptable RME cancer risks are defined within the range of 10^{-4} to 10^{-6} (corresponding to a one in 10,000 to a one in 1,000,000 excess cancer risk). Excess lifetime cancer risk is calculated from the following equation:

$$Risk = CDI \times CSF$$

where:

Risk = a unitless probability (e.g., 1×10^{-3} of an individual developing cancer)
CDI = Chronic Daily Intake averaged over (mg/kg-day)
CSF = Cancer Slope Factor, expressed as (mg/kg-day)$^{-1}$

The focused risk assessment of exposure to PCBs via fish ingestion at this Site indicates that cancer risks to individuals exposed under RME and CT (average) conditions are above the EPA's acceptable levels. Tables 8-7 to 8-11 summarize key cancer risks from Tables 5-82 (River recreational anglers), 5-83 (Green Bay recreational anglers), 5-86 (River high-intake fish consumers), and 5-87 (Green Bay high-intake fish consumers) in the focused HHRA for the Site. Cancer risks from exposure to dioxin-like PCBs were comparable to the cancer risks from total PCBs for fish ingestion. Differences in exposure assumptions and the resultant cancer risks between RME and CTE groups and recreational and high-intake fish consumers are based upon differences in exposure duration (50 years versus 30 years) and fish intake rates (ranging from 15 to 21 grams per day [CTE] and 59 to 81 grams per day [RME]).

Table 8-7 Cancer Risk from Fish Ingestion – Summary for OU 3

Pathway	RME Cancer Risk	CT (Average) Cancer Risk
Recreational Angler		
All Fish	3.3×10^{-4} (3.3 in 10,000)	4.9×10^{-5} (4.9 in 100,000)
Walleye	2.9×10^{-4} (2.9 in 10,000)	4.4×10^{-5} (4.4 in 100,000)
High-intake Fish Consumer		
All Fish	4.5×10^{-4} (4.5 in 10,000)	7.1×10^{-5} (7.1 in 100,000)
Walleye	4.1×10^{-4} (4.1 in 10,000)	6.4×10^{-5} (6.4 in 100,000)

Table 8-8 Cancer Risk from Fish Ingestion – Summary for OU 4 and OU 5, Zone 2 (combined)

Pathway	RME Cancer Risk	CT (Average) Cancer Risk
Recreational Angler		
All Fish	7.3×10^{-4} (7.3 in 10,000)	1.1×10^{-4} (1.1 in 10,000)
Walleye	7.3×10^{-4} (7.3 in 10,000)	1.1×10^{-4} (1.1 in 10,000)
High-intake Fish Consumer		
All Fish	1.0×10^{-3} (1.0 in 1,000)	1.6×10^{-4} (1.6 in 10,000)
Walleye	1.0×10^{-3} (1.0 in 1,000)	1.6×10^{-4} (1.6 in 10,000)

Table 8-9 Cancer Risk from Fish Ingestion – Summary for OU 5, Zone 3A

Pathway	RME Cancer Risk	CT (Average) Cancer Risk
Recreational Angler		
All Fish	7.4×10^{-4} (7.4 in 10,000)	1.1×10^{-4} (1.1 in 10,000)
Walleye	6.2×10^{-4} (6.2 in 10,000)	9.2×10^{-5} (9.2 in 100,000)
High-intake Fish Consumer		
All Fish	1.0×10^{-3} (1.0 in 1,000)	1.6×10^{-4} (1.6 in 10,000)
Walleye	8.5×10^{-4} (8.5 in 10,000)	1.3×10^{-4} (1.3 in 10,000)

Table 8-10 Cancer Risk from Fish Ingestion – Summary for OU 5, Zone 3B

Pathway	RME Cancer Risk	CT (Average) Cancer Risk
Recreational Angler		
All Fish	5.6×10^{-4} (5.6 in 10,000)	8.4×10^{-5} (8.5 in 100,000)
Walleye	5.9×10^{-4} (5.9 in 10,000)	8.8×10^{-5} (8.8 in 100,000)
High-intake Fish Consumer		
All Fish	7.8×10^{-4} (7.8 in 10,000)	1.2×10^{-4} (1.2 in 10,000)
Walleye	8.2×10^{-4} (8.2 in 10,000)	1.3×10^{-4} (1.3 in 10,000)

Table 8-11 Cancer Risk from Fish Ingestion – Summary for OU 5, Zone 4

Pathway	RME Cancer Risk	CT (Average) Cancer Risk
Recreational Angler		
All Fish	5.2×10^{-4} (5.2 in 10,000)	7.7×10^{-5} (7.7 in 100,000)
Walleye	3.7×10^{-4} (3.7 in 10,000)	5.5×10^{-5} (5.5 in 100,000)
High-intake Fish Consumer		
All Fish	7.1×10^{-4} (7.1 in 10,000)	1.1×10^{-4} (1.1 in 10,000)
Walleye	5.1×10^{-4} (5.1 in 10,000)	8.0×10^{-5} (8.0 in 100,000)

8.2.7 Noncancer Health Hazards

The potential for noncancer health effects is evaluated by comparing an exposure level over a specified time period (e.g., 7 years) with an RfD derived for a similar exposure period. An RfD represents a level that an individual may be exposed to that is not expected to cause any deleterious effect. The ratio of exposure to toxicity is called a hazard quotient (HQ). An HQ less than 1 indicates that a receptor's dose of a single contaminant is less than the RfD and that toxic noncarcinogenic effects from that chemical are unlikely. A hazard index (HI) represents the sum of the individual exposure levels for different chemicals and different media (e.g., fish, water, sediment) compared to their corresponding RfDs (i.e., HI is the sum of HQs for an individual). The key concept of a noncancer HI is that a threshold level (measured as an HI of 1) exists below which noncancer health effects are not expected to occur. Under the federal Superfund program, the EPA's goal for protection for noncancer health hazards is an HI equal to or less than 1 for the RME individual.

The HQ is calculated as follows:

$$Noncancer\ \ HQ = \frac{CDI}{RfD}$$

where:

CDI = chronic daily intake averaged over the exposure period (mg/kg-day)
RfD = reference dose (mg/kg-day)

CDI and RfD are expressed in the same units and represent the same exposure period (i.e., chronic).

The focused risk assessment of exposure to PCBs via fish ingestion indicates that all noncancer hazard indices to individuals exposed under RME and CT (average) conditions are above the EPA's generally acceptable levels, as shown below (Tables 8-12 to 8-16). Risks to children were calculated for OU 4 and OU 5, Zone 2, combined and are cited in Table 8-13. Based on these hazard indices, it is likely the risk to children would be two to three times higher than those hazard indices for Green Bay zones 3A, 3B, and 4. The tables below summarize key noncancer risks from Tables 5-84, 5-85, 5-88, 5-89, 5-104, and 5-105 from the focused HHRA for the Site. In addition, noncancer hazard indices to the average (CT) individual are above the EPA's generally acceptable levels. Noncancer hazard indices for dioxin-like PCBs were not evaluated quantitatively due to the EPA's ongoing evaluation of dioxin toxicity.

Table 8-12 Noncancer Health Hazard from Fish Ingestion – Summary for OU 3

Pathway	RME Noncancer HI	CT (Average) Noncancer HI
Recreational Angler		
All Fish	12.3	3.0
Walleye	11.0	2.7
High-intake Fish Consumer		
All Fish	17.0	4.4
Walleye	15.2	4.0

Note:
Hazard indices for young children are not listed here. However, based on analogy to OU 4, hazard indices would be two to three times higher than those cited in the table for adults.

Table 8-13 Noncancer Health Hazard from Fish Ingestion – Summary for OU 4 and OU 5, Zone 2 (combined)

Pathway	RME Noncancer HI	CT (Average) Noncancer HI
Recreational Angler		
All Fish	27.4	6.8
Walleye	27.4	6.8
High-intake Fish Consumer		
All Fish	37.8	9.9
Walleye	37.9	9.9
Recreational Child		
All Fish	66.3	16.4
Walleye	66.4	16.5
High-intake Fish Consumer Child		
All Fish	91.6	24.0
Walleye	91.8	24.0

Table 8-14 Noncancer Health Hazard from Fish Ingestion – Summary for OU 5, Zone 3A

Pathway	RME Noncancer HI	CT (Average) Noncancer HI
Recreational Angler		
All Fish	27.7	6.9
Walleye	23.1	5.7
High-intake Fish Consumer		
All Fish	38	10
Walleye	32	8.3

Note:
Hazard indices for young children are not listed here. However, based on analogy to OU 4, HI would be two to three times higher than those cited in the table for adults.

Table 8-15 Noncancer Health Hazard from Fish Ingestion – Summary for OU 5, Zone 3B

Pathway	RME Noncancer HI	CT (Average) Noncancer HI
Recreational Angler		
All Fish	21.2	5.2
Walleye	22.2	5.7
High-intake Fish Consumer		
All Fish	29	7.7
Walleye	31	8

Note:
Hazard indices for young children are not listed here. However, based on analogy to OU 4, HI would be two to three times higher than those cited in the table for adults.

Table 8-16 Noncancer Health Hazard from Fish Ingestion – Summary for OU 5, Zone 4

Pathway	RME Noncancer HI	CT (Average) Noncancer HI
Recreational Angler		
All Fish	19.4	4.8
Walleye	13.8	3.4
High-intake Fish Consumer		
All Fish	27	7
Walleye	19	5

Note:
Hazard indices for young children are not listed here. However, based on analogy to OU 4, HI would be two to three times higher than those cited in the table for adults.

8.2.8 Probabilistic Analysis

In addition to the deterministic calculations discussed above, the EPA calculated risks for ingestion of fish from the River and Bay using a probabilistic analysis, consistent with EPA guidance on probabilistic risk assessments (EPA, 1999). This analysis supports and complements the point estimates of risks and hazard indices calculated in evaluations of exposure to PCBs in fish.

Deterministic RME estimates of risk and hazard index provided in the probabilistic evaluation are generally consistent within the 90th to 95th percentiles of the respective probability distributions of risk and hazard indices. This is consistent with the interpretation provided by the EPA (EPA, 1999) of the RME as a plausible high-end risk or hazard index for the exposed population.

Deterministic CTE estimates of risk and hazard index are generally close to the means of probability distributions of risk and hazard index. This is consistent with the interpretation of the CTE as the average risk or hazard index for the exposed population.

8.2.9 Uncertainty

The process of evaluating human health cancer risks and noncancer hazard indices involves multiple steps. Inherent in each step of the process are uncertainties that ultimately affect the final cancer risks and noncancer hazard indices. Important sources of uncertainty in the HHRA are discussed below.

The uncertainties in the HHRA reflect uncertainties in the historical and trends of PCB concentrations in fish tissue over time, the assumptions relating to fish ingestion rates and PCB body burdens in people eating fish from the Lower Fox River and Green Bay, the assessment of PCB toxicity to humans, and the estimation of future PCB body burdens in fish. Each of these is discussed in more detail below.

Time Trends

Although concentrations in fish may be decreasing over time for some fish species in OU 3, OU 4, and OU 5, these trends were not consistent with all species (*White Paper No. 1 – Time Trends Analysis* (December 2002, released with the Lower Fox River and Green Bay ROD for OUs 1 and 2). In addition, trends in the surficial sediment layer are not consistent and concentrations in deeper sediments are not decreasing. Additionally, events that may scour sediments may cause declining trends currently observed to either slow or reverse.

Fish Ingestion Rate

The uncertainty in the fish ingestion rate was minimized by relying on a number of surveys. These included Michigan angler surveys for recreational anglers by West et al. (1989 and 1993) and a Wisconsin angler survey by Fiore et al. (1989). For high-intake fish consumers, surveys by West et al. (1993), Peterson (1994), Hutchison and Kraft (1994), Hutchison (1994), and Hutchison (1999) were also considered. In addition, the sensitivity/uncertainty analysis conducted for the probabilistic analysis showed that, despite the use of different fish, the overall conclusion of the HHRA – that cancer risks and noncancer hazard indices due to ingestion of fish are above levels of concern – essentially remains the same.

PCB Toxicity

The EPA describes the uncertainty in the cancer toxicity values as extending in both directions (i.e., contributing to possible underestimation or overestimation of cancer slope factors). However, the CSFs were developed to represent plausible upper-bound estimates, which means that the EPA is reasonably confident that the actual cancer risk will not exceed the estimated risk calculated using the CSF. The CSFs used in the HHRA were externally peer reviewed and supported by the panel of expert scientists and are the most current values recommended by the EPA in IRIS.

Noncancer toxicity values also have uncertainty. The current oral RfDs for Aroclor 1016 and 1254, which were used in the HHRA, have uncertainty factors of 100 and 300, respectively, in order to provide for protection of public health. The RfD for Aroclor 1016 was also subjected to peer review and was supported by a panel of scientists. The RfD for Aroclor 1254 was developed using the same methodology as Aroclor 1016 and was also subject to peer review. Since these RfDs were developed, a number of recent national and international studies have reported possible associations between developmental and neurotoxic effects in children from prenatal or postnatal exposures to PCBs. In light of these new studies, the current RfDs are now being evaluated as part of the IRIS process.

PCB Body Burden

The fact that any previous exposures (either background or past consumption of PCB-contaminated fish) may still be reflected in an individual’s body burden today is an additional source of uncertainty and may result in an underestimate of noncancer hazard indices and cancer risks.

PCB Bioaccumulation Modeling

A bioaccumulation model was used in the HHRA calculations to generate estimations of future concentrations of PCBs in fish if no action occurs. The Agencies minimized this uncertainty to the extent possible by developing a bioaccumulation model specifically for the River and the Bay (i.e., FRFood and GBFood, respectively), calibrating the model to the extensive database for the River and the Bay. Additionally the model was revised based on a peer review sponsored by the FRG. Based on the model calibration (i.e., the ability of the fish bioaccumulation model to capture the historical observed lipid-normalized PCB measurements in fish), and the feedback received from the peer review, the model uncertainty is not sufficient to change the overall conclusion of the HHRA that cancer risks and noncancer hazard indices due to ingestion of fish are above acceptable levels.

8.3 Ecological Risk Assessment

The Site provides habitat function for a variety of invertebrates, fish, birds, and mammals that inhabit or use this watershed for foraging, reproducing, rearing young, and other life cycle requirements. The Lower Fox River basin and Green Bay show considerable variation in their potential to provide and support different kinds of wildlife habitat and this variability affects the wildlife diversity and populations. The BLRA focuses primarily on aquatic or aquatic-dependent species. Aquatic habitats within the area are wetland (e.g., Lower Fox River and southern Green Bay), riverine (e.g., the River), and lacustrine (Green Bay).

The significant groups of wildlife found within these habitats include:

- Both pelagic and benthic aquatic invertebrate species form the primary prey in the food webs of the River and Bay. Species of oligochaetes and chironomids (e.g., worms and midges) are typically most abundant and are found throughout the River and Bay. Amphipods, crayfish, snails, and mussels are also present in the River and Bay. Zebra mussels, an exotic species, are present throughout the Bay and the River.

- Fish of the region include salmon/trout; game fish, including walleye, yellow perch, and northern pike; and pelagic and benthic non-game fish. A discussion of the significant fish species within the study area is presented later in this section.

- Birds of the region include raptors, gulls/terns, diving birds, migratory waterfowl, passerines, shorebirds, and wading birds. A listing of the significant bird species within the study area is presented later in this section. These animals are found nesting, feeding, and living in both terrestrial and aquatic habitat environments.

- Mammals of the region include large and small game animals that generally live in open or wooded habitat, as well as fur-bearing animals that may forage or live within or near aquatic environments. The small and large game animals include rabbits, squirrels, and deer. The fur-bearing animals include beaver, red fox, mink, raccoon, muskrat, and otter. Additionally, bats feed on insects in the vicinity of Lake Winnebago and near the communities along the River as well as areas around the Bay. Few of the mammals will be discussed in detail within this document. Mink are the principal species discussed in the BLRA.

- Reptiles and amphibians, including snakes, turtles, frogs, and toads, are present in the region (Exponent, 1998). Typically, the frogs and turtles confine themselves to the wetland and nearshore areas while several snake species and toads are found in association with both terrestrial and aquatic habitats. Frogs and toads that dwell in wetlands or nearshore areas are fed upon by wading birds of the region.

Through the mid-1970s, the population levels of fish species, such as walleye and perch, were low within the River and southern Green Bay ecosystems. Contaminants, along with low levels of dissolved oxygen (DO) conditions brought about by uncontrolled and untreated wastewater discharged into the River, were believed to be contributing factors causing low population levels. Principal species found within the system were those that could tolerate these conditions, especially bullhead and carp.

With the institution of water quality controls in the mid-1970s, contaminants and DO conditions improved. The WDNR undertook a program to reintroduce walleye into the River and Bay through a stocking program beginning in 1973. That program was very successful; self-sustaining populations of walleye now exist within the River and Bay. Recent electrofishing catch data for walleye from the De Pere dam to the mouth of the River are shown on Figure 2-15 of the BLRA.

In addition to walleye, a number of other species were reestablished in the River and the Bay, including white and yellow perch, alewife, shad, bass, and other species. Historical anecdotal data from the Oneida Tribe and more recent creel survey data from the WDNR indicate that Duck Creek and Suamico tributaries to southern Green Bay were used by numerous fish species (Nelson, 1998).

The WDNR has completed extensive fish surveys in the River and inner Green Bay. However, due to the numerous factors that may affect fish populations, reliable conclusions simply cannot be made based on reviewing and comparing the population survey results from various years. Year-to-year fish populations do not necessarily indicate whether conditions within the River/Bay are degraded or improving, because other environmental, physical, or biological factors may be impacting select fish species at any given time. Selected fish surveys for the River have been reviewed to provide data on the types of fish present within the system at given points in time. However, no in-depth analysis of whether these population surveys indicate declining or improving conditions is included in this discussion, nor are Bay fish surveys included. Rather, personal observations from WDNR and Michigan Department of Natural Resources personnel familiar with both the commercial and sport fisheries of the Bay are used.

8.3.1 Screening Level Risk Assessment

The SLRA for the River and Bay focused on the potential for ecological risks associated with chemicals in sediments, surface waters, and biota. The SLRA was conducted using conservative exposure and effects scenarios in an effort to identify which of the more than 300 contaminants previously identified potentially posed risks to ecological receptors. Data from 16 separate comprehensive studies conducted on the River and Bay by state, federal, university, and private parties were used to assess risk. The objective of the screening was to identify a smaller list of contaminants that would be carried through to the baseline risk assessment.

As defined in the Superfund Risk Assessment Guidance (EPA, 1997a), following the completion of the SLRA, a Scientific Management Decision Point (SMDP) was necessary to review the results of the SLRA. The technical team of risk managers and risk assessors, collectively referred to as the Biological Technical Assistance Group (BTAG), was assembled during the SLRA process to specifically address SMDPs and provide technical review.

The SMDP was formalized in a memorandum from the WDNR dated August 3, 1998 (BLRA, Appendix A). The memorandum identified and justified which chemicals should be carried forward into the BLRA, based on the potential for either human health or ecological risk. Of the 75 chemicals that were above screening level risk criteria, only those with the most potential for adverse risk were carried forward as BLRA COPCs.

The retained COPCs include PCBs (expressed as total and PCB coplanar congeners), dioxin and furan congeners, DDT and its metabolites DDE and DDD, dieldrin, arsenic, lead, and mercury. Sediment HQs were greatest for PCBs based on both human heath and ecological risk-based screening levels.

8.3.2 Baseline Ecological Risk Assessment

The overall ecological goals of the BLRA for the River and Bay were to:

- Examine how the COPCs carried forward from the SLRA (RETEC, 1998b) move from the sediment and water into ecological receptors within the River and Bay.
- Quantify the current (or baseline) ecological risk associated with the COPCs.
- Distinguish those COPCs that pose the greatest potential for risk to the environment and should be carried forward as COCs in the FS.
- Determine which exposure pathways lead to the greatest risks.
- Support the selection of a remedy that eliminates, reduces, and/or controls identified risks by calculating sediment quality thresholds (SQTs).

Consistent with Superfund policy and guidance, the BLRA assumes no actions (remediation) to control or mitigate hazardous substance releases. The following discussion summarizes the BLRA with respect to the four basic steps of the Superfund Ecological Risk Assessment process: (1) Problem Formulation, (2) Exposure Assessment, (3) Effects Assessment, and (4) Risk Characterization.

Problem Formulation

Chemicals of Concern

PCBs were carried forward in the BLRA as the primary COPC because SLRA-calculated sediment HQs ranged from 1,514 to 5,872, generally several orders of magnitude greater than HQs for other COPCs. Although 2,3,7,8-TCDD is the most toxic dioxin congener, all structurally related dioxin and furan congeners were evaluated for toxicity based on the toxicity equivalency method, further described in Section 6.3.2 of the BLRA. The dioxin and furan congeners evaluated are those that have been measured in Site media and those that have toxic equivalency factors (TEFs). The only PCB congeners that were evaluated for dioxin-like toxicity are those that most structurally resemble dioxin and have the greatest potential for bioaccumulation: congeners 77, 81, 105, 118, 126, and 169, as further discussed in Section 6.3.3 of the BLRA.

The FRDB currently contains more than 580,000 records representing contaminant data from sediment, water, and tissue. Total PCBs are the most frequently found analyte in the database. The cut-off date for inclusion of data for the evaluation of risk was set at 1989 for several reasons: (1) the contribution of these data toward assessing risk was considered to be less advantageous than the greater accuracy obtained by evaluating risk based on more current data; (2) no data collected prior to 1989 were validated; and (3) although data collected in 1989 were not validated, the total number of samples collected in that year is more than 30 percent of all samples collected.

Complete Exposure Pathways

The BLRA determined that the principal source for COPCs is currently the contaminated sediment deposits found throughout the system. The principal transport mechanism is sediment resuspension, with transport occurring by downstream currents in the River and by discrete resuspension transport and deposition events within the Bay (WDNR, 1998b, 1998c). The fate of these contaminants, following their release into the water column, depends on the chemical properties of the contaminant, abiotic factors within the receiving environment (e.g., organic carbon in sediments, pH, surface water hardness), and interaction with the biotic environment. This interaction can result in degradation, transformation, or bioconcentration of the contaminant. The fate of a contaminant is not fixed, and the degree of contaminant exchange between surface water, sediment, sediment pore water, and biota varies.

Aquatic organisms can be exposed to COPCs through the water column, through ingesting sediments, and through consumption of contaminated prey. Water column organisms are exposed to dissolved and particulate-based COPCs through respiration, ingestion, and direct contact. Benthic invertebrates are exposed through direct contact and ingestion of contaminated sediments. Benthic fish, carnivorous birds, and carnivorous mammals can incidentally ingest sediments during feeding on prey species. All of the COPCs have the potential to biomagnify up the food chain (i.e., increase in tissue concentrations as contaminants go up the food chain through two or more trophic levels) except for lead and arsenic, which can bioconcentrate. Therefore, benthic invertebrates, fish, birds, and mammals are all exposed to COPCs by consuming contaminated food.

PCBs in the environment are stable and persistent; cycling rather than degradation represents the predominant fate. PCBs are highly lipophilic and, therefore, more readily bind to sediments or accumulate in tissues rather than remain in the water column. For invertebrates, both aquatic and benthic, exposure to PCBs through contact with the water column or pore water contributes significantly to the total PCB body burden. For most species, however, particularly those in the upper trophic levels, prey consumption is likely the primary route of exposure. Biological uptake of PCBs by aquatic organisms appears to be species-specific. Rates of accumulation vary depending on species, age, sex, and size. Generally, when equally exposed, fish accumulate two to three times more PCBs than do aquatic invertebrates.

Bioaccumulation of non-polar organic compounds occurs as a result of uptake by a receptor, followed by partitioning of the compounds into the receptor's organic carbon compartment – the lipids. Once chemicals are accumulated within an organism's lipid fraction, biomagnification may occur when organisms at lower trophic levels are preyed upon by receptors higher in the food chain. The net result is an aggregate increase in tissue body burdens of the chemicals at higher trophic levels.

Animals and plants living in or near the River and Bay, such as invertebrates, fish, amphibians, and water-dependent reptiles, birds, and mammals, are or can be exposed to PCBs directly and/or indirectly through the food chain. Ecological exposure to PCBs is primarily an issue of bioaccumulation through the food chain rather than direct toxicity, because PCBs bioaccumulate in the environment by bioconcentrating (i.e., being absorbed from water and accumulated in tissue to levels greater than those found in surrounding water) and biomagnifying. As a result, the ecological risk assessment emphasizes indirect exposure at various levels of the food chain to address PCB-related risks at higher trophic levels. The ecological conceptual site models used for this portion of the River and the Bay are provided on Figures 6-2 to 6-4.

Assessment Endpoints

Appropriate selection and definition of assessment endpoints, which focus the risk assessment design and analysis, are critical to the utility of the risk assessment. It is not practical or possible to directly evaluate risks to all of the individual components of the ecosystem at the Site. Assessment endpoints were selected based on being representative components of the ecosystem that could be adversely affected by the contaminants present. Eight assessment endpoints were developed to evaluate the risk of contaminants in the River and Bay. These include:

- The functioning of water column and benthic invertebrate populations
- Benthic and pelagic fish survival and reproduction
- Insectivorous, piscivorous, and carnivorous bird survival and reproduction
- Piscivorous mammal survival and reproduction

By evaluating and protecting these assessment endpoints, it is assumed that this ecosystem as a whole would also be protected.

Conceptual Site Model

The ecological conceptual site model identifies where contaminant interactions with biota can occur, describes the uptake of Site contaminants into the biological system (in this case, the water and sediments of the River and Bay), and diagrams key receptor contaminant exposure pathways. Due to the large area being assessed for risk, more than one conceptual site model was necessary. The River, from the mouth of Lake Winnebago to the De Pere dam, was evaluated using the same conceptual site model (Figure 6-2). This includes OU 3. Figure 6-3 represents the conceptual site model for OU 4 (De Pere to Green Bay) and OU 5 – Zone 2 of Green Bay, while Figure 6-4 represents the conceptual site model for the rest of OU 5 (Green Bay zones 3A, 3B, and 4).

It should be noted that Figures 6-2 and 6-3 are not able to adequately show periphyton as part of the ecological conceptual site model. This is an organic, green to brown layer that colonizes hard surfaces (e.g., twigs, rocks) in a body of water. Some researchers believe that this is the organic layer that hydrophobic compounds (e.g., PCBs) would likely adhere to and would be a food source (and contaminant source) for many benthic organisms.

Measurement Endpoints

Risk questions are assessed using measurement endpoints. Types of measurement endpoints used in the risk assessment process fall generally into four categories: (1) comparison of estimated or measured exposure levels of COPCs to levels known to cause adverse effects, (2) bioassay testing of site and reference media, (3) *in-situ* toxicity testing of Site and reference media, and (4) comparison of observed effects on site with those observed at a reference site. Measurement endpoints selected for assessment endpoint evaluation in this risk assessment consistently fell into the first category of measurement endpoints and are presented in Table 6-2 of the BLRA. Only existing data were evaluated as part of this assessment. As such, the measurement endpoints were fashioned around the existing data. Where the data did not already exist to fulfill the measurement endpoint, it was modeled based on the existing data.

Exposure Assessment

The exposure assessment includes a quantitative evaluation of contaminant release, migration, and fate; characterization of exposure parameters; and measurement or estimation of exposure point concentrations. Complete exposure pathways and exposure parameters (e.g., body weight, prey ingestion rate, home range) used to calculate the concentrations or dietary doses to which the receptors of concern may be exposed were obtained from EPA references, from the scientific literature, and directly from researchers. In the FRDB, data were generally lacking for piscivorous and carnivorous birds, and no data were available for piscivorous mammals; therefore, ecological modeling was used to estimate COPC exposure to these receptors.

Description of Groups of Key Species

Invertebrate communities constitute a vast portion of the basis of the food chain in aquatic ecosystems. Since invertebrates process organic material and are prey items for other invertebrates, fish, and birds, they are important in nutrient and energy transfer in an aquatic ecosystem. Alterations in invertebrate functions may consequently affect nutrient and energy transfer and bird and fish populations. In addition, COPCs in invertebrates may be passed along through the food chain. Therefore, upper trophic levels can be affected not only by reduced prey abundance, but also by trophic transfer of accumulated contaminants in invertebrate prey. Examples of important benthic invertebrates in the River system include chironomids (e.g., midges) and oligochaetes (e.g., segmented worms).

Fish have many roles in the aquatic ecosystem, including the transfer of nutrients and energy, and are prey for mammals, birds, and predatory fish. In fact, several predators rely solely or primarily on fish for survival. Fish typically constitute a large proportion of the biomass in aquatic systems. Additionally, fish have social and economic value; impaired fish communities would adversely affect commercial and recreational fishing. Benthic fish are those fish that live in contact with and forage for food directly in the sediments. As such, they represent a unique exposure pathway because of their foraging behavior (i.e., high exposure to sediments) and prey items (i.e., predominately benthic invertebrates). Examples of benthic fish in the River include carp, catfish, and bullhead. Pelagial fish are those species that live and feed principally in the water column (as opposed to being in direct contact with sediment). Pelagial fish represent many trophic levels, with prey items predominately in the water column (e.g., zooplankton and other fish). Examples of important pelagial fish in the River include shiners, shad, alewife, perch, and walleye. Pelagial fish important to Green Bay include the same species as are found in the River, in addition to lake trout and other salmonids in the upper Bay.

Bird populations, in general, present one of the most significant biological components of the River/Bay system and occupy several trophic levels. Given the potential for some contaminants to biomagnify, birds, as upper trophic level receptors, may concentrate and be affected by contaminants in their tissues to a greater degree than lower trophic level species. In addition to their ecological importance, birds are socially valued because of recreational activities and aesthetics. Insectivorous birds rely predominately on insects (e.g., benthic invertebrates) for food. Examples of insectivorous birds in the River and Bay region include swallows and blackbirds. Piscivorous birds rely primarily on fish for food. Of the bird populations present at the Site, piscivorous birds represent a high trophic level and, therefore, are more at risk than insectivores from contaminants transferred through the food chain. Examples of piscivorous birds on the River and Bay include cormorants and terns. Carnivorous birds were selected for evaluation because of their diverse forage, which can include consumption of fish, piscivorous birds, or even small mammals. Examples of carnivorous birds on the River and Bay include eagles, osprey, and other raptors.

Piscivorous mammals represent the upper trophic level of the riverine corridor ecosystem and, therefore, are potentially highly exposed to contaminants that bioaccumulate or biomagnify. Piscivorous mammals rely primarily on fish as food, but may also consume amphibians, invertebrates, crayfish, clams, and mussels. The foraging behavior of these mammals represents a pathway through which energy is transferred from the aquatic to the terrestrial ecosystem. Mink are piscivorous mammals found in the River and Bay area.

A number of different animals have been or are currently on the Wisconsin, Michigan, or federal endangered and threatened species lists. Listed animals that have historically been found in the vicinity of the River or the Bay include osprey, common tern, Forster's tern, Caspian tern, and great egret (Matteson et al., 1998). The osprey, common tern, and Forster's tern have nested along the River as well as at upstream locations in Lake Winnebago, Little Lake Butte des Morts, and Lake Poygan. Osprey have been sighted near Kaukauna and have attempted to nest in the vicinity of Combined Locks, while terns have been observed farther upstream. Additionally, Caspian tern and great egret have nested on some of the islands located in the Bay. Very few nesting pairs have been observed over the past few years and recovery of these populations is slow (Matteson et al., 1998).

In addition to these birds, the WDNR reported a bed of clams or mussels, which may be threatened. The sediment bed, which these clams/mussels inhabit, is approximately 6 meters (20 feet) wide and 30.5 meters (100 feet) long and is located near the mouth of Mud Creek in the River (Szymanski, 1998, 2000).

As mentioned above, populations of both eagles and the double-crested cormorants have recovered to the point where both birds have been removed from the Wisconsin endangered species list. Other populations, specifically wild mink and otter, have been found to be declining around the River and the Bay, yet they are not currently listed by state or federal agencies as threatened or endangered. The endangered and threatened fish and birds of the region are listed in Tables 2-11 and 2-12 of the BLRA. The endangered and threatened mammals of the region are listed in Table 2-14 of the BLRA.

Derivation of Exposure Point Concentrations

All COPCs show the exposure point concentrations for chemicals where risk was indicated (see Tables 8-17 to 8-21). For calculation of exposure values, one-half of the sample quantitation limit was used for undetected values (EPA, 1991b). The 95 percent upper confidence limit (UCL) of the mean is the value that a mean, calculated repeatedly from subsamples of the data population, will not exceed 95 percent of the time. Therefore, there is a 95 percent probability that the true mean of the population does not exceed the 95 percent UCL. The 95 percent UCL was calculated from the sample values depending on whether the data were normally, log-normally, or not normally distributed. When the data distribution fit neither a normal nor log-normal distribution pattern, the 95 percent UCL selected was the greater of the two calculated 95 percent UCLs (normal and log-normal). In cases where data were limited or the variability in the data was high, the calculated 95 percent UCL can exceed the maximum detected concentration. The RME is defined as the lesser of the calculated 95 percent UCL or the maximum detected value.

As an estimate of risk, both the arithmetic mean concentration and the RME concentration are used as exposure point concentrations. The RME is an estimate of the highest average exposure expected to occur at a site. The intent of the RME is to provide an estimate of exposure that is above average, yet still within the range of most exposures. The RME thus provides a degree of protectiveness that encompasses the individual receptors that have a higher likelihood of exposure.

Tissue residue values were available for some of the bird assessment endpoint species. These data included measurements of PCBs in whole body, brain, and eggs. Where tissue data were available, exposure point concentrations were determined. In addition to the exposure point concentration, minimum and maximum exposures are presented along with frequency of detection information. In addition, exposure point concentrations were also determined, where appropriate, based on food chain exposure (water, sediment, and prey ingestion). Since the food chain exposure includes ingestion of a variety of food items, it is not possible to present the minimum and maximum concentrations nor the frequency of detection for each of the items ingested; therefore, these values are indicated as being not applicable in Table 8-20. Since exposure point concentrations for piscivorous mammals are also based solely on food chain exposure, it is also not possible to present the minimum or maximum values (Table 8-21).

Table 8-17 Summary of Chemicals of Concern and Medium-Specific Exposure Point Concentrations for Water Column Invertebrates

Scenario Time Frame:	Current					
Medium:	Water					
Exposure Medium:	Surface water					
Exposure Point	**Chemical of Concern**	**Concentration Detected (ng/L)**		**Frequency of Detection**	**Exposure Point Concentration (ng/L)**	**Statistical Measure and Source Table from BLRA**
		Min	**Max**			
Operable Unit 3						
Surface Water	Mercury (filtered)	1,260	2,520	2/3	2,520	Max, Table 6-28
	Mercury (unfiltered)	4,490	7,120	2/3	7,120	Max, Table 6-28
Operable Unit 4						
Surface Water	Total PCBs (particulate)	1.4	149	129/143	54.7	95% UCL, Table 6-35
					44.2	Mean, Table 6-35
Operable Unit 5, Zone 2						
Surface Water	Mercury (filtered)	1,150	2,330	2/10	2,300	Max, Table 6-41
	Mercury (unfiltered)	1,520	5,000	2/11	5,000	Max, Table 6-41

Table 8-18 Summary of Chemicals of Concern and Medium-Specific Exposure Point Concentrations for Benthic Invertebrates

Scenario Time Frame:	Current					
Medium:	Sediment					
Exposure Medium:	Sediment					
Exposure Point	**Chemical of Concern**	**Concentration Detected**		**Frequency of Detection**	**Exposure Point Concentration**	**Statistical Measure and Source Table from BLRA**
		Min	**Max**			
Operable Unit 3						
Sediment	Lead (mg/kg)	6.2	1,400	20/20	274	95% UCL Table 6-29
					159	Mean, Table 6-29
	Mercury (mg/kg)	0.01	9.8	74/74	4.0	95% UCL, Table 6-29
					3.5	Mean, Table 6-29
	2,3,7,8-TCDD (µg/kg)	3.7E-03	6.8E-03	2/2	6.8E-03	Max, Table 6-29
					5.3E-03	Mean, Table 6-29
	Total PCBs (µg/kg)	37	40,430	203/209	10,543	95% UCL, Table 6-29
	Total PCBs (µg/kg)	0	40,429	37,490/37,490	2,088	95% UCL, Table 6-29
					2,054	Mean, Table 6-29
	Total PCBs (µg/kg)	37.1	40,429	37,060/37,060	2,112	95% UCL, Table 6-29
					2,078	Mean, Table 6-29
	DDE (µg/kg)	6.6	22	4/19	22	Max, Table 6-29
					12.5	Mean, Table 6-29
	DDT (µg/kg)	5.1	20	3/14	20	Max, Table 6-29
					16.5	Mean, Table 6-29
Operable Unit 4						
Sediment	Arsenic (mg/kg)	0.8	386	66/92	16.9	95% UCL, Table 6-36
					10.1	Mean, Table 6-36
	Lead (mg/kg)	4.4	350	92/92	91.2	95% UCL, Table 6-36
					75.7	Mean, Table 6-36
	Mercury (mg/kg)	0.1	7.7	89/92	1.4	95% UCL, Table 6-36
					1.0	Mean, Table 6-36
	Total PCBs (µg/kg)	19.9	99,000	285/290	5,510	95% UCL, Table 6-36
					4,184	Mean, Table 6-36
	DDD (mg/kg)	1.2	4.5	3/22	4.5	Max, Table 6-36
	DDE (mg/kg)	1.9	1.9	1/22	1.9	Max, Table 6-36

Table 8-18 Summary of Chemicals of Concern and Medium-Specific Exposure Point Concentrations for Benthic Invertebrates (Cont.)

Scenario Time Frame:	Current					
Medium:	Sediment					
Exposure Medium:	Sediment					
Exposure Point	**Chemical of Concern**	**Concentration Detected**		**Frequency of Detection**	**Exposure Point Concentration**	**Statistical Measure and Source Table from BLRA**
		Min	**Max**			
Operable Unit 5 (Zones 2 through 4)						
Green Bay Zone 2						
Sediment	Mercury (mg/kg)	0.1	1.5	9/11	1.5	Max, Table 6-42
					0.5	Mean, Table 6-42
	Total PCBs (µg/kg)	26.0	799	14/15	720	95% UCL, Table 6-42
					251	Mean, Table 6-42
Green Bay Zone 3A						
Sediment	Total PCBs (µg/kg)	6.0	993	13/15	518	95% UCL, Table 6-54
					376	Mean, Table 6-54
Green Bay Zone 3B						
Sediment	Arsenic (mg/kg)	3.6	15.0	4/4	14.1	95% UCL, Table 6-62
					8.6	Mean, Table 6-62
	Lead (mg/kg)	9.6	50.0	4/4	49.4	95% UCL, Table 6-62
					29.9	Mean, Table 6-62
	Mercury (mg/kg)	0.2	0.2	1/4	0.2	Max, Table 6-62
	Total PCBs (µg/kg)	50.0	1,056	35/40	809	95% UCL, Table 6-62
					542	Mean, Table 6-62
Green Bay Zone 4						
Sediment	Total PCBs (mg/kg)	10.0	264	27/31	117	95% UCL, Table 6-71
					82.9	Mean, Table 6-71

Table 8-19 Summary of Chemicals of Concern and Medium-Specific Exposure Point Concentrations for Fish

Scenario Time Frame:	Current					
Medium:	Fish					
Exposure Medium:	Fish					
Exposure Point	**Chemical of Concern**	**Concentration Detected**		**Frequency of Detection**	**Exposure Point Concentration**	**Statistical Measure and Source Table from BLRA**
		Min	**Max**			
Operable Unit 3						
Whole Fish Tissue						
Carp	Mercury (mg/kg)	0.15	0.15	1/1	0.15	Max, Table 6-31
Walleye	Mercury (mg/kg)	0.16	0.16	1/1	0.16	Max, Table 6-31
Gizzard Shad	Total PCBs (µg/kg)	310	370	3/3	370	Max, Table 6-31
					347	Mean, Table 6-31
Golden Shiner	Total PCBs (µg/kg)	1,003	1,036	2/2	1,036	95% UCL, Table 6-31
					1,020	Mean, Table 6-31
Yellow Perch	Total PCBs (µg/kg)	627	627	1/1	627	Max, Table 6-31
Carp	Total PCBs (µg/kg)	604	6,000	20/20	5,800	95% UCL, Table 6-31
					3,919	Mean, Table 6-31
Walleye	Total PCBs (µg/kg)	1,490	4,587	4/4	4,587	Max, Table 6-31
					3,179	Mean, Table 6-31
Operable Unit 4 and Green Bay Zone 2						
Whole Fish Tissue						
Alewife	Mercury (mg/kg)	0.10	0.25	2/5	0.25	Max, Table 6-44
					0.10	Mean, Table 6-44
Rainbow Smelt		0.02	0.04	4/4	0.04	Max, Table 6-44
					0.03	Mean, Table 6-44
Carp		0.12	0.12	1/1	0.12	Max, Table 6-44
Walleye		0.11	0.39	10/11	0.27	95% UCL, Table 6-44
					0.21	Mean, Table 6-44
Alewife	Total PCBs (µg/kg)	990	19,000	51/51	3,182	95% UCL, Table 6-44
					2,599	Mean, Table 6-44
Gizzard Shad		700	4,100	50/50	2,005	95% UCL, Table 6-44
					1,852	Mean, Table 6-44
Rainbow Smelt		280	1,600	33/33	1,152	95% UCL, Table 6-44
					1,049	Mean, Table 6-44

Table 8-19 Summary of Chemicals of Concern and Medium-Specific Exposure Point Concentrations for Fish (Cont.)

Scenario Time Frame: / Medium: / Exposure Medium:	Current / Fish / Fish					
Exposure Point	**Chemical of Concern**	**Concentration Detected Min**	**Concentration Detected Max**	**Frequency of Detection**	**Exposure Point Concentration**	**Statistical Measure and Source Table from BLRA**
Common Shiner		3,100	4,000	5/5	3,846	95% UCL, Table 6-44
					3,520	Mean, Table 6-44
Emerald Shiner		3,100	4,000	5/5	3,846	95% UCL, Table 6-44
					3,520	Mean, Table 6-44
Golden Shiner		1,326	1,443	2/2	1,443	Max, Table 6-44
Yellow Perch		614	2,151	9/9	1,567	95% UCL, Table 6-44
					1,206	Mean, Table 6-44
Carp		202	22,500	115/115	7,369	95% UCL, Table 6-44
					6,637	Mean, Table 6-44
Walleye		387	19,000	91/91	7,658	95% UCL, Table 6-44
					6,539	Mean, Table 6-44
Carp	DDE (µg/kg)	15	88	3/4	88	Max, Table 6-44
Walleye		64	120	3/3	120	Max, Table 6-44
Operable Unit 5 – Green Bay						
Green Bay Zone 3A						
Whole Fish Tissue						
Alewife	Total PCBs (µg/kg)	280	2,700	18/18	1,271	95% UCL, Table 6-56
					907	Mean, Table 6-56
Gizzard Shad		3,524	3,524	1/1	3,524	Max, Table 6-56
Rainbow Smelt		210	1,300	31/32	735	95% UCL, Table 6-56
					570	Mean, Table 6-56
Walleye		980	7,500	14/14	5,064	95% UCL, Table 6-56
					4,155	Mean, Table 6-56
Brown Trout		1,800	4,400	14/14	3,612	95% UCL, Table 6-56
					3,250	Mean, Table 6-56
Green Bay Zone 3B						
Whole Fish Tissue						
Walleye	Mercury (mg/kg)	0.65	0.65	1/3	0.65	Max, Table 6-64
Alewife	Total PCBs (µg/kg)	536	2,800	8/8	2,375	95% UCL, Table 6-64
					1,821	Mean, Table 6-64

Table 8-19 Summary of Chemicals of Concern and Medium-Specific Exposure Point Concentrations for Fish (Cont.)

Scenario Time Frame: **Medium:** **Exposure Medium:**	Current Fish Fish					
Exposure Point	**Chemical of Concern**	**Concentration Detected Min**	**Concentration Detected Max**	**Frequency of Detection**	**Exposure Point Concentration**	**Statistical Measure and Source Table from BLRA**
Gizzard Shad		635	635	1/1	635	Max, Table 6-64
Rainbow Smelt		250	1,500	20/20	861	95% UCL, Table 6-64
					733	Mean, Table 6-64
Walleye		212	20,031	26/26	11,741	95% UCL, Table 6-64
					6,429	Mean, Table 6-64
Brown Trout		75	6,700	26/26	2,697	95% UCL, Table 6-64
					2,223	Mean, Table 6-64
Alewife	DDE (µg/kg)	80	80	1/1	80	Max, Table 6-64
Gizzard Shad		37	37	1/1	37	Max, Table 6-64
Walleye		64	540	2/3	540	Max, Table 6-64
Green Bay Zone 4						
Whole Fish Tissue						
Alewife	Total PCBs (µg/kg)	110	2,000	8/8	1,488	95% UCL, Table 6-73
					1,036	Mean, Table 6-73
Rainbow Smelt		150	1,600	18/18	764	95% UCL, Table 6-73
					526	Mean, Table 6-73
Walleye		620	9,620	36/36	3,294	95% UCL, Table 6-73
					2,546	Mean, Table 6-73
Brown Trout		1,456	3,900	18/18	2,714	95% UCL, Table 6-73
					2,451	Mean, Table 6-73
Walleye	DDE (µg/kg)	235	1,168	20/20	593	95% UCL, Table 6-73
					479	Mean, Table 6-73

Table 8-20 Summary of Chemicals of Concern and Medium-Specific Exposure Point Concentrations for Birds

Scenario Time Frame: **Medium:** **Exposure Medium:**	Current Prey Items Prey Items					
Exposure Point	**Chemical of Concern**	**Concentration Detected**		**Frequency of Detection**	**Exposure Point Concentration**	**Statistical Measure**
		Min	**Max**			
Operable Unit 3 (from Table 6-33 of the BLRA)						
Common Tern Ingestion	Mercury (µg/kg-BW/day)	NA	NA	NA	12.7	Mean
					25.3	RME
	Total PCBs (µg/kg-BW/day)	NA	NA	NA	170	Mean
					181	RME
Forster's Tern Ingestion	Mercury (µg/kg-BW/day)	NA	NA	NA	11.7	Mean
					23.4	RME
	Total PCBs (µg/kg-BW/day)	NA	NA	NA	157	Mean
					167	RME
Double-Crested Cormorant Ingestion	Mercury (µg/kg-BW/day)	NA	NA	NA	4.9	Mean
					9.8	RME
	Total PCBs (µg/kg-BW/day)	NA	NA	NA	65.6	Mean
					70.0	RME
Bald Eagle Ingestion	Mercury (µg/kg-BW/day)	NA	NA	NA	17.4	Mean
					17.5	RME
	Total PCBs (µg/kg-BW/day)	NA	NA	NA	427	Mean
					630	RME
Operable Unit 4 (from Tables 6-38 and 6-39 of the BLRA)						
Tree Swallow	Total PCBs (µg/kg)	510	17,000	22/22	4,505	RME
					3,118	Mean
	DDE (µg/kg)	28	520	22/22	331	RME
					218	Mean
Common Tern Ingestion	Mercury (µg/kg-BW/day)	NA	NA	NA	49	Mean
					123	RME
	Total PCBs (µg/kg-BW/day)	NA	NA	NA	1,274	Mean
					1,559	RME
	Dieldrin (µg/kg-BW/day)	NA	NA	NA	10.3	Mean
					28.4	RME
	DDE (µg/kg-BW/day)	NA	NA	NA	51.1	Mean
					70.0	RME

Table 8-20 Summary of Chemicals of Concern and Medium-Specific Exposure Point Concentrations for Birds (Cont.)

Scenario Time Frame: **Medium:** **Exposure Medium:**	Current Prey Items Prey Items					
Exposure Point	**Chemical of Concern**	**Concentration Detected**		**Frequency of Detection**	**Exposure Point Concentration**	**Statistical Measure**
		Min	**Max**			
Forster's Tern Ingestion	Mercury (µg/kg-BW/day)	NA	NA	NA	45.2	Mean
					113	RME
	Total PCBs (µg/kg-BW/day)	NA	NA	NA	1,175	Mean
					1,438	RME
	Dieldrin (µg/kg-BW/day)	NA	NA	NA	9.5	Mean
					26.2	RME
	DDE (µg/kg-BW/day)	NA	NA	NA	47.1	Mean
					64.6	RME
Double-Crested Cormorant Ingestion	Mercury (µg/kg-BW/day)	NA	NA	NA	18.9	Mean
					47.3	RME
	Total PCBs (µg/kg-BW/day)	NA	NA	NA	492	Mean
					602	RME
	Dieldrin (µg/kg-BW/day)	NA	NA	NA	4.0	Mean
					11.0	RME
	DDE (µg/kg-BW/day)	NA	NA	NA	19.7	Mean
					27.0	RME
Bald Eagle Ingestion	Mercury (µg/kg-BW/day)	NA	NA	NA	10.2	Mean
					12.5	RME
	Total PCBs (µg/kg-BW/day)	NA	NA	NA	750	Mean
					842	RME
	Dieldrin (µg/kg-BW/day)	NA	NA	NA	2.7	Mean
					3.8	RME
	DDE (µg/kg-BW/day)	NA	NA	NA	25.8	Mean
					74.0	RME
Operable Unit 5 – Green Bay						
Green Bay Zone 2 (from Tables 6-46 and 6-47 of the BLRA)						
Double-Crested Cormorant Brain	Total PCBs (µg/kg)	1,900	6,000	5/5	5,307	95% UCL
					3,700	Mean
Double-Crested Cormorant Egg		610	74,000	34/34	21,127	95% UCL
					13,944	Mean

Table 8-20 Summary of Chemicals of Concern and Medium-Specific Exposure Point Concentrations for Birds (Cont.)

Scenario Time Frame: **Medium:** **Exposure Medium:**	Current Prey Items Prey Items					
Exposure Point	**Chemical of Concern**	**Concentration Detected**		**Frequency of Detection**	**Exposure Point Concentration**	**Statistical Measure**
		Min	**Max**			
Double-Crested Cormorant Whole Body		324	63,000	74/74	13,870	95% UCL
					11,026	Mean
Common Tern Egg		2,266	9,011	10/10	5,963	95% UCL
					4,819	Mean
Forster's Tern Egg		1,478	8,092	10/10	6,234	95% UCL
					5,077	Mean
Tree Swallow Whole Body		1,200	4,500	15/15	3,495	95% UCL
					2,980	Mean
Double-Crested Cormorant Brain	Dieldrin (µg/kg)	30	64	5/5	60.5	95% UCL
					48.2	Mean
Double-Crested Cormorant Egg		39	1,300	32/34	445	95% UCL
					224	Mean
Double-Crested Cormorant Whole Body		36	1,300	73/73	243	95% UCL
					196	Mean
Common Tern Egg		29.8	155	5/5	139	95% UCL
					85.0	Mean
Forster's Tern Egg		26.5	84.9	7/7	62.7	95% UCL
					47.6	Mean
Double-Crested Cormorant Brain	DDE (µg/kg)	410	670	5/5	643	95% UCL
					534	Mean
Double-Crested Cormorant Egg		170	11,000	34/34	7,277	95% UCL
					4,132	Mean
Double-Crested Cormorant Whole Body		380	11,000	73/73	3,523	95% UCL
					2,756	Mean
Common Tern Egg		421	942	5/5	893	95% UCL
					666	Mean
Forster's Tern Egg		206	735	7/7	576	95% UCL
					447	Mean

Table 8-20 Summary of Chemicals of Concern and Medium-Specific Exposure Point Concentrations for Birds (Cont.)

Scenario Time Frame:	Current					
Medium:	Prey Items					
Exposure Medium:	Prey Items					
Exposure Point	**Chemical of Concern**	**Concentration Detected Min**	**Concentration Detected Max**	**Frequency of Detection**	**Exposure Point Concentration**	**Statistical Measure**
Common Tern Ingestion	Mercury (µg/kg-BW/day)	NA	NA	NA	49.1	Mean
					123	RME
	Total PCBs (µg/kg-BW/day)	NA	NA	NA	1,274	Mean
					1,559	RME
	Dieldrin (µg/kg-BW/day)	NA	NA	NA	10.3	Mean
					28.4	RME
	DDE (µg/kg-BW/day)	NA	NA	NA	51.1	Mean
					70.0	RME
Forster's Tern Ingestion	Mercury (µg/kg-BW/day)	NA	NA	NA	45.3	Mean
					114	RME
	Total PCBs (µg/kg-BW/day)	NA	NA	NA	1,174	Mean
					1,438	RME
	Dieldrin (µg/kg-BW/day)	NA	NA	NA	9.5	Mean
					26.2	RME
	DDE (µg/kg-BW/day)	NA	NA	NA	47.1	Mean
					64.6	RME
Double-Crested Cormorant Ingestion	Mercury (µg/kg-BW/day)	NA	NA	NA	19.0	Mean
					47.6	RME
	Total PCBs (µg/kg-BW/day)	NA	NA	NA	492	Mean
					602	RME
	Dieldrin (µg/kg-BW/day)	NA	NA	NA	4.0	Mean
					11.0	RME
	DDE (µg/kg-BW/day)	NA	NA	NA	19.7	Mean
					27.0	RME

Table 8-20 Summary of Chemicals of Concern and Medium-Specific Exposure Point Concentrations for Birds (Cont.)

Scenario Time Frame:	Current					
Medium:	Prey Items					
Exposure Medium:	Prey Items					
Exposure Point	**Chemical of Concern**	**Concentration Detected**		**Frequency of Detection**	**Exposure Point Concentration**	**Statistical Measure**
		Min	**Max**			
Bald Eagle Ingestion	Mercury (µg/kg-BW/day)	NA	NA	NA	10.2	Mean
					12.6	RME
	Total PCBs (µg/kg-BW/day)	NA	NA	NA	750	Mean
					842	RME
	Dieldrin (µg/kg-BW/day)	NA	NA	NA	2.7	Mean
					3.8	RME
	DDE (µg/kg-BW/day)	NA	NA	NA	25.8	Mean
					74.0	RME
Green Bay Zone 3A (from Tables 6-58 and 6-59 of the BLRA)						
Bald Eagle Egg	Mercury (mg/kg)	0.3	0.3	3/3	0.3	RME
					0.3	mean
	Total PCBs (µg/kg)	13,000	13,000	1/1	13,000	Max
	Dieldrin (µg/kg)	200	200	1/1	200	Max
Common Tern Ingestion	Mercury (µg/kg-BW/day)	NA	NA	NA	14.7	Mean
					19.6	RME
	Total PCBs (µg/kg-BW/day)	NA	NA	NA	444	Mean
					623	RME
	Dieldrin (µg/kg-BW/day)	NA	NA	NA	10.5	Mean
					13.5	RME
Forster's Tern Ingestion	Mercury (µg/kg-BW/day)	NA	NA	NA	13.6	Mean
					18.1	RME
	Total PCBs (µg/kg-BW/day)	NA	NA	NA	410	Mean
					575	RME
	Dieldrin (µg/kg-BW/day)	NA	NA	NA	9.7	Mean
					12.4	RME
Double-Crested Cormorant Ingestion	Mercury (µg/kg-BW/day)	NA	NA	NA	5.7	Mean
					7.6	RME
	Total PCBs (µg/kg-BW/day)	NA	NA	NA	172	Mean
					241	RME
	Dieldrin (µg/kg-BW/day)	NA	NA	NA	4.1	Mean
					5.2	RME

Table 8-20 Summary of Chemicals of Concern and Medium-Specific Exposure Point Concentrations for Birds (Cont.)

Scenario Time Frame: **Medium:** **Exposure Medium:**	Current Prey Items Prey Items					
Exposure Point	**Chemical of Concern**	**Concentration Detected**		**Frequency of Detection**	**Exposure Point Concentration**	**Statistical Measure**
		Min	**Max**			
Bald Eagle Ingestion	Mercury (µg/kg-BW/day)	NA	NA	NA	2.3	Mean
					4.5	RME
	Total PCBs (µg/kg-BW/day)	NA	NA	NA	334	Mean
					475	RME
	Dieldrin (µg/kg-BW/day)	NA	NA	NA	2.6	Mean
					6.3	RME
Green Bay Zone 3B (from Tables 6-66 and 6-67 of the BLRA)						
Double-Crested Cormorants Whole Body	Total PCBs (µg/kg)	246	15,000	20/21	15,000	Max
					5,384	mean
	DDE (µg/kg)	140	6,500	20/20	4,546	95% UCL
					2,010	Mean
Common Tern Ingestion	Mercury (µg/kg-BW/day)	NA	NA	NA	12.3	Mean
					24.5	RME
	Total PCBs (µg/kg-BW/day)	NA	NA	NA	892	Mean
					1,164	RME
	Dieldrin (µg/kg-BW/day)	NA	NA	NA	9.3	Mean
					13.4	RME
	DDE (µg/kg-BW/day)	NA	NA	NA	39.2	Mean
					39.2	RME
Forster's Tern Ingestion	Mercury (µg/kg-BW/day)	NA	NA	NA	11.3	Mean
					22.6	RME
	Total PCBs (µg/kg-BW/day)	NA	NA	NA	823	Mean
					1,073	RME
	Dieldrin (µg/kg-BW/day)	NA	NA	NA	8.6	Mean
					12.3	RME
	DDE (µg/kg-BW/day)	NA	NA	NA	36.2	Mean
					36.2	RME

Table 8-20 Summary of Chemicals of Concern and Medium-Specific Exposure Point Concentrations for Birds (Cont.)

Scenario Time Frame: Medium: Exposure Medium:	Current Prey Items Prey Items					
Exposure Point	**Chemical of Concern**	**Concentration Detected**		**Frequency of Detection**	**Exposure Point Concentration**	**Statistical Measure**
		Min	**Max**			
Double-Crested Cormorant Ingestion	Mercury (µg/kg-BW/day)	NA	NA	NA	4.7	Mean
					9.5	RME
	Total PCBs (µg/kg-BW/day)	NA	NA	NA	345	Mean
					450	RME
	Dieldrin (µg/kg-BW/day)	NA	NA	NA	3.6	Mean
					5.2	RME
	DDE (µg/kg-BW/day)	NA	NA	NA	15.1	Mean
					15.1	RME
Bald Eagle Ingestion	Mercury (µg/kg-BW/day)	NA	NA	NA	15.6	Mean
					30.1	RME
	Total PCBs (µg/kg-BW/day)	NA	NA	NA	594	Mean
					823	RME
	Dieldrin (µg/kg-BW/day)	NA	NA	NA	5.1	Mean
					6.4	RME
	DDE (µg/kg-BW/day)	NA	NA	NA	16.1	Mean
					34	RME
Green Bay Zone 4 (from Table 6-75 of the BLRA)						
Common Tern Ingestion	Mercury (µg/kg-BW/day)	NA	NA	NA	14.7	Mean
					14.7	RME
	Total PCBs (µg/kg-BW/day)	NA	NA	NA	508	Mean
					729	RME
	DDE (µg/kg-BW/day)	NA	NA	NA	7.3	Mean
					7.6	RME
Forster's Tern Ingestion	Mercury (µg/kg-BW/day)	NA	NA	NA	13.6	Mean
					13.6	RME
	Total PCBs (µg/kg-BW/day)	NA	NA	NA	468	Mean
					672	RME
	DDE (µg/kg-BW/day)	NA	NA	NA	6.7	Mean
					7.0	RME

Table 8-20 Summary of Chemicals of Concern and Medium-Specific Exposure Point Concentrations for Birds (Cont.)

Scenario Time Frame: Medium: Exposure Medium:	Current Prey Items Prey Items					
Exposure Point	Chemical of Concern	Concentration Detected		Frequency of Detection	Exposure Point Concentration	Statistical Measure
		Min	Max			
Double-Crested Cormorant Ingestion	Mercury (μg/kg-BW/day)	NA	NA	NA	5.7	Mean
					5.7	RME
	Total PCBs (μg/kg-BW/day)	NA	NA	NA	196	Mean
					282	RME
	DDE (μg/kg-BW/day)	NA	NA	NA	2.8	Mean
					3.0	RME
Bald Eagle Ingestion	Mercury (μg/kg-BW/day)	NA	NA	NA	20.2	Mean
					23.3	RME
	Total PCBs (μg/kg-BW/day)	NA	NA	NA	329	Mean
					489	RME
	DDE (μg/kg-BW/day)	NA	NA	NA	91.2	Mean
					119	RME

Notes:
BW – body weight
NA – not applicable
RME – reasonable maximum exposure
Since the food chain exposure includes ingestion of a variety of food items, it is not possible to present the minimum and maximum concentrations nor the frequency of detection for each of the items ingested; therefore, these values are indicated as being not applicable in Table 8-20.

Table 8-21 Summary of Chemicals of Concern and Medium-Specific Exposure Point Concentrations for Mammals

Scenario Time Frame Medium: Exposure Medium:	Current Prey items Prey items					
Exposure Point	**Chemical of Concern**	**Concentration Detected**		**Frequency of Detection**	**Exposure Point Concentration**	**Statistical Measure**
		Min	**Max**			
Operable Unit 3 (from Table 6-34 of the BLRA)						
Mammal Ingestion	Total PCBs (µg/kg-BW/day)	NA	NA	NA	773	Mean
					1,162	RME
Operable Unit 4 (from Table 6-40 of the BLRA)						
Mammal Ingestion	Total PCBs (µg/kg-BW/day)	NA	NA	NA	1,290	Mean
					1,437	RME
Operable Unit 5 (Zones 2 through 4)						
Green Bay Zone 2 (from Table 6-52 of the BLRA)						
Mammal Ingestion	Total PCBs (µg/kg-BW/day)	NA	NA	NA	1,271	Mean
					1,413	RME
Green Bay Zone 3A (from Table 6-60 of the BLRA)						
Mammal Ingestion	Total PCBs (µg/kg-BW/day)	NA	NA	NA	507	Mean
					763	RME
	Dieldrin (µg/kg-BW/day)	NA	NA	NA	3.4	Mean
					10.5	RME
Green Bay Zone 3B (from Table 6-69 of the BLRA)						
Mammal Ingestion	Total PCBs (µg/kg-BW/day)	NA	NA	NA	949	Mean
					1,180	RME
	Dieldrin (µg/kg-BW/day)	NA	NA	NA	8.3	Mean
					10.5	RME
Green Bay Zone 4 (from Table 6-76 of the BLRA)						
Mammal Ingestion	Total PCBs (µg/kg-BW/day)	NA	NA	NA	573	Mean
					875	RME

Notes:
BW – body weight
NA – not applicable
RME – reasonable maximum exposure
Since exposure point concentrations for piscivorous mammals are based solely on food chain exposure, it is also not possible to present the minimum or maximum values in Table 8-21.

PCB-Specific Exposure Point Concentrations

Water

Filtered and particulate concentrations of PCBs were detected in all River reaches and Bay zones. These concentrations were summed to give estimated water concentrations of total PCBs. Estimated mean, 95 percent UCL, and maximum total PCB concentrations in water are presented on Figure 6-6 of the BLRA. Estimated mean total PCB concentrations were greatest in OU 4 (60.9 micrograms per liter [µg/L]) and represented an increase of 2.2 times over the estimated mean total PCB concentrations in Little Lake Butte des Morts (27.6 µg/L).

Sediment

Total PCBs were detected frequently in all River reaches and the Bay zones. Total PCBs were reported as both statistical representations of the data in the FRDB (i.e., mean, 95 percent UCL, and maximum concentrations) and as concentrations based upon the interpolated bed maps. In contrast to metals, PCB concentrations generally decreased moving down the River and into the Bay. The mean total PCB concentration ranged from 82.9 micrograms per kilogram (µg/kg) (Green Bay Zone 4) to 10,724 µg/kg (Little Lake Butte des Morts). Mean, 95 percent UCL, and maximum concentrations of PCBs are presented on Figure 6-8 of the BLRA.

Fish

Total PCBs were detected frequently in all River reaches and the Bay zones. The range of detection frequency was 85 to 100 percent. The mean total PCB concentration ranged from 79.8 µg/kg (yellow perch from Green Bay Zone 4) to 6,637 µg/kg (carp from Green Bay zones 1 and 2). Mean, 95 percent UCL, and maximum total PCB concentrations in yellow perch, carp, and walleye are presented on Figure 6-11 of the BLRA. Mean, 95 percent UCL, and maximum total PCB concentrations in forage fish species (gizzard shad, alewife, shiner species, and rainbow smelt) are presented on Figure 6-12 of the BLRA.

Birds

Where they were analyzed, total PCBs were detected at a frequency of 100 percent, except for Green Bay Zone 3B, where they were detected at a frequency of 95 percent. The mean total PCB concentration ranged from 2,135 µg/kg (whole tree swallow from Little Lake Butte des Morts) to 11,026 µg/kg (whole double-crested cormorants from Green Bay Zone 2). Measured total PCB concentrations in birds are presented on Figure 6-15 of the BLRA. As indicated by this figure, the area where the most bird species were sampled was Green Bay Zone 2. This area also contained the highest concentrations of total PCBs, found in double-crested cormorants.

Mammals

Little Rapids to De Pere (OU 3): The mean exposure concentration for total PCBs was estimated to be between 760 and 773 micrograms per kilogram of body weight per day (µg/kg-BW/day).

De Pere to Green Bay (OU 4): The mean exposure concentration for total PCBs was estimated to be between 1,284 and 1,290 µg/kg-BW/day.

Green Bay Zone 2: The mean exposure concentration for total PCBs was estimated to be between 1,271 and 1,275 µg/kg-BW/day.

Green Bay Zone 3A: The mean exposure concentration for total PCBs was estimated to be 507 µg/kg-BW/day.

Green Bay Zone 3B: The mean exposure concentration for total PCBs was estimated to be 949 µg/kg-BW/day.

Green Bay Zone 4: The mean exposure concentration for total PCBs was estimated to be 573 µg/kg-BW/day.

Summary of Field Studies
Within the River and Bay system, there have been numerous field studies on a variety of different species. Many of the species studied were also evaluated in the BLRA as receptor species that represented the assessment endpoints in the BLRA. While not specifically included in the risk characterization, the studies are presented in BLRA Section 6.5.4 to provide the risk managers with an integrated tool for decision-making.

Effects Assessment

Toxic effects of all COPCs were evaluated in the BLRA. Section 6.3 of the BLRA provides details of the effects of all the COPCs on the assessment endpoints. The discussion below focuses on effects of PCBs.

PCBs have been shown to cause lethal and sublethal reproductive, developmental, immunological, and biochemical effects. The BLRA limited its focus to adverse impacts on survival, growth, and reproduction. The ecological effects assessment includes literature reviews, field studies, and toxicity tests that correlate concentrations of PCBs to effects on ecological receptors. Toxic equivalency factors, based on the toxicity of dioxin, have been developed for the dioxin-like PCB congeners. The effects of PCBs on Great Lakes fish and wildlife have been extensively documented. PCB-induced reproductive impairment has been demonstrated for several fish species (Mac, 1988; Ankley et al., 1991; Walker and Peterson, 1991; Walker et al., 1991a, 1991b; Williams and Giesy, 1992), a number of insectivorous and piscivorous birds (Kubiak et al., 1989; Gilbertson et al., 1991; Tillitt et al., 1992), and mink (Aulerich et al., 1973, Aulerich and Ringer, 1977; Bleavins et al., 1980; Wren, 1991; Giesy et al., 1994c; Heaton et al., 1995a, 1995b; Tillitt et al., 1996).

Derivation of Toxicity Reference Values

In order to derive toxicity reference values (TRVs), a comprehensive literature search was performed for all COPCs. A variety of databases were searched for literature references containing toxicological information. Some of these literature sources included Biological Abstracts, Applied Ecology Abstracts, Chemical Abstract Services, Medline, Toxline, BIOSIS, ENVIROLINE, Current Contents, IRIS, the Aquatic Information Retrieval Database (AQUIRE) maintained by the EPA, and the Environmental Residue Effects Database (ERED) maintained by the EPA and USACE. The TRVs selected for this assessment were discussed with and agreed upon by BTAG members. Importantly, the consensus on the TRVs is for Site-specific use only; the TRVs are not intended to be used at other sites (Table 6-5 of the BLRA).

TRVs were used to estimate the potential for ecological risk at the Site. The selected TRVs were either Lowest Observed Adverse Effects Levels (LOAELs) and/or No Observed Adverse Effects Levels (NOAELs) from laboratory and/or field-based studies reported in the scientific literature. LOAELs are the lowest values at which adverse effects have been observed, and NOAELs are the highest values at which adverse effects were not observed.

The PCB and dioxin-like PCB congener TRVs for fish, birds, and mammals are based on effects on survival, growth, and reproduction of fish and wildlife species in the River. Reproductive effects (e.g., egg maturation, egg hatchability, and survival of juveniles) were generally the most sensitive endpoints for animals exposed to PCBs.

Risk Characterization

Hazard Quotient Calculations

Risk characterization for each assessment endpoint was based upon the calculated HQs and, as available, population or field study data. Hazard quotients calculated based on literature values provide one line of evidence for characterizing ecological effects. Field studies were evaluated, where appropriate, as a supplement to the risk evaluation, particularly when the contamination has a historical basis (EPA, 1994b, 1997a).

While HQs and other lines of evidence (i.e., field studies and other data types) cannot be quantitatively combined, each can inform risk managers on the presence of risk and how these risks may be reduced. Therefore, this risk characterization process did not result in the distillation of a single conclusive statement regarding overall risk to each assessment endpoint. Consideration of the magnitude of uncertainty, discussed in Section 6.6 of the BLRA, is also a key component of the risk interpretation process.

For this risk assessment, it was agreed by the BTAG that degree of risk would be determined based on three categories: “no” risk was concluded when both the No Observed Adverse Effects Concentration (NOAEC) and Lowest Observed Adverse Effects Concentration (LOAEC) HQs evaluated were less than 1.0; “potential” risk was concluded when the NOAEC HQ exceeded 1.0 but the LOAEC HQ was less than 1.0; and risk was concluded when both the NOAEC and LOAEC HQs evaluated were greater than 1.0. When constituents were analyzed but not detected, it was concluded that no risk existed.

OU 3 – Little Rapids to De Pere: The results suggest that measured or estimated concentrations of total PCBs are at sufficient levels to cause risk to benthic invertebrates and piscivorous mammals. Potential risks are indicated for benthic and pelagic fish and piscivorous and carnivorous birds. There are no data to evaluate insectivorous birds. Measured or estimated concentrations of mercury are found to be at sufficient concentrations to cause, or potentially cause, risk to aquatic invertebrates, benthic invertebrates, pelagic fish, piscivorous birds, and carnivorous birds. There are persistent risks to benthic infaunal communities in sediments from exposure to lead, mercury, 2,3,7,8-TCDD, total PCBs, p,p'-DDE, and p,p'-DDT. Concentrations of arsenic, dieldrin, all o,p'- isomers of DDT and its metabolites, and p,p'-DDD are not sufficient to pose risk to any assessment endpoint.

OU 4 – De Pere to Green Bay: The results taken in total suggest that measured or estimated concentrations of total PCBs are at sufficient levels to cause risk to benthic invertebrates and piscivorous mammals. Total PCBs are at sufficient levels to potentially cause risk to aquatic invertebrates and insectivorous birds. Concentrations of dieldrin, all o,p'- isomers of DDT and its metabolites, and p,p'-DDT are not sufficient to pose risk to any of the evaluated assessment endpoints. Risks to fish and birds are discussed in the Green Bay Zone 2 summary.

OU 5 – Green Bay Zone 2: The results taken in total suggest that measured or estimated concentrations of total PCBs are at sufficient levels to cause risks to benthic invertebrates, carnivorous birds, and piscivorous mammals. Potential risks are indicated for benthic and pelagial fish and piscivorous birds. Measured or estimated concentrations of mercury are at sufficient concentrations to cause or potentially cause risk to aquatic invertebrates, benthic invertebrates, pelagial fish, piscivorous birds, and carnivorous birds. Measured or estimated concentrations of DDE are at sufficient concentrations to cause or potentially cause risk to benthic fish, pelagic fish, insectivorous birds, piscivorous birds, and carnivorous birds.

OU 5 – Green Bay Zone 3A: The results taken in total suggest that concentrations of total PCBs are at sufficient levels to cause or potentially cause risk to benthic invertebrates, benthic fish, pelagic fish, piscivorous birds, carnivorous birds, and piscivorous mammals. There were no data to evaluate insectivorous birds. Mercury concentrations are potentially causing risk to piscivorous birds. Concentrations of dieldrin are a potential risk for carnivorous birds and piscivorous mammals. Concentrations of arsenic, lead, and all o,p'- and p,p'- isomers of DDT and its metabolites were not found to pose risk to any assessment endpoint.

OU 5 – Green Bay Zone 3B: The results taken in total suggest that measured or estimated concentrations of total PCBs are at sufficient levels to cause or potentially cause risk to benthic invertebrates, pelagial fish, piscivorous birds, carnivorous birds, and piscivorous mammals. There are no data to evaluate insectivorous birds. Mercury concentrations are causing or potentially causing risk to benthic invertebrates, pelagial fish, piscivorous birds, and carnivorous birds. DDE concentrations are causing or potentially causing risk to pelagial fish, piscivorous birds, and carnivorous birds. Dieldrin concentrations are potentially causing risk to piscivorous mammals. Arsenic and lead concentrations are only of risk to benthic invertebrates.

OU 5 – Green Bay Zone 4: These results taken in total suggest that concentrations of total PCBs are at sufficient levels to cause or potentially cause risk to benthic invertebrates, pelagial fish, piscivorous birds, carnivorous birds, and piscivorous mammals. Concentrations of DDE are causing or potentially causing risk to pelagial fish and carnivorous birds. Concentrations of mercury are causing or potentially causing risk to piscivorous and carnivorous birds.

Major Findings

A summary of the risk to each assessment endpoint in each reach and zone is presented in Table 6-134 of the BLRA. OUs 3, 4, and 5 are discussed below and summarized in Table 8-22.

The principal findings of the ecological risk assessment are:

- Total PCBs cause or potentially cause risk to all identified receptors. The exception is insectivorous birds, where the weight of evidence suggests that these receptors are not at risk from PCB concentrations. Not all receptors at risk or potentially at risk from PCBs are at risk in all River reaches or Bay zones.

- Mercury poses a risk in all River reaches and zones, but not to all receptors. Mercury was not identified as a risk for insectivorous birds or piscivorous mammals.

- DDT or its metabolites pose a risk to benthic invertebrates in OUs 3 and 4, benthic and pelagic fish in OUs 4 and 5, and piscivorous and carnivorous birds in OUs 4 and 5. DDT or its metabolites were not identified as a risk to water column invertebrates or to piscivorous mammals.

- Dieldrin poses a risk in either or both OUs 4 and 5 to piscivorous and carnivorous birds as well as piscivorous mammals.

- Arsenic and/or lead pose a risk to benthic invertebrates in OUs 3 and 4 and parts of OU 5. No other receptor is at risk from arsenic or lead.

Table 8-22 Ecological Risk Summary for OUs 3 through 5

OU	Water Column Invertebrates	Benthic Invertebrates	Benthic Fish	Pelagic Fish	Insectivorous Bird	Piscivorous Bird	Carnivorous Bird	Piscivorous Mammal
3	● mercury	● lead, mercury, 2,3,7,8-TCDD, PCBs, DDE, DDT	☼ mercury, PCBs	☼ mercury, PCBs	NA	☼ mercury PCBs	☼ mercury, PCBs	● PCBs
4	☼ PCBs	● arsenic, lead, mercury, PCBs, DDD, DDE	☼ PCBs, DDE	☼ mercury, PCBs, DDE	☼ PCBs	☼ mercury, PCBs, dieldrin, DDE	☼ PCBs, mercury, DDE	● PCBs
OU 5, Zone								
2	● mercury	● mercury, PCBs	☼ PCBs, DDE	☼ mercury, PCBs, DDE	☼ PCBs, DDE	☼ mercury, PCBs, dieldrin DDE	☼ PCBs, mercury, DDE	● PCBs
3A		● PCBs	☼ PCBs	☼ PCBs	NA	☼ mercury, PCBs	● PCBs, ☼ dieldrin	● PCBs, ☼ dieldrin
3B		● arsenic, lead, mercury, PCBs		● PCBs, ☼ mercury, DDE	NA	● PCBs, mercury ☼ dieldrin DDE	☼ PCBs, mercury, DDE	● PCBs, ☼ dieldrin
4		● PCBs	NA	☼ PCBs, DDE	NA	☼ mercury, PCBs	☼ PCBs, mercury, DDE	● PCBs

Notes:
NA – no data available
Risk conclusions based on HQs
= No Risk
● = Risk
☼ = Potential Risk
Risk conclusions based on weight of evidence
= Site-specific receptor data suggest that there is no risk.
= Because of the federal listing of the bald eagle as threatened, it is concluded that potential risk is actual risk.

Uncertainty

The goal of this uncertainty analysis is to both qualitatively and, to the degree possible, quantitatively define the degree of confidence that exists with the estimations of effects from exposure to hazardous chemicals in toxic amounts. EPA's Superfund Ecological Risk Assessment Guidance (EPA, 1997a) and the Guidelines for Ecological Risk Assessment (EPA, 1998b) provide general instructions on what should be addressed in an uncertainty analysis.

Conceptual Site Model

Qualitatively, there is a high degree of certainty that factors such as fate and distribution, downstream transport, biological uptake, effects on field populations, and habitat and life histories of important fish, birds, and mammals within the River and Bay are well understood and adequately characterized in the conceptual site model. There remains, however, some uncertainty as to whether the receptors identified within the conceptual site model adequately represent the ecosystem and other species potentially at risk within the River. The selection of the important receptor species was made in consultation with biologists both within the WDNR and the USFWS. In addition, input on the receptor species was provided by biologists and resource managers within the EPA, NOAA, and the Oneida and Menominee Nations through the EPA BTAG process. However, despite this, there remain a class of organisms and a threatened species that were not addressed in the BLRA. Reptile and amphibian species were not evaluated for risk because there are no data within the FRDB to evaluate this receptor group, and there are no uptake models to estimate risk for frogs or other amphibians. For the fish species sturgeon, listed as a threatened species in Michigan (but not in Wisconsin), there are also too few data points within the FRDB to evaluate potential risks.

Data

The FRDB represents numerous separate data collection efforts with over 580,000 discrete data records of air, water, sediments, and tissue from throughout the River and Bay. A rigorous evaluation of the quality of the data was undertaken, and only data for which at least partial data validation (quality assurance) packages could be reviewed were placed into the FRDB. Of the studies between 1971 and 1991, only partial packages could be reviewed, and so those data were used as supporting evidence in the BLRA. Several studies were completed on the River in the 1990s. All studies conducted after 1992 have fully validated data packages. Given the temporal and spatial density of the data within the River, there are good reasons to assume that the overall quality of the data is high, and, therefore, the related degree of data uncertainty is low. There were no significant biases or gaps observed in the sediment, fish, or bird sample data.

Another data gap in the BLRA is that there are limited measurements of metals and the organochlorine pesticides in surface water. However, this data gap impacts only the ability to assess risks to pelagic invertebrate communities; the remaining assessment endpoints could be addressed through the other media (e.g., bird tissues) for which data were judged adequate. Finally, there are relatively too few data points on all PCB congeners for all media within the River and Bay to make conclusive assessments or predictions of risk. While the FRDB contains numerous congener-specific data points, until relatively recently all of the dioxin-like congeners have not been adequately assessed. For example, while PCB congener 169 has been detected in the fish and birds of the River and Bay, there have been too few measurements taken in sediment or water.

Temporal

A time trends analysis was undertaken specifically to address the question of losses or gains in PCB concentrations over time in sediment and fish (see *White Paper No. 1 – Time Trends Analysis*, December 2002). For sediment, a large fraction of analyses provided little information useful for projecting future trends because of the lack of statistical significance and the wide confidence limits observed. This is especially true for sediment below the top 4 inches; changes in the sediment PCB concentrations cannot be distinguished from zero or no change. Generally over time, however, PCB concentrations in the surface sediment (i.e., top 10 cm) have been steadily decreasing, but the rate of change in surface sediment is both reach- and deposit-specific. The change averages an annual decrease of 15 percent, but ranges from an increase of 17 percent to a decrease of 43 percent. Given these conditions, the sediment data used may over- or under-evaluate the risks, depending on how much older data were used in the point estimates or interpolated bed maps.

Like sediment PCB concentrations, fish tissue PCB concentrations showed a significant but slow rate of change throughout the River and Bay. In all of the reaches of the River and in Zone 2, there were steep declines in fish tissue PCB concentrations from the 1970s, but with significant breakpoints in declines beginning around 1980. After the breakpoint, depending on the fish species, the additional apparent declines were either not significantly different from zero or were relatively low (i.e., 5 to 7 percent annually) or in some cases showed statistically significant increase in PCB concentrations. For example, whole body carp showed a significant increase in 1995 in OU 4. Likewise, gizzard shad in Zone 2 show a non-significant increase of 6 percent per year into 1999. These data, taken collectively, suggest that since the breakpoint for tissue declines occurred in the early 1980s and the changes in fish tissue concentrations were not typically greater than 4 to 7 percent annually, aggregating fish tissue from 1989 does not likely result in any significant biasing of the risk estimations. At worst, the tissue point estimates might overestimate risks by 50 percent (i.e., average of 5 percent per year over 10 years), but given that at least some fish tissue concentrations increased, it is reasonable to suggest that some risks were underestimated by at least an equivalent amount.

Spatial Variability

Uncertainty in the spatial variability refers principally to where sediment samples were collected from within the River and Bay. Within the River, most sampling efforts are concentrated in areas where there were thick sediment deposits (e.g., A, POG, N, GG/HH, and the SMUs below De Pere). There were no systematic sampling efforts to define PCB concentrations throughout the River. Within the Bay, systematic grid sampling was employed, but the spatial uncertainty is higher because of the large distance between sampling points. Sediment concentrations used in the risk assessment were based on both non-interpolated and interpolated concentration estimation methods so that the differences in risk estimates could be compared. The calculations demonstrate that, in general, using the interpolated sediment data yields a lower estimation of sediment-based risk than using the non-interpolated data.

Toxic Exposure

Point estimates of exposure concentrations were compared in the BLRA to point estimates of toxicity in the literature to yield the hazard quotients. While the rationale used to select the most representative value from the literature was presented in Section 6.3 of the BLRA, there remain uncertainties associated with effects concentrations above or below the selected TRV, the selection of TRVs from one species and application to another, interpretation between NOAECs and LOAECs based on application of uncertainty factors, or application of different sets of toxicity equivalent factors from the literature. For PCBs, risk estimation uncertainty was reduced by determining risk potential on a total PCB basis and a PCB congener basis for receptors where both exposure and effects data were available (i.e., fish and birds).

Alternative Exposure Points

The principal exposure point concentration used for risk evaluation in the BLRA was the RME (i.e., the lower of either the 95 percent UCL or the maximum concentration) for all media and receptors evaluated. In order to determine the degree to which risk may have been under- or overestimated, 90th percentile concentrations were estimated and evaluated for risk for two representative species: walleye and double-crested cormorants.

For walleye, results of this comparison indicated that risk evaluation of the 90th percentile concentrations would result in only two changes to the risk conclusions. Hazard quotients for the total PCB NOAEL for walleye in OU 4 increase from 10 to 14 using the 90th percentile. The risk determination for walleye from total PCBs would change from "potential risk" to "likely risk" in Green Bay zones 1 and 2, and risk from mercury in Green Bay Zone 4 would change from "no risk" to "potential risk." The net conclusions of the ecological risk assessment for piscivorous fish would be negligibly affected by using the 90th percentile.

For double-crested cormorants, risk evaluation of the 90th percentile concentrations would result in only one change to the risk conclusions. Risk to double-crested cormorants from p,p'-DDE would change from "potential risk" to "likely risk" in Green Bay Zone 3B. Because of the limited 90th percentile data in fish appropriate as prey for double-crested cormorants, dietary concentrations could not be modeled. However, use of the 90th percentile would not appreciably affect the risk determinations for piscivorous birds.

Population Data

As noted previously, although population level endpoints can be an appropriate tool to assess risk, the population data discussed in the BLRA were not collected specifically for risk assessment. There is some uncertainty introduced given the potential for other confounding environmental factors that may affect the absence or abundance of receptors within the River and Bay. These factors can include such things as immigration, emigration, food availability, habitat suitability and availability, species competition, predation, and weather. For example, while the risk assessment concludes that PCBs are at sufficient concentrations to affect mink reproduction within the River and Bay, Section 2 of the BLRA documented that there is limited habitat for mink, especially along the River. While contaminant conditions exist that potentially would jeopardize mink health along the River corridor, the absence of mink due to an absence of habitat must be considered.

Likewise, the apparent increase in populations of walleye and cormorants suggest little or no current risks to these species. Increases in walleye populations have occurred since the 1980s and are directly linked to improvement in water quality and habitat in the River, not necessarily to decreases in contaminants. That some risks persist is evidenced in the apparent presence of pre-cancerous lesions. Cormorant population increases may be related to decreases in contaminant concentrations, but are also likely tied to increases in available prey (fish). As for walleye, sublethal conditions appear to persist within the cormorant population. Given a shift in food or habitat conditions, those risks could be potentially of greater concern.

Quantitative Analysis

Only the data for benthic infauna for the River were thought to be amenable to a quantitative analysis. This analysis involved use of a range of toxicity values as listed in the literature rather than the single point estimate for toxicity that was used in the main body of the BLRA. This re-analysis was performed for each River reach and Bay zone.

Operable Unit 3 – Little Rapids to De Pere Reach: There is a high probability (80 percent) that PCBs are widely distributed throughout the reach at sufficiently high concentrations to moderately impact benthic infaunal populations and at least a 30 percent probability of encountering sediment concentrations associated with extreme effects.

Operable Unit 4 – De Pere to Green Bay: There is a high probability (95 percent) that PCBs are widely distributed throughout the reach at sufficiently high concentrations to moderately impact benthic infaunal populations and at least a 60 percent probability of encountering sediment associated with extreme effects.

Operable Unit 5 – Green Bay:

- **Green Bay Zone 2.** There is a high probability (40 percent) that PCBs are widely distributed throughout the reach at sufficiently high concentrations to moderately impact benthic infaunal populations and at least a 25 percent probability of encountering sediment associated with extreme effects.
- **Green Bay Zone 3A.** Relative to the other reaches discussed, there is a moderate probability (30 percent) of encountering PCBs at sufficiently high concentrations to moderately impact benthic infaunal populations, but a 0 percent probability of encountering sediment associated with extreme effects.
- **Green Bay Zone 3B.** There is a high probability (60 percent) that PCBs are widely distributed throughout the reach at sufficiently high concentrations to moderately impact benthic infaunal populations, but a 0 percent probability of encountering sediment associated with extreme effects.
- **Green Bay Zone 4.** There is only a very low probability that PCBs are widely distributed throughout the reach at sufficiently high concentrations to impact benthic infaunal populations.

Concluding Statement

The evaluation of uncertainties did not change the general conclusions drawn from the BLRA, which are that:

- Fish consumption by other fish, birds, and mammals is the exposure pathway that represents the greatest level of risk for receptors (other than direct risk to benthic invertebrates).
- The primary COC is PCBs; other COCs carried forward for remedial evaluation and long-term monitoring are mercury and DDE.

8.4 Derivation of Sediment Quality Thresholds

To facilitate the selection of a remedy that would result in decreased risks, it was necessary to establish a link between levels of PCBs toxic to human and ecological receptors and the principal source of those PCBs, the River and Bay sediment. SQTs are estimated threshold concentrations of PCBs in sediment below which risks should not occur. The SQTs themselves are not cleanup criteria, but are a good approximation of protective sediment thresholds and were considered to be “working values” from which a range of remedial action levels could be evaluated. Development of SQTs is consistent with the NCP guidance and the recommendations of the National Research Council (NRC) (*A Risk Management Strategy for PCB-Contaminated Sediment*, 2001).

SQTs were estimated for PCBs with the assumption that a remedy that reduces PCB exposure would also address the other co-located COCs. Risk-based concentrations in fish for human and ecological receptors were determined based on:

- Human health cancer risk levels of 10^{-4}, 10^{-5}, and 10^{-6} and a noncancer hazard index of 1.0 for risk in recreational anglers and high-intake fish consumers

- The NOAECs and LOAECs for species of benthic invertebrates, fish, birds, and riverine mammals found in the River and Bay

8.5 Basis for Action

The excess cancer risk and noncancer health hazards associated with human ingestion of fish, as well as the ecological risks associated with ingestion of fish by birds, fish, and mammals, are above acceptable levels under baseline conditions. The response action selected in this ROD is necessary to protect the public health, safety, or welfare and the environment from actual releases of hazardous substances into the environment.

9 REMEDIAL ACTION OBJECTIVES

Consistent with the NCP and RI/FS guidance, the WDNR and EPA developed remedial action objectives (RAOs) for the protection of human health and the environment. The RAOs specify the contaminants and media of concern, exposure routes and potential receptors, and an acceptable concentration limit or range for each contaminant for each of the various media, exposure routes, and receptors. RAOs were then used to establish specific remedial action levels (RALs) for the Site. Action levels were established after review of both the preliminary chemical-specific applicable or relevant and appropriate requirements (ARARs) and risk-based concentrations and serve to focus the development of alternatives or remedial technologies that can achieve the remedial goals. Although this ROD addresses only remediation of OUs 3, 4, and 5, the RAOs were developed for the entire River and the Bay.

The FS brought together the four major components used to evaluate risk, remedial goals, and alternative technologies in its analysis of remedial options. These components are briefly described below, then discussed in more detail on the following pages.

- **Remedial Action Objectives.** RAOs are site-specific goals for the protection of human and ecological health. Five RAOs were developed; all five apply to the River, while RAOs 1, 2, 3, and 5 apply to the Bay. RAO 4 does not apply to the Bay.

- **Remedial Action Levels.** A range of action levels was considered for the River and Bay; action levels were chosen based in part on SQTs, which link risk in humans, birds, mammals, and fish with safe threshold concentrations of PCBs in sediment. The SQTs were developed in the human health and ecological risk assessments.

- **Operable Units.** Four River reaches (OU 1 through OU 4) and the Bay (OU 5) were identified as Operable Units based on geographical similarities for the purpose of analyzing remedial actions. This ROD encompasses OU 3, OU 4, and OU 5. A previous ROD covered OU 1 and OU 2.

- **Remedial Alternatives.** Following a screening process detailed in the FS, six remedial alternatives (A through F) were retained for the River and seven (A through G) were retained for the Bay.

For each River reach, six possible remedial alternatives were applied to each of five possible action levels and evaluated against each of five RAOs. For the Bay, seven possible remedial alternatives were applied to each of three possible action levels and evaluated against each of four RAOs. The steps in this process are described in more detail below. Cost estimates were also prepared for each remedial alternative and action level.

9.1 Remedial Action Objectives

RAOs address protection of human health and protection of the environment. No numeric cleanup standards have been promulgated by the federal government or the State of Wisconsin for PCB-contaminated sediment. Therefore, site-specific RAOs to protect human and ecological health were developed based on available information and standards, such as ARARs, non-promulgated guidelines referred to as "to be considereds" (TBCs), and risk-based levels established using the human and ecological risk assessments. The following five RAOs have been established for the Lower Fox River and Green Bay Site.

- **RAO 1: Achieve, to the extent practicable, surface water quality criteria throughout the Lower Fox River and Green Bay.** This RAO is intended to reduce PCB concentrations in surface water as quickly as possible. The current water quality criteria for PCBs are 0.003 ng/L for the protection of human health and 0.012 ng/L for the protection of wild and domestic animals. Water quality criteria incorporate all routes of exposure assuming the maximum amount is ingested daily over a person's lifetime.

- **RAO 2: Protect humans who consume fish from exposure to COCs that exceed protective levels.** This RAO is intended to protect human health by targeting removal of fish consumption advisories as quickly as possible. The WDNR and EPA defined the expectation for the protection of human health as the likelihood for recreational anglers and high-intake fish consumers to consume fish within 10 years and 30 years, respectively, at an acceptable level of risk or without restrictions following completion of a remedy.

- **RAO 3: Protect ecological receptors from exposure to COCs above protective levels.** RAO 3 is intended to protect ecological receptors such as invertebrates, birds, fish, and mammals. The WDNR and EPA defined the ecological expectation as the likelihood of achieving safe ecological thresholds for fish-eating birds and mammals within 30 years following remedy completion. Although the FS did not identify a specific time frame for evaluating ecological protection, the 30-year figure was used as a measurement tool.

- **RAO 4: Reduce transport of PCBs from the Lower Fox River into Green Bay and Lake Michigan.** The objective of this RAO is to reduce the transport of PCBs from the River into the Bay and Lake Michigan as quickly as possible. The WDNR and EPA defined the transport expectation as a reduction in loading to the Bay and Lake Michigan to levels comparable to the loading from other Lake Michigan tributaries. This RAO applies only to River reaches.

- **RAO 5: Minimize the downstream movement of PCBs during implementation of the remedy.** A remedy is to be completed within 10 years.

Remedial Action Levels

PCB remedial action levels were developed based on the SQTs derived in the BLRA for the River and Bay. SQTs are estimated concentrations that link risk in humans, birds, mammals, and fish with safe threshold concentrations of PCBs in sediment (see discussion in Section 8.4). The PCB RALs considered are 0.125, 0.25, 0.5, 1, and 5 ppm for the River and 0.5, 1, and 5 ppm for the Bay.

A range of RALs was considered in order to balance the feasibility of removing PCB-contaminated sediment down to each action level against the residual risk to human and ecological receptors after remediation. For each Operable Unit, all of the sediment with PCB concentrations greater than the selected RAL is to be remediated. One of the outcomes of applying a specific RAL to various remedial alternatives, such as dredging or capping or a combination of those, is the recognition that Monitored Natural Recovery (MNR) may also be a component of the remedy. This was considered because when sediment is removed to a specific action level, some sediment with PCB concentrations above the SQTs will likely be left in place. MNR can also be a standalone remedy if it is determined to achieve sufficient protection within a reasonable time frame. As a result, each action level and each remedial alternative has an MNR component relating to PCBs left in place following active remediation.

9.2 Applicable or Relevant and Appropriate Requirements (ARARs)

Section 121(d) of CERCLA requires that Superfund remedial actions meet ARARs. In addition to applicable requirements, the ARARs analysis considered criteria and relevant and appropriate standards and non-promulgated TBC guidelines that were useful in evaluating remedial alternatives. ARARs are promulgated cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations; TBCs are guidelines and other criteria that have not been promulgated.

Location-specific ARARs establish restrictions on dredging and grading activities and the management of waste or hazardous substances in specific protected locations, such as riverbeds, lakebeds, wetlands, floodplains, historic places, and sensitive habitats.

Action-specific ARARs are technology-based or activity-based requirements or limitations on actions taken with respect to remediation. These requirements are triggered by particular remedial activities that are selected to accomplish the remedial objectives. The action-specific ARARs indicate the way in which the selected alternative must be implemented, as well as specify levels for discharge (see Table 4-2 of the FS).

Chemical-specific ARARs are health- or risk-based numerical values or methodologies that establish concentration or discharge limits, or a basis for calculating such limits, for particular substances, pollutants, or contaminants.

In addition to the water quality criteria, substantive requirements of the National Pollutant Discharge Elimination System (NPDES), as implemented under Wisconsin administrative rules, would also be applicable to wastewaters that are planned to be discharged to the River, which will require treatment. These wastewaters include liquids generated during construction activities, such as dewatering liquids, excavation area liquids, and liquids generated during construction of any on-Site consolidation area. Discharges to publicly owned treatment works (POTWs) may be pursued as an alternative discharge location. However, such discharges must also comply with pretreatment limitations to ensure acceptable discharge from the POTW after treatment. The specific discharge levels will be determined during the design stage in coordination with the WDNR.

Sediments removed from the River may contain PCBs at a concentration equal to or greater than 50 ppm. PCB sediment with concentrations less than 50 ppm will be managed as a solid waste in accordance with statutes and rules governing the disposal of solid waste in Wisconsin. PCB sediment with concentrations equal to or greater than 50 ppm will be managed in accordance with the Toxic Substances Control Act (TSCA) of 1976 (Appendix E of the FS).

Presently, TSCA compliance would be achieved through the extension of the January 24, 1995, approval issued by the EPA to WDNR pursuant to 40 CFR 761.60(a)(5) under the authority of TSCA. This TSCA approval, granted by EPA Region 5, states that the disposal of PCB-contaminated sediment with concentrations equal to or greater than 50 ppm into an NR 500 WAC landfill (a landfill that complies with requirements established under a rule in the Wisconsin Administrative Code referred to as NR [Natural Resources] 500) that is also in compliance with the conditions of the TSCA approval: (1) provides adequate protection to human health and the environment as required by 40 CFR 761.60(a)(5), and (2) will provide the same level of protection required by EPA Region 5 and therefore is no less restrictive than TSCA. However, should other administrative rules pertaining to disposal under TSCA be in effect at the time that TSCA compliance decisions are made for the River sediment, then compliance with those rules will be achieved.

10 DESCRIPTION OF ALTERNATIVES

Following development of the RAOs, the WDNR and EPA conducted a rigorous screening and evaluation in accordance with CERCLA and the NCP. First, a wide range of potentially applicable remedial technologies or process options for addressing PCB-contaminated sediments were identified and screened (evaluated) based on effectiveness and technical implementability at the Site. Those technologies that were retained after the first screening of potential remedial technologies were then evaluated in a second screening based on effectiveness, implementability, and cost. After the second screening, the following technologies were retained for consideration in the analysis of remedial alternatives: (A) no action, which the NCP requires be evaluated; (B) MNR; (C) dredging with various disposal options, (D) dredging to confined disposal facility, (E) dredging to a vitrification facility, and, (F) capping to the maximum extent practicable with dredging in areas where capping is not appropriate. Alternatives C through F would be followed by MNR once the active remediation was complete.

Process options for treatment and disposal that were retained after the second screening include vitrification and upland and in-water disposal. After the technology screening, the WDNR and EPA developed and screened remedial alternatives. A specified cleanup value or action level for PCBs in sediment was not developed for purposes of evaluating remedial alternatives. Because fish consumption is the major pathway of concern, remedial alternatives were evaluated based on their ability to reduce PCB concentrations in fish. Because PCB concentrations in fish are largely a function of PCB concentrations in both the sediment and the water column, sediment cleanup is considered the means to the goal of protecting human health and the environment.

The criteria identified in Section 6.4.4 of the FS were used to identify locations where the capping alternative was feasible. For excavation and capping alternatives, the WDNR and EPA evaluated the following action levels for the River: PCB concentrations of 0.125 ppm, 0.25 ppm, 0.5 ppm, 1 ppm, 5 ppm, and no action. These results were then compared to the RAOs, particularly RAOs 2 and 3, which deal with protection of human health and the environment. On the basis of that analysis and to achieve the risk reduction objectives using a consistent action level, 1 ppm was agreed upon as the appropriate RAL. In making this determination, the Agencies relied on projections of the time required to achieve the risk reduction, the post-remediation surface-weighted average concentration (SWAC), and cost.

Table 10-1 (derived from FS Tables 8-14 and 8-16) shows the time necessary to achieve acceptable fish tissue concentrations for walleye that are protective of human health at the selected action level of 1 ppm at OU 3. PCB fish consumption advisories are lifted when the contaminant concentration in the fish fillets falls below 50 parts per billion (ppb). Therefore, for the recreational angler, PCB tissue levels in young-of-the-year walleye would be just at or below the level triggering fish consumption advisories about 9 years post-remediation of OU 3. This compares to 92 years under a no action alternative (and MNR), also shown in the table. Additional time (in years) is necessary for older fish to achieve acceptable levels of PCB tissue concentration for potentially removing fish consumption advisories.

Table 10-1 Years to Human Health and Ecological Thresholds for Lower Fox River at 1 ppm PCB Action Level and No Action in OU 3

Fish	Risk Level (and comparative fillet PCB concentration)	Receptor	Estimated Years (for 1 ppm Action Level)	Estimated Years (for No Action/ MNR)
Walleye	RME hazard index of 1.0 (49 ppb)	Recreational angler	9	92
Walleye	RME hazard index of 1.0 (31 ppb)	High-intake fish consumer	17	100+
Walleye	RME 10^{-5} cancer risk level (18 ppb)	Recreational angler	30	100+
Walleye	RME 10^{-5} cancer risk level (12 ppb)	High-intake fish consumer	42	100+
Carp	NOAEC	Carnivorous bird deformity	22	100+
Carp	NOAEC	Piscivorous mammal	43	100+

Notes:
Shaded row represents time to achieve safe tissue concentrations for young-of-the-year fish.
NOAEC – No Observed Adverse Effects Concentration.
RME – Indicates the reasonable maximum exposure.

Table 10-2 (derived from FS Tables 8-14 and 8-16) shows the time necessary to achieve acceptable fish tissue concentrations for walleye that are protective of human health at the selected action level of 1 ppm at OU 4. PCB fish consumption advisories are lifted when the contaminant concentration in the fish fillets falls below 50 ppb. Therefore, for the recreational angler, PCB tissue levels in young-of-the-year walleye would be just at or below the level triggering fish consumption advisories about 20 years post-remediation of OU 4. This compares to over 100 years under a no action alternative (and MNR), also shown in the table. Additional time (in years) is necessary for older fish to achieve acceptable levels of PCB tissue concentration for potentially removing fish consumption advisories.

Table 10-2 Years to Human Health and Ecological Thresholds for Lower Fox River at 1 ppm PCB Action Level and No Action in OU 4

Fish	Risk Level (and comparative fillet PCB concentration)	Receptor	Estimated Years (for 1 ppm Action Level)	Estimated Years (for No Action/ MNR)
Walleye	RME hazard index of 1.0 (49 ppb)	Recreational angler	20	100+
Walleye	RME hazard index of 1.0 (31 ppb)	High-intake fish consumer	30	100+
Walleye	RME 10^{-5} cancer risk level (18 ppb)	Recreational angler	45	100+
Walleye	RME 10^{-5} cancer risk level (12 ppb)	High-intake fish consumer	59	100+
Carp	NOAEC	Carnivorous bird deformity	20	100+
Carp	NOAEC	Piscivorous mammal	45	100+

Notes:
Shaded row represents time to achieve safe tissue concentrations for young-of–the-year fish.
NOAEC – No Observed Adverse Effects Concentration.
RME – Indicates the reasonable maximum exposure.

The SWAC is a measure of the average surface (upper 10 cm) concentration over a given area. In terms of the River and Bay, this would be the average residual contaminant concentration in the upper 10 cm divided by the area of the Operable Unit. The SWAC calculation for a particular OU includes inter-deposit areas. The estimated post-removal SWAC values for OU 3 and OU 4 at an action level of 1 ppm are 264 µg/kg and 156 µg/kg, respectively.

The SWAC value provides a number that can be compared to the SQTs developed in the BLRA. SQTs are estimated concentrations that link risk in humans, birds, mammals, and fish with safe threshold concentrations of PCBs in sediment. Human health and ecological SQTs for carp and walleye are listed in Tables 10-3 and 10-4, respectively.

Table 10-3 Human Health Sediment Quality Threshold (SQT) Values

		Recreational Angler		High-intake Fish Consumer	
		RME µg/kg	CTE µg/kg	RME µg/kg	CTE µg/kg
Cancer Risk at 10^{-5}					
Carp		16	180	11	57
Walleye		21	143	14	75
Noncancer Risk (HI = 1)					
Carp		44	180	28	90
Walleye		58	238	37	119

Notes:
CTE – central tendency exposure.
RME – reasonable maximum exposure.

Table 10-4 Ecological Sediment Quality Threshold (SQT) Values

	NOAEC (µg/kg)
Carp – fry growth and mortality	363
Walleye – fry growth and mortality	176
Common Tern – hatching success	3,073
Common Tern – deformity	523
Cormorant – hatching success	997
Cormorant – deformity	170
Bald Eagle – hatching success	339
Bald Eagle – deformity	58
Mink – reproduction and kit survival	24

Note:
NOAEC – No Observed Adverse Effects Concentration.

The volume of sediment and PCB mass that would be removed, as well as the cost to implement the remedy at the 1 ppm action level, were also considered. For OU 3, an estimated 586,800 cy of contaminated sediments and 1,111 kg (2,444 pounds) of PCBs would be removed. In addition, removal of Deposit DD would add 9,000 cy of sediment containing 31 kg (68 pounds) of PCBs. The cost for remediation of OU 3 (including Deposit DD) is estimated to be $26.5 million. For OU 4, an estimated 5,880,000 cy of contaminated sediments and 26,433 kg (58,150 pounds) of PCBs would be removed. The cost for remediation of OU 4 is estimated to be $257.5 million.

10.1 Description of Alternative Components

<u>Remedial Alternatives</u>

The WDNR and EPA evaluated several alternatives to address contamination in the Lower Fox River (OU 3 and OU 4) and Green Bay (OU 5). Because the level of contamination in the OUs and their size vary, a specific proposed cleanup plan was developed for each OU. The FS outlines the process used to develop and screen appropriate technologies and alternatives for addressing PCB-contaminated sediment and provides detailed discussions of the remedial alternatives, which are briefly described below. The suite of remedial alternatives is intended to represent the remedial alternatives that are available, not to be inclusive of all possible approaches. The proposed alternative for an Operable Unit may consist of any combination of the remedial alternatives. Other implementable and effective alternatives could theoretically be used; however, a ROD amendment, or Explanation of Significant Difference (ESD), would be required before a “fundamental” or ”significant” modification could be made to the selected remedy.

The WDNR and EPA selected six remedial alternatives for detailed analysis for the River and Bay: No Action, Monitored Natural Recovery and Institutional Controls, Dredge and Off-Site Disposal, Dredge to a Confined Disposal Facility (CDF), Dredge and Vitrification, and *In-situ* Capping. For the Bay, a seventh remedial alternative, Dredge to a Confined Aquatic Disposal (CAD) Facility, was also evaluated. These alternatives cover the range of viable approaches to remedial action and include a no action alternative, as required by the NCP.

<u>Alternative A – No Action</u>

A No Action alternative is included for all River reaches and Bay zones. This alternative involves taking no action. The No Action alternative is required by the National Contingency Plan, because it provides a basis for comparison with the alternatives for active remediation.

Alternative B – Monitored Natural Recovery

Similar to Alternative A, the MNR alternative relies on naturally occurring degradation, dispersion, and burial processes to reduce the toxicity, mobility, and volume of contaminants. However, the MNR alternative also includes a long-term monitoring program for measuring PCB levels in various media (e.g., water, sediment, and tissue from sources such as invertebrates, fish, and birds) to effectively determine achievement of and progress toward the RAOs. Monitoring would continue until acceptable levels of PCBs are reached in sediments, surface water, and fish. Until the RAOs are achieved, institutional controls would be necessary to prevent exposure of human and biological receptors to contaminants. Institutional controls include measures that restrict access to or uses of a site. They typically consist of some combination of physical restraints (such as fences to limit access), legal restrictions (such as local ordinances and restrictive covenants that limit land development), and outreach activities (such as public education programs and health advisories). Land and water use restrictions, fishing restrictions, and access restrictions may require local or state legislative action to prevent development or inappropriate use of contaminated areas of the River.

Alternative C – Dredge and Off-Site Disposal

Alternative C includes removing sediment having PCB concentrations greater than the RAL using a hydraulic or mechanical dredge, dewatering the sediment either passively or mechanically, treating the water before discharging it back to the River, and then disposing of the sediment off site, transporting it by truck. It is anticipated that sediment disposal would be at a local landfill (within approximately 40 miles) in compliance with the requirements of NR 500 WAC, which regulates the disposal of waste and the WDNR's TSCA approval issued by the EPA. The EPA issued this approval under the authority of the federal TSCA. This approval allows for the disposal of PCB-contaminated sediment with concentrations equal to or greater than 50 mg/kg (ppm) in landfills that are licensed by the WDNR under the NR 500 WAC rule series, provided that certain requirements are met. In this removal alternative, four different dewatering and disposal alternatives were examined for OU 3 and OU 4: C1 – dredging with passive dewatering followed by transport to an NR 500 disposal facility; C2A – dredging to a combined passive dewatering and disposal facility; C2B – dredging to a separate passive dewatering facility followed by disposal in an adjacent landfill; and C3 – dredging with mechanical dewatering and disposal at an NR 500 disposal facility. Alternatives C2A and C2B may rely on a pipeline to transport the dredge slurry directly to the passive dewatering facility.

Alternative D – Dredge to a Confined Disposal Facility (CDF)

Alternative D includes the removal of sediment having PCB concentrations greater than the RAL to an on-site CDF for long-term disposal. A CDF is an engineered containment structure that provides both dewatering and a permanent disposal location for contaminated sediment. A CDF can be located in the water adjacent to the shore or at an upland location near the shore. Sediment with PCB concentrations equal to or greater than 50 mg/kg are not eligible for disposal in a CDF. Such sediments would be mechanically dredged for solidification and disposal at a solid waste landfill conforming to requirements defined by the state in the NR 500 WAC rule series and the WDNR's TSCA approval. Conceptual nearshore CDF locations were identified in OU 4.

Alternative E – Dredge and Vitrification

This alternative is similar to Alternative C except that all the dewatered sediment would be thermally treated using a vitrification process. Alternative E assumes that the residual material would be available for possible beneficial reuse after vitrification. Vitrification has been used as a representative thermal treatment process option and was included as an alternative after a recently completed pilot-scale evaluation.

Alternative F – *In-Situ* (In-Place) Capping

Alternative F includes primarily sand capping to the maximum extent possible. The maximum extent of the capping action was defined in each River reach on the basis of Site-specific conditions such as water depth, average river current, river current under flood conditions, wave energy, ice scour, and boat traffic. Using these criteria, it was determined that certain areas of the Site are not suited for capping. Therefore, capping alone is not a viable option to achieve the Site RAOs. In the FS, where capping is a viable alternative, the conceptual design included a 20-inch sand cap overlaid by 12 inches of graded armor stone. Sediment that is not capped but still exceeds the action level would be hydraulically dredged to an on-site CDF, similar to Alternative D. In the FS, several cap designs were retained for possible application; design factors that influence the final selection of an *in-situ* cap include an evaluation of capping materials and cap thickness when applied in the field. In general, sandy sediment is a suitable capping material, with the additional option of armoring at locations where there is the potential for scouring and erosion. Laboratory tests developed in the past indicate that a minimum *in-situ* cap thickness of 12 inches (30 cm) is required to isolate contaminated sediment, as indicated in FS Section 7.1, pages 7-4 to 7-5. Full-scale design would require consideration of currents during storm events, wave energy, and ice scour. A minimum river depth of 6 feet was proposed in the FS (FS Section 7.1.1, page 7-5) for any location where a cap is proposed. Institutional controls and monitoring and maintenance are also components of this alternative. Institutional controls may be necessary to ensure the long-term integrity of the cap. Recent climate models indicate that Lake Michigan water levels could decrease by 3 feet by 2050 and 4.5 feet by 2090, below historical low water levels. Therefore decisions concerning capping, should consider potential future declines in Lake Michigan water levels which would in turn affect levels within the Lower Fox River and Green Bay. Monitoring and maintenance would be required in perpetuity to ensure the integrity of the cap and the permanent isolation of the contaminants. As part of the ROD for OU 1 and OU 2, *White Paper No. 6B – In-Situ Capping as a Remedy Component for the Lower Fox River* was prepared. This white paper provides additional criteria that would need to be considered in the design of a remedial cap.

Alternative G – Dredge to a Confined Aquatic Disposal (CAD) Facility

Alternative G includes the removal of sediment to a CAD facility for long-term disposal; this alternative is technically feasible only in the Bay (OU 5). A CAD facility is a variation on capping in which the contaminated sediment is placed in a natural or excavated depression or natural deposition area and covered with clean material. Ideal CAD sites are in "null-zones" where circulation patterns create areas with net deposition instead of erosion and scour. Three possible locations were determined in the FS on the basis of water depth and currents. Each location was assumed to provide enough capacity for each action level. Construction of the CAD would involve placing contaminated sediment with a mechanical dredge and covering the sediment at completion with 3 feet of clean sand. Institutional controls and monitoring are also components of this alternative. Institutional controls would be necessary to ensure the long-term integrity of the CAD cap. Monitoring and maintenance of the CAD cap would be required to ensure the integrity of the cap and the permanent isolation of the contaminants. Monitoring would continue until acceptable levels of PCBs are reached in sediments, surface water, and fish.

In evaluating the alternatives, the WDNR and EPA considered the level of protection that would satisfy the concern of the natural resource trustees that future natural resource injuries be minimized. Many of the natural resource trustees cooperated in the development of the Proposed Plan and agreed with the combination of active remediation to a proposed PCB cleanup level of 1 ppm and the use of MNR in areas where active remediation will not occur. Additionally, it is recognized that natural recovery processes would be required to meet RAOs in areas undergoing removal because of residual contaminant concentrations that may remain after active remediation.

10.2 Key/Common Elements

The following discussion applies primarily to the alternatives that involve dredging or dredging and capping.

Phasing of Work and Collection of Additional Data

The first construction season of remedial dredging will include an extensive monitoring program of all operations. Monitoring data will be compared to performance standards developed during remedial design. Performance standards are likely to address (but may not be limited to) resuspension rates during dredging, production rates, residuals after dredging, and community impacts (e.g., noise, air quality, odor, navigation). Data gathered will enable the WDNR to determine whether adjustments to operations are needed in the succeeding phase of dredging or whether performance standards need to be reevaluated. The WDNR will make the data, as well as its final report evaluating the work with respect to the performance standards, available to the public.

Institutional Controls

Institutional controls (fish consumption advisories and fishing restrictions) would be utilized with the MNR, capping, and removal alternatives. Institutional controls are considered to be limited action alternatives and therefore are not included in the No Action alternative.

Source Control

Point sources of contaminants have been effectively addressed by water discharge permits for the River. Thus, no additional actions related to source control are necessary. Final closure of Renard Island in southern Green Bay will be undertaken by the USACE, but is not part of this decision.

Monitored Natural Recovery

Natural recovery refers to the beneficial effects of natural processes that reduce surface sediment concentrations of PCBs. These processes include biodegradation, diffusion, dilution, sorption, volatilization, chemical and biochemical stabilization of contaminants, and burial by natural deposition of cleaner sediments. The primary mechanisms for natural recovery in the River and Bay are desorption and dispersion in the water column (i.e., as a dissolved constituent), burial, and sediment resuspension and transport. Biodegradation is a negligible contributor to the lowering of PCB concentrations (and is not a factor for mercury). The relative importance of each of these mechanisms in reducing PCB concentrations in the River and Bay is not easily estimated based on available data. Some or all of these processes may be occurring at varying rates at any given time and location within the River or Bay. During the design phase, a monitoring program will be developed to measure the net effects of the natural attenuation processes after remedial activities are completed until the remediation goals are reached. Monitoring would continue until acceptable levels of PCBs are reached in sediments, surface water, and fish.

Sediment Concentrations

Sediments that may significantly contribute to the PCB levels in fish, both now and in the future, are considered principal threats. The determination of the significance of the sediment contribution to fish is based primarily on model projections, in conjunction with geochemical and statistical analyses. The model projections indicate that the significance of the sediment contribution to PCB fish tissue levels varies by Operable Unit; therefore, the sediment levels that are considered principal threats will correspondingly vary by Operable Unit.

Treatment

Conventional treatment technologies, such as vitrification, are technically feasible; however, the associated costs could be substantially greater than off-site landfill disposal. Because the Agencies believe that vitrification of sediments is feasible, it is considered a possible alternative to the current plans for conventional disposal in an approved, licensed landfill. Dredged sediments processed using vitrification technology could be beneficially reused.

Sediment Processing/Transfer Facilities

It is expected that sediment processing/transfer facilities would be established to handle materials from the environmental dredging process. The locations of these facilities will be determined during the remedial design phase of the remedy considering engineering issues (such as those associated with the type of dredging selected), property issues, noise and air impacts, and other appropriate factors. Although it is projected that these facilities would be based on land, water-based facilities will also be evaluated. Dredged sediment will be dewatered and then disposed of in a licensed engineered landfill.

Water that is separated from the dredged sediment will undergo treatment to remove fine sediment particles and dissolved PCBs. Ultimately, the water will be discharged back into the River in compliance with the substantive requirements of the State of Wisconsin Pollutant Discharge Elimination System, which is an ARAR for this Site. As part of the ROD for OU 1 and OU 2, *White Paper No. 7 – Lower Fox River Dredged Sediment Process Wastewater Quality and Quantity: Ability to Achieve Compliance with Water Quality Standards and Associated WPDES Permit Limits* was prepared. This white paper provides additional direction on wastewater processes, compliance with standards, and Wisconsin Pollutant Discharge Elimination System (WPDES) limits associated with the treatment of wastewater from dredging operations.

Transportation

Dredged materials will likely be transported from the dredging site to the sediment processing facility by river pipeline. Transportation from the sediment processing facility to disposal facilities will likely be by truck, although other means such as a conveyor system will be considered.

Disposal

Disposal of PCB-contaminated sediment from OUs 3 and 4 would be to an existing upland landfill or a newly constructed or modified landfill designed to receive the dewatered sediment. ARARs/TBCs specific to the landfill option include the siting requirements for a landfill (Chapter 289, Wisconsin Statutes) and the technical requirements for construction, operation, and closure of a landfill in the NR 500 rule series, WAC.

Sediments removed from the River may contain PCBs equal to or greater than 50 ppm. PCB sediment with concentrations less than 50 ppm will be managed as a solid waste in accordance with statutes and rules governing the disposal of solid waste in Wisconsin. PCB sediment with concentrations equal to or greater than 50 ppm will be managed in accordance with the Toxic Substances Control Act of 1976 (Appendix E of the FS). Presently, TSCA compliance would be achieved through the extension of the January 24, 1995, approval issued by the EPA to WDNR pursuant to 40 CFR 761.60(a)(5) under the authority of TSCA. This TSCA approval, granted by EPA Region 5, states that the disposal of PCB-contaminated sediment with concentrations equal to or greater than 50 ppm into an NR 500 WAC landfill that is also in compliance with the conditions of the TSCA approval: (1) provides adequate protection to human health and the environment as required by 40 CFR 761.60(a)(5), and (2) will provide the same level of protection required by EPA Region 5 and therefore is no less restrictive than TCSA. However, should other administrative rules pertaining to disposal under TSCA be in effect at the time that TSCA compliance decisions are made for the River sediment, then compliance with those rules will be achieved.

Therefore, this disposal method meets the TSCA regulatory requirement of 40 CFR 761.61(c) that the risk-based method for disposal of PCB remediation waste does not pose an unreasonable risk of injury to health and the environment.

Although off-site landfilling is anticipated, vitrification and beneficial reuse of dredged excavated sediment will be evaluated during the design phase. Value engineering to reduce waste volumes (which will also reduce costs) will be explored and, if appropriate, finalized during remedial design.

Monitoring

Short- and long-term (i.e., pre-, during, and post-construction) monitoring programs will be developed to ensure compliance with performance standards and protection of human health and the environment. The types and frequency of pre-construction monitoring will be developed during remedial design. Plans for monitoring during and after construction will be developed during the remedial design and modified during and after construction as appropriate. This approach is consistent with the NRC report recommendation that long-term monitoring evaluate the effectiveness of the remedial action as well as ensure protection of public health and the environment (*A Risk Management Strategy for PCB-Contaminated Sediment*, NRC, 2001). Monitoring would continue until acceptable levels of PCBs are reached in sediments, surface water, and fish.

11 COMPARATIVE ANALYSIS OF ALTERNATIVES[2]

In selecting a remedy for the Site, the WDNR and EPA considered the factors set forth in CERCLA § 121, 42 USC § 9621 by conducting a detailed analysis of the viable remedial alternatives pursuant to the NCP, 40 CFR § 300.430(e)(9), EPA's *Guidance for Conducting Remedial Investigations and Feasibility Studies*, OSWER Directive 9355.3-01, and EPA's *A Guide to Preparing Superfund Proposed Plans, Records of Decision, and Other Remedy Selection Decision Documents*, OSWER 9200.1-23.P. The detailed analysis consists of an assessment of the individual alternatives against each of nine evaluation criteria (two threshold, five primary balancing, and two modifying criteria) and a comparative analysis focusing upon the relative performance of each alternative against those criteria.

Threshold Criteria

1. **Overall Protection of Human Health and the Environment** addresses whether a remedy provides adequate protection of human health and the environment and describes how risks posed through each exposure pathway are eliminated, reduced, or controlled through treatment, engineering, or institutional controls. The selected remedy must meet this criterion.

[2] Publication details for references cited in this section can be found in the BLRA and/or RI/FS documents, which appear in the Administrative Record and are also available in the information repositories, or in the ROD and associated Responsiveness Summary for OU 1 and OU 2.

2. **Compliance with Applicable or Relevant and Appropriate Requirements (ARARs)** addresses whether a remedy will meet applicable or relevant and appropriate federal and state environmental laws and/or justifies a waiver from such requirements. The selected remedy must meet this criterion or a waiver of the ARAR(s) must be attained.

Primary Balancing Criteria

3. **Long-Term Effectiveness and Permanence** refers to expected residual risk and the ability of a remedy to maintain reliable protection of human health and the environment over time, once cleanup levels have been met.

4. **Reduction of Toxicity, Mobility, or Volume through Treatment** addresses the statutory preference for selecting remedial actions that employ treatment technologies that permanently and significantly reduce toxicity, mobility, or volume of the hazardous substances as their principal element. This preference is satisfied when treatment is used to reduce the principal threats at a site through destruction of toxic contaminants, reduction of the total mass of toxic contaminants, irreversible reduction in contaminant mobility, or reduction of total volume of contaminated media.

5. **Short-Term Effectiveness** addresses the period of time needed to achieve protection and any adverse impacts on human health and the environment that may be posed until cleanup levels are achieved.

6. **Implementability** is the technical and administrative feasibility of a remedy, including the availability of materials and services needed to implement a particular option.

7. **Cost** includes estimated capital costs, annual operation and maintenance costs (assuming a 30-year time period), and net present value of capital and operation and maintenance costs, including long-term monitoring.

Modifying Criteria

8. **Agency Acceptance** considers whether the support agency, in this instance the EPA, concurs with the lead agency's remedy selection and the analyses and recommendations of the RI/FS and the Proposed Plan. The WDNR is the lead agency for this project with technical support and funding from the EPA.

9. **Community Acceptance** addresses the public's general response to the remedial alternatives and Proposed Plan. The ROD includes a Responsiveness Summary that presents public comments and the WDNR's and EPA's responses to those comments. The level of community acceptance of the selected alternative is outlined in the Responsiveness Summary (see Appendix A). Comments that address issues common to OU 1 and OU 2 as well as to OU 3, OU 4, and OU 5 are discussed in the Responsiveness Summary attached to the OU 1 and OU 2 ROD.

11.1 Operable Unit 3 (Little Rapids to De Pere)

Table 11-1 summarizes the comparative analysis for OU 3 alternatives and how each alternative meets, or does not meet, requirements for each of the nine criteria described above.

Table 11-1 OU 3 – Little Rapids to De Pere Alternatives

Yes = Fully meets criterion Partial = Partially meets criterion No = Does not meet criterion	Alternative A No Action	Alternative B Monitored Natural Recovery	Alternative C1 Dredge with Off-Site Disposal	Alternative C2A Dredge with Off-Site Disposal	Selected Remedy Alternative C2B Dredge with Off-Site Disposal	Alternative C3 Dredge with Off-Site Disposal	Alternative D Dredge to a Confined Disposal Facility	Alternative E Dredge and Vitrification	Alternative F *In-Situ* Capping
1. Overall Protection of Human Health and the Environment	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
2. Compliance with Applicable or Relevant and Appropriate Requirements	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
3. Long-Term Effectiveness and Permanence	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
4. Reduction of Toxicity, Mobility, or Volume Through Treatment	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
5. Short-Term Effectiveness	No	No	Yes	Yes	Yes	Yes	Partial	Partial	Yes
6. Implementability	Yes	Yes	Yes	Yes	Yes	Yes	Partial	Partial	Yes
7. Cost (millions of $)	$ 4.5	$ 9.9	$ 95.1	$ 43.9	$ 26.5 *	$ 69.1	$ 52.5	$ 86.2	$ 62.9
8. Agency Acceptance	The WDNR has been the lead agency in developing the RI/FS and Proposed Plan. Both the WDNR and EPA support the selected alternative for this Operable Unit at the 1 ppm action level.								
9. Community Acceptance	The level of community acceptance of the selected alternative is outlined in the Responsiveness Summary.								

* This remedy is combined with Alternative C2B in OU 4. The total cost for this combined remedy is $284 million. Estimated costs for the combined remedy are discussed in *White Paper No. 23 – Evaluation of Cost and Implementability of Alternative C2B for Operable Unit 3 and Operable Unit 4*, which is attached to this ROD. The estimated cost for OU 3 (including Deposit DD) is $26.5 million.

11.1.1 Threshold Criteria for Operable Unit 3

Protection of Human Health and the Environment

The primary risk to human health associated with the contaminated sediment is consumption of fish. The primary risk to the environment is the bioaccumulation of PCBs from the consumption of fish or, for invertebrates, the direct ingestion/consumption of sediment. Protection of human health and the environment were evaluated by residual risk in surface sediment using five lines of evidence:

- Residual PCB concentrations in surficial sediment using surface-weighted averaging after completion of a remedy
- Average PCB concentrations in surface water
- The projected number of years required to reach safe consumption of fish
- The projected number of years required to reach a surface sediment concentration protective of fish or other biota
- PCB loadings to Green Bay and total mass contained or removed

Each of these is discussed below.

Residual PCB Concentrations in Surficial Sediment and Surface Water

As shown in Table 11-2, substantial reductions in the average PCB concentration in surficial sediment and in surface water for OU 3 is achieved by Alternatives C1, C2A, C2B, C3, D, E, and F when compared to Alternatives A and B. Implementation of Alternative C1, C2A, C2B, C3, D, E, or F results in reduction in residual PCB concentrations in surface sediment from 2.1 ppm to 0.264 ppm using surface-weighted averaging when compared to Alternatives A and B (No Action and MNR). It is also estimated that surface water concentrations 30 years after remediation will be reduced from 5.37 ng/L to 0.37 ng/L for Alternatives C1, C2A, C2B, C3, D, E, and F relative to Alternatives A and B.

Table 11-2 Post-Remediation Sediment and Surface Water Concentrations in OU 3

Alternative	Post-Remediation SWAC (ppm)	Estimated Surface Water Concentrations 30 Years after Remediation (ng/L)
A, B	2.078	5.37
C1, C2A, C2B, C3, D, E, F	0.264	0.37

Notes:
SWAC – surface-weighted average concentration
Data are from FS Table 8-5B and Table 1 in *White Paper No. 11 – Comparison of SQTs, RALs, RAOs and SWACs for the Lower Fox River* of the OU 1 and OU 2 ROD.

Time Required to Achieve Acceptable Fish Tissue Concentrations

As shown in Table 11-3, substantial reductions in the time when humans could safely consume fish are achieved by Alternatives C1, C2A, C2B, C3, D, E, and F when compared to Alternatives A and B. The implementation of Alternative C1, C2A, C2B, C3, D, E, or F is expected to achieve acceptable fish tissue concentrations for recreational fishers within 9 to 30 years and acceptable tissue concentrations for high-intake fish consumers within 42 years, as compared to

92 to more than 100 years for Alternatives A and B. It should be noted that because of limitations of modeling analysis, this relative comparison for three of the four receptors does not reflect how many years more than 100 would be required for natural recovery.

Table 11-3 Time to Achieve Acceptable Fish Tissue Concentrations for Walleye in OU 3

Fish	Receptor	Risk Level Goal	Estimated Years to Achieve	
			Alternatives C1, C2A, C2B, C3, D, E, F	Alternatives A, B
Walleye	Recreational Angler	RME Hazard Index of 1.0	9	92
Walleye	High-intake Fish Consumer	RME Hazard Index of 1.0	17	>100
Walleye	Recreational Angler	RME 10^{-5} cancer risk level	30	>100
Walleye	High-intake Fish Consumer	RME 10^{-5} cancer risk level	42	>100

Notes:
RME – reasonable maximum exposure
Data are from FS Table 8-14.

Time Required to Achieve Surface Sediment Concentration Protective of Fish or Other Biota

As shown in Table 11-4, substantial reductions in the time required to reach protective levels for ecological receptors are achieved by Alternatives C1, C2A, C2B, C3, D, E, and F relative to Alternatives A and B. For representative ecological receptors, implementation of Alternative C1, C2A, C2B, C3, D, E, or F achieves a protective level in 22 to 46 years as compared to more than 100 years for Alternatives A and B. Because of limitations of the modeling analysis, this relative comparison does not reflect how many years more than 100 would be required for natural recovery.

Table 11-4 Time Required to Achieve Protective Levels in Sediment for Representative Ecological Receptors in OU 3

Fish	Receptor	Risk Level Goal	Estimated Years to Achieve	
			Alternatives C1, C2A, C2B, C3, D, E, F	Alternatives A, B
Carp	Carnivorous bird	NOAEC	22	>100
Carp	Piscivorous mammal	NOAEC	43	>100
Sediment	Sediment invertebrate	TEL	46	>100

Notes:
NOAEC – No Observed Adverse Effects Concentration
TEL – threshold exposure limit
Data are from FS Table 8-16.

PCB Loadings to Downstream Areas and Total Mass Contained or Removed

Reduction of the PCB load transported from the River into Green Bay is a measure of the overall protection of human health and the environment. Reduced PCB loading will ultimately contribute to downstream reduction of concentrations of PCBs in sediment, water, and fish, thereby reducing risk to humans and ecological receptors in the River, the Bay, and Lake Michigan. After implementation of Alternative C1, C2A, C2B, C3, D, E, or F, estimates are that releases from the River to Green Bay would be reduced from the present 77 kg (170 pounds) per year to 1.5 kg (3.2 pounds) per year 30 years after completion of remediation as compared to 21 kg (47 pounds) per year after 30 years for Alternatives A and B. Thus, Alternatives C1, C2A, C2B, C3, D, E, and F would provide a 93 percent reduction in loadings relative to the alternatives of No Action and MNR.

Summary

Alternatives C1, C2A, C2B, C3, D, E, and F provide a substantially more protective remedy than do Alternatives A and B. Alternatives A and B are not protective of human health and the environment.

Compliance with Applicable or Relevant and Appropriate Requirements

Section 121(d) of CERCLA and NCP § 300.430(f)(1)(ii)(B) require that remedial actions at CERCLA sites attain legally applicable or relevant and appropriate federal and state requirements, standards, criteria, and limitations, collectively referred to as ARARs, unless such ARARs are waived under CERCLA Section 121(d)(4). Compliance with ARARs addresses whether a remedy will meet all of the applicable or relevant and appropriate requirements of other federal and state environmental statutes or provide a basis for invoking a waiver.

The ARAR discussion below is organized by the different operational components of the alternatives (Table 11-5), because various components are utilized in essentially the same manner for some alternatives and apply equally to those alternatives with a common component. There is additional discussion of compliance with ARARs in Section 14.2.

Table 11-5 Operational Components for OU 3 Alternatives

		Alternatives								
		A	B	C1	C2A	C2B	C3	D	E	F
Removal				X	X	X	X	X	X	X
Dewatering	Mechanical						X			
	Passive			X	X	X		X	X	X
Sediment Treatment				*	*	*	*	*	X	*
Water Treatment				X	X	X	X	X	X	X
Transportation	Trucking			X		X**	X		X	X
	Pipeline				X	X				
Disposal	Upland			X	X	X	X			X
	In-water CDF							X		
Beneficial Reuse of Sediments									X	
Capping										X

Notes:
X: Required activity for alternative.
* Possible supplement.
** Trucking would be minimal (disposal location is adjacent to the dewatering facility).

A description of the components listed in Table 11-5 follows.

- **Removal:** The removal technology utilized for Alternatives C1, C2A, C2B, C3, D, E, and F is dredging (although Alternative F also includes capping). The ARARs that directly relate to the removal of sediment from the River and Bay concern the protection of surface water (NR 322, 200, and 220 through 297). The surface water ARARs limit the discharge of PCBs into the receiving water bodies so that water quality is not adversely affected. These ARARs will be achieved by Alternatives C1, C2A, C2B, C3, D, E, and F. Dredge material will be moved to the dewatering facility by pipeline or barge.

- **Dewatering and Water Treatment:**

  - Mechanical dewatering would be utilized for Alternative C3. Discharge requirements (NR 200 and 220 through 297, WAC) are set forth for the discharge of water to POTWs and to navigable waters such as the River (NR 105 and 106, WAC). Discharges from prior remedial activities on the River provide an indication of the treatment requirements for discharging effluent water to the River or to a POTW. Another requirement covers stormwater discharge. A potentially important ARAR (NR 108, WAC) relates to the construction of a wastewater treatment facility specifically to treat water from remedial activities.

  - Passive dewatering ponds would be part of Alternatives C1, C2A, C2B, D, E, and F and would be constructed under the wastewater ARAR (NR 213, WAC), which associated with wastewater treatment lagoons. Based on previous experience gained during the SMU 56/57 pilot dredging project, ARARs associated with passive dewatering lagoons are achievable.

- ***Ex-Situ* (Off-site) Treatment:** ARARs specific to vitrification technology (Alternative E) relate to the air emission and permitting requirements of thermal treatment units (40 CFR 701 and NR 400 through 499). In addition, the thermal unit must meet performance requirements in NR 157 for the efficient treatment of PCB-containing sediment. These ARARs would be met.

- **Transportation:** The likely method for transporting PCB-containing sediment to upland disposal locations for Alternatives C1, C3, and F is by trucking it to the disposal facility, although other transportation methods could be used if it is determined during design that there are better methods. Alternatives C2A and C2B would initially use a pipeline to transport the dredge slurry to the dewatering facility. Alternative C2B would involve moving the dewatered sediment, likely trucking it from the passive dewatering facility to the adjacent disposal site, although other options may be considered during design. Alternative C2A does not require transportation of the sediment after dewatering, because the dredge material would be disposed of in the dewatering facility. Alternative D would not require off-site transportation, because all removed sediments would be disposed on site in a nearshore CDF. Alternative E would require trucking contaminated sediments to a treatment facility and trucking the treated (non-hazardous) materials to a site for beneficial or commercial reuse. ARARs and TBCs important to this process option include the requirements to prevent spills and releases of PCB materials (NR 140 and 157, WAC). Two ARARs applicable only to the trucking method include Wisconsin Department of Transportation (WDOT) requirements for the shipping of PCB materials and NR 157 shipping requirements. ARARs and TBCs related to in-water transportation activities (i.e., piping) include the protection of surface water (NR 322, 200, and 220 through 297, WAC). Alternatives C1, C2A, C2B, E, and F will comply with these ARARs.

- **Disposal:** For Alternatives C1, C2A, C2B, C3, and F, contaminated sediment removed (i.e., dredged) from OU 3 will be disposed of at either an existing upland landfill or in a newly constructed or modified landfill designed to receive the dewatered sediment. ARARs specific to this process option include the siting requirements for a landfill (Chapter 289, Wisconsin Statutes) and the technical requirements for construction, operation, and closure of a landfill in the NR 500 rule series, WAC. For contaminated sediments with PCB concentrations equal to or greater than 50 ppm, disposal will comply with TSCA, 40 CFR Part 761. General disposal requirements for PCB-containing sediments are simplified by the EPA's current approval requirements for placing TSCA-level PCB-containing material in a state-licensed landfill. In all cases, for sediment to be disposed of at a local landfill, the landfill must be in compliance with the requirements of the NR 500 WAC series that regulates the disposal of waste and with the WDNR's TSCA approval issued by the EPA. This EPA approval currently allows for the disposal of PCB-contaminated sediment with concentrations equal to or greater than 50 mg/kg in landfills licensed under the NR 500 rule series, WAC, provided that certain technical and administrative requirements are met. These ARARs will be met by Alternatives C1, C2A, C2B, C3, and F.

- **Capping:** For Alternative F, some sediments would be capped in place, primarily in the deeper portions of OU 3. This would require compliance with Section 10 of the Rivers and Harbors Act of 1899 (22 CFR 403) and with the Wisconsin Statutes Chapter 30 (defining riparian rights of upland owners which extend to the center of a stream). It is expected that these ARARs would be met.

11.1.2 Primary Balancing Criteria for Operable Unit 3

<u>Long-Term Effectiveness and Permanence</u>

<u>Reduction of Residual Risk</u>

Alternatives A and B result in a continuation of the degraded condition of the sediment and surface water quality of the Little Rapids to De Pere Reach (OU 3) for at least several decades. Alternatives A and B do not eliminate PCBs from the River and do not reduce PCB levels in fish to acceptable levels for the foreseeable future.

Alternatives C1, C2A, C2B, C3, D, E, and F reduce residual risk through removal or containment of 586,800 cy of sediments containing approximately 1,111 kg (2,444 pounds) of PCBs over an area of 330 acres. The reduction in the time required to reach acceptable fish tissue concentrations ranges from a minimum of 58 to 90 percent (see Section 11.1.1 for detailed discussion).

<u>Adequacy of Controls</u>

Alternatives A and B do not produce a reduction in human risk and exposure in the foreseeable future, unlike Alternatives C1, C2A, C2B, C3, D, E, and F. Additionally, fish consumption surveys indicate that 50 percent of anglers do not follow fish advisories. Therefore, existing institutional controls do not adequately reduce human exposure to PCBs from consumption of contaminated fish. In addition, institutional controls are not protective for ecological receptors (e.g., birds, mammals, and fish). Given the survey data, it is unlikely that these types of controls alone would be reliable in the long term to ensure human health and ecological protection. In effect, institutional controls by themselves are not sufficiently effective for OU 3.

Alternatives C1, C2A, C2B, C3, D, and E provide for the removal of PCB-contaminated sediments in OU 3. Alternative F also removes a large portion of PCB-contaminated sediments and provides for an engineered cap over an estimated approximately 40 percent of contaminated deposits in OU 3. Like Alternative B (MNR), Alternative F also requires institutional controls such as Site use restrictions in capped areas (e.g., prohibition of activities that disturb sediment). Although institutional controls would still be required for the removal alternatives, the risk to consumers of fish would be greatly reduced by these alternatives.

All alternatives would require institutional controls, such as fish consumption advisories and fishing restrictions, until remedial action objectives were met at a future date, but they are unlikely to require additional Site use restrictions after removal activities are completed.

All alternatives will require some degree of monitoring. Monitoring programs will be developed, as appropriate, for all phases of the project.

Alternatives C1, C2A, C2B, C3, D, and F rely on engineering controls at the disposal facility. Properly designed and managed landfills provide proven, reliable controls for long-term disposal for Alternatives C1, C2A, C2B, C3, and F (which have off-site landfill disposal). Alternative F would also require a long-term operation and maintenance plan to ensure containment of PCBs in perpetuity. Alternative D would require on-site engineering controls at an in-water disposal facility. Long-term monitoring and maintenance are included in operation of the landfill and confined disposal facility. The final disposition of contaminated sediments is summarized in Table 11-6.

Table 11-6 Final Disposition of Contaminated Sediments in OU 3

	Alternatives (cubic yards)					
	A	**B**	**C1/C2A/C2B/C3**	**D**	**E**	**F**
Treated and residual disposal	0	0	0	0	586,788	0
Removed and disposed at upland (off-site) landfill	0	0	586,788	0	0	170,418
Removed and disposed at in-water, on-site CDF	0	0	0	586,788	0	
Capped in place	0	0	0	0	0	416,370

Note:
Data are from FS Table 7-2.

Reliability of Controls

For Alternatives B, C1, C2A, C2B, C3, D, E, and F, fish consumption advisories and fishing restrictions will continue to provide some protection of human health until PCB concentrations in fish are reduced to the point where the fish consumption advisories and fishing restrictions can be relaxed or lifted. However, in the interim, these controls will provide only an uncertain measure of protection. Among the active alternatives, sediment capping, sediment removal (dredging and excavation), and off-site disposal/treatment of removed sediments are all established technologies.

The capping portion of Alternative F relies upon proper design, placement, and maintenance of the cap in perpetuity for its effectiveness, continued performance, and reliability. A cap-integrity monitoring and maintenance program would provide reasonable reliability, although there are inherent challenges in monitoring and maintaining a cap in the River environment. The capping portion of Alternative F may not be as reliable as the removal alternatives because of the unknown potential for damage to the cap, potentially exposing PCBs. In addition, the capping component of Alternative F is vulnerable to a catastrophic flow event, such as might be seen during a 500-year flood or a dam failure. However, with proper design and maintenance, these risks can be minimized.

In general, Alternatives C1, C2A, C2B, C3, D, and E are the most reliable, because there is little or no additional long-term, on-site maintenance associated with the remedial work. These alternatives permanently remove the greatest amount of contaminated sediment and PCBs from the River and achieve the greatest reduction of the potential scour-driven resuspension of PCB-contaminated sediments. However, Alternative F is also considered to be sufficiently reliable.

Summary

Based on the above analysis of reduction in residual risk and adequacy and reliability of controls, Alternatives C1, C2A, C2B, C3, D, E, and F are superior to Alternatives A and B because of the greater risk reduction and mass of PCBs removed from the River. Alternatives C1, C2A, C2B, C3, and E are similar to each other in terms of risk reduction being the most effective over time. The Agencies' analysis of residual risk for each alternative is consistent with the NRC report recommendation to consider options to reduce risk and to consider residual risks associated with material left behind (*A Risk Management Strategy for PCB-Contaminated Sediment*, NRC, 2001).

Reduction of Toxicity, Mobility, and Volume Through Treatment

Reduction in toxicity, mobility, or volume of contaminants through treatment evaluates an alternative's use of treatment to reduce the harmful effects of principal contaminants, their ability to move in the environment, and the amount of contamination present.

Alternatives A and B do not involve any containment or removal of contaminants from OU 3 sediments. Alternatives A and B rely exclusively on natural attenuation processes such as burial by cleaner sediments, biodegradation, bioturbation, and dilution to reduce concentrations of PCBs in sediments and surface water.

Natural degradation processes were not found to be effective in reducing PCB concentrations or toxicity in River sediments (FS, Appendix F, "Dechlorination Memorandum"). Nevertheless, concentrations of PCBs in fish populations will respond slowly over time to slow natural decreases in concentrations in sediments and surface water due primarily to dilution and the burial of contaminated sediments by cleaner sediments.

For Alternative F, the mobility of the PCBs in capped areas (estimated to be approximately 140 acres) would be reduced because these PCBs are sequestered under the cap. However, capping does not satisfy the CERCLA statutory preference for treatment. In addition, there is no reduction in the toxicity or volume of the PCBs under the cap. Under Alternative F, the mass of PCBs and the volume of contaminated sediments within OU 3 are permanently reduced because approximately 170,400 cy of sediment would be removed from the ecosystem either to an upland landfill or a CDF, and approximately 416,400 cy would be contained under a cap in OU 3. A total of approximately 1,111 kg (2,444 pounds) of total PCBs would be removed or isolated from the ecosystem by this alternative. In addition, after construction of the remedy is completed, natural attenuation processes could provide additional reductions in PCB concentrations in the remaining sediments and surface water.

For Alternatives C1, C2A, C2B, C3, D, and E, the approximately 1,111 kg (2,444 pounds) of PCBs and 590,000 cy of contaminated sediments in OU 3 are permanently removed from the ecosystem. As for Alternative F, natural attenuation processes would provide additional reductions in PCB concentrations in the remaining sediments and surface water after construction of the remedy is completed.

Although Alternatives C1, C2A, C2B, C3, D, and F would permanently remove large volumes of PCBs from the River (thereby reducing their mobility), they do not satisfy the statutory preference for treatment as a principal element of the remedy. Given the volume of material to be removed, treatment of the dredged material prior to off-site disposal (other than stabilization of the sediments for handling purposes) may not be cost-effective. Vitrification would reduce toxicity, mobility, and volume, and the glass aggregate product would be available for beneficial reuse.

Short-Term Effectiveness

Short-term effectiveness relates to the length of time needed to implement an alternative and the risks the alternative poses to workers, residents, and the environment during implementation up until the time that remediation levels are achieved.

Length of Time Needed to Implement the Remedy

The implementation times for the active alternatives are approximately 1 to 5 years for Alternatives C1, C2A, C2B, C3, D, E, and F (see Table 11-7). These estimates represent the estimated time required for mobilization, operation, and demobilization of the remedial work, but do not include the time required for long-term monitoring or operations and maintenance. These estimates do take into consideration the fact that winter conditions will not allow for dredging (or capping) operations during the winter season. Alternatives A and B do not involve any active remediation and therefore require no time to implement. Alternative B would require monitoring until acceptable levels of PCBs are achieved in sediment, surface water, and fish.

Table 11-7 Time to Implement Alternatives for OU 3

Alternative	Years to Implement (rounded up to whole number)
A/B	0
C1	5
C2A/C2B	1
C3	5
D	5
E	1
F	2

Protection of the Community and Workers During Remedial Action

No construction activities are associated with the remediation of sediments for Alternatives A and B, so those alternatives neither increase nor decrease the short-term potential for direct contact with or ingestion and inhalation of PCBs from the surface water and sediments.

Community Protection. Access to sediment processing/transfer facilities and process and treatment areas under Alternatives C1, C2A, C2B, C3, D, E, and F will be restricted to authorized personnel. Controlling access to the dredging locations and sediment processing/transfer facilities, along with monitoring and engineering controls developed during the design phase, will minimize potential short-term risks to the community. The design will also provide for appropriate control of air emissions, noise, and light through the use of appropriate equipment that meets all applicable standards. Compliance with these design provisions will be monitored during construction, operation, and demobilization. Vehicular traffic associated with workers and the delivery of supplies will increase at the sediment processing and transfer facilities.

For Alternatives C1, C2A, C2B, C3, D, E, and F, work in the River will also be designed with provisions for control of air emissions, noise, and light. Work areas will be isolated (access-restricted), with an adequate buffer zone so that pleasure craft can safely avoid these areas. Environmental dredging in the River will be conducted at times and in ways to minimize disruption to River traffic. Targeted dredging will be sequenced and directed to ensure minimal impacts to navigation within the River. To help ensure that navigation is not impeded, the WDNR and EPA will consult with local authorities during the remedial design and construction phases regarding issues related to River uses and other remedy-related activities within OU 3. Discrete areas of the River will be subject to dredging and related activities over only short periods of time; once an area is dredged, dredging equipment will move to another area, thereby minimizing locational impacts.

Based on air monitoring for the SMU 56/57 demonstration project, air emissions at dredging sites and at land-based facilities are expected to be minimal. Nevertheless, community and worker protection would be considered relative to potential air monitoring requirements. Action levels will be established, monitoring conducted as required, and appropriate engineering control measures employed to ensure that any air releases do not exceed acceptable levels.

Vehicles used for the transportation of hazardous waste will be designed and operated in conformance with state and local regulations. The WDNR and EPA will provide the community and local government with the opportunity to provide input on plans related to the off-site transportation of hazardous wastes. This approach is consistent with the NRC recommendation to involve the local communities in risk management decisions (*A Risk Management Strategy for PCB-Contaminated Sediment*, NRC, 2001).

The WDNR and EPA believe that implementation of Alternatives C1, C2A, C2B, C3, D, E, and F would have little, if any, adverse impact on local businesses or recreational opportunities. Indeed, the WDNR and EPA believe that the remedy will have substantial positive economic impacts on local communities and will facilitate enhanced recreational activities in and along the River. To the extent that any adverse local impacts do occur, the WDNR and EPA expect that they will be short term and manageable. Moreover, the Agencies believe that any such impacts will be outweighed by the long-term benefits of the remediation on human health and the environment.

Worker Protection. For Alternatives A and B, occupational risks to persons performing the sampling activities (for the 5-year reviews) will be unchanged from current levels. There is some minimal increase in occupational risk associated with Alternative B because of the degree of sampling involved in the River.

For Alternatives C1, C2A, C2B, C3, D, E, and F, potential occupational risks to Site workers from direct contact, ingestion, and inhalation of PCBs from the surface water and sediments, as well as routine physical hazards associated with construction work and working on water, are higher than for Alternatives A and B. For Alternatives C1, C2A, C2B, C3, D, E, and F, personnel will follow a Site-specific health and safety plan and Occupational Safety and Health Administration (OSHA) health and safety procedures and wear the necessary personal protective equipment; therefore, no unacceptable risks would be posed to workers during implementation of the remedy.

In summary, Alternatives C1, C2A, C2B, C3, D, E, and F would not pose significant risk to the nearby communities or Site workers. A short-term risk to the community and Site workers may be possible as a result of potential air emissions and noise from construction equipment, dewatering operations, and hauling activities. However, as successfully shown during the Lower Fox River demonstration dredging projects, these risks can be effectively managed or minimized by: (1) coordinating with and involving the community; (2) limiting work hours; (3) establishing buffer zones around the work areas; (4) using experienced contractors who would assist project design; and (5) giving consideration to experience gained on other sediment remediation projects and applying that knowledge to this Site's specific circumstances.

Environmental Impacts of Remedy and Controls

Environmental impacts consist of PCB releases from removed sediment into the air and water. As successfully shown during the River demonstration dredging projects, environmental releases will be minimized during remediation by: (1) treating water prior to discharge;

(2) controlling stormwater runon and runoff from staging and work areas; (3) utilizing removal techniques that minimize losses; and through (4) the possible use of silt curtains where necessary to reduce the potential downstream transport of PCBs.

Habitat impacts from Alternatives C1, C2A, C2B, C3, D, E, and F are expected to be minimal, as the benthic community should recover relatively quickly from dredging activities (see *White Paper No. 8 – Habitat and Ecological Considerations as a Remedy Component for the Lower Fox River* attached to the OU 1 and OU 2 ROD). Additionally, dredging remediation can result in collateral benefits in the course of mitigation, including removal of other chemical contaminants (e.g., mercury and ammonia) and nuisance species, reintroduction of native species, aeration of compacted and anaerobic soils, and other enhancements to submerged habitats. For the capping portion of Alternative F, there could be similar effects on aquatic vegetation and benthic invertebrate and fish communities, but recovery of benthic invertebrate communities would likely be slower (relative to recovery from dredging) because of changes in the subaqueous habitat to sand and rock as well as decreases in organic content of the sediment.

Potential Adverse Environmental Impacts During Construction

Alternatives A and B do not involve construction activities associated with the River sediments. Continuing the existing limited sampling activities (under the No Action alternative) or increasing the monitoring program (under the MNR alternative) is not anticipated to have any adverse effect on the environment beyond that already caused by PCB contamination of the sediments and ongoing releases of PCBs from the sediments in OU 3. For Alternatives C1, C2A, C2B, C3, D, E, and F, the release of PCBs from the contaminated sediments into the surface water during construction (dredging and cap placement) will be controlled by operational practices (e.g., control of sediment removal rates, use of environmental dredges, and possible use of sediment barriers). Although precautions to minimize resuspension will be taken, it is likely that there could be a localized, temporary increase in suspended PCB concentrations in the water column and possibly in fish PCB body burdens.

Analysis of results from projects at Deposit N and SMU 56/57 and comparison to yearly sediment resuspension rates, as well as resuspension quantities during yearly high-flow events, show the expected resuspension resulting from dredging to be well within the variability that normally occurs on a yearly basis. Analysis of results from other dredging projects indicates that releases from environmental dredging are relatively insignificant. The performance standards and monitoring program developed during design will ensure that dredging operations are performed consistent with the environmental and public health goals of the project. This was readily achieved on the Deposit N and SMU 56/57 projects and is expected to be feasible for other River dredging activities.

Dredging activities may result in short-term, temporary impacts to aquatic and wildlife habitat of OU 3 but, as discussed below and in *White Paper No. 8 – Habitat and Ecological Considerations as a Remedy Component for the Lower Fox River* (attached to the OU 1 and OU 2 ROD), recovery is expected to be rapid.

For Alternatives C1, C2A, C2B, C3, D, E, and F, there is the potential for transient impact from the temporary exposure of deeper, more highly contaminated sediments during excavation activities. This impact would be minimized by the quick completion of removal activities and (if needed) placement of a post-dredging sand cover as soon as practicable after the removal operations are complete.

Implementability

Implementability addresses the technical and administrative feasibility of a remedy from design through construction and operation. Factors such as the availability of services and materials, administrative feasibility, and coordination with other governmental entities are also considered.

Technical Feasibility

Both Alternatives A and B are technically feasible because no active measures other than continued sampling would be taken. Technical feasibility for the active remediation alternatives is discussed below in terms of the main components of the alternatives. Additional information is provided in the FS.

Sediment Processing/Transfer Facilities: Alternatives C1, C2A, C2B, C3, E, and F require sediment processing/transfer facilities. At these facilities, the transfer, dewatering, and stabilization of dredged material would be conducted. Each of these activities is considered a readily implementable, commonly engineered activity. Design of sediment processing/transfer facilities will include requirements for the control of light, noise, air emissions, and water discharges.

The WDNR and EPA have not determined the location of the sediment processing/transfer facilities. Preliminary criteria were utilized to establish a list of preliminary candidate sites to allow for the preparation of a cost estimate. In preparing the cost estimate in the FS, the WDNR and EPA assumed a number of upland staging and access areas in the cities of De Pere and Green Bay, as well as access for a potential pipeline. These facilities (wherever located) would be temporary and removed after completion of the active remedial activities.

Removal: Alternatives C1, C2A, C2B, C3, D, E, and F require the dredging of contaminated sediments. Dredging of sediments is a readily implementable and environmentally effective engineering activity. Two concerns are relevant to whether sediments can be dredged effectively: (1) resuspension and releases during dredging, and (2) resulting residual contaminant concentrations that may remain in sediments after dredging is completed. Regarding resuspension, environmental dredges have been shown to generally not release significant quantities of contaminants during removal operations. The type of dredging equipment (mechanical and/or hydraulic) will be selected during the remedial design on the basis of what is the most appropriate equipment for the specific conditions in the River. Silt screens or other barriers, as appropriate, could further assist in limiting downstream migration of PCBs and may be used as well. Regarding post-dredging residual contaminant concentrations, comparable projects indicate that the 1 ppm action level in remaining sediments is readily achievable. The Lower Fox River SMU 56/57 dredging project achieved a 96 percent reduction in the average concentration of contaminated sediments targeted for removal. This outcome is consistent with results for other dredging projects having similar site conditions (see Appendix B of the FS and Hudson River White Paper ID 312663, “Post-Dredging PCB Residuals”).

Dewatering: Alternatives C1, C2A, C2B, C3, D, E, and F would require the removal of excess water from dredged sediments. Either mechanical or passive dewatering would be used for this purpose. These are conventional technologies and are readily implementable and effective.

Water Treatment: Conventional water treatment technologies for dredge water have been proven commonly reliable and are readily implementable and effective.

Capping: Alternative F includes capping in areas that are acceptable for capping. Capping is not acceptable in navigation channels, in areas where a cap may interfere with infrastructure (e.g., pipelines, utility easements, bridge piers), in areas where PCB concentrations are equal to or greater than 50 ppm, and in areas with shallower water (e.g., where a cap would result in water depths less than 3 feet). The placement of capping materials is a readily implementable engineering activity. Sand and/or fine-grained materials may be utilized for capping. Clean sand placed over contaminated deposits would result in a new sediment bed surface that is essentially without contamination initially. The type of material (e.g., texture/size and sorting), thickness of the isolation cap, and armoring requirements will need to be determined on a location-specific basis. Recent climate models indicate that Lake Michigan water levels could decrease by 3 feet by 2050 and 4.5 feet by 2090, below historical low water levels. Therefore, decisions concerning capping should consider potential future declines in Lake Michigan water levels which would in turn affect levels within the Lower Fox River and Green Bay.

Post-Dredging Sand Cover: The selected alternative envisions an option of limited backfilling (see the discussion of capping as a contingent remedy in Sections 13.4 through 13.7). The placement of a sand backfill is a readily implementable engineering activity. Sand or other materials, as appropriate, may be utilized for backfill. This “residual cap” is defined as placement of a thin cap layer over a residual sediment contamination left behind following dredging. Residual capping serves to dilute the contaminated sediment and speed up the natural recovery process. Residual caps are not designed as isolation caps. An example of a residual cap is the material placed at the SMU 56/57 demonstration project.

Transportation: Different dredging alternatives have different transportation requirements (see Table 11-5).

For Alternatives C1, C2A, C2B, C3, D, and E, dredged materials may be transported in-River to sediment processing/transfer facilities or a nearshore CDF using barges or pipelines. These are considered readily implementable engineering activities.

For Alternatives C2A and C2B, an on-land pipeline to the dewatering facilities or dewatering/disposal facilities would be necessary. For Alternative C2B, trucks, or possibly some other transportation method, would serve for transferring the dewatered sediments from the dewatering location to the adjacent disposal facility.

For Alternatives C1, C3, E, and F, off-site transportation of dredged materials to disposal facilities would be by truck, rail, and/or barge. These forms of transportation are routine engineering activities that have been employed at many Superfund sites and are technically implementable. The WDNR and EPA will comply with all legal regulatory requirements for transporting both hazardous and non-hazardous wastes.

Disposal: Off-site disposal is a common activity at many Superfund sites. The number and location of off-site disposal facilities will be based on dredged material volume, transportation, and cost considerations. It is expected that appropriate disposal will be in the Fox River Valley area.

Alternatives C1, C2A, C2B, C3, and F all include upland disposal options. Alternative D uses an in-water confined disposal facility for disposal. These are conventional technologies and readily implementable. Under Alternative F, based on the criteria for cap placement, approximately 40 percent of the surface area of the 1 ppm footprint could be capped *in situ*. For the areas that will be capped, it is considered technically achievable. It should be noted that certain areas are not amenable to capping, as noted above in the “Capping” discussion.

Alternative E, the *ex-situ* treatment alternative of vitrification, was determined to be technically feasible. As discussed in the FS, this alternative does require reuse of residual materials after treatment. For purposes of this ROD, it is assumed that there will a beneficial reuse of the residual material and an associated value (range of $2 to $25 per ton) and, as a consequence, there is no disposal cost associated with this alternative.

Treatment: Alternative E includes thermal treatment by vitrification and is technically implementable to meet cleanup goals.

Administrative Feasibility

Alternatives A and B require no active measures. All alternatives except Alternative A include an administrative requirement for fish consumption advisories. Because fish consumption advisories are already in place, this requirement is already met and would continue even under the No Action alternative. Alternatives C1, C2A, C2B, C3, D, E, and F are somewhat more difficult to implement in terms of administrative feasibility because of the need to site a pipeline and the sediment processing/transfer facilities, to address the associated real property issues, and to make arrangements to utilize the River with minimal interruption of boat traffic.

Sediment Processing/Transfer Facilities: For Alternatives C1, C2A, C2B, C3, D, and F, the transfer facilities, constructed on land adjacent to or in the River, are considered "on site" for the purposes of the permit exemption under CERCLA Section 121(e), although any such facilities will comply with the substantive requirements of any otherwise necessary federal or state permits.

Removal: Operations under these alternatives will have to be performed in conformance with the substantive requirements of regulatory programs implemented by the USACE under Section 10 of the Rivers and Harbors Act and Section 404 of the Clean Water Act. In addition, discharges during remediation will conform to Wisconsin Statutes and substantive WDNR regulations related to dredging and maintaining water quality.

Disposal: Identifying a local landfill for disposal of dredged sediments is feasible. This would have to be coordinated with local authorities, consistent with appropriate ARARs.

Capping and CDF: For Alternatives D and F, consideration of riparian rights would require use/access agreements with property owners of land adjacent to the riverbed. If capping or CDF areas are considered to be a "lake" due to dams, a lakebed grant would have to be approved by the state. Regulations concerning impacts to floodplains and floodways would need to be addressed. These considerations would be addressed during design.

Treatment: Alternative E is administratively feasible. Air emissions permits would be required if sediments are treated off site.

Availability of Services and Materials: For Alternatives A and B, all needed services and materials are available. For Alternatives C1, C2A, C2B, C3, D, E, and F, equipment and personnel related to dredging and materials handling (e.g., sediment dewatering) are commercially available. Technology and associated goods and services for capping or a post-dredging sand cover, upland landfill, or CDF construction are locally available.

Cost

Cost includes estimated capital and annual operation and maintenance costs, as well as total capital cost. Present worth cost is the total capital cost and operation and maintenance costs of an alternative over time in today's dollar value. Cost estimates are expected to be accurate within a range of –30 to +50 percent. (This is a standard assumption in accordance with EPA CERCLA guidance.)

For Alternatives C1, C2A, C2B, C3, D, E, and F, the estimated costs range from approximately $26.5 million for Alternative C2B to $95.1 million for Alternative C1 at the 1 ppm RAL. The estimated costs of Alternative A (No Action) and Alternative B (MNR) are $4.5 million and $9.9 million, respectively. Capital costs, present worth of operation and maintenance (O&M) costs, and the total costs are listed in Table 11-8.

Table 11-8 Comparison of Costs for OU 3 Alternatives at the 1 ppm RAL

	Estimated Volume Removed or Treated (cubic yards)	Estimated PCB Mass Remediated (pounds)	Capital Cost ($ millions)	O&M Cost ($ millions)	Present Worth Total Cost ($ millions)
A – No Action	0	0	0	4.5	4.5
B – Monitored Natural Recovery	0	0	0	9.9	9.9
C1 – Dredging/Passive Dewatering/Off-Site Disposal	586,788	2,444	90.6	4.5	95.1
C2A – Dredging/Combined Passive Dewatering/Disposal Facility	586,788	2,444	39.4	4.5	43.9
C2B – Dredging/Passive Dewatering/Monofill	586,788	2,444	21.2	4.5	25.7
C2B – DD Incremental Cost	9,000	31	0.8	0.0	0.8
C3 – Dredging/Mechanical Dewatering/Off-Site Disposal	586,788	2,444	64.6	4.5	69.1
D – Dredge to a Confined Disposal Facility	586,788	2,444	48.0	4.5	52.5
E – Dredge and Vitrification	586,788	2,444	81.7	4.5	86.2
F – Dredging and Capping to Maximum Extent Practicable	170,418	2,444	58.4	4.5	62.9

Note:
Data are Table 7-7 of the FS and *White Paper No. 23 – Evaluation of Cost and Implementability of Alternative C2B for Operable Unit 3 and Operable Unit 4.* The white paper impacts only Alternative C2B and these costs were developed assuming capital costs were prorated based on the volume of sediment in OU 3 compared to the total for OU 3 and OU 4 combined (~9 percent) and that 50 percent of the O&M costs are applicable to OU 3.

11.1.3 Agency and Community Criteria for Operable Unit 3

Agency Acceptance

The State of Wisconsin has been actively involved in managing the resources of the River since before there was a federal Superfund law. These efforts have led to significant state knowledge and understanding of the River and Bay and of the contamination problems within those areas. As a result of this expertise, the WDNR has served as the lead agency responsible for assessing risks and conducting the RI/FS, which formed the basis for the Proposed Plan; the ROD for OU 1 and OU 2; and this ROD addressing OU 3, OU 4, and OU 5. As the lead agency, the WDNR has worked closely with the EPA to cooperatively develop this ROD. Both the WDNR and EPA support the selection of this remedy, as is evidenced by their joint issuance of this ROD.

Community Acceptance

Community acceptance considers whether the local community agrees with the EPA's analyses and preferred alternative. Comments received on the Proposed Plan are an important indicator of community acceptance. Community acceptance of the Proposed Plan was evaluated based on comments received at the public meetings and during the public comment period. More than 4,800 comments were received concerning the Proposed Plan. This ROD includes a Responsiveness Summary (see Appendix A). Comments that address issues common to OU 1 and OU 2, as well as to OU 3, OU 4, and OU 5, are discussed in the Responsiveness Summary attached to the OU 1 and OU 2 ROD.

11.2 Operable Unit 4 (De Pere to Green Bay)

Table 11-9 summarizes the comparative analysis for OU 4 alternatives and how each alternative meets, or does not meet, requirements for each of the nine criteria described above.

Table 11-9 OU 4 – De Pere to Green Bay Alternatives

Yes = Fully meets criterion Partial = Partially meets criterion No = Does not meet criterion	Alternative A No Action	Alternative B Monitored Natural Recovery	Alternative C1 Dredge with Off-Site Disposal	Alternative C2A Dredge with Off-Site Disposal	Selected Remedy Alternative C2B Dredge with Off-Site Disposal	Alternative C3 Dredge with Off-Site Disposal	Alternative D Dredge to a Confined Disposal Facility	Alternative E Dredge and Vitrification	Alternative F *In-Situ* Capping
1. Overall Protection of Human Health and the Environment	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
2. Compliance with Applicable or Relevant and Appropriate Requirements	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
3. Long-Term Effectiveness and Permanence	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
4. Reduction of Toxicity, Mobility, or Volume Through Treatment	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
5. Short-Term Effectiveness	No	No	Yes	Yes	Yes	Yes	Partial	Partial	Yes
6. Implementability	Yes	Yes	Yes	Yes	Yes	Yes	Partial	Partial	Yes
7. Cost (millions of $)	$ 4.5	$ 9.9	$656.4	$169.3	$257.5*	$509.3	$500.9	$350.9	$352.9
8. Agency Acceptance	The WDNR has been the lead agency in developing the RI/FS and Proposed Plan. Both the WDNR and EPA support the selected alternative for this Operable Unit at the 1 ppm action level.								
9. Community Acceptance	The level of community acceptance of the selected alternative is outlined in the Responsiveness Summary.								

* This remedy is combined with Alternative C2B in OU 3. The total cost for this combined remedy is $284 million. Estimated costs for the combined remedy are discussed in *White Paper No. 23 – Evaluation of Cost and Implementability of Alternative C2B for Operable Unit 3 and Operable Unit 4*, which is attached to this ROD. The estimated cost for OU 4 is $257.5 million.

11.2.1 Threshold Criteria for Operable Unit 4

Protection of Human Health and the Environment

The primary risk to human health associated with the contaminated sediment is consumption of fish. The primary risk to the environment is the bioaccumulation of PCBs from the consumption of fish or, for invertebrates, the direct ingestion/consumption of sediment. Protection of human health and the environment were evaluated by residual risk in surface sediment using five lines of evidence:

- Residual PCB concentrations in surficial sediment using surface-weighted averaging after completion of a remedy
- Average PCB concentrations in surface water
- The projected number of years required to reach safe consumption of fish
- The projected number of years required to reach a surface sediment concentration protective of fish or other biota
- PCB loadings to Green Bay and total mass contained or removed

Each of these is discussed below.

Residual PCB Concentrations in Surficial Sediment and Surface Water

As shown in Table 11-10, substantial reductions in the average PCB concentration in surficial sediment and in surface water for OU 4 is achieved by Alternatives C1, C2A, C2B, C3, D, E, and F when compared to Alternatives A and B. Implementation of Alternative C1, C2A, C2B, C3, D, E, or F results in reduction in residual PCB concentrations in surface sediment from 3.11 ppm to 0.156 ppm using surface-weighted averaging when compared to Alternatives A and B (No Action and MNR). It is also estimated that surface water concentrations 30 years after remediation will be reduced from 21.08 ng/L to 0.42 ng/L for Alternatives C1, C2A, C2B, C3, D, E, and F relative to Alternatives A and B.

Table 11-10 Post-Remediation Sediment and Surface Water Concentrations in OU 4

Alternative	Post-Remediation SWAC (ppm)	Estimated Surface Water Concentrations 30 Years after Remediation (ng/L)
A, B	3.11	21.08
C1, C2A, C2B, C3, D, E, F	0.156	0.42

Notes:
SWAC – surface-weighted average concentration
Data are from FS Table 8-5B and Table 1 in *White Paper No. 11 – Comparison of SQTs, RALs, RAOs and SWACs for the Lower Fox River* of the OU 1 and OU 2 ROD.

Time Required to Achieve Acceptable Fish Tissue Concentrations

As shown in Table 11-11, substantial reductions in the time when humans could safely consume fish are achieved by Alternatives C1, C2A, C2B, C3, D, E, and F when compared to Alternatives A and B. The implementation of Alternative C1, C2A, C2B, C3, D, E, or F is expected to achieve acceptable fish tissue concentrations for recreational fishermen within 20 to 45 years and acceptable tissue concentrations for high-intake fish consumers within 59 years, as compared to more than 100 years for Alternatives A and B. It should be noted that because of limitations of modeling analysis, this relative comparison does not reflect how many years more than 100 would be required for natural recovery.

Table 11-11 Time to Achieve Acceptable Fish Tissue Concentrations for Walleye in OU 4

Fish	Receptor	Risk Level Goal	Estimated Years to Achieve	
			Alternatives C1, C2A, C2B, C3, D, E, F	Alternatives A, B
Walleye	Recreational Angler	RME Hazard Index of 1.0	20	>100
Walleye	High-intake Fish Consumer	RME Hazard Index of 1.0	30	>100
Walleye	Recreational Angler	RME 10^{-5} cancer risk level	45	>100
Walleye	High-intake Fish Consumer	RME 10^{-5} cancer risk level	59	>100

Notes:
RME – reasonable maximum exposure
Data are from FS Table 8-14.

Time Required to Achieve Surface Sediment Concentration Protective of Fish or Other Biota

As shown in Table 11-12, substantial reductions in the time required to reach protective levels for ecological receptors are achieved by Alternatives C1, C2A, C2B, C3, D, E, and F relative to Alternatives A and B. For representative ecological receptors, implementation of Alternative C1, C2A, C2B, C3, D, E, or F is expected to achieve protective levels within 20 to 45 years as compared to more than 100 years for Alternatives A and B. Because of limitations of the modeling analysis, this relative comparison does not reflect how many years more than 100 would be required for natural recovery.

Table 11-12 Time Required to Achieve Protective Levels in Sediment for Representative Ecological Receptors in OU 4

Fish	Receptor	Risk Level Goal	Estimated Years to Achieve	
			Alternatives C1, C2A, C2B, C3, D, E, F	Alternatives A, B
Carp	Carnivorous bird	NOAEC	20	>100
Carp	Piscivorous mammal	NOAEC	45	>100
Sediment	Sediment invertebrate	TEL	37	>100

Notes:
NOAEC – No Observed Adverse Effects Concentration
TEL – threshold exposure limit
Data are from FS Table 8-16.

PCB Loadings to Downstream Areas and Total Mass Contained or Removed

Reduction of the PCB load transported from the Lower Fox River into Green Bay is a measure of the overall protection of human health and the environment. Reduced PCB loading from OU 4 will ultimately contribute to downstream reduction of concentrations of PCBs in sediment, water, and fish, thereby reducing risk to humans and ecological receptors in the River, Green Bay, and Lake Michigan. Implementation of Alternative C1, C2A, C2B, C3, D, E, or F is expected to reduce the estimates for releases from the River to Green Bay from the present range of 125 kg (276 pounds) to 221 kg (486 pounds) per year to a level of 1.7 kg (3.7 pounds) per year 30 years after completion of remediation, as compared to 75 kg (166 pounds) per year after 30 years for Alternatives A and B. Thus, Alternatives C1, C2A, C2B, C3, D, E, and F would provide a 98 percent reduction in loadings relative to Alternatives A and B.

Summary

Alternatives C1, C2A, C2B, C3, D, E, and F provide a substantially more protective remedy than do Alternatives A and B. Alternatives A and B are not protective of human health and the environment.

Compliance with Applicable or Relevant and Appropriate Requirements

Section 121(d) of CERCLA and NCP § 300.430(f)(1)(ii)(B) require that remedial actions at CERCLA sites attain legally applicable or relevant and appropriate federal and state requirements, standards, criteria, and limitations, collectively referred to as ARARs, unless such ARARs are waived under CERCLA Section 121(d)(4). Compliance with ARARs addresses whether a remedy will meet all of the applicable or relevant and appropriate requirements of other federal and state environmental statutes or provide a basis for invoking a waiver.

The ARAR discussion below is organized by the different operational components of the alternatives (Table 11-13), because various components are utilized in essentially the same manner for some alternatives and apply equally to those alternatives with a common component. There is additional discussion of compliance with ARARs in Section 14.2.

Table 11-13 Operational Components for OU 4 Alternatives

		Alternatives								
		A	**B**	**C1**	**C2A**	**C2B**	**C3**	**D**	**E**	**F**
Removal	Mechanical			X						
	Hydraulic				X	X	X	X	X	X
Dewatering	Mechanical						X			
	Passive			X	X	X		X	X	X
Sediment Treatment				*	*	*	*	*	X	*
Water Treatment				X	X	X	X	X	X	X
Transportation	Trucking			X		X***	X	X**	X	X
	Pipeline				X	X				
Disposal	Upland			X	X	X	X	X**		X
	In-water CDF							X**		
Beneficial Reuse of Sediments									X	
Capping										X

Note:
X: Required activity for alternative.
* Possible supplement.
** Upland disposal for this alternative includes approximately 3,742,800 cy of sediments with PCB concentrations less than 50 ppm and 240,800 cy of sediments with concentrations equal to or greater than 50 ppm. Due to capacity limitations, 2,136,700 cy of sediments with PCB concentrations less than 50 ppm will be disposed of in an in-water CDF.
*** Trucking would be minimal (disposal location is adjacent to the dewatering facility).

A description of the components listed in Table 11-13 follows:

- **Removal:** The removal technology utilized for Alternatives C1, C2A, C2B, C3, D, E, and F is dredging (although Alternative F also includes capping). The ARARs that directly relate to the removal of sediment from the River and Bay concern the protection of surface water (NR 322, 200, and 220 through 297). The surface water ARARs limit the discharge of PCBs into the receiving water bodies so that water quality is not adversely affected. These ARARs will be achieved by Alternatives C1, C2A, C2B, C3, D, E, and F. Dredge material will be moved to the dewatering facility by pipeline or barge.

- **Dewatering and Water Treatment:**

  - ♦ Mechanical dewatering would be utilized for Alternative C3. Discharge requirements (NR 200 and 220 through 297, WAC) are set forth for the discharge of water to POTWs and to navigable waters such as the River (NR 105 and 106, WAC). Discharges from prior remedial activities on the River provide an indication of the treatment requirements for discharging effluent water to the River or to a POTW. Another requirement covers stormwater discharge. A potentially important ARAR (NR 108, WAC) relates to the construction of a wastewater treatment facility specifically to treat water from remedial activities.

  - ♦ Passive dewatering ponds would be part of Alternatives C1, C2A, C2B, D, E, and F and would be constructed under the wastewater ARAR (NR 213, WAC), which is associated with wastewater treatment lagoons. Based on previous experience gained during the SMU 56/57 pilot dredging project, ARARs associated with passive dewatering lagoons are achievable.

- ***Ex-Situ* (Off-site) Treatment:** ARARs specific to vitrification technology (Alternative E) relate to the air emission and permitting requirements of thermal treatment units (40 CFR 701 and NR 400 through 499). In addition, the thermal unit must meet performance requirements in NR 157 for the efficient treatment of PCB-containing sediment. These ARARs would be met.

- **Transportation:** The likely method for transporting PCB-containing sediment to upland disposal locations for Alternatives C1, C3, D, and F is by trucking it to the disposal facility, although other transportation methods could be used if it is determined during design that there are better methods. Alternative C2B would involve moving sediment from the passive dewatering facility to the adjacent disposal site. Alternative C2A does not require disposal transportation, because the dredge material will be disposed of in the dewatering facility. Alternatives C2A and C2B would require use of a pipeline to convey the dredge slurry to the dewatering/disposal facility or to the dewatering facility. Alternative D would not require off-site transportation, because all removed sediments would be disposed of on site in a nearshore CDF. Alternative E would require trucking contaminated sediments to a treatment facility and trucking the treated (non-hazardous) materials to a site for beneficial or commercial reuse. ARARs and TBCs important to this process option include the requirements to prevent spills and releases of PCB materials (NR 140 and 157, WAC). Two ARARs applicable only to the trucking method include WDOT requirements for the shipping of PCB materials and NR 157 shipping requirements. ARARs and TBCs related to in-water transportation activities (i.e., piping) include the protection of surface water (NR 322, 200, and 220 through 297, WAC). Alternatives C1, C2A, C2B, D, E, and F will comply with these ARARs.

- **Disposal:** For Alternatives C1, C2A, C2B, C3, and F, contaminated sediment removed (i.e., dredged) from OU 4 will be disposed of at either an existing upland landfill or in a newly constructed or modified landfill designed to receive the dewatered sediment. ARARs specific to this process option include the siting requirements for a landfill (Chapter 289, Wisconsin Statutes) and the technical requirements for construction, operation, and closure of a landfill in the NR 500 rule series, WAC. For contaminated sediments with PCB concentrations equal to or greater than 50 ppm, disposal will comply with TSCA, 40 CFR Part 761. Alternative D would also have a relatively small portion (i.e., an estimated 2 percent) of dredged materials with concentrations equal to or greater than 50 ppm that would be disposed of at a TSCA-compliant upland landfill.

- **Capping:** For Alternative F, some sediments would be capped in place, primarily in the deeper portions of OU 4 outside of the navigation channel. This would require compliance with Section 10 of the Rivers and Harbors Act of 1899 (22 CFR 403) and with the Wisconsin Statutes Chapter 30 (defining riparian rights of upland owners which extend to the center of a stream). It is expected that these ARARs would be met.

11.2.2 Primary Balancing Criteria for Operable Unit 4

Long-Term Effectiveness and Permanence

Reduction of Residual Risk

Alternatives A and B result in a continuation of the degraded condition of the sediment and surface water quality of the De Pere to Green Bay Reach (OU 4) for at least more than 100 years. Alternatives A and B do not eliminate PCBs from the River and do not reduce PCB levels in fish to acceptable levels for the foreseeable future.

Alternatives C1, C2A, C2B, C3, D, E, and F reduce residual risk through removal or containment of an estimated 5,880,000 cy of sediments containing approximately 26,433 kg (58,150 pounds) of PCBs over an area of 1,030 acres. The implementation of Alternative C1, C2A, C2B, C3, D, E, or F is expected to reduce the time required to reach acceptable fish tissue concentrations for recreational fishermen to 20 to 45 years and for high-intake fish consumers to within 59 years when compared to Alternatives A and B (Table 11-11). It should be noted that because of limitations of modeling analysis, this relative comparison does not reflect how many years more than 100 would be required for natural recovery.

Adequacy of Controls

Alternatives A and B do not produce a reduction in human risk and exposure in the foreseeable future, unlike Alternatives C1, C2A, C2B, C3, D, E, and F. Additionally, fish consumption surveys indicate that 50 percent of anglers do not follow fish advisories. Therefore, existing institutional controls do not adequately reduce human exposure to PCBs from consumption of contaminated fish. In addition, institutional controls are not protective for ecological receptors (e.g., birds, mammals, and fish). Given the survey data, it is unlikely that these types of controls alone would be reliable in the long term to ensure human health and ecological protection. In effect, institutional controls by themselves are not effective for OU 4.

Alternatives C1, C2A, C2B, C3, D, and E provide for the removal of PCB-contaminated sediments in OU 4. Alternative F also removes a large portion of PCB-contaminated sediments and provides for an engineered cap over an estimated 40 percent of the surface area of the 1 ppm footprint of contaminated deposits in OU 4. Like Alternative B (MNR), Alternative F also requires institutional controls such as Site use restrictions in capped areas (e.g., prohibition of activities that disturb sediment). Although institutional controls would still be required for Alternatives C1, C2A, C2B, C3, D, E, and F, the risk to consumers of fish would be greatly reduced by these alternatives.

All alternatives would require institutional controls, such as fish consumption advisories and fishing restrictions, until remedial action objectives were met at a future date, but they are unlikely to require additional Site use restrictions after removal activities are completed.

All alternatives will require some degree of monitoring. Monitoring programs will be developed, as appropriate, for all phases of the project. Monitoring would continue until acceptable levels of PCBs are reached in sediments, surface water, and fish.

Alternatives C1, C2A, C2B, C3, D, and F rely on engineering controls at the disposal facility. Properly designed and managed landfills provide proven, reliable controls for long-term disposal for Alternatives C1, C2A, C2B, C3, and F (which have off-site landfill disposal). Alternative F would also require a long-term operation and maintenance plan to ensure containment of PCBs in perpetuity. Alternative D would require on-site engineering controls at an in-water disposal facility. Long-term monitoring and maintenance are included in operation of the landfill and confined disposal facility. The final disposition of contaminated sediments is summarized in Table 11-14.

Table 11-14 Final Disposition of Contaminated Sediments in OU 4

	Alternatives (cubic yards)					
	A	B	C1/C2A/C2B/C3	D	E	F
Treated and residual disposal	0	0	0	0	5,879,529	0
Removed and disposed at upland (off-site) landfill	0	0	5,879,529	3,742,758	0	1,909,504
Removed and disposed at in-water, on-site CDF	0	0	0	2,136,771	0	2,136,771
Capped in place	0	0	0	0	0	1,833,253

Note:
Data are from FS Table 7-2.

<u>Reliability of Controls</u>

For Alternatives B, C1, C2A, C2B, C3, D, E, and F, fish consumption advisories and fishing restrictions will continue to provide some protection of human health until PCB concentrations in fish are reduced to the point where the fish consumption advisories and fishing restrictions can be relaxed or lifted. However, in the interim, these controls will provide only an uncertain measure of protection. Among these alternatives, sediment capping, sediment removal (dredging and excavation), and off-site disposal/treatment of removed sediments are all established technologies.

The capping portion of Alternative F relies upon proper design, placement, and maintenance of the cap in perpetuity for its effectiveness, continued performance, and reliability. A cap-integrity monitoring and maintenance program would provide reasonable reliability, although there are inherent challenges in monitoring and maintaining a cap in the River environment. The capping portion of Alternative F may not be as reliable as the removal alternatives because of the unknown potential for damage to the cap, potentially exposing PCBs. In addition, the capping component of Alternative F is vulnerable to a catastrophic flow event, such as might be seen during a 500-year flood or a dam failure. However, with proper design and maintenance, these risks can be minimized.

In general, Alternatives C1, C2A, C2B, C3, D, and E are the most reliable, because there is little or no additional long-term, on-site maintenance associated with the remedial work. These alternatives permanently remove the greatest amount of contaminated sediment and PCBs from the River and achieve the greatest reduction of the potential scour-driven resuspension of PCB-contaminated sediments. However, Alternative F is also considered to be sufficiently reliable.

Summary

Based on the above analysis of reduction in residual risk and adequacy and reliability of controls, Alternatives C1, C2A, C2B, C3, D, E, and F are superior to Alternatives A and B because of the greater risk reduction and mass of PCBs removed from the River. Alternatives C1, C2A, C2B, C3, D, E, and F are similar to each other in terms of risk reduction, with Alternatives C1, C2A, C2B, C3, and E likely being the most effective over time. The Agencies' analysis of residual risk for each alternative is consistent with the NRC report recommendation to consider options to reduce risk and to consider residual risks associated with material left behind (*A Risk Management Strategy for PCB-Contaminated Sediment*, NRC, 2001).

Reduction of Toxicity, Mobility, and Volume Through Treatment

Reduction in toxicity, mobility, or volume of contaminants through treatment evaluates an alternative's use of treatment to reduce the harmful effects of principal contaminants, their ability to move in the environment, and the amount of contamination present.

Alternatives A and B do not involve any containment or removal of contaminants from OU 4 sediments. Alternatives A and B rely on natural attenuation processes such as burial by cleaner sediments, biodegradation, bioturbation, and dilution to reduce concentrations of PCBs in sediments and surface water.

Natural degradation processes were not found to be effective in reducing PCB concentrations or toxicity in River sediments (FS Appendix F, "Dechlorination Memorandum"). Nevertheless, concentrations of PCBs in fish populations will respond slowly over time to slow natural decreases in concentrations in sediments and surface water due primarily to dilution and the burial of contaminated sediments by cleaner sediments.

For Alternative F, the mobility of the PCBs in capped areas (approximately 437 acres) would be reduced because these PCBs are sequestered under the cap. However, capping does not satisfy the CERCLA statutory preference for treatment. In addition, there is no reduction in the toxicity or volume of the PCBs under the cap. Under Alternative F, the mass of PCBs and the volume of contaminated sediments within OU 4 are permanently reduced because approximately 4,050,000 cy of sediment would be removed and approximately 1,830,000 cy would be contained under a cap in OU 4. A total of approximately 26,433 kg (58,150 pounds) of total PCBs would be removed or isolated from the ecosystem by this alternative. In addition, after construction of the remedy is completed, natural attenuation processes could provide additional reductions in PCB concentrations in the remaining sediments and surface water.

For Alternatives C1, C2A, C2B, C3, D, and E at OU 4, approximately 26,433 kg (58,150 pounds) of PCBs and 5,880,000 cy of contaminated sediments are permanently removed from the ecosystem. As for Alternative F, natural attenuation processes would provide additional reductions in PCB concentrations in the remaining sediments and surface water after construction of the remedy is completed.

Although Alternatives C1, C2A, C2B, C3, D, and F would permanently remove large volumes of PCBs from the River (thereby reducing their mobility), they do not satisfy the statutory preference for treatment as a principal element of the remedy. Given the volume of material to be removed, treatment of the dredged material prior to off-site disposal (other than stabilization of the sediments for handling purposes) may not be cost-effective. Vitrification under Alternative E would reduce toxicity, mobility, and volume, and the glass aggregate product would be available for beneficial reuse.

Short-Term Effectiveness

Short-term effectiveness relates to the length of time needed to implement an alternative and the risks the alternative poses to workers, residents, and the environment during implementation up until the time that remediation levels are achieved.

Length of Time Needed to Implement the Remedy

The implementation times are approximately 6 to 8 years for Alternatives C1, C2A, C2B, C3, D, E, and F (see Table 11-15). These estimates represent the estimated time required for mobilization, operation, and demobilization of the remedial work, but do not include the time required for long-term monitoring or operations and maintenance. These time estimates do take into consideration the fact that winter conditions will not allow for dredging (or capping) operations during the winter season. Alternatives A and B do not involve any active remediation and therefore require no time to implement. Alternative B would require monitoring until acceptable levels of PCBs are achieved in sediment, surface water, and fish.

Table 11-15 Time to Implement Alternatives for OU 4

Alternative	Years to Implement (rounded up to whole number)
A/B	0
C1	8
C2A/C2B	7
C3	6
D	8
E	8
F	6

Protection of the Community and Workers During Remedial Action

No construction activities are associated with the remediation of sediments for Alternatives A and B, so those alternatives neither increase nor decrease the short-term potential for direct contact with or ingestion and inhalation of PCBs from the surface water and sediments.

Community Protection: Access to sediment processing/transfer facilities and process and treatment areas under Alternatives C1, C2A, C2B, C3, D, E, and F will be restricted to authorized personnel. Controlling access to the dredging locations and sediment processing/transfer facilities, along with monitoring and engineering controls developed during the design phase, will minimize potential short-term risks to the community. The design will also provide for appropriate control of air emissions, noise, and light through the use of appropriate equipment that meets all applicable standards. Compliance with these design provisions will be monitored during construction, operation, and demobilization. Vehicular traffic associated with workers and the delivery of supplies will increase at the sediment processing and transfer facilities.

For Alternatives C1, C2A, C2B, C3, D, E, and F, work in the River will also be designed with provisions for control of air emissions, noise, and light. Work areas will be isolated (access-restricted), with an adequate buffer zone so that pleasure craft can safely avoid these areas. Environmental dredging in the River will be conducted at times and in ways to minimize disruption to River traffic. Targeted dredging will be sequenced and directed to ensure minimal impacts to navigation within the River. To help ensure that navigation is not impeded, the WDNR and EPA will consult with local authorities during the remedial design and construction phases regarding issues related to River uses and other remedy-related activities within OU 4. Discrete areas of the River will be subject to dredging and related activities over only short periods of time; once an area is dredged, dredging equipment will move to another area, thereby minimizing locational impacts.

Based on air monitoring for the SMU 56/57 demonstration project, air emissions at dredging sites and at land-based facilities are expected to be minimal. Nevertheless, community and worker protection would be considered relative to potential air monitoring requirements. Action levels will be established, monitoring conducted as required, and appropriate engineering control measures employed to ensure that any air releases do not exceed acceptable levels.

Vehicles used for the transportation of hazardous waste will be designed and operated in conformance with state and local regulations. The WDNR and EPA will provide the community and local government with the opportunity to provide input on plans related to the off-site transportation of hazardous wastes. This approach is consistent with the NRC recommendation to involve the local communities in risk management decisions (*A Risk Management Strategy for PCB-Contaminated Sediment*, NRC, 2001).

The WDNR and EPA believe that implementation of Alternatives C1, C2A, C2B, C3, D, E, and F would have little, if any, adverse impact on local businesses or recreational opportunities. Indeed, the WDNR and EPA believe that the remedy will have substantial positive economic impacts on local communities and will facilitate enhanced recreational activities in and along the River. To the extent that any adverse local impacts do occur, the WDNR and EPA expect that they will be short term and manageable. Moreover, the Agencies believe that any such impacts will be outweighed by the long-term benefits of the remediation on human health and the environment. Alternatives A and B involve sampling of OU 4, which would also have minimal to no impact.

Worker Protection: For Alternatives A and B, occupational risks to persons performing the sampling activities (for the 5-year reviews) will be unchanged from current levels. There is some minimal increase in occupational risk associated with Alternative B because of the greater degree of sampling involved in the River.

For Alternatives C1, C2A, C2B, C3, D, E, and F, potential occupational risks to Site workers from direct contact, ingestion, and inhalation of PCBs from the surface water and sediments, as well as routine physical hazards associated with construction work and working on water, are higher than for Alternatives A and B. For all alternatives, personnel will follow a Site-specific health and safety plan and OSHA health and safety procedures and wear the necessary personal protective equipment; therefore, no unacceptable risks would be posed to workers during the implementation of the remedies.

In summary, Alternatives C1, C2A, C2B, C3, D, E, and F would not pose significant risk to the nearby communities or Site workers. A short-term risk to the community and Site workers may be possible as a result of potential air emissions and noise from construction equipment, dewatering operations, and hauling activities. However, as successfully shown during the River demonstration dredging projects, these risks can be effectively managed or minimized by: (1) coordinating with and involving the community; (2) limiting work hours; (3) establishing buffer zones around the work areas; (4) using experienced contractors who would assist project design; and (5) giving careful consideration to the experience gained on other sediment remediation projects and applying that knowledge to this Site's specific circumstances. Alternatives A and B will also have minimal to no risk to workers or nearby communities.

<u>Environmental Impacts of Remedy and Controls</u>

Environmental impacts consist of PCB releases from removed sediment into the air and water. As successfully shown during the River demonstration dredging projects, environmental releases will be minimized during remediation by: (1) treating water prior to discharge; (2) controlling stormwater runon and runoff from staging and work areas; (3) utilizing removal techniques that minimize losses; and through (4) the possible use of silt curtains where necessary to reduce the potential downstream transport of PCBs.

Habitat impacts from Alternatives C1, C2A, C2B, C3, D, E, and F are expected to be minimal, as the benthic community should recover relatively quickly from dredging activities (see *White Paper No. 8 – Habitat and Ecological Considerations as a Remedy Component for the Lower Fox River* attached to the OU 1 and OU 2 ROD). Additionally, dredging remediation can result in collateral benefits in the course of mitigation, including removal of other chemical contaminants (e.g., mercury and ammonia) and nuisance species, reintroduction of native species, aeration of compacted and anaerobic soils, and other enhancements to submerged habitats. For the capping portion of Alternative F, there could be similar effects on aquatic vegetation and benthic invertebrate and fish communities, but recovery of benthic invertebrate communities would likely be slower (relative to recovery from dredging) because of changes in the subaqueous habitat to sand and rock as well as decreases in organic content of the sediment.

Potential Adverse Environmental Impacts During Construction

Alternatives A and B do not involve construction activities associated with the River sediments. Continuing the existing limited sampling activities (under the No Action alternative) or increasing the monitoring program (under the MNR alternative) is not anticipated to have any adverse effect on the environment beyond that already caused by the PCB contamination of the sediments and the ongoing releases of PCBs from the sediments in OU 4. For Alternatives C1, C2A, C2B, C3, D, E, and F, the release of PCBs from the contaminated sediments into the surface water during construction (dredging and cap placement) will be controlled by operational practices (e.g., control of sediment removal rates, use of environmental dredges, and possible use of sediment barriers). Although precautions to minimize resuspension will be taken, it is likely that there could be a localized, temporary increase in suspended PCB concentrations in the water column and possibly in fish PCB body burdens.

Analysis of results from projects at Deposit N and SMU 56/57 and comparison to yearly sediment resuspension rates, as well as resuspension quantities during yearly high-flow events, show the expected resuspension resulting from dredging to be well within the variability that normally occurs on a yearly basis. Analysis of results from other dredging projects indicates that releases from environmental dredging are relatively insignificant. The performance standards and monitoring program developed during design will ensure that dredging operations are performed consistent with the environmental and public health goals of the project. This was readily achieved on the Deposit N and SMU 56/57 projects and is expected to be feasible for other River dredging activities.

Dredging activities may result in short-term, temporary impacts to aquatic and wildlife habitat of Little Lake Butte des Morts, but as discussed in *White Paper No. 8 – Habitat and Ecological Considerations as a Remedy Component for the Lower Fox River* (attached to the OU 1 and OU 2 ROD), recovery is expected to be rapid.

For Alternatives C1, C2A, C2B, C3, D, E, and F, there is the potential for transient impact from the temporary exposure of deeper, more highly contaminated sediments during excavation activities. This impact would be minimized by the quick completion of removal activities and (if needed) placement of a post-dredging sand cover as soon as practicable after the removal operations are complete.

Implementability

Implementability addresses the technical and administrative feasibility of a remedy from design through construction and operation. Factors such as the availability of services and materials, administrative feasibility, and coordination with other governmental entities are also considered.

Technical Feasibility

Both Alternatives A and B are technically feasible because no active measures other than continued sampling would be taken. Technical feasibility for Alternatives C1, C2A, C2B, C3, D, E, and F is discussed below in terms of the main components of the alternatives. Additional information is provided in the FS.

Sediment Processing/Transfer Facilities: Alternatives C1, C2A, C2B, C3, D, E, and F require sediment processing/transfer facilities. At these facilities, the transfer, dewatering, and stabilization of dredged material would be conducted. Each of these activities is considered a readily implementable, commonly engineered activity. Design of sediment processing/transfer facilities will include requirements for the control of light, noise, air emissions, and water discharges.

The WDNR and EPA have not determined the location of the sediment processing/transfer facilities. Preliminary criteria were utilized to establish a list of preliminary candidate sites to allow for the preparation of a cost estimate. In preparing the cost estimate in the FS, the WDNR and EPA assumed a number of upland staging and access areas in the cities of De Pere and Green Bay. These facilities (wherever located) would be temporary and removed after completion of the active remedial activities.

Removal: Alternatives C1, C2A, C2B, C3, D, E, and F require the dredging of contaminated sediments. Dredging of sediments is a readily implementable and environmentally effective engineering activity. Two concerns are relevant to whether sediments can be dredged effectively: (1) resuspension and releases during dredging, and (2) resulting residual contaminant concentrations that may remain in sediments after dredging is completed. Regarding resuspension, environmental dredges have been shown to generally not release significant quantities of contaminants during removal operations. The type of dredging equipment (mechanical and/or hydraulic) will be selected during the remedial design on the basis of what is the most appropriate equipment for the specific conditions in the River. Silt screens or other barriers, as appropriate, could further assist in limiting downstream migration of PCBs and may be used as well. Regarding post-dredging residual contaminant concentrations, comparable projects indicate that achieving the 1 ppm action level in remaining sediments is readily achievable. The Lower Fox River SMU 56/57 dredging project achieved a 96 percent reduction in the average concentration of contaminated sediments targeted for removal. This outcome is consistent with results for other dredging projects having similar site conditions (see Appendix B of the FS, and Hudson River White Paper ID 312663, “Post-Dredging PCB Residuals”).

Dewatering: Alternatives C1, C2A, C2B, C3, D, E, and F would require the removal of excess water from dredged sediments. Either mechanical or passive dewatering would be used for this purpose. These are conventional technologies and are readily implementable and effective.

Water Treatment: Conventional water treatment technologies for dredge water have been proven commonly reliable and are readily implementable and effective.

Capping: Alternative F includes capping in areas that are acceptable for capping. Capping is not acceptable in navigation channels, in areas where a cap may interfere with infrastructure (e.g., pipelines, utility easements, bridge piers), in areas where PCB concentrations are equal to or greater than 50 ppm, and in areas with shallower water (e.g., where a cap would result in water depths less than 3 feet). The placement of capping materials is a readily implementable engineering activity. Sand and/or fine-grained materials may be utilized for capping. Clean sand placed over contaminated deposits would result in a new sediment bed surface that is essentially without contamination initially. The type of material (e.g., texture/size and sorting), thickness of the isolation cap, and armoring requirements will need to be determined on a location-specific basis. Recent climate models indicate that Lake Michigan water levels could decrease by 3 feet by 2050 and 4.5 feet by 2090, below historical low water levels. Therefore, decisions concerning capping should consider potential future declines in Lake Michigan water levels which would in turn affect levels within the Lower Fox River and Green Bay.

Post-Dredging Sand Cover: The selected alternative envisions an option of limited backfilling (see the discussion of capping as a contingent remedy in Sections 13.4 through 13.7). The placement of a sand backfill is a readily implementable engineering activity. Sand or other materials, as appropriate, may be utilized for backfill. This "residual cap" is defined as placement of a thin cap layer over a residual sediment contamination left behind following dredging. Residual capping serves to dilute this contaminated sediment and speed up the natural recovery process. Residual caps are not designed as isolation caps. An example of a residual cap is the material placed at the SMU 56/57 demonstration project.

Transportation: Different dredging alternatives have different transportation requirements (see Table 11-13).

For Alternatives C1, C2A, C2B, C3, D, and E, dredged materials may be transported in-River to sediment processing/transfer facilities or a nearshore CDF using barges or pipelines. These are considered readily implementable engineering activities.

For Alternatives C2A and C2B, an on-land pipeline to the dewatering facilities or dewatering/disposal facilities would be required. For Alternative C2B, trucks, or possibly some other method, would serve for transferring the dewatered sediments from the dewatering location to the adjacent disposal facility.

For Alternatives C1, C3, E, and F, off-site transportation of dredged materials to disposal facilities would be by truck, rail, and/or barge. These forms of transportation are routine engineering activities that have been employed at many Superfund sites and are technically implementable. The WDNR and EPA will comply with all legal regulatory requirements for transporting both hazardous and non-hazardous wastes.

Disposal: Off-site disposal is a common activity at many Superfund sites. The number and location of off-site disposal facilities will be based on dredged material volume, transportation, and cost considerations. It is expected that appropriate disposal will be in the Fox River Valley area.

Alternatives C1, C2A, C2B, C3, and F all include upland disposal options. Alternative D uses an in-water confined disposal facility for disposal. These are conventional technologies and readily implementable. Under Alternative F, approximately 40 percent of the surface area of the 1 ppm footprint could be capped *in situ*. For the areas that will be capped, it is considered technically achievable. It should be noted that certain areas are not amenable to capping, as noted above in the Capping discussion.

Alternative E, the *ex-situ* treatment alternative of vitrification, was determined to be technically feasible. As discussed in the FS, this alternative does require reuse of residual materials after treatment. For purposes of this ROD, it is assumed that there will a beneficial reuse of the residual material and an associated value (range of $2 to $25 per ton) and, as a consequence, there is no disposal cost associated with this alternative.

Treatment: Alternative E includes thermal treatment by vitrification and is technically implementable to meet cleanup goals.

<u>Administrative Feasibility</u>

Alternatives A and B require no active measures. All alternatives include an administrative requirement for fish consumption advisories. Because fish consumption advisories are already in place, this requirement is already met and would continue even under the No Action alternative. Alternatives C1, C2A, C2B, C3, D, E, and F are somewhat more difficult to implement in terms of administrative feasibility because of the need to site a pipeline and the sediment processing/transfer facilities, to address the associated real property issues, and to make arrangements to utilize the River with minimal interruption of boat traffic.

Sediment Processing/Transfer Facilities: For Alternatives C1, C2A, C2B, C3, D, E, and F, the transfer facilities, constructed on land adjacent to or in the River, are considered "on site" for the purposes of the permit exemption under CERCLA Section 121(e), although any such facilities will comply with the substantive requirements of any otherwise necessary federal or state permits.

Removal: Operations under these alternatives will have to be performed in conformance with the substantive requirements of regulatory programs implemented by the USACE under Section 10 of the Rivers and Harbors Act and Section 404 of the Clean Water Act. In addition, discharges during remediation will conform to Wisconsin Statutes and substantive WDNR regulations related to dredging and maintaining water quality.

Disposal: Identifying a local landfill for disposal of dredged sediments from OU 4 is feasible. This would have to be coordinated with local authorities, consistent with appropriate ARARs.

Capping and CDF: For Alternatives D and F, consideration of riparian rights would require use/access agreements with property owners of land adjacent to the riverbed. These considerations would be addressed during the design phase.

Treatment: Alternative E is administratively feasible. Air emissions permits would be required if sediments are treated off site.

Availability of Services and Materials: For Alternatives A and B, all needed services and materials are available. For the Alternatives C1, C2A, C2B, C3, D, E, and F, equipment and personnel related to dredging and materials handling (e.g., sediment dewatering) are commercially available. Technology and associated goods and services for capping or a post-dredging sand cover, upland landfill, or CDF construction are locally available.

<u>Cost</u>

Cost includes estimated capital and annual O&M costs, as well as total capital cost. Present-worth cost is the total capital cost and O&M costs of an alternative over time in today's dollar value. Cost estimates are expected to be accurate within a range of –30 to +50 percent. (This is a standard assumption in accordance with EPA CERCLA guidance.)

The estimated costs range from $4.5 million for Alternative A to $656 million for Alternative C1. For Alternatives C1, C2A, C2B, C3, D, E, and F, the estimated cost of the capital and O&M

costs range from approximately $170 million for Alternative C2A to $656 million for Alternative C1. Capital costs, present worth of O&M costs, and the total costs are listed in Table 11-16.

Table 11-16 Comparison of Present Worth Costs for OU 4 Alternatives at the 1 ppm RAL

	Estimated Volume Removed or Treated (cubic yards)	Estimated PCB Mass Remediated (pounds)	Capital Cost ($ millions)	O&M Cost ($ millions)	Present Worth Total Cost ($ millions)
A – No Action	0	0	0	4.5	4.5
B – Monitored Natural Recovery	0	0	0	9.9	9.9
C1 – Dredging/Passive Dewatering/Off-Site Disposal	5,879,529	58,150	651.9	4.5	656.4
C2A – Dredging/Combined Passive Dewatering/ Disposal Facility	5,879,529	58,150	164.8	4.5	169.3
C2B – Dredging/Passive Dewatering/Monofill	5,879,529	58,150	253.0	4.5	257.5
C3 – Dredging/Mechanical Dewatering/Off-Site Disposal	5,879,529	58,150	504.8	4.5	509.3
D – Dredge to a Confined Disposal Facility	5,879,529	58,150	496.4	4.5	500.9
E – Dredge and Vitrification	5,879,529	58,150	346.4	4.5	350.9
F – Dredging and Capping to Maximum Extent Practicable	4,046,276	58,150	348.4	4.5	352.9

Note:
Data are from Table 7-8 of the FS and *White Paper No. 23 – Evaluation of Cost and Implementability of Alternative C2B for Operable Unit 3 and Operable Unit 4.* The white paper impacts only Alternative C2B and these costs were developed assuming total costs were prorated based on the volume of sediment in OU 4 compared to the total for OU 3 and OU 4 combined (~91 percent) and that 50 percent of the O&M costs are applicable to OU 4. Costs listed here exclude costs associated with Bayport closure.

11.2.3 Agency and Community Criteria for Operable Unit 4

Agency Acceptance

The State of Wisconsin has been actively involved in managing the resources of the River since before there was a federal Superfund law. These efforts have led to significant state knowledge and understanding of the River and Bay and of the contamination problems within those areas. As a result of this expertise, the WDNR has served as the lead agency responsible for assessing risks and conducting the RI/FS, which formed the basis for the Proposed Plan; the ROD for OU 1 and OU 2; and this ROD addressing OU 3, OU 4, and OU 5. As the lead agency, the WDNR has worked closely with the EPA to cooperatively develop this ROD. Both the WDNR and EPA support the selection of this remedy, as is evidenced by their joint issuance of this ROD.

Community Acceptance

Community acceptance considers whether the local community agrees with the EPA's analyses and preferred alternative. Comments received on the Proposed Plan are an important indicator of community acceptance. Community acceptance of the Proposed Plan was evaluated based on comments received at the public meetings and during the public comment period. More than 4,800 comments were received concerning the Proposed Plan. This ROD includes a Responsiveness Summary (see Appendix A). Comments that address issues common to OU 1 and OU 2, as well as to OU 3, OU 4, and OU 5, are discussed in the Responsiveness Summary attached to the OU 1 and OU 2 ROD.

11.3 Operable Unit 5 (Green Bay)

Table 11-17 summarizes the comparative analysis for OU 5 alternatives and how each alternative meets, or does not meet, requirements for each of the nine criteria described above. Although seven alternatives (A through G) were initially considered for the Bay, Alternatives E and F were not carried forward for detailed evaluation because of issues associated with the technology or implementation. Therefore, the alternatives considered for the Bay are A, B, C, D, and G.

Table 11-17 OU 5 – Green Bay Alternatives

		Selected Alternative			
Yes = Fully meets criterion Partial = Partially meets criterion No = Does not meet criterion	**Alternative A No Action**	**Alternative B Monitored Natural Recovery**	**Alternative C Dredge with Off-Site Disposal**	**Alternative D Dredge to a Confined Disposal Facility**	**Alternative G Dredge to a Confined Aquatic Disposal Facility**
1. Overall Protection of Human Health and the Environment	No	No	No	No	No
2. Compliance with Applicable or Relevant and Appropriate Requirements	No	Yes	No	No	No
3. Long-Term Effectiveness and Permanence	No	Partial	Yes	Yes	Yes
4. Reduction of Toxicity, Mobility, or Volume Through Treatment	No	No	Yes	Partial	Partial
5. Short-Term Effectiveness	No	Partial	Partial	Partial	Partial
6. Implementability	Yes	Yes	No	No	No
7. Cost (millions of $)	18	39.6	11–507.2	166.5–2,454.1	124–2,107.4
8. Agency Acceptance	The WDNR has been the lead agency in developing the RI/FS and Proposed Plan. Both the WDNR and EPA support the selected alternative of MNR for this OU.				
9. Community Acceptance	The level of community acceptance of the selected alternative is outlined in the Responsiveness Summary.				

11.3.1 Threshold Criteria for Operable Unit 5

Protection of Human Health and the Environment

The primary risk to human health associated with the contaminated sediment is consumption of fish. The primary risk to the environment is the bioaccumulation of PCBs from the consumption of fish or, for invertebrates, the direct ingestion/consumption of sediment. Protection of human health and the environment were evaluated by residual risk in surface sediment using three lines of evidence:

- Residual PCB concentrations in surficial sediment using surface-weighted averaging after completion of a remedy
- The projected number of years required to reach safe consumption of fish
- The projected number of years required to reach a surface sediment concentration protective of fish or other biota

Each of these is discussed below.

Residual PCB Concentrations in Surficial Sediment

The estimated SWACs for different Green Bay zones (2, 3A, 3B, and 4; see Figure 1-2) in combination with a 1 ppm PCB action level for the River are summarized in Table 11-18.

Table 11-18 Estimated PCB Surface-Weighted Average Concentrations (SWACs) for OU 5 by Zone

SWAC Based on Action Levels (ppm)			
Zone	**No Action/MNR**	**5 ppm**	**1 ppm**
2	1.159	1.025	0.476
3A	0.320	0.274	0.274
3B	0.561	0.551	0.551
4	0.073	0.063	0.063

Note:
Data are from FS Table 5-5.

Using the approach outlined in Technical Memorandum 2f, the average surface concentration in the 0- to 2-cm range in all of Green Bay is 0.351 ppm. Based on the alternative method identified in *White Paper No. 18 – Evaluation of an Alternative Approach of Calculating Mass, Sediment Volume, and Surface Concentrations in Operable Unit 5, Green Bay* (attached to this ROD), the overall average concentration in the 0- to 2-cm range for the Bay is 0.353 ppm. While remediating Zone 2 to a 1 ppm remedial action level has the effect of reducing the SWAC in Zone 2 by 60 percent, there appears to be little risk reduction associated with this effort. Remediating zones 3A, 3B, and 4 to a 1 ppm remedial action level has no apparent impact on the average concentrations for those zones.

Time Required to Achieve Acceptable Fish Tissue Concentrations

For both cancer and noncancer risk for recreational anglers and high-intake fish consumers, it would take more than 100 years to reach acceptable human health thresholds for walleye for representative human receptors (see Table 11-19). This is true for all action levels evaluated for Green Bay zones in combination with the River action level of 1 ppm.

Table 11-19 Time to Achieve Acceptable Fish Tissue Concentrations for Walleye in OU 5 at a 1 ppm River RAL

Fish	Receptor	Risk Level Goal	Estimated Years to Achieve Based on Bay Action Levels	
			1 ppm	No Action/ MNR
Walleye	Recreational Angler	RME Hazard Index of 1.0	>100	>100
Walleye	High-intake Fish Consumer	RME Hazard Index of 1.0	>100	>100
Walleye	Recreational Angler	RME 10^{-5} cancer risk level	>100	>100
Walleye	High-intake Fish Consumer	RME 10^{-5} cancer risk level	>100	>100

Notes:
RME – reasonable maximum exposure
Data are from FS Table 8-15.

Time Required to Achieve Surface Sediment Concentration Protective of Fish or Other Biota

As shown in Table 11-20, the estimated time to achieve protective standards for representative receptor mammals (mink) would be more than 100 years for all cleanup levels evaluated for OU 5 (No Action/MNR and 1 ppm) in combination with a River remedial action level of 1 ppm. The estimated time to achieve protective standards for representative receptor bird species (Forster's tern and bald eagle) varies by Bay zone and receptor for cleanup levels evaluated for OU 5 (No Action/MNR and 1 ppm) in combination with a River remedial action level of 1 ppm. These estimated time frames range from less than a year for Forster's tern deformities (LOAEC) in all zones to more 100 years for bald eagle deformities (NOAEC) in all zones.

Table 11-20 Time Required to Achieve Protective Levels in Sediment for Representative Ecological Receptors in OU 5 at a 1 ppm River RAL

Fish	Receptor	Risk Level Goal	Estimated Years to Achieve Based on Bay Action Levels	
			1 ppm	No Action/ MNR
Zone 2				
Alewife	Forster's Tern deformity	LOAEC	< 1	< 1
Alewife	Forster's Tern hatch success	LOAEC	< 1	< 1
Alewife	Forster's Tern hatch success	NOAEC	3	23
Alewife	Forster's Tern deformity	NOAEC	30	> 100
Walleye	Bald Eagle deformity	NOAEC	> 100	> 100
Walleye	Mink	NOAEC	> 100	> 100
Alewife	Mink	NOAEC	> 100	> 100
Zone 3A				
Alewife	Forster's Tern deformity	LOAEC	< 1	< 1
Alewife	Forster's Tern hatch success	LOAEC	< 1	< 1
Alewife	Forster's Tern hatch success	NOAEC	< 1	< 1
Alewife	Forster's Tern deformity	NOAEC	11	43
Walleye	Bald Eagle deformity	NOAEC	> 100	> 100
Walleye	Mink	NOAEC	> 100	> 100
Alewife	Mink	NOAEC	> 100	> 100
Zone 3B				
Alewife	Forster's Tern deformity	LOAEC	NC	< 1
Alewife	Forster's Tern hatch success	LOAEC	NC	< 1
Alewife	Forster's Tern hatch success	NOAEC	NC	< 1
Alewife	Forster's Tern deformity	NOAEC	NC	32
Walleye	Bald Eagle deformity	NOAEC	NC	> 100
Walleye	Mink	NOAEC	NC	> 100
Alewife	Mink	NOAEC	NC	> 100
Zone 4				
Alewife	Forster's Tern deformity	LOAEC	NC	< 1
Alewife	Forster's Tern hatch success	LOAEC	NC	< 1
Alewife	Forster's Tern hatch success	NOAEC	NC	< 1
Alewife	Forster's Tern deformity	NOAEC	NC	5
Walleye	Bald Eagle deformity	NOAEC	NC	> 100
Walleye	Mink	NOAEC	NC	> 100
Alewife	Mink	NOAEC	NC	> 100

Notes:
LOAEC – Lowest Observed Adverse Effects Concentration
NOAEC – No Observed Adverse Effects Concentration
NC – not considered
Data are from FS Table 8-17.

<u>Summary</u>

There is no reduction in time to reach human health representative thresholds for OU 5 for the selected RAL of 1 ppm for the River combined with action levels evaluated for OU 5 (1 ppm and No Action/MNR). There would also be no reduction in time to reach ecological thresholds, except for certain piscivorous birds.

Compliance with Applicable or Relevant and Appropriate Requirements

Section 121(d) of CERCLA and NCP § 300.430(f)(1)(ii)(B) require that remedial actions at CERCLA sites attain legally applicable or relevant and appropriate federal and state requirements, standards, criteria, and limitations, collectively referred to as ARARs, unless such ARARs are waived under CERCLA Section 121(d)(4). Compliance with ARARs addresses whether a remedy will meet all of the applicable or relevant and appropriate requirements of other federal and state environmental statutes or provide a basis for invoking a waiver.

The ARAR discussion below is organized by the different operational components of the alternatives (Table 11-21), because various components are utilized in essentially the same manner for some alternatives and apply equally to those alternatives with a common component. There is additional discussion of compliance with ARARs in Section 14.2.

Table 11-21 Operational Components for OU 5, Alternatives for Zones 2, 3A, and 3B[1]

		Alternatives				
		A	B	C*	D	G
Removal (mechanical or hydraulic dredging)				X	X	X
Passive Dewatering				X	X	X
Water Treatment				X	X	X
Transportation (trucking)				X		X
Disposal	Upland**			X**		
	In-water CDF				X	
	CAD					X

Notes:
X: Required activity for alternative.
* Alternative C was evaluated only for zones 2 and 3A of OU 5.
** Upland disposal was considered only for a 5 ppm action level for Zone 2 because volumes for lower action levels would be too large for off-site disposal (i.e., 29 million cy, which would be 28 percent of the capacity of all existing Wisconsin landfills).
[1] Only Alternatives A and B were evaluated for Zone 4.

A description of the components listed in Table 11-21 follows.

- **Removal:** The removal technology evaluated for Green Bay zones 2, 3A, and 3B is mechanical dredging. The ARARs that directly relate to the removal of sediment from the River and Bay concern the protection of surface water (NR 322, 200, and 220 through 297). The surface water ARARs limit the discharge of PCBs into the receiving water bodies so that water quality is not adversely affected. These ARARs will be achieved by Alternatives C, D, and G.

- **Transportation:** The likely method for transporting PCB-containing sediment to upland disposal locations under Alternative C (evaluated for zones 2 and 3A) is by trucking it to the disposal facility, although other transportation methods could be used if it is determined during design that there are better methods. ARARs and TBCs important to this process option include the requirements to prevent spills and releases of PCB materials (NR 140 and 157, WAC). Two ARARs applicable only to the trucking method include WDOT requirements for the shipping of PCB materials and NR 157 shipping requirements. ARARs and TBCs related to in-water transportation activities (i.e., piping) include the protection of surface water (NR 322, 200, and 220 through 297, WAC). Alternatives C and G will comply with these ARARs.

- **Disposal:** For Alternative C, contaminated sediment removed (i.e., dredged) from zones 2 and 3B of OU 5 would be disposed of at either an existing upland landfill or in a newly constructed or modified landfill designed to receive the dewatered sediment. ARARs specific to this process option include the siting requirements for a landfill (Chapter 289, Wisconsin Statutes) and the technical requirements for construction, operation, and closure of a landfill in the NR 500 rule series as well as NR 157, WAC requirements. For Alternatives D and G, Wisconsin Statutes Chapter 289 on obtaining lakebed and riverbed grants from the Legislature and riparian landowners would be met. Sediment in any of the Green Bay zones is not expected to have PCB concentrations equal to or greater than 50 ppm. Therefore, although TSCA, 40 CFR Part 761 is an ARAR for the River portion of the Site, it is not an ARAR for the Bay.

11.3.2 Primary Balancing Criteria for Operable Unit 5

Long-Term Effectiveness and Permanence

Reduction of Residual Risk

Alternatives A, B, C, D, and G for OU 5 result in a continuation of the existing condition of the sediment and surface water quality for more than 100 years (the limit of modeling estimates).

It is possible that there is upwards of approximately 89,600,000 cy of sediment containing an estimated mass of 36,870 kg (81,100 pounds) of PCBs above the 0.5 ppm Bay RAL in the Bay. It is possible that there is upwards of approximately 29,300,000 cy of sediment with an approximate PCB mass of 29,770 kg (65,500 pounds) at the 1 ppm RAL (FS Tables 7-2 and 7-3). None of the alternatives appears to significantly reduce residual risk through removal or containment. Based on modeling estimates, there is no reduction in time required to reach acceptable fish tissue concentration ranges for any of the alternatives.

Adequacy of Controls

None of the alternatives indicates recovery of OU 5. Alternatives C, D, and G provide for the removal or containment of PCB-contaminated sediments in OU 5.

All alternatives would require institutional controls, such as fish consumption advisories and fishing restrictions, until remedial action objectives were met at a future date, but they are unlikely to require additional Site use restrictions after removal activities are completed; however, Alternative G also requires institutional controls such as Site use restrictions in disposal areas.

All alternatives will require some degree of monitoring. Monitoring programs will be developed, as appropriate, for all phases of the project.

Alternatives C, D, and G rely on engineering controls at the disposal facility. Properly designed and managed landfills provide proven, reliable controls for long-term disposal for Alternative C (which has off-site landfill disposal). Alternative G would also require a long-term operation and maintenance plan to ensure containment of PCBs in perpetuity. Alternative D would require on-site engineering controls at an in-water disposal facility. Long-term monitoring and maintenance are included in operation of the landfill, confined disposal facility, or confined aquatic disposal facility.

Reliability of Controls

For all alternatives, fish consumption advisories and fishing restrictions will continue to provide some protection of human health until PCB concentrations in fish are reduced to the point where the fish consumption advisories and fishing restrictions can be relaxed or lifted. However, in the interim, these controls will provide only an uncertain measure of protection.

Summary

Based on the above analysis of reduction in residual risk and adequacy and reliability of controls, and given the limited ability of modeling to estimate recovery times, the alternatives provide effectively the same level of long-term effectiveness and permanence.

Reduction of Toxicity, Mobility, and Volume Through Treatment

Reduction in toxicity, mobility, or volume of contaminants through treatment evaluates an alternative's use of treatment to reduce the harmful effects of principal contaminants, their ability to move in the environment, and the amount of contamination present.

Alternatives A and B do not involve any containment or removal of contaminants from OU 5 sediment. Alternatives A and B rely exclusively on natural attenuation processes such as burial by cleaner sediments, biodegradation, bioturbation, and dilution to reduce concentrations of PCBs in sediment and surface water.

Natural degradation processes were not found to be effective in reducing PCB concentrations or toxicity in River sediments (FS Appendix F, "Dechlorination Memorandum"). Nevertheless, concentrations of PCBs in fish populations will respond slowly over time to slow natural decreases in concentrations in sediments and surface water due primarily to dilution and, to a lesser degree, the burial of contaminated sediments by cleaner sediments.

For Alternatives C, D, and G, the mass of PCBs and volume of contaminated sediment in OU 5 are permanently reduced in mobility because for action levels of 5 and 0.5 ppm, volumes ranging from 4 million to 90 million cy of contaminated sediment containing a total PCB mass of approximately 6,360 to 36,775 kg (14,000 to 81,000 pounds) would be removed from the ecosystem and contained.

Although Alternatives C, D, and G would permanently remove large volumes of PCBs from the Bay (thereby reducing their mobility), they do not satisfy the statutory preference for treatment as a principal element of the remedy. Given the volume of material that would be removed, treatment of the dredged material prior to off-site disposal would likely not be cost-effective.

Short-Term Effectiveness

Short-term effectiveness relates to the length of time needed to implement an alternative and the risks the alternative poses to workers, residents, and the environment during implementation up until the time that remediation levels are achieved.

Length of Time Needed to Implement the Remedy

Table 11-22 summarizes estimated implementation times for Alternatives C, D, and G at zones 2, 3A, and 3B in OU 5. (Alternatives C, D, and G were not evaluated for Zone 4.) These estimates represent the estimated time required for mobilization, operation, and demobilization of the remedial work, but do not include the time required for long-term monitoring or operations and maintenance. Alternatives A and B do not involve any active remediation and therefore require no time to implement.

Table 11-22 Time to Implement Alternatives (for 0.5 to 5 ppm Action Levels) for OU 5 Zones 2, 3A, and 3B

Alternative	Years – Zone 2 Action Levels, ppm			Years – Zone 3A Action Levels, ppm			Years – Zone 3B Action Levels, ppm		
	0.5	1	5	0.5	1.0	5.0	0.5	1.0	5.0
A/B	0			0			0		
C	NE	NE	1.1	NE	<1	NE	NE	NE	NE
D	8.2	8.1	1.1	4.5	NE	NE	12	NE	NE
G	10.2	10.1	2.1	6.5	NE	NE	16	NE	NE

Note:
NE – not evaluated

<u>Protection of the Community and Workers During Remedial Action</u>

No construction activities are associated with the remediation of sediments for Alternatives A and B, so those alternatives neither increase nor decrease the short-term potential for direct contact with or ingestion and inhalation of PCBs from the surface water and sediments.

Community Protection: Access to sediment processing/transfer facilities and process and treatment areas for Alternatives C, D, and G will be restricted to authorized personnel. Controlling access to the dredging locations and sediment processing/transfer and on-site disposal facilities, along with monitoring and engineering controls developed during the design phase, will minimize potential short-term risks to the community. The design will also provide for appropriate control of air emissions, noise, and light through the use of appropriate equipment that meets all applicable standards. Compliance with these design provisions will be monitored during construction, operation, and demobilization. Vehicular traffic associated with workers and the delivery of supplies will increase at the sediment processing and transfer facilities. These effects are likely to be minimal, in part because the transportation of sediments for disposal (Alternative C only) will take place within the River area.

For Alternatives C, D, and G, work in the Bay will also be designed with provisions for control of air emissions, noise, and light. Work areas will be isolated (access-restricted), with an adequate buffer zone so that pleasure craft can safely avoid these areas. Environmental dredging in OU 5 would be conducted at times and in ways to minimize disruption to Bay activities or navigation traffic. The WDNR and EPA would consult with local authorities during remedial design and construction phases on issues related to Bay uses and other remedy-related activities within OU 5.

Based on air monitoring for the SMU 56/57 demonstration project, air emissions at dredging sites and at land-based facilities are expected to be minimal. Action levels will be established, monitoring conducted as required, and appropriate engineering control measures employed to ensure that any air releases do not exceed acceptable levels.

Vehicles used for the transportation of hazardous waste will be designed and operated in conformance with state and local regulations. The WDNR and EPA will provide the community and local government with the opportunity to provide input on plans related to the off-site transportation of hazardous wastes. This approach is consistent with the NRC recommendation to involve the local communities in risk management decisions (*A Risk Management Strategy for PCB-Contaminated Sediment*, NRC, 2001).

The WDNR and EPA believe that implementation of Alternatives C, D, and G would have little, if any, adverse impact on local businesses or recreational activities. To the extent that any adverse local impacts do occur, the WDNR and EPA expect they will be short term and manageable. Moreover, the Agencies believe that any such impacts will be outweighed by the long-term benefits of the remediation on human health and the environment.

Worker Protection: For Alternatives A and B, occupational risks to persons performing the sampling activities (for the 5-year reviews) will be unchanged from current levels. There is some minimal increase in occupational risk associated with Alternative B because of the greater degree of sampling involved in the Bay.

For Alternatives C, D, and G, potential occupational risks to Site workers from direct contact, ingestion, and inhalation of PCBs from the surface water and sediments, as well as routine physical hazards associated with construction work and working on water, are higher than for Alternatives A and B. Personnel will follow a Site-specific health and safety plan and OSHA health and safety procedures and wear the necessary personal protective equipment; therefore, no unacceptable risks would be posed to workers during implementation of the remedy. Worker protection for Alternatives A and B would be relatively less than for Alternatives C, D, and G, which involve more construction activities.

In summary, the Alternatives C, D, and G would not pose significant risk to the nearby communities. A short-term risk to the community and Site workers may be possible as a result of potential air emissions and noise from construction equipment, dewatering operations, and hauling activities. However, as successfully shown during the River demonstration dredging projects, these risks can be effectively managed or minimized by: (1) coordinating with and involving the community; (2) limiting work hours; (3) establishing buffer zones around the work areas; (4) using experienced contractors who would assist project design; and (5) giving consideration to experience gained on other sediment remediation projects and applying that knowledge to this Site's specific circumstances.

Environmental Impacts of Remedy and Controls

Environmental impacts consist of PCB releases from removed sediment into the air and water. As successfully shown during the River demonstration dredging projects, environmental releases will be minimized during remediation by: (1) treating water prior to discharge; (2) controlling stormwater runon and runoff from staging and work areas; (3) utilizing removal techniques that minimize losses; and through (4) the possible use of silt curtains where necessary to reduce the potential downstream transport of PCBs.

Habitat impacts from Alternatives C, D, and G are expected to be minimal, as the benthic community should recover relatively quickly from dredging activities. Additionally, dredging remediation can result in collateral benefits in the course of mitigation, including removal of nuisance species, reintroduction of native species, aeration of compacted and anaerobic soils, and other enhancements to submerged habitats. For the in-water disposal portion of Alternatives D and G, habitat would be impacted.

Potential Adverse Environmental Impacts During Construction

Alternatives A and B do not involve construction activities associated with the Bay sediments. Continuing the existing limited sampling activities (under the No Action alternative) or increasing the monitoring program (under the MNR alternative) is not anticipated to have any adverse effect on the environment beyond that already caused by the PCB contamination of the sediments and the ongoing releases of PCBs from the sediments in OU 5. For Alternatives C, D, and G, the release of PCBs from the contaminated sediments into the surface water during construction (dredging and cap placement) will be controlled by operational practices (e.g., control of sediment removal rates, use of environmental dredges, and possible use of sediment barriers). Although precautions to minimize resuspension will be taken, it is likely that there could be a localized, temporary increase in suspended PCB concentrations in the water column and possibly in fish PCB body burdens. Analysis of results from projects at Deposit N and SMU 56/57 and comparison to yearly sediment resuspension rates, as well as resuspension quantities during yearly high-flow events, show the expected resuspension resulting from dredging to be well within the variability that normally occurs on a yearly basis. Analysis of results from other dredging projects indicates that releases from environmental dredging are relatively insignificant (substantially less than 1 percent of the mass of contaminants). The performance standards and monitoring program developed during design will ensure that dredging operations are performed consistent with the environmental and public health goals of the project. This was readily achieved on the Deposit N and SMU 56/57 projects and is expected to be feasible for Bay dredging activities.

Dredging activities could result in short-term temporary impacts to aquatic and wildlife habitat of OU 5 but, as discussed below and in *White Paper No. 8 – Habitat and Ecological Considerations as a Remedy Component for the Lower Fox River* (attached to the OU 1 and OU 2 ROD), recovery is expected to be rapid.

For Alternatives C, D, and G, there is the potential for transient impact from the temporary exposure of deeper, more highly contaminated sediments during excavation activities. This impact would be minimized by the quick completion of removal activities and (if needed) placement of a post-dredging sand cover as soon as practicable after the removal operations are complete.

Implementability

Implementability addresses the technical and administrative feasibility of a remedy from design through construction and operation. Factors such as availability of services and materials, administrative feasibility, and coordination with other governmental entities are also considered.

Technical Feasibility

Both Alternatives A and B are technically feasible because no active measures other than continued sampling would be taken. Technical feasibility for Alternatives C, D, and G is discussed below in terms of the main components of the alternatives. Additional information is provided in the FS.

Sediment Processing/Transfer Facilities: Alternative C would require sediment processing/transfer facilities. At these facilities, the transfer, dewatering, and stabilization of dredged material would be conducted. Each of these activities is considered a readily implementable, commonly engineered activity. Design of sediment processing/transfer facilities will include requirements for the control of light, noise, air emissions, and water discharges.

The WDNR and EPA have not determined the location of the sediment processing/transfer facilities. Preliminary criteria were utilized to establish a list of preliminary candidate sites to allow for the preparation of a cost estimate. In preparing the cost estimate in the FS, the WDNR and EPA assumed a number of upland staging and access areas adjacent to or near Green Bay. These facilities (wherever located) would be temporary and removed after completion of the active remedial activities.

Removal: Alternatives C, D, and G require the dredging of contaminated sediment. Dredging of sediment is a readily implementable and environmentally effective engineering activity. Two concerns are relevant to whether sediment can be dredged effectively: (1) resuspension and releases during dredging and, (2) resulting residual contaminant concentrations that may remain in sediment after dredging is completed. Regarding resuspension, environmental dredges have been shown to generally not release significant quantities of contaminants during removal operations. The use of silt screens or other barriers, as appropriate, could further assist in limiting downstream migration of PCBs and may be used as well.

It should be noted, however, that while removal of contaminated sediment might be theoretically feasible, the volumes removed would be large (see Table 11-23). If removal were performed for all of Green Bay, the volumes would be orders of magnitude greater than has been previously implemented for environmental dredging projects. The exception to these unprecedented volumes would be at a PCB action level of 5 ppm.

Table 11-23 Removal Volumes for Different Action Levels for Green Bay by Zone

Bay Zone	Volume (cy) Based on Action Level		
	0.5 ppm	**1 ppm**	**5 ppm**
Zone 2	29,700,000	29,300,000	4,060,000
Zone 3A	16,300,000	14,400	0
Zone 3B	43,600,000	0	0
Zone 4	0	0	0
TOTAL	89,600,000	29,314,400	4,060,000

Note:
Data are adapted from FS Table 5-5.

Dewatering: Alternative C would require removal of excess water from dredged sediment. Dewatering would be conducted primarily on-barge and in upland staging areas. This is a conventional, commonly utilized, proven technology and is readily implementable and effective.

Water Treatment: Conventional water treatment technologies for dredge water have been proven commonly reliable and are readily implementable and effective.

Transportation: For Alternatives C, D, and G, dredged materials would be transported in-river to sediment processing/transfer facilities or a nearshore CDF or CAD using barges. These are considered implementable engineering activities.

For Alternative C, off-site transportation of dredged materials to disposal facilities will be by truck, rail, and/or barge. These forms of transportation are routine engineering activities that have been employed at many Superfund sites and are technically implementable. The WDNR and EPA would comply with all legal regulatory requirements for transporting both hazardous and non-hazardous wastes.

Disposal: Off-site disposal is a common activity at many Superfund sites and would be hypothetically implementable for Alternative C. However, to achieve even relatively minimal risk reduction under Alternative C would require disposal of a volume impracticable to dispose of or treat. For example, a PCB action level of 0.5 ppm would require disposal of about 90 million cy (see Table 11-24), more than double the total existing landfill capacity of 44 million cy estimated for landfills within 40 miles of the River (FS Table 6-10). The next higher PCB action level, 1 ppm, would utilize about 66 percent of the capacity for landfills located in the Fox River Valley and Green Bay area.

Table 11-24 Disposal Volume by Action Level for OU 5 Compared to Landfill Capacity in the Fox River Area

Action Level (ppm)	Total Volume (cy)	Capacity of Existing Landfills* Required for Disposal of Total Volume (%)
0.5	89,560,898	203
1	29,290,778	66
5	4,063,804	9

Notes:
* Total capacity of major landfills within approximately 40 miles of the Lower Fox River is 44,158,706 cy.
Data are from FS Tables 5-5 and 6-10.

Treatment: The large volumes of material that would be dredged and the low concentrations of PCBs make it impracticable to treat sediment dredged from OU 5.

<u>Administrative Feasibility</u>

Alternatives A and B require no active measures. All alternatives except Alternative A include an administrative requirement for fish consumption advisories. Because fish consumption advisories are already in place, this requirement is already met and would continue even under the No Action alternative. Alternatives C, D, and G are somewhat more difficult to implement in terms of administrative feasibility because of the need to site the sediment processing/transfer and disposal facilities and to address the associated real property issues.

Sediment Processing/Transfer Facilities: For Alternatives C, D, and G, the transfer facilities, which would be constructed on land adjacent to or in the general vicinity of Green Bay, are considered on site for the purposes of the permit exemption under CERCLA Section 121(e), although any such facilities will comply with the substantive requirements of any otherwise necessary federal or state permits.

Removal: Operations under Alternatives C, D, and G will have to be performed in conformance with the substantive requirements of regulatory programs implemented by the USACE under Section 10 of the Rivers and Harbors Act and Section 404 of the Clean Water Act. In addition, discharges during remediation will conform to Wisconsin Statutes and substantive WDNR regulations related to dredging and maintaining water quality.

Disposal: Identifying a local landfill for disposal of sediments dredged from OU 5 is likely not feasible because of the large volumes that would be removed.

Capping and CDF: For Alternatives D and G, a lakebed grant may have to be approved by the state. This would be addressed during the design phase.

Treatment: Treatment would be administratively feasible. Air emissions permits would be required if sediments are treated off site.

Availability of Services and Materials: For Alternatives A and B, all needed services and materials are available. For Alternatives C, D, and G, equipment and personnel related to dredging and materials handling (e.g., sediment dewatering) are commercially available. Technology and associated goods and services for an upland landfill or CDF or CAD construction are locally available.

Cost

Cost includes estimated capital and annual O&M costs, as well as total capital cost. Present worth cost is the total capital cost and O&M costs of an alternative over time in today's dollar value. Cost estimates are expected to be accurate within a range of –30 to +50 percent. (This is a standard assumption in accordance with EPA CERCLA guidance.)

The net present worth of remedial alternatives for OU 5 (Table 11-25) range from $18 million for Alternative A (No Action) to $2.454 billion for Alternative D (Dredge to a Confined Disposal Facility). For Alternatives C, D, and G, which all involve active remediation, the estimated costs range from approximately $124 million to $2.454 billion.

Table 11-25 Cost Comparison of Active Remediation of OU 5 at the 0.5, 1, and 5 ppm Action Levels and MNR, by Zone

Action Level							
	0.5 ppm		1 ppm		5 ppm		MNR
Zone	Sediment Volume (cy)	Cost (million $)	Sediment Volume (cy)	Cost (million $)	Sediment Volume (cy)	Cost (million $)	Cost (million $)
2	29,700,000	707–825	29,300,000	698–814	4,060,000	124–507	9.9
3A	16,300,000	389–474	14,400	11	—	—	9.9
3B	43,600,000	1,010–1,155	—	—	—	—	9.9
4	—	—	—	—	—	—	9.9
Totals	89,600,000	2,106–2,454	29,314,400	709–825	4,060,000	124–507	39.6

Notes:
Zone 3 is subdivided into zones 3A and 3B on the basis of sediment movement patterns.
There is insufficient volume of PCBs in zones 3A, 3B, and 4 to warrant cost estimates at the 5 ppm action level.
There is insufficient volume of PCBs in zones 3B and 4 to warrant cost estimates at the 1 ppm action level.
There is insufficient volume of PCBs in Zone 4 to warrant cost estimates at the 0.5 ppm action level.

11.3.3 Agency and Community Criteria for Operable Unit 5

Agency Acceptance

The State of Wisconsin has been actively involved in managing the resources of the River since before there was a federal Superfund law. These efforts have led to significant state knowledge and understanding of the River and Bay and of the contamination problems within those areas. As a result of this expertise, the WDNR has served as the lead agency responsible for assessing risks and conducting the RI/FS, which formed the basis for the Proposed Plan; the ROD for OU 1 and OU 2; and this ROD addressing OU 3, OU 4, and OU 5. As the lead agency, the WDNR has worked closely with the EPA to cooperatively develop this ROD. Both the WDNR and EPA support the selection of this remedy, as is evidenced by their joint issuance of this ROD.

Community Acceptance

Community acceptance considers whether the local community agrees with the EPA's analyses and preferred alternative. Comments received on the Proposed Plan are an important indicator of community acceptance. Community acceptance of the Proposed Plan was evaluated based on comments received at the public meetings and during the public comment period. More than 4,800 comments were received concerning the Proposed Plan. This ROD includes a Responsiveness Summary (see Appendix A). Comments that address issues common to OU 1 and OU 2, as well as to OU 3, OU 4, and OU 5, are discussed in the Responsiveness Summary attached to the OU 1 and OU 2 ROD. While all comments were considered in selecting the final cleanup alternatives for OU 3, OU 4, and OU 5, comments for OU 5 in particular caused the Agencies to revisit issues related to the Proposed Remedy for Green Bay. Because of this reconsideration, additional Green Bay sampling was conducted and further evaluations were completed (see *White Paper No. 18 – Evaluation of an Alternative Approach of Calculating Mass, Sediment Volume, and Surface Concentrations in Operable Unit 5, Green Bay*; *White Paper No. 19 – Estimates of PCB Mass, Sediment Volume, and Surface Sediment Concentrations in Operable Unit 5, Green Bay Using an Alternative Approach*; *White Paper No.20 – Green Bay Modeling Evaluation of the Effects of Sediment PCB Bed Map Revisions on GBTOXe Model Results*; and *White Paper No. 21 – Green Bay Modeling Evaluation of a Hypothetical Open-Water Disposal Site for Navigational Dredged Material in Southern Green Bay*, which are included with this ROD).

12 PRINCIPAL THREAT WASTES

The NCP establishes an expectation that treatment will be used to address the principal threats at a site whenever practical. Engineering controls, such as on-site or off-site containment, may be used for wastes that pose a relatively low long-term threat or where treatment is impractical (NCP Section 300.430(a)(1)(iii) and Superfund Publication 9380.3-06FS, November 1991, “A Guide to Principal Threat and Low Level Threat Wastes”).

The concept of principal threat and low-level threat wastes is applied on a site-specific basis when characterizing source material. Source material is defined as material that includes or contains hazardous substances, pollutants, or contaminants that act as a reservoir for migration of contamination to groundwater, to surface water, or to air or act as a source for direct exposure. At this Site, the contaminated sediments are source materials.

Principal threat wastes are those source materials considered to be highly toxic or highly mobile that cannot be reliably contained or that would present a significant risk to human health or the environment should exposure occur. The manner in which principal threats are addressed generally will determine whether the statutory preference for treatment as a principal element is satisfied. Although the EPA has not established a threshold level of toxicity/risk to identify a principal threat waste, generally where toxicity and mobility of source material combine to pose a potential risk of “several orders of magnitude greater” than acceptable, 10^{-3} or greater, the source material is considered principal threat waste.

With respect to the River sediments in OUs 3 and 4, some PCB concentrations create a risk sufficient to be considered a principal threat waste. The preference for treatment outlined above applies to these particular sediments. However, it would be impracticable to closely identify, isolate, and treat these principal threat wastes differently than the other PCB sediments. The dredging technology that will be employed to accomplish this remedy does not distinguish among gradations of contamination in source materials. Nevertheless, at the conclusion of the OU 3 and OU 4 remedy, the source materials (and principal threat wastes) will have been removed from the River, dewatered, and deposited in a state-licensed landfill and in accordance the WDNR’s TSCA agreement with the EPA. Dredge water will be treated prior to discharge back to the River. In so doing, the mobility of the principal threat wastes will have been greatly reduced.

13 SELECTED REMEDY

13.1 The Selected Remedy

The selected remedy for OUs 3 and 4 is Alternative C2B, which is a variation of Alternative C, Dredge and Off-Site Disposal. This remedy includes removal, dewatering, and off-site disposal of an estimated 586,800 cy of PCB-contaminated sediment from OU 3 (Little Rapids to De Pere) and removal, dewatering, and off-site disposal of an estimated 5,880,000 cy of PCB-contaminated sediment from OU 4 (De Pere to Green Bay) with PCB concentrations greater than 1 ppm. The sediments in OU 3 are estimated to contain approximately 1,111 kg (about 2,444 pounds) of PCBs, or approximately 89 percent of the total PCB mass in that OU. In addition, Deposit DD (located in OU 2) will be removed as part of the OU 3 remediation. An estimated PCB mass of 31 kg (68 pounds) and a contaminated sediment volume of 9,000 cy from Deposit DD are included in the OU 3 mass, volume, and cost estimates. Therefore, the estimated totals for OU 3 are 1,142 kg (2,512 pounds) of PCB mass and 595,800 cy of contaminated sediment.

The sediments in OU 4 are estimated to contain approximately 26,430 kg (about 58,150 pounds) of PCBs, or approximately 99 percent of the total PCB mass in that OU. As part of the remediation effort for OU 4, the Agencies will, during the design phase of this project, more clearly define the extent of contamination from the River's mouth out into Green Bay. All sediment contaminated with a PCB concentration of greater than 1 ppm extending from the River mouth will also be subject to dredging. Currently, the Agencies do not have a good estimate of the sediment volume or PCB mass in this area, although it is not expected that the volume of material will exceed a few thousand cubic yards.

The selected remedy for OU 5 is Alternative B, Monitored Natural Recovery and Institutional Controls, with limited dredging near the mouth of the River as part of the OU 4 remediation. The Agencies will also conduct additional modeling and evaluation of risks in Green Bay.

Summary and Description of the Rationale for the Selected Remedy

The following sections address the rationale for the remedy selection for OUs 3 and 4 (discussed together) and OU 5, as well as how the selected alternatives would be implemented. Five-year reviews of remedial activities at each OU will be conducted to determine remedy effectiveness.

Operable Unit 3 (Little Rapids to De Pere) and Operable Unit 4 (De Pere to Green Bay) — Alternative C2B

OUs 3 and 4 are discussed together because of the interdependency of the remedy for these two Operable Units. Alternative C2B includes the removal of sediment with PCB concentrations greater than the 1 ppm RAL using an environmental dredge, followed by dewatering and off-site disposal of the sediment. The total volume of sediment with PCB concentrations greater than 1 ppm to be dredged in this alternative is approximately 595,800 cy (including Deposit DD) from OU 3 and 5,880,000 cy from OU 4. The addition of Deposit DD to the OU 3 cleanup does not substantially alter the Comparative Analysis of Alternatives, because the additional volume and increase in cost are relatively small.

- **Site Mobilization and Preparation:** The final decision on the staging area(s) for these Operable Units will be made during the design stage. Site preparation at the staging area(s) will include collecting soil samples, securing the onshore property for equipment staging, and constructing the necessary onshore facilities for sediment management and transportation. A docking facility for dredging and ancillary equipment may need to be constructed and multiple staging areas may be necessary.

- **Sediment Removal:** Sediment removal will be conducted using a dredge (e.g., cutterhead or horizontal auger or other method). Given the volumes and operating assumptions described in the FS, completing the removal effort is estimated to take approximately 1 year for OU 3 and 7 years for OU 4. For dredging removal, in-water pipelines will carry the slurry from the dredging area to the staging area(s). For longer pipeline runs, it may be necessary to utilize in-line booster pumps to pump the slurry to the staging area. If necessary, silt curtains may be used around the dredging area to minimize sediment resuspension downstream of the dredging operation. Buoys and other waterway markers will be installed around the perimeter of the in-water work area.

  From the staging area, the sediment slurry would be pumped, via pipeline, to a passive dewatering facility. Preliminary assumptions are that the pipeline could follow the existing route of the Fox River Trail, although a final decision on the pipeline location will be made during the design phase. Estimates are that four booster pumps would be necessary for the pipeline, although the specifics will be determined during the design phase. Dewatered sediment will be disposed of in an adjacent engineered landfill facility. Other activities associated with sediment removal will be water quality monitoring and post-removal sediment surveys in the River, as well as site restoration of the staging area(s) and pipeline route. The staging area(s) and the dewatering and disposal facilities will be fenced to limit access.

- **Sediment Dewatering and Disposal:** Passive dewatering requires land acquisition and construction of the dewatering cells. At this conceptual design stage, the sediment dewatering system is envisioned to be a multi-cell passive dewatering system designed to accommodate 26 weeks of dredge production, including a maximum water surge capacity for multiple construction seasons to enhance the system's dewatering capability. However, the specifics of the dewatering system will be finalized during the design phase. Ancillary activities include water treatment and disposal of solids as well as decommissioning of the dewatering system and site restoration.

  Disposal of dewatered sediment will be at a dedicated NR 500 engineered landfill, which will be operated as a monofill accepting only Lower Fox River sediments. The landfill will be constructed and operated in accordance with the WDNR's TSCA agreement with the EPA, which is necessary if PCB concentrations in sediment are over 50 mg/kg. The disposal facility will be located adjacent to the dewatering facility.

- An ongoing evaluation by the Agencies has indicated the potential viability of vitrification as an alternative to the disposal of PCB-contaminated sediments in an engineered landfill. If this technology is determined to be an appropriate substitute for sediment disposal, the Agencies would address this modification through a ROD amendment. Criteria for the selection and use of vitrification are identified in Section 13.8 of this ROD.

- **Water Treatment:** Water treatment will require the use of equipment and materials for flocculation, clarification, and sand and carbon filtration. Water treatment will be conducted 24 hours per day, 7 days per week during the dredging season. In the FS, the discharge water for hydraulic dredging is estimated at 570,000 gallons per day for OU 3 and 5,131,000 gallons per day for OU 4 during the term of the water treatment activity. Daily discharge water quality monitoring is included in the cost estimate. Treated water will be sampled and analyzed to verify compliance with the appropriate discharge requirements.

- **Demobilization and Site Restoration:** Demobilization and site restoration will involve removing all equipment from the staging and work areas and restoring the site to, at a minimum, its original condition.

- **Institutional Controls and Monitoring:** Baseline monitoring will include pre- and post-remedial sampling of water, sediment, and tissue. Monitoring during implementation will include air and surface water sampling. Verification monitoring to confirm that PCB contamination has been removed to the RAL will include sediment sampling. Long-term monitoring will include surface water, biological tissue, and surface sediment sampling. Details concerning long-term sampling will be developed in the design of the final Long-term Monitoring Plan. Monitoring would continue until acceptable levels of PCBs are reached in sediments, surface water, and fish. The types and frequency of pre-construction monitoring will be developed during remedial design. Plans for monitoring during and after construction will be developed during the remedial design and modified during and after construction, as appropriate. Until the RAOs have been achieved, institutional controls will have to be maintained to help prevent exposure of human receptors to contaminants. Institutional controls may include access restrictions, land use or water use restrictions, possible dredging moratoriums, fish consumption advisories, and domestic water supply restrictions. Land and water use restrictions and access restrictions may require local legislative action and state administrative action to prevent inappropriate use or development of contaminated areas.

- **Achievement of Remedial Action Level (RAL) Objective:** The mass and volume to be remediated will be depend on the dredge elevation that is set to achieve an RAL of 1 ppm. The success of the selected remedy for OU 3 and OU 4 will be evaluated based on removal of all material with a PCB concentration greater than 1 ppm. In addition, a SWAC for each OU will be computed following completion of dredging with samples from 0 to 10 cm depth. If dredging is completed to the dredge elevation representing a 1 ppm removal, based on pre-design sampling data, and post-dredging sampling shows that the 1 ppm RAL has not been achieved, a determination by the Agencies regarding whether the SWAC of 0.26 ppm for OU 3 or a SWAC of 0.25 ppm for OU 4 has been achieved may be used to assess the effectiveness of PCB removal for these Operable Units. A 0.25 ppm SWAC will be deemed acceptable as a level of performance for determining completion. If the appropriate SWAC has not been achieved for either OU 3 or OU 4, then the remedy provides certain options to further reduce risk. The first option is that additional dredging may be undertaken to ensure that all sediments with PCB concentrations greater than the 1 ppm RAL are removed. A second option is to place a sand cover on dredged areas to reduce surficial concentrations such that a SWAC is achieved. This option is discussed further in Section 13.4. These options allow for achievement of the RAL under certain conditions (e.g., obstructions or debris).

Operable Unit 5 (Green Bay) — Alternative B

The selected remedy for OU 5 is Monitored Natural Recovery (MNR) with institutional controls and limited dredging. This remedy includes the following:

- Additional sampling near the mouth of the Lower Fox River to identify sediments with PCB concentrations greater than 1 ppm. Any PCB-contaminated sediments with concentrations greater than1 ppm adjacent to the River mouth will be dredged as an extension of the OU 4 removal. A preliminary (rough) estimate of the volume of material in Green Bay adjacent to the River mouth with PCB concentrations above 1 ppm may be as high as 200,000 cy. This area will be more precisely delineated in design activities.

- Additional evaluation of the contaminant distribution and associated risks in Green Bay, including fate and transport and biological modeling. Estimates regarding recovery times would be developed similar to those completed in the Alternative-Specific Risk Assessment, summarized in Section 8 in the FS.

- Monitoring to confirm long-term recovery of Green Bay, relying on natural processes, primarily dispersion. Neither biodegradation nor burial is expected to occur at a significant rate.

OU 5 is expected to recover eventually through natural processes in combination with removal of the major sources of PCBs to the Bay (i.e., the removal of PCBs from the River sediment and, in part, removal of sediments adjacent to the River mouth). A monitoring program for measuring PCB and possibly mercury levels in water, tissue (e.g., invertebrates, fish, birds), and sediment will be developed as discussed in the FS to measure progress toward and achievement of Site RAOs for the Bay. In summary, the monitoring program will include:

- Surface water quality sampling at several stations in Green Bay to determine the transport of PCB mass within Green Bay and into Lake Michigan

- Fish and possibly waterfowl tissue sampling to determine the residual risk of PCBs and possible mercury consumption to human receptors

- Fish, bird, and zebra mussel tissue sampling to determine the residual risk of PCB uptake to environmental receptors

- Possible avian population studies of bald eagles and double-crested cormorants to assess the residual effects of PCBs and mercury on reproductive viability

- Possible surface sediment sampling to assess potential recontamination from upstream sources and the status of natural recovery

Types and frequency of monitoring to occur during pre-design, construction, and post-remediation will be developed as part of a comprehensive Site monitoring program. Monitoring would continue until acceptable levels of PCBs are reached in sediments, surface water, and fish. Plans will be developed as part of the

Explanation of Remedial Action Level, Surface-Weighted Average Concentration, and Sediment Quality Threshold

The term Remedial Action Level (RAL) refers to a PCB concentration in sediment used to define an area or volume of contaminated sediment that is targeted for remediation. In other words, the RAL in this ROD calls for the removal by dredging of all sediment in OU 3 and OU 4 that has a PCB concentration of greater than 1 ppm. If all sediment with a concentration greater than the 1 ppm RAL is removed, it is expected that the residual Surface-Weighted Average Concentration (SWAC) of sediment will be approximately 0.26 ppm in OU 3 and 0.16 ppm in OU 4. The SWACs in this instance are less than the RAL because a SWAC is calculated as an average concentration over the entire Operable Unit, after the removal of sediment from discrete areas (deposits) that are above the RAL, and includes averaging over areas in which there are surface concentrations less than the RAL. SWAC calculations are discussed in Section 5 of the FS.

The term Sediment Quality Threshold (SQT) refers to the PCB concentration in the sediment that is protective of specified human and ecological receptors. SQTs vary depending on the sensitivity of the particular receptor (such as recreational anglers, high-intake fish consumers, walleye, mink, etc.). Put another way, if the remediation called for in this ROD results in a sediment concentration at or below the SQT, then the risk to specified human and ecological receptors will have been reduced to a safe level. It is important to understand that it is not expected that the SQT will be achieved immediately upon completion of the dredging; rather, the estimated SWAC will be met. For example, the estimated post-dredging SWAC for OU 3 is 0.26 ppm, whereas the SQT for unlimited walleye consumption is 0.049 ppm and would take an estimated 9 years to achieve. It is contemplated that the SQT will be met only after the River is allowed a certain amount of time to "recover" through natural processes following active dredging.

remedial design and modified during and after the upstream remedial construction in OUs 3 and 4, as appropriate.

Until the RAOs have been achieved, existing institutional controls will have to be maintained to help prevent exposure of human receptors to contaminants. Institutional controls may include access restrictions, land use or water use restrictions, dredging moratoriums, fish consumption advisories, and domestic water supply restrictions. Land and water use restrictions and access restrictions may require local legislative action and state administrative action to prevent inappropriate use or development of contaminated areas. At the current time, the only institutional control in place for Green Bay is fish consumption advisories.

13.2 Summary of the Estimated Costs of the Selected Remedy

The total estimated present-worth cost of the selected remedy is $284 million for OUs 3 and 4 and $39.6 million for OU 5 for a total of $323.6 million. The estimated increase in cost to remediate Deposit DD is approximately $0.8 million when remediated with OU 3. This is based on a unit cost developed from the total cost ($283,200,000) for remediation of the volume of contaminated sediment within OUs 3 and 4 (6,466,800 cy). This is an engineering cost estimate that is expected to be within –30 to +50 percent of the actual project cost (based on year 2001 dollars). Changes in the cost elements are likely to occur as a result of new information and data collected during the remedial design. Major changes may be documented in a memorandum in the Administrative Record, an ESD, or a ROD amendment.

13.3 Cleanup Standards and Outcomes for the Selected Remedy

The selection of a remedy was accomplished through the evaluation of the nine criteria as specified in the NCP. A remedy selected for a site must be protective of human health and the environment, comply with ARARs (or justify a waiver), and offer the best balance of tradeoffs with respect to the balancing and modifying criteria in the NCP.

Through the analyses conducted for the RI/FS, the WDNR and EPA have determined that there is an unacceptable risk to human health and the environment from the consumption of fish from the River. It has also been determined that the unacceptable risk will continue for many decades without active remediation of the PCB-contaminated sediment in OU 3 and OU 4. For OU 5, it has been determined that risks will continue for decades under all alternatives, with there being no effective difference between alternatives. Additional modeling of OU 5 will further evaluate this matter.

13.3.1 Achieving Cleanup Standards

The WDNR and EPA believe that the removal of sediment in OU 3 and OU 4 with PCB concentrations greater than the 1 ppm RAL is important to achieving the timely reduction of risks to an acceptable level (i.e., fish can be safely consumed by human or ecological receptors). The WDNR and EPA envision that all sediment in OU 3 and OU 4 contaminated at concentrations above the RAL will be removed. However, this ROD also provides that under certain circumstances a sand cover may be used to supplement the primary dredging remedy in order to reach the risk reduction targets. Pre-remediation sampling and characterization efforts will define a spatial “footprint” (both horizontally and vertically) of the sediment in both Operable Units that has a concentration of PCBs greater than 1 ppm. It is this footprint that is targeted for removal by dredging. If dredging is able to achieve this result (i.e., remove all sediments with PCB concentrations greater than 1 ppm), the active remediation portion of the OU 3 and OU 4 remedy will be complete.

However, if sampling after dredging is completed for OUs 3 and 4 shows that the 1 ppm RAL has not been achieved, a SWAC of 0.26 ppm for OU 3 and of 0.25 ppm for OU 4 may be used to assess the effectiveness of PCB removal. If the SWAC has not been achieved for either OU 3 or OU 4, then the remedy provides certain options to further reduce risk. One option is that additional dredging may be undertaken to ensure that all sediments with PCB concentrations greater than the 1 ppm RAL are removed throughout the particular deposit. Another option would be to place a sand cover on dredged areas to reduce surficial concentrations. The determination of the appropriate option will be made by the Agencies.

13.3.2 Expected Outcomes of Selected Remedy and RAL Rationale

Remedial Action Objectives were developed to provide relative comparisons for different remedial alternatives. RAO 1 relates to achieving surface water quality standards. RAOs 2 and 3 relate to protectiveness for human and ecological receptors. RAO 4 evaluates long-term relative releases to Green Bay and Lake Michigan. RAO 5 considers short-term releases from the potential remedies themselves.

RAO 1 may not be achieved in the foreseeable future because of the stringent regulations for acceptable PCB concentrations in surface waters. Nevertheless, significant risk reduction will occur. Recovery times estimated for RAO 2 (protection of human health) and RAO 3 (protection of ecological receptors) indicate that they will be met well within the defined goals. RAO 4 relates to PCB movement from the River to Green Bay and Lake Michigan. Reductions of loadings as a result of the removal of contaminants in OU 3 and OU 4 will reduce contaminant migration downstream and will therefore contribute to achieving RAO 4. Although the time to recover for Green Bay is not known (because of the time limitations of the models), the substantive reduction of contaminant loading from the River to Green Bay resulting from implementation of the remedy for OU 3 and OU 4 should assist in Bay recovery. RAO 5 is achievable with conventional environmental removal technologies for OU 3 and OU 4 and does not apply directly to the remedy for OU 5.

RAOs 2 and 3 are evaluated in the Alternative-Specific Risk Assessment in the FS by estimating the time required to reach the protectiveness criteria for human health (i.e., removal of fish advisories) and the time required to reach the protectiveness criteria for ecological receptors. This analysis was performed for each of the different remedial action levels and for the alternatives that do not involve contaminant removal, Alternatives A and B.

A PCB concentration of 1 ppm has been selected as the appropriate RAL based on its ability to achieve RAOs for human health and ecological receptors within a reasonable time frame relative to the anticipated costs. This RAL will also reduce the PCB concentration in surface water. Exposures to PCB sediment concentrations above 1 ppm must be eliminated in order to achieve a protective SWAC within a reasonable time frame. This RAL will also reduce and minimize surface water concentrations and the release of contaminants to downstream areas of the River. Studies conducted as part of the Lower Fox River and Green Bay RI/FS indicate that a 1 ppm RAL shows the greatest decrease in projected surface water concentrations relative to the other action levels.

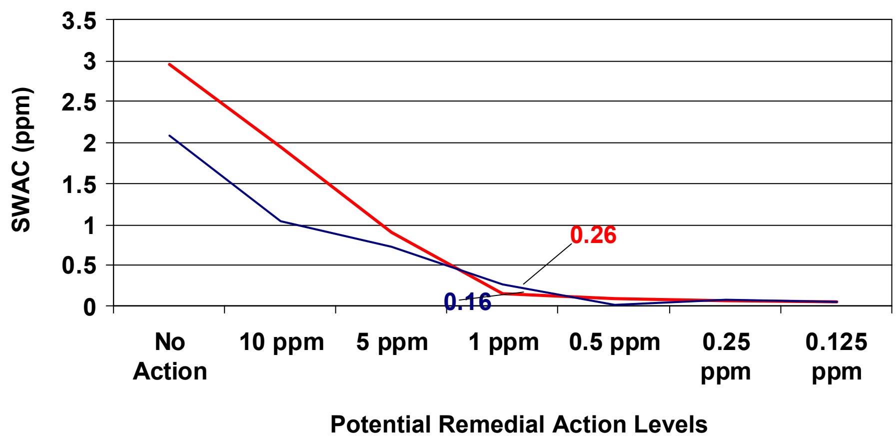
PCB RALs of No Action, 5 ppm, 1 ppm, and 0.5 ppm, were also evaluated. However, those RALs greater than 1 ppm would require a significant amount of additional time to achieve the RAOs for the Site. For those RALs of less than 1 ppm, the RAOs would not necessarily be achieved sooner than they would using the 1 ppm RAL. The RAOs considered in determining the RAL are discussed below for OUs 3, 4, and 5. It is important to note that while absolute numbers are inherently uncertain because of uncertainties in modeling, the relative differences among the RALs are reliable. Furthermore, it should be noted that the Agencies expect that the

Bay may recover more rapidly as a result of the reduction of PCB loading that will occur with the removal of PCBs from the Lower Fox River (OU 1, OU 3, and OU 4). Modeling results may not clearly show this improvement because of the model's time limitations (a maximum of 100 years).

<u>Rationale for Operable Units 3 and 4 – Remedial Action Level of 1 ppm</u>

Figure 13-1 shows the modeling analysis of sediment RALs in comparison with the SWACs, which will result from cleanup to the selected 1 ppm RAL. Modeling suggests that a 1 ppm RAL can achieve an estimated 0.26 ppm PCB SWAC for OU 3 and a 0.16 ppm SWAC for OU 4. A sediment RAL of 1 ppm is the most effective RAL, because the risk declines significantly in a reasonable time period (see Figures 13-2 and 13-3), which will result in achieving risk reduction in the number of years estimated in Table 13-1.

Figure 13-1 Remedial Action Levels and Estimated SWACs for Evaluated RALs for OUs 3 and 4 (from FS Table 5-4 and BLRA Tables 5-33 and 5-34)



As shown in Table 13-1, modeling suggests that a sediment RAL of 1 ppm will lead to fairly rapid declines in PCB fish tissue concentrations. Using the 1 ppm RAL, Table 13-1 projects the number of years until the risk of fish ingestion/consumption declines to acceptable levels for different consumers.

Table 13-1 Estimated Years to Reach Human Health and Ecological Thresholds to Achieve Risk Reduction for Operable Units 3 and 4 at an RAL of 1 ppm

Fish	Receptor	Risk Level Goal	Estimated Years
Operable Unit 3			
Walleye	Recreational Angler	RME Hazard Index of 1.0	9
Walleye	High-intake Fish Consumer	RME Hazard Index of 1.0	17
Walleye	Recreational Angler	RME 10^{-5} cancer risk level	30
Walleye	High-intake Fish Consumer	RME 10^{-5} cancer risk level	42
Carp	Carnivorous Bird	NOAEC	22
Carp	Piscivorous Mammal	NOAEC	43
Operable Unit 4			
Walleye	Recreational Angler	RME Hazard Index of 1.0	20
Walleye	High-intake Fish Consumer	RME Hazard Index of 1.0	30
Walleye	Recreational Angler	RME 10^{-5} cancer risk level	45
Walleye	High-intake Fish Consumer	RME 10^{-5} cancer risk level	59
Carp	Carnivorous Bird	NOAEC	20
Carp	Piscivorous Mammal	NOAEC	45

Notes:
NOAEC – No Observed Adverse Effects Concentration
RME – reasonable maximum exposure

A 1 ppm RAL shows the greatest decrease in projected surface water concentrations in OU 3 and OU 4. Figure 13-2 shows model estimates for PCB surface water concentration 30 years after remediation for OU 3, and Figure 13-3 shows model estimates for PCB surface water concentrations 30 years after remediation for OU 4. Further decline for projected surface water concentrations for an RAL of less than 1 ppm are relatively small in both Operable Units. In other words, selection of an RAL of less than 1 ppm would marginally reduce the SWAC and surface water concentrations. A comparison of various RALs shows the 1 ppm RAL has the greatest relative post-remediation decrease in surface water concentrations.

Figure 13-2 Estimates of Surface Water PCB Concentrations for the Evaluated RALs 30 Years After Completion of Remedial Activities for OU 3

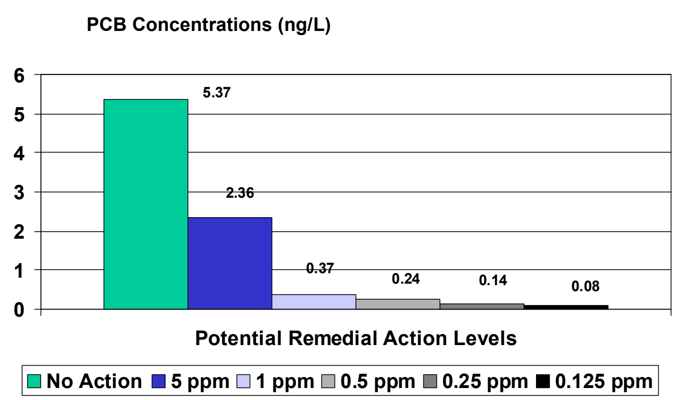
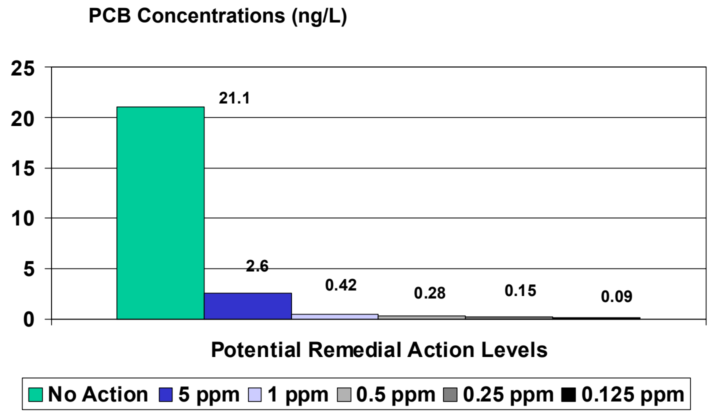


Figure 13-3 Estimates of Surface Water PCB Concentrations for the Evaluated RALs 30 Years After Completion of Remedial Activities for OU 4



RAO 1 relates to achieving surface water quality standards. A comparison of the reduction expected 30 years after completion of the proposed alternative at the 1 ppm RAL to the No Action alternative is presented in Table13-2.

Table 13-2 RAO 1: Surface Water PCB Concentrations 30 Years After Completion of the Proposed Alternative

River Reach	No Action	1 ppm Action Level	% Difference
OU 3	5.37 ng/L	0.37 ng/L	93
OU 4	21.08 ng/L	0.42 ng/L	98

"Acceptable fish tissue concentrations" are levels that would allow unlimited consumption of young-of-the-year fish, recognizing it would take longer for fish (about 5 years for walleye) to become large enough to be legally caught and eaten. "Acceptable risks" assume an acceptable cancer risk less than 10^{-4} (within the EPA's acceptable risk range of 10^{-4} to 10^{-6}) and a hazard index of less than 1. As shown on Figures 13-4 and 13-5, a 1 ppm RAL shows similar relative decreases in relation to acceptable fish tissue concentrations for walleye. Figures 13-4 and 13-5 show that for RAL concentrations greater than 1 ppm, significantly more years will elapse before the risk of fish consumption declines to acceptable levels. Other species of fish show similar reductions and are discussed in detail in Section 8 of the FS. Figures 13-4 and 13-5 clearly show that there is limited additional risk reduction achieved by selecting an RAL of less than 1 ppm.

Figure 13-4 Time to Achieve Acceptable Fish Tissue Concentrations for OU 3

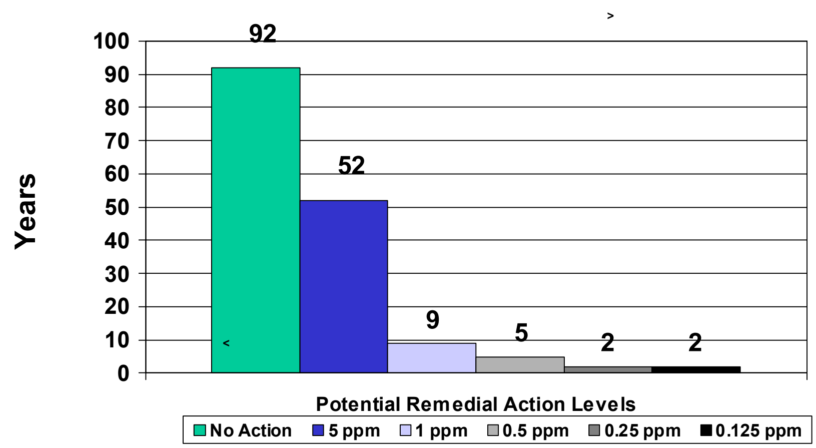
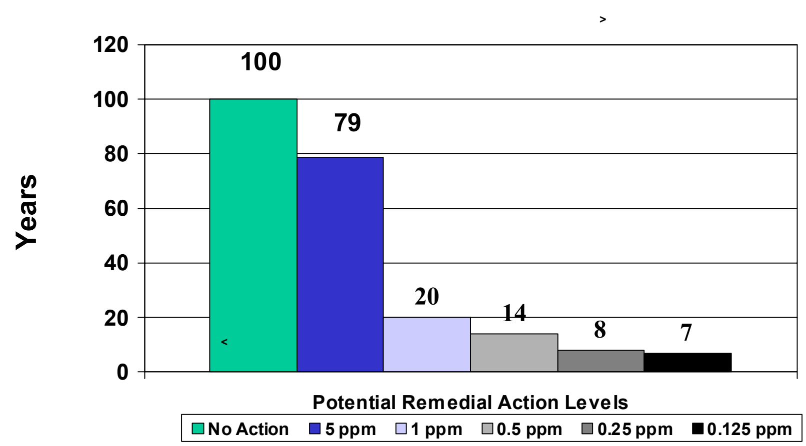


Figure 13-5 Time to Achieve Acceptable Fish Tissue Concentrations for OU 4



Safe fish consumption by birds showed similar relative reductions for the 1 ppm RAL versus other potential cleanup levels (Figures 13-6 and 13-7). Thus, the 1 ppm RAL provides the greatest relative reduction of time required for ecosystem recovery.

Figure 13-6 Time to Safe Fish Consumption by Birds in OU 3

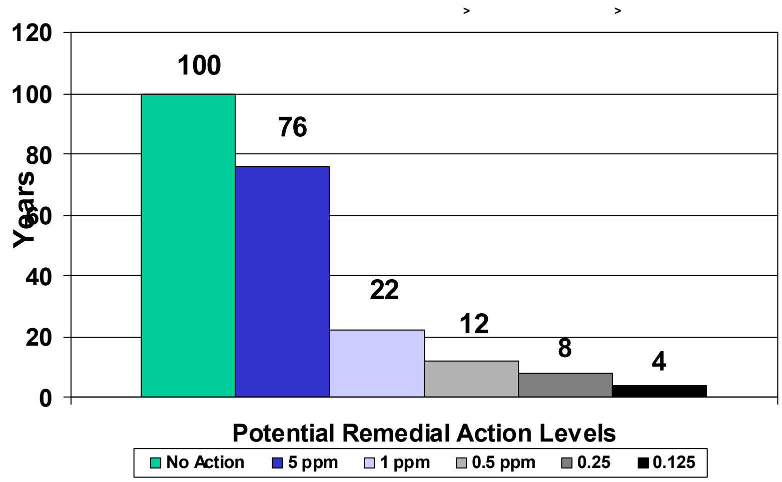
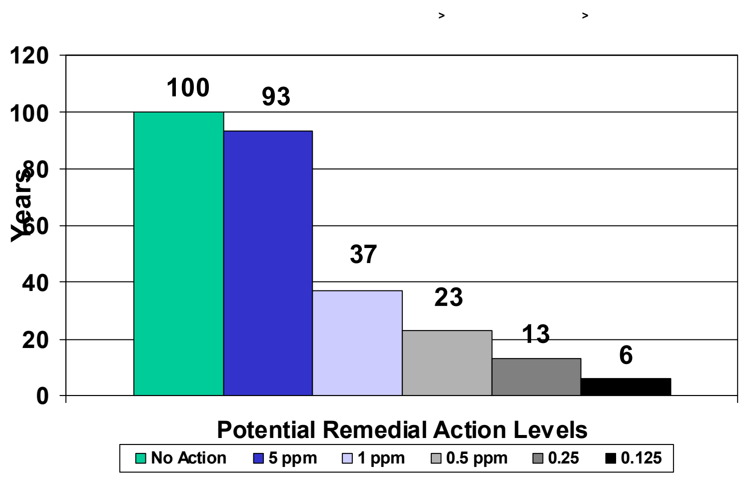
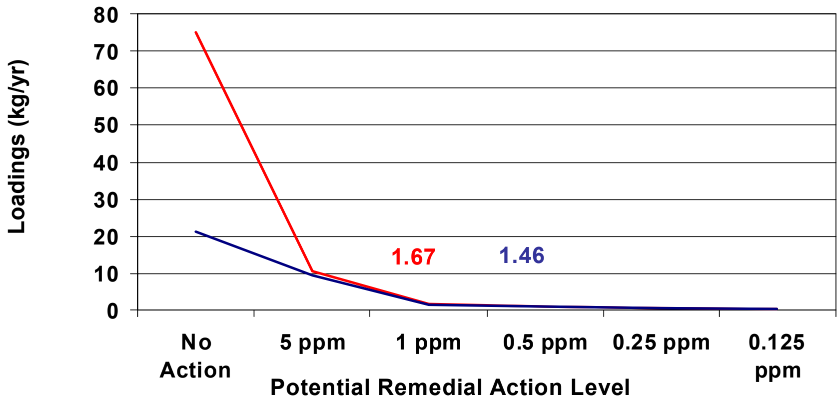


Figure 13-7 Time to Safe Fish Consumption by Birds in OU 4



A 1 ppm RAL is also the most protective based on estimates of downstream loadings (i.e., movement and migration of PCBs into OU 4 of the River and into Green Bay). Downstream loadings of PCBs from OUs 3 and 4 relative to remedial activities are shown on Figure 13-8 for OU 3 and OU 4. The RAL of 1 ppm provides the greatest decrease in downstream loadings relative to the other RALs. Figure 13-8 shows that, with respect to downstream loadings, the 1 ppm RAL level achieves the most reduction when compared to time and cost.

Figure 13-8 RALs and Downstream Loadings in OU 3 and OU 4



A tabular comparison of the reduction expected 30 years after completion of the proposed alternative at the 1 ppm RAL to the No Action alternative is presented in Table 13-3.

Table 13-3 RAO 4: Annual Sediment Loading Rates 30 Years After Completion of the Proposed Alternative

Operable Unit	No Action	1 ppm Action Level	% Difference
OU 3	21.25 kg/yr	1.46 kg/yr	93
OU 4	75.27 kg/yr	1.67 kg/yr	97

In summary, the 1 ppm RAL shows the most significant relative improvement for all the pertinent RAOs, resulting in a protective and cost-effective cleanup level for OU 3 and OU 4.

Rationale for Operable Unit 5 — Monitored Natural Recovery

Green Bay has a water surface area of approximately 2,700 square miles and a water volume of 20 cubic miles. The mean depth of the Bay is approximately 65 feet; the maximum depth is 176 feet. PCB concentrations in the sediment are typically low (i.e., less than 1 ppm) because of the vast sediment volume. Of the total sediment volume in the Bay, the RI estimated only about 2 percent has PCB concentrations greater than 1 ppm and less than 0.2 percent has PCB concentrations above 5 ppm, representing 2.6 and 0.2 percent of the sediment mass, respectively.

The BLRA identifies the risks associated with the OU 5 zones. It appears there is not a significant difference in the human and ecological health endpoints between an aggressive remedial approach throughout the Bay and Alternatives A and B (No Action and MNR), in which no active remediation is undertaken for the Bay. In other words, because of the enormous quantity of Bay sediment contaminated at low levels (PCB concentrations less than 1 ppm), any large-scale Bay remediation would add substantially to remedial costs without significantly reducing risks in the Bay. Costs for active remediation in Green Bay were developed for each Bay zone at 0.5, 1, and 5 ppm action levels. Costs and related issues are discussed in Section 11.3. The cost to implement the MNR alternative in the Bay is $39.6 million.

13.4 Contingent Remedy – *In-Situ* Capping (i.e., "Partial Capping" or "Supplemental Capping")

The WDNR and EPA have selected Alternative C as identified in the Proposed Plan and the RI/FS as the *selected* alternative. However, during the RI/FS public comment period, the Agencies received numerous comments relating to the viability of capping as a possible remedy. An analysis of these comments (discussed in *White Paper No. 5A – Responses to the API Panel Report*, *White Paper No. 5B – Evaluation of API Capping Costs Report*, *White Paper No. 5C – Evaluation of Remedial Alternatives for Little Lake Butte des Morts Proposed by WTMI and P.H. Glatfelter*, *White Paper No. 6A – Comments on the API Panel Report*, and *White Paper No. 6B – In-Situ Capping as a Remedy Component for the Lower Fox River*, attached to the ROD for OU 1 and OU 2) evaluated the viability of a capping-only remedy. This evaluation indicated that a capping-only remedy would not be protective, and would be technically and administratively difficult to implement. The evaluation also indicated that capping would only be technically feasible in some areas. Based on these public comments, the WDNR and EPA have developed a contingent remedy that may supplement the selected remedy in certain circumstances. This capping contingency is different than Alternative F presented in the FS. Alternative F included capping in all areas where certain technical and engineering requirements were met. The pre-design sampling results, the engineering requirements outlined below, and costs would provide the basis for determining whether capping would be appropriate to implement for a particular deposit or subset of deposits. Design considerations would be the basis for determination of the exact deposits that would be capped. This contingent remedy may only be implemented if it meets the following requirements:

1. The contingent remedy, consisting of a combination of dredging and capping, must provide the same level of protection to human health and the environment as the selected remedy. To demonstrate that a cap would provide the same level of protectiveness as the selected remedy, the following would have to be addressed: (a) the potential for PCB releases from flooding and ice scour, as well as advective and diffusional processes; and (b) the potential for a breach of the cap and how that or other potential cap failures mechanisms would be monitored.

2. The contingent remedy must be less costly to implement than the selected remedy.

3. The contingent remedy must not take more time to implement than the selected remedy.

4. The contingent remedy must comply with all necessary regulatory, administrative, and technical requirements, discussed below.

5. The capping contemplated in the contingent remedy will not be permitted in certain areas of OUs 3 and 4:

    - No capping in areas of navigation channels (with an appropriate buffer zone to ensure no impacts to maintenance of the navigation channel)

    - No capping in areas of infrastructure such as pipelines, utility easements, bridge piers, etc. (with appropriate buffer zone)

    - No capping in areas with PCB concentrations exceeding TSCA levels (50 ppm)

    - No capping in areas that do not have sufficient load-bearing capacity

- ♦ No capping in shallow-water areas (bottom elevations that would result in a cap surface at elevation greater than –3 feet chart datum without prior dredging to allow for cap placement

In addition to other controls, institutional controls unique to capping would be required to ensure the integrity and protectiveness of capped areas, including restrictions on anchoring or dredging.

Because capping relies on long-term integrity of the cap in a dynamic river environment, long-term monitoring would need to ensure that the cap would remain physically intact and chemical contaminants were contained. For example, in addition to other monitoring requirements, if there were a large storm or other event that could impair a cap's ability to retain contaminants, additional monitoring would likely be required.

Assuming the above criteria are met, capping is considered a viable and protective alternative for OU 3 and OU 4 and may be implemented. The specific areas where caps could be placed will be determined during design. Design will be based, in part, on considerations included in *White Paper No. 6B – In-Situ Capping as a Remedy Component for the Lower Fox River*, attached to the ROD for OU 1 and OU 2. To ensure the permanence of an OU 3 cap, permanent maintenance of the De Pere dam would be required.

13.5 Basis for Implementing the Contingent Remedy (OUs 3 and 4)

The contingent remedy may be employed in OUs 3 and 4 to supplement the selected dredging remedy if one or both of the following criteria are satisfied. The decision as to whether one or both of the criteria have been satisfied will be made solely by the EPA and WDNR.

1. It can be predicted with a high degree of certainty based on sampling results (taken after a sufficient amount of contaminated sediment in OUs 3 and 4 has been dredged) that a PCB SWAC of 0.26 ppm for OU 3 and 0.25 ppm for OU 4 would not be achieved by dredging alone, or

2. Capping would be less costly than dredging and would provide the same level of protection to human health and the environment as the selected remedy, as evaluated in accordance with the protectiveness provisions and the nine criteria in the NCP (40 CFR 300.430).

The selected dredging remedy would still be completed in areas not capped. Based on estimates in the FS, and because of limitations on where capping could be performed, capping would be limited to about 40 percent of the total volume of contaminated sediments in OU 3 and OU 4. Selection and implementation of this contingency would be documented in an ESD.

It should be noted that if dredging alone achieves cleanup standards, and the contingent remedy is not shown to be more cost-effective than dredging alone, then capping would not be implemented.

13.6 Description of Contingent Remedy

The contingent remedy, which may supplement the selected remedy, consists of the following components:

- **Cap Design:** Cap construction specifications would be determined during design. Although the FS envisioned a cap composed of 20 inches of sand overlaid with 12 inches of large cobble "armor" to provide erosion protection, the final cap design would be based on predicted performance. The final cap design must have sufficient thickness to ensure containment of contaminants, resistance to burrowing organisms, and "armoring" to provide sufficient permanence and resistance to erosion and scour.

- **Demobilization and Site Restoration:** Demobilization and site restoration would require removing all capping-related equipment, fencing, facilities, etc., from staging and work areas.

- **Monitoring:** Operations and maintenance monitoring would be required to ensure proper placement, maintenance of cap integrity, and isolation and containment of contaminants. For this type of capping, monitoring would be performed to ensure that the cap is placed as intended, the necessary capping thickness is maintained, and contaminants are contained and do not become bioavailable. In addition to other dredging-related monitoring, cap monitoring would include bathymetric or side-scan sonar profiling, sediment and cap sampling, and capture and analysis of pore water that may migrate through the cap, as well as diver inspections to ensure that the cap is intact and containing contaminants. Additionally, provisions would have to be made for cap repair should that be necessary.

- **Institutional Controls:** Institutional controls may include deed restrictions, Site access and anchoring limitations, and continuation of fish and waterfowl consumption advisories, as appropriate. Access restrictions could include limitations on the use or development of capped areas, possibly requiring local legislative action and state administrative action. These controls and limitations are intended to ensure the permanence of the cap and to minimize reexposure and/or migration of contaminants. Deed and access restrictions, dredging moratoriums, and other limitations (e.g., no anchor zones) on the use or development of capped areas would continue in perpetuity or until contaminants were removed or rendered nontoxic. Fish consumption advisories would continue until fish contaminant concentrations reach levels protective for human health and the environment. Monitoring in perpetuity would likely also be required, as the cap would need to permanently contain contaminants.

13.7 Estimated Costs of the Contingent Remedy

Costs would be determined prior to implementation of capping. Estimates of capping costs would be documented in an ESD.

13.8 Use of Vitrification Technology

The Agencies have selected land disposal as the technology for managing dewatered dredged material from the Lower Fox River. In Section 10.2 of this ROD, an option to use vitrification is identified. This section discusses vitrification and provides the basis upon which it can be used as part of the remedy for OUs 3 and 4. If successfully implemented, vitrification is an effective technology, has the added benefit of destruction of PCBs, and would allow beneficial reuse of dredged sediment. However, if vitrification is used instead of disposal of contaminated sediments, the Agencies would issue a ROD Amendment, consistent with the requirements of the NCP.

Certain criteria must be considered prior to the use of vitrification. These criteria include the ability of vitrification technology to treat the chemicals of concern, the cost of constructing and operating a vitrification facility, the amount of dredged material that would be managed at the vitrification facility, and issues related to siting a facility.

- **Vitrification Technology.** As part of the evaluation of technologies in Section 6 of the FS, vitrification was evaluated as the representative process option for thermal treatment. Vitrification is a high-temperature process (2,500 to 3,000 °F) that destroys organic compounds (e.g., PCBs) while melting the contaminated sediment into glass aggregate material. Inorganic contaminants (e.g., most heavy metals) are contained in the glass matrix of the aggregate. Vitrification units can be operated to achieve the 99.9999 percent destruction removal efficiency requirement for PCBs. In cooperation with and supported by funding from the WDNR and EPA Great Lakes National Program Office, Minergy Corporation has undertaken a multi-phase study to evaluate the feasibility of vitrification technology, based on glass furnace technology, to treat PCB-contaminated sediment. The EPA's Superfund Innovative Technology Evaluation (SITE) program has also participated in this study and conducted an independent evaluation of the cost and treatment effectiveness of the technology. Reports prepared by Minergy and submitted to the WDNR and EPA did demonstrate the effectiveness of the technology and provided initial cost information. While the SITE report is not yet final, initial indications are that vitrification using glass furnace technology has been demonstrated to be successful at treating PCB-contaminated sediment.

- **Amount of Dredged Material to be Managed.** Estimated quantities to be dredged are 595,800 cy from OU 3 (including Deposit DD) and 5,880,000 cy from OU 4, for a total quantity of approximately 6.5 million cy. Once dewatered to 55 percent solids, this quantity is equivalent to approximately 3.6 million wet tons of filter cake. When converted to dry tons for comparison with the tables presenting unit cost estimates in the Minergy report, this quantity is approximately 1.98 million dry tons.

- **Cost to Construct and Operate.** As part of a contract with the WDNR, Minergy Corporation prepared a study entitled *Revised Unit Cost Study for Commercial Scale Sediment Meter Facility – Glass Furnace Technology*. This study provides additional information on capital and operating costs of a vitrification facility. Various parameters influence the unit cost of a vitrification facility, such as the amount of dredge material processed, the water content of the dredge material, the size of the plant needed to process the dredge material, the amount of glass produced, annual days of operation, and the assumed value of the glass, as well as initial capital construction costs and operating costs. Based on work documented in the FS, the following values were developed for these parameters:

Amount of dredge material	3,600,000 wet tons
Water content of dredge material	55%
Plant size	750 to 1,125 tons/day
Project life	7 to 10 years
Annual operating days	240 to 350 days
Amount of glass produced	180,000 to 270,000 tons
Assumed value of the glass	$2 to $25 per ton

  Following these assumptions, the unit cost ranges from $32.21/ton to $53.04/ton on a wet ton basis. Consequently, the cost to manage all the dredge material from OU 3 and OU 4 using vitrification could range upwards to $191 million. Note that the unit costs increase as the amount of material managed at a vitrification facility decreases. Also note that this cost does not include dewatering.

- **Siting of a Disposal Facility.** Siting a location to construct a passive dewatering facility and a monofill to dispose of all the dredged material from OUs 3 and 4 presents several challenges. The passive dewatering and monofill disposal facilities are key features in the cost-effectiveness of the selected remedy. The challenges to siting these facilities include finding a site with the necessary geophysical characteristics, such as favorable geology; the need for a large land area to place these facilities; and the need to go through the state's siting process for the disposal facility. Current land area estimates are approximately 327 acres for the dewatering cells and approximately 121 acres for the disposal facility, for an approximate total of 448 acres. Although it may be possible to restore the area used for the dewatering cells to an alternative use or to the previous use, the disposal facility will be permanent. Such parcels of land are available in southern Brown County, but these parcels would still have to be procured. Part of the site evaluation process will be to determine whether existing properties having the necessary physical characteristics are available and whether there are concerns related to wetlands, sensitive habitat, or archaeological or historical matters. The state's siting law requires that the owners of a proposed landfill negotiate a host agreement with the community in which the landfill will be located. These negotiations can place limits on the size and operation of a landfill and the type of materials accepted, can lead to negotiation of a host community fee, and can be time consuming. An inability to successfully negotiate an agreement may result in the need to seek an alternative location for the proposed disposal facility or to seek a means to manage the dredge material, such as vitrification.

In summary, vitrification is a potentially viable technology for the management of dredge material for the Lower Fox River. The Agencies will allow for vitrification technology to be used on all or part of the contaminated sediment dredged from the River under any of the following circumstances. The decision as to whether the following criteria have been satisfied will be made solely by the EPA and WDNR.

1. **Protection of Human Health and the Environment.** Vitrification must provide the same level of protection to human health and the environment as the selected remedy as evaluated in accordance with the protectiveness provisions and the nine criteria in the NCP (40 CFR 300.430).

2. **Lack of Disposal Capacity.** If, following attempts to secure land and site a monofill disposal facility for dredge material management, there is either no disposal capacity or insufficient disposal capacity.

3. **Costs.** In the event that costs to site, construct, and operate a disposal facility are unacceptable to the responsible parties or the incremental increase in cost to permanently destroy PCBs is unacceptable, the responsible parties can use vitrification as an alternative means of disposal.

It is also important to note that given the need for a higher percent solids in the dewatered material, it is likely that mechanical dewatering would have to be used in lieu of passive dewatering. If this happens, it may lead to higher costs to implement the remediation of OUs 3 and 4. In the event that use of vitrification technology is proposed, the public would be informed and public input would be sought on the proposal to use this technology, as well as on the rationale concerning its selection, implementation, and cost, through a ROD amendment.

14 STATUTORY DETERMINATIONS

Under CERCLA Section 121 and the NCP, the remedies that are selected for Superfund sites are required to be protective of human health and the environment, comply with applicable or relevant and appropriate requirements (unless a statutory waiver is justified), be cost-effective, and utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. In addition, CERCLA includes a preference for remedies that employ treatment that permanently and significantly reduces the volume, toxicity, or mobility of hazardous wastes as a principal element and a bias against off-site disposal of untreated wastes. The following sections discuss how the selected remedy meets these statutory requirements.

14.1 Protection of Human Health and the Environment

Implementation of the selected remedy will adequately protect human health and the environment through the removal and off-site disposal of PCB-contaminated sediment and the monitoring of the natural recovery of PCB-contaminated sediment that is left in place. The selected remedy will target a sediment cleanup level of 1 ppm in OUs 3 and 4. The residual risk posed by this action level in OUs 3 and 4, expressed in years to reach human health and ecological thresholds, is presented in Table 13-1. This table indicates that for the selected action level of 1 ppm, acceptable fish tissue concentrations in young-of-the-year walleye would be achieved in 9 to 42 years for OU 3 and in 20 to 59 years for OU 4.

Reduced reliance on fish consumption advisories is an overall objective of all cleanup alternatives. For that reason, fish consumption advisories are not considered to be part of the remedial alternatives presented to protect public health. It is expected, however, that once the selected remedy is implemented, the fish consumption advisories will continue to be an important part of the human health risk reduction strategy for years to come. Efforts to improve advisory awareness and voluntary compliance with advisories will be ongoing during both remedial design, implementation, and long-term monitoring of remedy effectiveness.

The SWAC value in OU 5 will be 0.352 ppm. Implementation of the selected alternative in OU 3, OU 4, and OU 5 will result in PCB concentrations within acceptable risk ranges over time. The selected remedy does not pose unacceptable short-term risk.

14.2 Compliance with ARARs

Section 121(d) of CERCLA requires that Superfund remedial actions meet ARARs. The selected remedy will comply with the ARARs summarized in Table 14-1 and discussed below.

14.2.1 Potential Chemical-Specific ARARs

Toxic Substances Control Act (TSCA)

TSCA establishes requirements for the handling, storage, and disposal of PCB-containing materials equal to or greater than 50 ppm. TSCA is an ARAR at the Site with respect to any PCB-containing materials with PCB concentrations equal to or greater than 50 ppm that are removed from the Site.

Clean Water Act

Federal surface water quality standards are adopted under Section 304 of the Clean Water Act where a state has not adopted standards. These federal standards, if any, are ARARs for point discharges to the River. Related to these standards are the federal ambient water quality criteria. These criteria are non-enforceable guidelines that identify chemical levels for surface waters and generally may be related to a variety of assumptions, such as use of a surface water body as a water supply. While these criteria are not ARARs, they may be TBCs for this Site.

Groundwater Quality Standards

State groundwater quality standards for various substances are set forth in Chapter NR 140, WAC. In general, Sections NR 140.24 and NR 140.26 require preventive action limits (PALs) to be achieved to the extent it is technically and economically feasible to do so. In the remediation context, the NR 140 groundwater quality standards are to be achieved within a reasonable time frame. Natural attenuation is allowed as a remedial method where source control activities have been undertaken and where groundwater quality standards will be achieved within a reasonable period of time. The groundwater quality standards constitute an ARAR.

Soil Cleanup Standards

The State of Wisconsin has adopted generic, site-specific, and performance-based soil cleanup standards in the NR 700 series, WAC. These regulations allow the party conducting the remedial action to select which approach to apply. The generic soil standards are divided into those necessary to protect the groundwater quality and those necessary to prevent unacceptable, direct contact exposure. Generic soil standards, based on conservative default values and assumptions, have been adopted only for a few substances, none of which is relevant to the Site. Site-specific soil standards depend upon a variety of factors, including local soil conditions, depth to groundwater, type of chemical, access restrictions, and current and future use of the property. These site-specific soil standards also may be adjusted based on an assessment of the site-specific risk presented by the chemical constituents of concern. With respect to the Site, the soil standards constitute an ARAR.

Surface Water Quality Standards

The State of Wisconsin has promulgated water quality standards that are based on two components: (1) use designation for the water body and (2) water quality criteria. These standards, designations, and criteria are set forth in Chapters NR 102 to NR 105, WAC. The State also has rules for applying the water quality standards when establishing water quality-based effluent limits (Chapters NR 106 and NR 207, WAC). The state water quality standards are used in making water management decisions and controlling municipal, business, land development, and agricultural activities (Section NR 102.04, WAC). In the remediation context, surface water quality standards are applicable to point source discharges that may be part of the remedial action. Further, to the extent that the remedial work is conducted in or near a water body, such work is to be conducted so as to prevent or minimize an exceedance of a water quality criterion (in Chapters NR 102 to 105, WAC).

As recognized in the WDNR's sediment guidance (1995), the water quality standards are goals to be used in guiding the development of the sediment remediation work. As a goal, but not a legal requirement, the water quality standards as applied to the remediation of sediment contamination constitute a TBC.

In addition, the NCP states that, in establishing RAOs, water quality criteria established under the Clean Water Act (Water Quality Standards [WQSs] in Wisconsin), shall be attained where "relevant and appropriate under the circumstances of the release" (40 CFR 300.430(e)(2)(I)(E)).

The WDNR and EPA have determined that WQSs, while relevant to sediment cleanup RAOs, are not appropriate for direct application at this time. Calculating a site-specific sediment quality standard from a WQS using current scientific methods such as equilibrium partitioning is very uncertain. Moreover, the EPA's 1996 Superfund PCB cleanup guidance directly addresses sediment cleanup targets using water quality criteria. The guidance suggests using equilibrium partitioning to develop a sediment criterion and then compare it to risk-based cleanup numbers for establishing an RAO. If the guidance considered a derived sediment quality number to be an ARAR, it would be directly applied to each alternative as a threshold criterion. Therefore, WQSs are not ARARs and are not threshold criteria for selecting an alternative for the Site.

14.2.2 Potential Action- and Location-Specific ARARs

Wisconsin Statutes Chapter 30

Chapter 30 of the Wisconsin Statutes requires permits for work performed in navigable waterways or on or near the bank of such a waterway. For remediation that is conducted under CERCLA, only the substantive provisions set forth in Chapter 30 (but not the procedural requirements for obtaining a permit) must be satisfied. In general, the substantive provisions address minimizing any adverse effects on the waterway that may result from the work. This includes Chapter NR 116, Wisconsin's Floodplain Management Program. The substantive provisions are action-specific ARARs.

Section 10 – Rivers and Harbors Act; Section 404

Section 404 of the Clean Water Act requires approval from the U.S. Army Corps of Engineers for discharges of dredged or fill material into waters of the United States, and Section 10 of the Rivers and Harbors Act requires approval from the USACE for dredging and filling work performed in navigable waters of the United States. As the River is a water of the United States, these statutes might dictate action-specific ARARs for dredging/filling work that may be conducted in the River. Under the Fish and Wildlife Coordination Act, the USACE must coordinate with the USFWS regarding minimization of effects from such work. The work would be subject to the substantive environmental law aspects of permits under these statutes, which would be ARARs. Permits are not required for remediation that is implemented under the authority of CERCLA.

Floodplain and Wetland Regulations and Executive Orders 11988 and 11990

The requirements of 40 CFR § 264.18(b) and Executive Order 11988, Protection of Flood Plains, are relevant and appropriate to action on the Site. Executive Order 11990 (Protection of Wetlands) is an applicable requirement if there are any wetlands present in the areas to be remediated.

National Historic Preservation Act (NHPA), 16 USC 470 *et seq.*

The NHPA provides protections for historic properties (cultural resources) on or eligible for inclusion on the National Register of Historic Places (see 36 CFR Part 800). In selecting a remedial alternative, adverse effects to such properties are to be avoided. If any portion of the Site is on or eligible for the National Historical Register, the NHPA requirements would be ARARs.

Endangered Species

Both State and federal law have statutory provisions that are intended to protect threatened or endangered species (i.e., the federal Endangered Species Act and s. 29.604, State Statutes). In general, these laws require a determination as to whether any such species (and its related habitat) reside within the area where an activity under review by governmental authority may take place. If the species is present and may be adversely affected by the selected activity, where the adverse effect cannot be prevented, the selected action may proceed. If threatened or endangered species exist in certain areas of the River and Bay, these laws may constitute an action-specific ARAR. At the Site, the queen snake as well as several plant species were noted by the WDNR to be endangered or rare resources occurring within or near the Site.

Management of PCBs and Products Containing PCBs

Wisconsin regulations (i.e., Chapter NR 157, WAC, "Management of PCBs and Products Containing PCBs" that was adopted pursuant to Section 299.45. Wisconsin Statutes) that establish procedures for the storage, collection, transport, and disposal of PCB-containing materials also apply to remedial actions taken at the Site.

Solid Waste Management Statutes and Rules (Chapter 289, Wisconsin Statutes and Chapters NR 500 to 520 and NR 600 to 685, WAC) establish standards that apply to the collection, transportation, storage, and disposal of solid and hazardous waste.

It is not expected that federal Resource Conservation and Recovery Act (RCRA) or State regulations governing hazardous waste management will be applicable at this Site.

TSCA – Disposal Approval

TSCA regulations for the disposal of PCB remediation waste (40 CFR 761.61) are applicable to the selection of the cleanup alternative for remediation of PCBs in sediments at the Site and to the disposal of removed sediments at a state-licensed landfill. These regulations provide cleanup and disposal options for PCB remediation waste. The three options include self-implementing, performance-based, and risk-based disposal approvals. The risk-based disposal approval option is allowed if it will not pose an unreasonable risk of injury to health and the environment.

The current situation in the River and Bay, as described in the risk assessment conducted as part of the RI/FS, is that PCB-contaminated sediment poses an unacceptable level of risk in the River at this time. Remediation of PCB-contaminated sediment via the selected remedy will reduce risks to human health and the environment.

Sediment removed from the River may contain PCBs equal to or greater than 50 ppm. PCB-contaminated sediment with concentrations less than 50 ppm will be managed as a solid waste in accordance with statutes and rules governing the disposal of solid waste in Wisconsin. PCB-contaminated sediment with concentrations equal to or greater than 50 ppm will be managed in accordance with the Toxic Substances Control Act of 1976 (Appendix E of the FS). Presently, TSCA compliance would be achieved through the extension of the January 24, 1995, approval issued by the EPA to WDNR pursuant to 40 CFR 761.60(a)(5) under the authority of TSCA.

This TSCA approval, granted by EPA Region 5, states that the disposal of PCB-contaminated sediment with concentrations equal to or greater than 50 ppm into an NR 500 WAC landfill that is also in compliance with the conditions of the TSCA approval provides adequate protection to human health and the environment as required by 40 CFR 761.60(a)(5) and will provide the same level of protection required by EPA Region 5 and therefore is no less restrictive than TSCA. However, should other administrative rules pertaining to disposal under TSCA be in effect at the time that TSCA compliance decisions are made for the River sediment, then compliance with those rules will be achieved.

14.2.3 Additional To Be Considered Information

Section 303(d), Clean Water Act

Under Section 303(d) of the federal Clean Water Act, states are required, on a periodic basis, to submit lists of "impaired waterways" to the EPA. In December 1996, the WDNR submitted its first list of impaired waters under Section 303(d). The Fox River was included on the initial list. The WDNR has taken no further action with respect to the listing, nor has it developed a total maximum daily load (TMDL) for the River. Currently, a state-wide watershed committee is advising WDNR on the steps to be taken in this process, and the listing process is being reviewed by the Wisconsin Natural Resources Board. The listing of the Fox River under Section 303(d) is a TBC.

Great Lakes Water Quality Initiative, Part 132, Appendix E

The Great Lakes Water Quality Initiative set forth guidance to the states bordering the Great Lakes regarding their wastewater discharge programs. For remedial actions, the guidance states that any remedial action involving discharges should, in general, minimize any lowering of water quality to the extent practicable. The concepts of the guidance have been incorporated into Chapters NR 102 to NR 106, WAC. The Great Lakes Water Quality Initiative constitutes a TBC.

Sediment Remediation Implementation Guidance

Part of the Strategic Directions Report of the WDNR approved by Secretary Meyer in 1995 addressed the sediment remediation approach to be followed by the WDNR. This approach includes meeting water quality standards as a goal of sediment remediation projects. In developing a remedial approach, the guidance calls for use of a complete risk management process in consideration of on-site and off-site environmental effects, technological feasibility, and costs. The guidance constitutes a TBC.

Great Lakes Water Quality Agreement

The Great Lakes Water Quality Agreement calls for the identification of "Areas of Concern" in ports, harbors, and river mouths around the Great Lakes. Remedial goals to improve water quality are to be established in conjunction with the local community. In the case of the Lower Fox River and lower Green Bay, a Remedial Action Plan (RAP) has been prepared and finalized. The RAP lists a series of recommendations ranging from addressing contaminated sediments to controlling non-point source runoff. This RAP is a TBC.

Fox River Basin Water Quality Management Plan

This plan was developed by the WDNR and lists management objectives for improving water quality in the Fox River Basin. The Fox River Basin Water Quality Management Plan is a TBC.

Table 14-1 Fox River ARARs

Act/Regulation	Citation
Federal Chemical-Specific ARARs	
TSCA	40 CFR 761.60(a)(5)-761.79 and EPA Disposal Approval
Clean Water Act – Federal Water Quality Standards	40 CFR 131 (if no Wisconsin regulation) and 33 CFR 323
Federal Action-/Location-Specific ARARs	
Fish and Wildlife Coordination Act	16 USC 661 *et seq.* 33 CFR 320-330 – Rivers and Harbors Act 40 CFR 6.304
Endangered Species Act	16 USC 1531 *et seq.* 50 CFR 200 50 CFR 402
Rivers and Harbors Act	33 USC 403; 33 CFR 322, 323
National Historic Preservation Act	15 USC 470; *et seq.* 36 CFR Part 800
Floodplain and Wetlands Regulations and Executive Orders	40 CFR 264.18(b) and Executive Order 11988
State Chemical-Specific ARARs	
TSCA-Disposal Approval	EPA Approval
Surface Water Quality Standards	NR 102, 105 (*To Be Considered*), and 207 NR 722.09 1–2
Groundwater Quality Standards	NR 140
Soil Cleanup Standards	NR 720 and 722
Hazardous Waste Statutes and Rules	NR 600–685
State Action-/Location-Specific ARARs	
Management of PCBs and Products Containing PCBs	NR 157
Wisconsin's Floodplain Management Program	NR 116
Solid Waste Management	NR 500–520
Navigable Waters, Harbors, and Navigation	Chapter 30 – Wisconsin Statutes
Fish and Game	Chapter 29.415 – Wisconsin Statutes

14.3 Cost-Effectiveness

The WDNR and EPA have determined that the selected remedy is cost-effective. Section 300.430(f)(1)(ii)(D) of the NCP requires that all the alternatives that meet the threshold criteria (protection of human health and the environment and compliance with ARARs) must be evaluated by comparing their effectiveness to the three primary balancing criteria (long-term effectiveness and permanence; reduction of toxicity, mobility, or volume through treatment; and short-term effectiveness). The selected remedies meet these criteria by achieving a permanent protection of human health and the environment at low risk to the public and provide for overall effectiveness in proportion to their cost.

The Superfund program does not mandate the selection of the least costly cleanup alternative. The least costly effective remedy is not necessarily the remedy that provides the best balance of tradeoffs with respect to the remedy selection criteria, nor is the least costly alternative necessarily both protective of human health and the environment and ARAR-compliant. Cost-effectiveness is concerned with the reasonableness of the relationship between the effectiveness afforded by each alternative and its costs compared to other available options.

The total net present worth of the selected remedy for OU 3, OU 4, and OU 5 is $323.6 million.

14.4 Utilization of Permanent Solutions and Alternative Treatment Technologies or Resource Recovery Technologies to the Maximum Extent Practicable

The WDNR and EPA believe that the selected remedy represents the maximum extent to which permanent solutions and treatment technologies can be utilized in a cost-effective manner for the Site. The selected remedy does not pose excessive short-term risks. There are no special implementability issues that set the selected remedy apart from the other alternatives evaluated.

14.5 Preference for Treatment as a Principal Element

Based on current information, the WDNR and EPA believe that the selected remedy is protective of human health and the environment and utilizes permanent solutions to the maximum extent possible. The remedy, however, does not satisfy the statutory preference for treatment of the hazardous substances present at the Site as a principal element because such treatment was not found to be practical or cost-effective.

14.6 Five-Year Review Requirements

The NCP, at 40 CFR § 300.430(f)(4)(ii), requires a 5-year review if the remedial action results in hazardous substances, pollutants, or contaminants remaining on site above levels that allow for unlimited use and unrestricted exposure. Because this remedy will result in hazardous contaminants remaining on site above levels that allow for unlimited exposure, a statutory review will be conducted within 5 years after initiation of the remedial action to ensure that the remedy is, or will be, protective of human health and the environment.

15 DOCUMENTATION OF SIGNIFICANT CHANGES FROM PREFERRED ALTERNATIVE OF PROPOSED PLAN

To fulfill the requirements of CERCLA 117(b) and the NCP (40 CFR § 300.430(f)(5)(iii)(B) and 300.430(f)(3)(ii)(A)), a ROD must document and discuss the reasons for any significant changes made to the Proposed Plan.

The Proposed Plan was released for public comment in October 2001. It identified a PCB sediment cleanup target of 1 ppm in OUs 3 and 4 with Monitored Natural Recovery in OU 5.

In the selection of the remedy for OU 3, OU 4, and OU 5, the WDNR and EPA considered information submitted during the public comment period and reevaluated portions of the proposed alternative.

New Information Obtained During the Public Comment Period

The WDNR and EPA considered alternative proposals for OUs 3 and 4 submitted as comments. As a result, the following elements were incorporated into this ROD: (1) If dredging is unable to reduce exposed contaminant PCB concentrations, a sand cover will be employed to further reduce risks rather than continuing with dredging removal operations (Section 13.3); and (2) if it is predicted that concentrations may not sufficiently reduce risks, or if capping is shown to be less costly than complete dredging and as protective of human health and the environment, then capping may be employed for some areas not yet dredged (Sections 13.4 through 13.7).

These proposals may be given further consideration prior to implementation of remedial actions. However, if these proposals cause a fundamental change to the alternatives described in this ROD (e.g., changing the remedy from removal to containment), then the WDNR and EPA will issue a new, revised Proposed Plan and have a public comment period, after which a ROD amendment would be finalized. If the change is not "fundamental," but is "significant" (e.g., modification of volumes to be removed), then an Explanation of Significant Difference would be issued, and there would be limited public comment.

The Agencies conducted a comprehensive reconsideration of Green Bay largely due to the numerous comments and concerns expressed, including the appropriateness of the proposed remedy and the need for additional data. To this end, the Agencies performed the following:

1. Additional sampling and analysis in Green Bay Zone 2 in areas not previously sampled and believed to have the greatest potential for relatively high PCB concentrations.

2. Modeling to determine the effects of a hot spot remediation and to determine alternative mass and volume numbers for the Bay.

3. Reevaluation of the techniques used to estimate sediment volume and PCB mass and preparation of bed maps with alternative mass and volume estimates.

White Papers Nos. 18, 19, 20, and 21, which are included with this ROD, present the new data and modeling information regarding evaluation of new and existing Green Bay data. These are:

- *White Paper No. 18 – Evaluation of an Alternative Approach of Calculating Mass, Sediment Volume, and Surface Concentrations in Operable Unit 5, Green Bay*

- *White Paper No. 19 – Estimates of PCB Mass, Sediment Volume, and Surface Sediment Concentrations in Operable Unit 5, Green Bay Using an Alternative Approach*

- *White Paper No. 20 – Green Bay Modeling Evaluation of the Effects of Sediment PCB Bed Map Revisions on GBTOXe Model Results*

- *White Paper No. 21 – Green Bay Modeling Evaluation of a Hypothetical Open-Water Disposal Site for Navigational Dredged Material in Southern Green Bay*

The additional sampling data provide revised estimates of average PCB concentrations, mass, and volume of contaminated sediments and revised mapping interpolations (discussed in White Papers Nos. 18, 19, 20, and 21 and summarized in Table 15-1). It should be noted that in addition to the consideration of the July 2002 Bay data, these evaluations also used an "alternative" method for calculating Green Bay PCB mass and contaminated sediment volumes.

Table 15-1 Summary of Green Bay SWAC, Volume, and PCB Mass Calculations

	PCB SWAC (ppm)	Mass		Volume	
		Kilograms	Pounds	Cubic Meters	Cubic Yards
RI/FS[1]	0.351	69,955	154,600	622,353,000	806,182,830
White Paper No. 18	0.353	14,600	32,120	242,543,000	316,204,200
White Paper No. 19	0.246	14,565	32,190	266,228,000	344,765,120

Note:
[1] Discussed in White Paper No. 18.

Results of these new calculations in White Papers Nos. 18 and 19 demonstrate that the RI/FS mass and volume estimates are high. Using the alternative method of calculating PCB mass and volume with the additional Green Bay data gives a lower estimate for the Bay SWAC and less PCB mass and volume of contaminated sediments. For example, the SWAC in the revised calculation from White Paper No. 19 is 0.246 ppm, less than the SWAC goal of 0.250 ppm, considered protective for the Lower Fox River. This compares to an estimated PCB SWAC of 0.351 ppm originally calculated in the RI/FS and 0.353 ppm for White Paper No. 18. These new data also confirm that the only area known to have PCB concentrations significantly above 1 ppm is located near the mouth of the Lower Fox River in the extreme southern portion of Green Bay.

Therefore, information developed in the RI/FS and the new information and evaluations provide the basis for the decision for OU 5 as described in Section 13.1. However, if additional evaluations indicate that it is appropriate, an Explanation of Significant Difference or a ROD amendment will be developed.

Responsiveness Summary

Lower Fox River and Green Bay, Wisconsin Site

Record of Decision, Operable Units 3, 4, and 5

Wisconsin Department of Natural Resources
101 S. Webster Street
Madison, Wisconsin 53703

Wisconsin Department of Natural Resources
Northeast Region
1125 N. Military Avenue
Green Bay, Wisconsin 54307

U.S. Environmental Protection Agency, Region 5
Superfund
77 W. Jackson Boulevard
Chicago, Illinois 60604

June 2003

Responsiveness Summary

Lower Fox River and Green Bay, Wisconsin Site

Record of Decision, Operable Units 3, 4, and 5

Wisconsin Department of Natural Resources
101 S. Webster Street
Madison, Wisconsin 53703

Wisconsin Department of Natural Resources
Northeast Region
1125 N. Military Avenue
Green Bay, Wisconsin 54307

U.S. Environmental Protection Agency, Region 5
Superfund
77 W. Jackson Boulevard
Chicago, Illinois 60604

June 2003

Table of Contents

List of White Papers

The previous white papers were part of the *Responsiveness Summary for the Lower Fox River and Green Bay, Wisconsin Site Record of Decision for Operable Unit 1 and Operable Unit 2* issued in December 2002.

List of White Papers

List of Acronyms

µg/kg	micrograms per kilogram
Agencies	Wisconsin Department of Natural Resources and United States Environmental Protection Agency
API	Appleton Papers, Inc.
API Panel	Appleton Paper, Inc., Panel
ARAR	applicable or relevant and appropriate requirement
ATSDR	Agency for Toxic Substances and Disease Registry
AVM	Acoustical Velocity Meter
Bay	Green Bay
BLRA	Baseline Human Health and Ecological Risk Assessment
BTAG	Biological Technical Assistance Group
CAD	confined aquatic disposal
CDF	confined disposal facility
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
cm	centimeter
CSF	cancer slope factor
CTE	central tendency exposure
CWAC	Clean Water Action Council
cy	cubic yard
cy/hr	cubic yards per hour
DMR	Data Management Summary Report
EPA	United States Environmental Protection Agency
FDA	Food and Drug Administration
FIELDS	Fully Integrated Environmental Location Decision Support
FRFood	Fox River Food Model
FRG	Fox River Group
FS	Feasibility Study
GBFood	Green Bay Food Chain Model
GBMBS	Green Bay Mass Balance Study
g/cy	grams per cubic yard
GFT	glass furnace technology
GIS	geographical information system
IDW	Inverse Distance Weighting
kg	kilogram
LaMP	Lake-wide Management Plan
LTI	Limno-Tech, Inc.
LTMP	Long-Term Monitoring Plan
MEE	Microexposure Event
mg/kg	milligrams per kilogram
MNR	Monitored Natural Recovery
NAS	National Academies of Science
NCP	National Contingency Plan
ng/m^3	nanograms per cubic meter
NOAA	National Oceanic and Atmospheric Administration

List of Acronyms

NRC	National Research Council
OU	Operable Unit
OU 1	Little Lake Butte des Morts
OU 2	Appleton to Little Rapids
OU 3	Little Rapids to De Pere
OU 4	De Pere to Green Bay
OU 5	Green Bay
Panel Report	Ecosystem-Based Rehabilitation Plan
PCB	polychlorinated biphenyl
ppb	parts per billion
ppm	parts per million
Proposed Plan	Proposed Remedial Action Plan
RAL	remedial action level
RAO	remedial action objective
RD	remedial design
RfD	reference dose
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
River	Lower Fox River
RME	reasonable maximum exposure
ROD	Record of Decision
RP	Responsible Party
RS	Responsiveness Summary
Site	Lower Fox River and Green Bay Site
SMU	Sediment Management Unit
SQT	sediment quality threshold
SWAC	surface-weighted average concentration
TAG	Technical Assistance Grant
TBC	to be considered
TTA	Time Trends Analysis
USACE	United States Army Corps of Engineers
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
WDNR	Wisconsin Department of Natural Resources
wLFRM	whole Lower Fox River Model
Workgroup	Model Evaluation Workgroup
WPDES	Wisconsin Pollution Discharge Elimination System

Executive Summary

This document is the *Responsiveness Summary for the Lower Fox River and Green Bay, Wisconsin Site Record of Decision for Operable Units 3, 4, and 5*. This Responsiveness Summary (RS) is being released subsequent to the *Responsiveness Summary for the Lower Fox River and Green Bay, Wisconsin Site Record of Decision for Operable Unit 1 and Operable Unit 2* (RS for OUs 1 and 2), which was made available to the public in January 2003. In October 2001, the Wisconsin Department of Natural Resources (WDNR) and United States Environmental Protection Agency (EPA) (collectively "the Agencies") released the *Proposed Remedial Action Plan, Lower Fox River and Green Bay* (Proposed Plan). Although the Proposed Plan recommended a cleanup plan for all five Operable Units (OUs 1 through 5) at the Lower Fox River and Green Bay Site (the Site), the Agencies are issuing two separate Records of Decision (RODs): one for OUs 1 and 2 and one for OUs 3, 4, and 5. There is an RS associated with each of the RODs.

As with the RS for OUs 1 and 2, this RS for OUs 3, 4, and 5 concludes a comprehensive comment process during which the Agencies accepted public comment on the Proposed Plan, the *Remedial Investigation for the Lower Fox River and Green Bay, Wisconsin* (RI), and the *Feasibility Study for the Lower Fox River and Green Bay, Wisconsin* (FS). These documents were presented to the public through an extensive public-involvement program, which began even before the initiation of the formal public comment period. The public-involvement program included numerous meetings/forums presented by the Agencies for and with the public.

The WDNR released a draft Remedial Investigation/Feasibility Study (RI/FS) for public review and comment in February 1999. Comments were received from other governmental agencies, the public, environmental groups, and private-sector corporations. The Agencies used these comments to revise and refine the scope of the RI/FS and Proposed Plan, which were released for public comment in October 2001, as announced in a press conference on October 5, 2001. This press conference was followed by extensive coverage through television, radio, and newspaper stories. The Proposed Plan was made available to the public through the formal comment process from October 5, 2001, until January 22, 2002.

Public comments were accepted during the comment period. Additionally, the WDNR and EPA mailed meeting reminders and Proposed Plan summaries to the 10,000 parties identified in the Lower Fox River mailing list who receive the *Fox River Current* newsletter. As with the Proposed Plan, press releases regarding the comment period and the public-support meetings were sent to newspapers and television and radio stations throughout the Fox River Valley. Further, newspaper advertisements announcing the availability of the Proposed Plan and its supporting documents were placed in the *Green Bay*

Press Gazette and the *Appleton Post Crescent*. A copy of the Proposed Plan was placed in the Site's information repositories. In addition, the Proposed Plan, the draft RI/FS, and other supporting documents containing information upon which the proposed alternative was based were made available on the WDNR's website.

In response to this public outreach, the WDNR and EPA received approximately 4,800 written comments via letter, fax, and email. The Agencies have made an exhaustive effort to respond to all of the comments received. Through the comment process, the Agencies reached agreement on remedial action plans for all five OUs, as set out in the two separate RODs. The second of those RODs, to which this RS is attached and into which this RS is incorporated, is being released at this time.

This RS is a companion document to the RS for OUs 1 and 2. Many of the comments addressed in the RS for OUs 1 and 2 are generally applicable to the entire Lower Fox River and Green Bay Site. Therefore, this RS specifically addresses comments received during the comment period that focus on OUs 3, 4, and 5. For continuity and clarity, the organization of the documents is identical (i.e., sections and subsections are presented in the same order, and the numbering of Master Comments follows sequentially from the RS for OUs 1 and 2).

This Executive Summary describes the background of the Site as it was originally presented in the first RS. It further describes the RODs and highlights the topics commented upon and responded to in the RS for OUs 3, 4, and 5. For each topic/Master Comment discussed here, a detailed response can be found within the main body of this RS.

Site Description and Background

The Lower Fox River (River) and Green Bay (Bay) Site includes an approximately 39-mile stretch of the Lower Fox River and all of Green Bay. The River portion of the Site extends from the outlet of Lake Winnebago and continues downstream to the River's mouth at Green Bay, Wisconsin. The Bay portion of the Site includes all of Green Bay, from the city of Green Bay north to Big Bay De Noc, to the point where the Bay enters Lake Michigan.

For many years, paper mills have been — and continue to be — intensely concentrated along the River. Some of these mills operated de-inking facilities in connection with the recycling of paper. Others manufactured carbonless copy paper. Polychlorinated biphenyls (PCBs) were used in the emulsion that coated carbonless copy paper. In the de-inking process and in the manufacturing process, PCBs were released from the mills to the River, either directly or after passing through wastewater treatment works. PCBs have a tendency to adhere to sediment and, consequently, have contaminated the River sediments. In addition, PCBs and contaminated sediments have been carried downriver and into the Bay.

For ease of management and administration, the Site has been divided into five discrete areas referred to as Operable Units (OUs). The River has been divided into OUs 1 through 4 and Green Bay constitutes OU 5. These OUs are:

- OU 1 – Little Lake Butte des Morts
- OU 2 – Appleton to Little Rapids
- OU 3 – Little Rapids to De Pere
- OU 4 – De Pere to Green Bay
- OU 5 – Green Bay

Record of Decision

The Record of Decision for OUs 3, 4, and 5 presents the selected remedial action for those Operable Units and is an adjunct to the ROD addressing Operable Units 1 and 2, which was released in January 2003. Together, the two RODs represent the completion of a remedial decision-making process and present the final remedial decisions for the entire Site.

The RI/FS and subsequent investigation showed that the PCBs reside primarily in the sediments in the River and Bay. Therefore, the remedial plan focuses on action involving the PCB-contaminated sediments. Removal of PCB-contaminated sediments will result in reduced PCB concentrations in fish tissue, thereby accelerating the reduction in potential future human health and ecological risks. The Agencies believe that the human health and ecological risks created by PCBs will be addressed by the remedial actions selected and documented in the ROD for OUs 3, 4, and 5.

Presently, OU 3 contains approximately 1,250 kilograms (kg) (2,750 pounds) of PCBs in 3,030,100 cubic yards (cy) of sediment. The ROD for OUs 3, 4, and 5 provides for the removal of 1,111 kg (2,444 pounds) of PCBs from OU 3 through the dredging of 586,800 cy of contaminated sediments. In addition, the ROD calls for the removal of sediments in Deposit DD in OU 2 as part of the OU 3 remedy. Deposit DD adds approximately 9,000 cy of contaminated sediment and 31 kg (68 pounds) of PCB mass to the OU 3 project.

OU 4 is estimated to contain approximately 26,650 kg (58,620 pounds) of PCBs in 8,491,400 cy of sediment. The ROD for OUs 3, 4, and 5 provides for the removal of 26,433 kg (58,150 pounds) of PCBs from OU 4 through the dredging of 5,879,500 cy of contaminated sediments.

For OU 5, the selected remedy is Monitored Natural Recovery (MNR). MNR is the monitoring of natural processes, such as degradation, dispersion, and the burial of contaminant concentrations, to the point at which the contaminants are no longer of concern. The MNR alternative includes a 40-year monitoring program for measuring PCB levels in water, sediment, fish, and birds to effectively measure progress toward and achievement of the remedial action objectives for OU 5. The selection of the MNR for OU 5 is discussed in more detail in a separate subsection below.

The Agencies have estimated that the cost for the remedial action is $284 million for OUs 3 and 4 and $39.6 million for OU 5. Although these cost estimates represent an increase from the estimate set forth in the Proposed Plan, the Agencies believe the cost estimates to be reasonable. A full evaluation of costs for implementation of the remedy in OUs 3 and 4 is contained in *White Paper No. 23 – Evaluation of Cost and Implementability of Alternative C2B for Operable Unit 3 and Operable Unit 4*.

Issuing two separate RODs made a phased approach to the remedial work possible, allowing work on upstream areas to commence first, consistent with the Agencies' policy. In addition, addressing upstream contamination first will dramatically reduce the downstream transport of PCBs and will not interfere with further downstream remediation. Reasons for issuing two separate RODs also include the following:

- OUs 1 and 2 represent approximately 6.5 percent of the PCB mass and 18 percent of the sediment volume in the River. Because they account for a smaller portion of the River area requiring remediation than do OUs 3, 4, and 5, OUs 1 and 2 present a project of more manageable size.

- Therefore, planning for the remedial action at OUs 3, 4, and 5 may benefit from knowledge gained during remedial activities conducted on a smaller scale for OUs 1 and 2.

Comments and Responses

Remedial Investigation

Definition of Operable Unit 4

Many comments were received regarding the possible division of OU 4 into two operable units (4A and 4B). Following careful review of these comments, the Agencies found no compelling reason to change the current definition of OU 4. The Agencies' basis for defining OU 4 as a single River reach include the following:

- That a large and continuous layer of soft sediment is present from the De Pere dam to the River mouth

- That there are no dams downstream of the De Pere dam

- That this reach has been modeled in the past as a single model unit

- That fish move throughout the entire reach and, from a risk-management perspective, are exposed to PCBs over the entire OU

In addition, an independent panel of professors and scientists (the Appleton Paper, Inc., Panel, referred to as "the API Panel") evaluated the Proposed Plan and completed a report entitled *Ecosystem-Based Rehabilitation Plan – An Integrated Plan for Habitat Enhancement and Expedited Exposure Reduction in the Lower Fox River and Green Bay*. This report, dated January 17, 2002, pointed out many similarities between the two parts of OU 4, including that they have similar flow velocities, that the entire OU is subject to seiche effects, and that the substrate is predominately soft sediment. In addition, the WDNR's Model Evaluation Workgroup demonstrated in *Technical Memorandum 2g: Quantification of Lower Fox River Sediment Bed Elevation Dynamics through Direct Observations* (July 23, 1999) that the riverbed in OU 4 is dynamic throughout the OU.

For all of these reasons, the Agencies determined that dividing OU 4 into two separate zones would be inappropriate.

Green Bay Mass and Volume Estimates

Several commenters expressed concern about mass and volume estimates for total PCBs in Green Bay. The estimates of PCB mass in the Lower Fox River and Green Bay in the RI/FS were generated from Technical Memoranda 2e and 2f, respectively, which are included in the *Final Model Documentation Report for the Lower Fox River and Green Bay, Wisconsin* (Model Documentation Report). The Agencies conferred with University of Wisconsin researchers who had previously performed a mass estimate for Green Bay, and the WDNR conducted a side-by-side evaluation of the two methods used for estimating PCB mass and volume. The procedures and results of this work are discussed in *White Paper No. 18 – Evaluation of an Alternative Approach of Calculating Mass, Sediment Volume, and Surface Concentrations in Operable Unit 5, Green Bay*. The general findings of White Paper No. 18 are that the mathematical approaches used in Technical Memorandum 2f and by the University of Wisconsin are both valid, with similarities in the way mass and volume are estimated. *An important finding is that regardless of the method used, PCB surface concentrations estimated for the Green Bay zones are similar*. The Agencies have concluded from these results that the differences in PCB mass estimates are not the result of the process or the mathematical models used, but arise from decisions about which data to include in the interpolation. The Agencies further determined that the PCB mass estimates derived in White Paper No. 18 following the University of Wisconsin methodology likely represent a sound estimate of PCB mass in Green Bay using a well-defined data set.

In July 2002, the WDNR and EPA collected additional data from Green Bay that has been incorporated into new PCB distribution maps included in *White Paper No. 19 – Estimates of PCB Mass, Sediment Volume, and Surface Sediment Concentrations in Operable Unit 5, Green Bay Using an Alternative Approach*. The estimates of PCB mass and volume presented in White Paper No. 19 are based on the alternative methods outlined in White Paper No. 18. Those estimates are 14,565 kg (32,116 pounds) of PCB mass and approximately 266,000,000 cubic meters (350,000,000 cy) of contaminated sediments in Green Bay. The results of the work conducted for White Paper No. 18 and White Paper No. 19 have been discussed with University of Wisconsin researchers.

Given the potential uncertainty associated with PCB mass estimates and the perceived presence of elevated levels of PCBs in Green Bay, the WDNR took the step of conducting two additional modeling evaluations. These model evaluations are documented in *White Paper No. 20 – Green Bay Modeling Evaluation of the Effects of Sediment PCB Bed Map Revisions on GBTOXe Model Results* and *White Paper No. 21 – Green Bay Modeling Evaluation of a Hypothetical Open-Water Disposal Site for Navigational Dredged Material in Southern Green Bay*. The additional modeling presented in White Paper No. 20 demonstrates that changes to PCB mass in Zone 2 of OU 5 do affect the initial conditions for the GBTOXe model, but the effect is to make those initial conditions more consistent with zones 3A, 3B, and 4 of OU 5.

The second model white paper (White Paper No. 21) evaluated how sediments dredged from the federally maintained navigation channel and disposed of in the open-water disposal areas that were operated up until the 1970s might have affected PCB distribution in the Bay. That work illustrated how PCBs within a hypothetical dredge material disposal site would be initially high in Zone 2 but would tend to become less appreciable within a 10-year time frame. Furthermore, there is no appreciable impact to sediment and water column PCB concentrations for zones 3A, 3B, and 4. In addition to the modeling work, additional samples collected within those areas did not show any detectable PCBs. Collectively, these results demonstrate that concerns about elevated PCBs from dredged material disposal are unfounded.

The end result of this work on the Bay is twofold. First, the Agencies believe the work is adequate for decision-making purposes and, therefore, the Agencies are proceeding with selection of the remedy for OU 5, which is MNR. The MNR alternative relies on naturally occurring degradation, dispersion, and burial processes to reduce the toxicity, mobility, and volume of contaminants. In selecting MNR for the Bay, the Agencies considered Superfund guidance on the nine evaluation criteria for determining whether remediation is necessary or not.

Second, the Agencies plan to conduct further remedial evaluations for Green Bay, including conducting the GBTOXe and GBFood models using the lower mass and volume estimates from White Paper No. 19. Once these evaluations are complete, the Agencies will make the results public. If the Agencies find there is reason to reconsider the MNR alternative for Green Bay, they will do so; steps in that process would include issuing a Proposed Plan, holding a public comment period, considering the comments, and finalizing a ROD Amendment.

Technical Remedial Alternatives

Vitrification

Several commenters recommended vitrification as a remedial alternative to the landfill placement of sediments. The Agencies have continued to work on evaluating the cost- and treatment-effectiveness of vitrification as a potential remedial alternative that could be identified in the remedial design phase. The WDNR recently completed a pilot-scale evaluation of vitrification, or glass furnace technology (GFT). The outcome of that study reflects that vitrification could be selected as the process option in this remedial alternative or for portions of other alternatives for OUs 3 and 4.

Dredge Slurry Pipeline

Some commenters questioned the implementability of a pipeline to carry dredge slurry to an upland disposal facility, which would be located a considerable distance from the River. The WDNR and EPA believe that the pipeline alternative is both technically feasible and implementable. A project-specific example of the feasibility of this technology can be found in the White Rock Lake (Texas) sediment dredging project (described in Section 6 of the FS), in which a 20-mile-long pipeline was used to transport 3 million cy of hydraulically dredged sediment in one year. The WDNR expects that similar success could be achieved utilizing pipeline transport technology in the Lower Fox River sediment remediation project. The WDNR and EPA plan to empanel an experienced expert technical review team to further assess planning for and construction and operation of the pipeline and disposal facility. In addition, the WDNR prepared White Paper No. 23, which reviewed technical and cost issues associated with the Proposed Plan for OUs 3 and 4, as well as the possible use and cost of a pipeline to remove dredge slurry from the River. It was determined that Alternative C2B (use of a pipeline to transfer dredge slurry) is an implementable and technically feasible alternative.

Selection of the MNR Remedial Alternative for OU 5

Several commenters disagreed with the selection of MNR as a remedial alternative for OU 5. In general, the basis for their disagreement was that MNR would not sufficiently reduce risks to the public and the environment.

The Agencies cannot agree with the expenditure of significant resources when there may be little or no benefit associated with the work. The Agencies found that none of the remedial action levels (RALs) identified in the FS provides 100 percent protection immediately after remediation (or after initiation of MNR) for all of the human or ecological receptors in the Lower Fox River or Green Bay. As summarized in Table 8-15 of the FS, none of the RALs modeled would achieve human health remedial action objectives (RAOs) in Green Bay earlier than more than 100 years after remediation. The remedial modeling forecasts (Section 8 of the FS) show that even remediating nearly 90,000,000 cy of sediment in OU 5 would achieve only limited reduction of human health and ecological risks. Given the limited risk reduction and the substantial costs and difficulties of implementing an active remedial solution, the WDNR and EPA believe that MNR is the only feasible option for Green Bay. In addition, sediments in Green Bay near the mouth of the Lower Fox River that contain PCB concentrations above 1 part per million (ppm) will be remediated as part of the removal at OU 4. This will enhance the benefits of reduced loading from the Lower Fox River as well as remove the area in Green Bay having the greatest PCB concentrations.

The proposed remediation of the Lower Fox River is expected to reduce future PCB loadings by 98 percent, and the Agencies believe that addressing continuing PCB discharges to Green Bay will be more cost-effective at reducing long-term risks in Green Bay than would active remediation in any portion of the Bay. The Agencies will continue to evaluate remedial alternatives for the Bay through the use of the GBTOXe and GBFood models and to make the results of these evaluations public.

The remedial decision-making process for OUs 3, 4, and 5 is fully described in *White Paper No. 22 – Remedial Decision-Making for the Lower Fox River/Green Bay Remedial Investigation, Feasibility Study, Proposed Remedial Action Plan, and Record of Decision for Operable Units 3 through 5*.

Implementability of Remedy—Disposal of Dredged Sediments

Some commenters expressed concern about the feasibility of disposing of the dredged, PCB-contaminated sediments. Commenters specifically noted the problems of siting and constructing a landfill in southern Brown County and the prohibitive cost of shipping dewatered sediment out of state. After investigating the issue, the Agencies concluded that the construction of such a disposal facility is feasible. Similar, larger landfills do currently exist in

Wisconsin. The Agencies believe that while siting a landfill may be difficult, it is feasible with the cooperation of the local parties and county, state, and federal officials. To facilitate this option, the WDNR has supported legislation to indemnify municipal landfills and publicly owned treatment works that accept sediment and leachate from sediment remediation projects (S. 292.70 Wisconsin State Statutes). The Agencies also concluded that tipping and transportation costs would be high if dredged sediments had to be shipped out of state.

Conclusion

The WDNR and EPA, after extensive public involvement and input, have selected a remedy for the Site that will achieve a protective result for human health and the environment by meeting the Site RAOs, as set forth in the Proposed Plan and the ROD for OUs 3, 4, and 5.

The Responsiveness Summary that follows presents comments associated with OUs 3, 4, and 5 that were received during the comment period, along with the Agencies' responses to those comments. This RS was prepared with the same level of effort as, and is a companion document to, the RS for OUs 1 and 2. The comments and responses presented in this RS were used in selecting the final remedy for OUs 3, 4, and 5. This Responsiveness Summary completes the comment process for the entire Site.

The ROD for OUs 3, 4, and 5, the accompanying Responsiveness Summary, and the associated white papers are available at the WDNR's website, the Fox River information repositories, and in the Administrative Record for the Site. The complementary ROD for OUs 1 and 2 and associated documents, including the RS for OUs 1 and 2, are also available at those locations. The WDNR's website address is:
http://www.dnr.state.wi.us/org/water/wm/lowerfox/index.html.

The Administrative Record for the Site can be found at:

Wisconsin Department of Natural Resources
Remediation and Redevelopment – 3rd Floor
101 S. Webster Street
Madison, Wisconsin 53707
Contact: Jill Castleberg
(608) 266-5247

Wisconsin Department of Natural Resources
Lower Fox River Basin
801 E. Walnut Street
Green Bay, Wisconsin 54301
Contact: Kelley O'Connor
(920) 448-5133

Office Hours are Monday through Friday, 8:00 a.m. to 4:30 p.m. Please call for an appointment. These materials are also available at the EPA Region 5 office at:

United States Environmental Protection Agency
Office of Public Affairs
77 W. Jackson Boulevard
Chicago, Illinois 60604-3511

Public information repositories are located at:

Appleton Public Library
225 N. Oneida Street
Appleton, Wisconsin 54911-4717

Brown County Library
515 Pine Street
Green Bay, Wisconsin 542301-5139

Door County Library
107 S. Fourth Avenue
Sturgeon Bay, Wisconsin 54235-2203

Oneida Community Library
201 Elm Street
Oneida, Wisconsin 54155-8934

Oshkosh Public Library
106 Washington Avenue
Oshkosh, Wisconsin 54901-4933

1 Legal, Policy, and Public Participation Issues

Section 1 of the RS for OUs 1 and 2 included the following subsections:

- *1.1 Policy Issues*
- *1.2 CERCLA Requirements and Issues*
- *1.3 Applicability of NAS/NRC and 11 Principles*
- *1.4 ARARS and TBCs*
- *1.5 Public Participation and Concerns*

The RS for OUs 3, 4, and 5 follows the same general organization as the RS for OUs 1 and 2. However, many of the comments addressed in the RS for OUs 1 and 2 were generally applicable to the entire Lower Fox River and Green Bay Site and so are not repeated here. Because there are no new comments associated with Sections 1.1, 1.2, 1.3, and 1.5, those sections are not included in the RS for OUs 3, 4, and 5. Prior comments associated with those sections can be found in the RS for OUs 1 and 2, which is available on the WDNR website, at the various information repositories, and in the Administrative Record for the Site. The WDNR's website address is: http://www.dnr.state.wi.us/org/water/wm/lowerfox/rifs/index.html.

Section 1 of the RS for OUs 1 and 2 included Master Comments 1.1 to 1.24. Master Comment 1.25 is therefore the first comment in the RS for OUs 3, 4, and 5.

1.4 ARARs and TBCs

ARARs stands for "applicable or relevant and appropriate requirements." TBCs stands for "to be considereds." ARARs are promulgated cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations; TBCs are guidelines and other criteria that have not been promulgated.

Master Comment 1.25

Commenters recommended that a River and Bay PCB Remediation Advisory Committee be created as an oversight group without veto power but with the power to force reconsideration and/or appeal upon a majority vote and public interest advocacy.

Response

Through an EPA program called Technical Assistance Grants (TAGs), the Clean Water Action Council (CWAC), which is based in Green Bay, has received $150,000 to hire its own technical advisor to interpret and provide input on information generated by the WDNR and EPA. The CWAC's technical advisors can also serve as liaisons between the CWAC and the Agencies. In addition, the CWAC is using TAG funds to maintain its website, produce printed materials, and mail informational pieces to those on its mailing list.

While the TAG program does not provide its participants with veto power or the ability to force reconsideration of various aspects of the cleanup, it does encourage groups to serve as local points of contact for their communities. TAG recipients are obligated to inform the rest of the community about what they learn via their technical advisors. More information on the TAG program can be found at http://www.epa.gov/superfund/tools/tag/.

2 Remedial Investigation

Section 2 of the RS for OUs 1 and 2 included the following subsections:

- *2.1 Sources of PCBs*
- *2.2 Aroclor 1242 vs. 1254*
- *2.3 Time Trends Analysis*
- *2.4 Validity of Interpolated PCB Maps*
- *2.5 Evaluation Based on New Little Lake Butte des Morts Data*
- *2.6 Scour and Hydrology*
- *2.7 Lower Fox River Dams*
- *2.8 Adequacy of Data Collected to Support the RI/BLRA/FS*

The RS for OUs 3, 4, and 5 follows the same general organization as the RS for OUs 1 and 2. However, many of the comments addressed in the RS for OUs 1 and 2 were generally applicable to the entire Lower Fox River and Green Bay Site and so are not repeated here. Because there are no new comments associated with Sections 2.2, 2.3, 2.5, and 2.7, those sections are not included in the RS for OUs 3, 4, and 5. Prior comments associated with those sections can be found in the RS for OUs 1 and 2, which is available on the WDNR website, in the various information repositories, and in the Administrative Record for the Site. The WDNR's website address is: http://www.dnr.state.wi.us/org/water/wm/lowerfox/rifs/index.html.

Section 2 of the RS for OUs 1 and 2 included Master Comments 2.1 to 2.28. Master Comment 2.29 is therefore the first comment in the RS for OUs 3, 4, and 5.

2.1 Sources of PCBs

Master Comment 2.29

The commenter believes that the WDNR should apply the sediment subarea approach taken in the 1999 draft Feasibility Study during evaluation of risks and selection of remedial alternatives. The commenter believes that OU 4 should not be treated as a single Operable Unit because of site-specific differences between the upstream and downstream portions of the reach.

Response

Following careful review of the comments about splitting OU 4 into two portions, the WDNR and EPA did not find compelling reason to change the current definition of OU 4. OU 4 is first defined in the RI. The physical and chemical characteristics of OU 4 are also discussed throughout the *Baseline Human Health and Ecological Risk Assessment for the Lower Fox River and*

Green Bay, Wisconsin (BLRA), which identifies the risks posed to human health and the environment by chemicals of concern, and the FS, which develops and evaluates a range of remedial alternatives to support the selection of a remedy that will eliminate, reduce, and/or control these risks. The basis for defining OU 4 as a single River reach consists of the following points:

- A large and continuous layer of soft sediment is present from the De Pere dam to the River mouth. Contamination is generally continuous across this Operable Unit. There is no discontinuity or physical change to clearly indicate that the subareas should be considered separately.

- Remediation would be continuous across the existing definition of the Operable Unit. Dividing OU 4 could needlessly complicate remedial activities.

- There are no more dams downstream of the De Pere dam.

- Previous research and modeling, including the Green Bay Mass Balance Study (GBMBS), considered this area as a single model unit.

- Defining OU 4 as a single River reach is consistent with the definitions of other OUs, including OU 1 and OU 3.

An independent panel of university professors and scientists (the Appleton Paper, Inc., Panel, referred to as "the API Panel") evaluated the Proposed Plan and completed a report dated January 17, 2002, and entitled *Ecosystem-Based Rehabilitation Plan – An Integrated Plan for Habitat Enhancement and Expedited Exposure Reduction in the Lower Fox River and Green Bay* (Panel Report). This report also pointed out many similarities between upstream and downstream portions of OU 4, including:

- Similar flow velocities
- Subjection to seiche effects
- Substrate that is predominately soft sediment

In addition, the WDNR demonstrated in the Model Evaluation Workgroup's *Technical Memorandum 2g: Quantification of Lower Fox River Sediment Bed Elevation Dynamics through Direct Observations* (July 23, 1999) that the riverbed in OU 4 is dynamic throughout the OU and that it is incorrect to characterize OU 4 as a continuous depositional area.

Master Comment 2.30

Several comments concerned differences in the extent of sediments in areas of OU 4 and that some areas of OU 4 contain less sediment and are more consistently depositional than others. A commenter suggests that a substantial portion of the dredging costs for OU 4 would be incurred in downstream portions.

Response

As previously noted, following careful review of comments about splitting OU 4 into two portions, the WDNR and EPA did not find a compelling reason to change the current definition of OU 4. See the response to Master Comment 2.29 for a discussion of the Agencies' reasoning.

With respect to dredging costs at OU 4, the WDNR and EPA believe that there is no compelling reason to separate costs at this stage in the remedial process. Cost estimates are prepared on an OU basis, and the costs associated with the 1 ppm cleanup level at OU 4 were reviewed again as part of the WDNR's and EPA's evaluation of comments on the RI/FS and Proposed Plan. In addition, to ensure that cost estimates were adequate, the WDNR prepared *White Paper No. 23 – Evaluation of Cost and Implementability of Alternative C2B for Operable Unit 3 and Operable Unit 4* to review technical and cost issues associated with the Proposed Plan for OUs 3 and 4.

The cost for separate dewatering and disposal facilities is greater than was estimated in the Proposed Plan, but less than what was estimated in the final FS. The cost estimate to remediate OUs 3 and 4 has increased from $200.5 million to $284 million, although some cost savings may yet be identified in the remedial design phase. The WDNR believes, based on EPA guidance, that the estimated cost for remediating OU 4 is representative and adequate (within –30 to +50 percent) for this stage of the Superfund process regardless of how the remedial design for OU 4 is staged.

2.4 Validity of Interpolated PCB Maps

Master Comment 2.31

A commenter stated that the RI appears to have erroneously added over one million cy (1,219,787 cy) of sediment to the total volume of contaminated sediment in OU 4.

Response

Sediment volume data are provided in the RI for each Sediment Management Unit (SMU). In OU 4, the entire surface area of the River bottom is addressed by the various SMU designations, and there are no significant inter-deposit areas. The Agencies have reviewed the sediment volumes for OU 4; the sediment volume estimates are accurately reflected in Table 5-13 of the RI.

Master Comment 2.32

A commenter expressed concern regarding the following statement in the Proposed Plan: "Approximately 70 percent of the total PCB quantity discharged into the River has migrated into Green Bay." The commenter believed that the statement is not accurate because it assumes that all discharged PCBs not currently in the River must be in Green Bay.

Response

The intent of this statement was to follow through on the finding of the Lake Michigan Mass Balance Study that up to 70 percent of the PCBs ultimately entering Lake Michigan on an annual basis come from the Lower Fox River. Wording has been modified in the ROD.

2.6 Scour and Hydrology

Master Comment 2.33

A commenter remarked that: (1) the downstream portion of OU 4 is not subject to shallow-water erosion effects, (2) bathymetric surveys performed by the United States Army Corps of Engineers (USACE) have been misinterpreted, and (3) scour has not occurred over the last 30 to 40 years and is unlikely to occur in the future.

Response

Comments relating to interpretations of bathymetric data and shallow-water erosion effects were previously addressed in Master Comments 2.20 through 2.24 in the RS for OUs 1 and 2. As discussed there, the WDNR's investigation of sediment bed elevation change is not a misinterpretation of the USACE bathymetric survey data in regard to elevation changes resulting from dredging activities as opposed to scouring. Technical Memorandum 2g (in the Model Documentation Report) discusses the possibility of measurement error contributing to apparent elevation changes. This possibility has been further investigated using actual field data collected by the USACE at the SMU 56/57 demonstration site in August 1999. These data show the combined vertical accuracy (both equipment and procedural) achieved by the USACE, Kewaunee Office to be on the order of ±4 centimeters (cm) for their mapping work on the Lower Fox River, which is well within the 15-cm requirement for Class I hydrographic surveys.

Geographical information system (GIS)-aided analysis of bed elevation changes in the upstream half of OU 4 (De Pere dam to the turning basin) using 1997, 1998, and 1999 USACE hydrographic survey data shows that large areas of the navigation channel undergo between 15 and 30 cm of scour even at non-spectacular flows. EPA Fully Integrated Environmental Location Decision Support (FIELDS) staff also reevaluated their analysis of USACE data; their findings are discussed in *White Paper No. 3 – Fox River Bathymetric Survey Analysis*, which is included in the ROD for OUs 1 and 2. White Paper No. 3 concludes that both erosion and depositional forces are continually changing the sediment bed throughout OU 4. Given this direct evidence about the nature of sediment bed elevation dynamics in OU 4, the WDNR feels that there is significant potential for the scouring of PCB-laden sediments given the timescale of natural recovery.

Changes in Lake Michigan water levels, and therefore Green Bay water levels, result in increasing scour to sediments in OU 4 (LTI, 2002). As a result of changes in global climate, elevations in Lake Michigan are expected to be lower through this century (EPA, 2000). Recent climate models indicate that Lake Michigan water levels could decrease by 3 feet by 2050 and by 4.5 feet by 2090, below historical low water levels (Lofgren et al., 2002; Mortsch, 1998).

In that event, resulting erosional effects would occur throughout OU 4, but would likely be more acute within the lower stretch of the River into Green Bay. Therefore, it is the position of both the WDNR and EPA that the sediments of the Lower Fox River do not represent a secure location for the long-term storage of PCBs. In addition, decisions concerning remediation, such as capping, should take into consideration potential future declines in Lake Michigan water levels that could affect water levels within the Lower Fox River and Green Bay.

References

EPA, 2000. *Preparing for a Changing Climate: The Potential Consequences of Climate Variability and Change, Great Lakes – A Summary by the Great Lakes Regional Assessment Group for the U.S. Global Change Research Program*. United States Environmental Protection Agency, Office of Research and Development, Global Research Program. October.

Lofgren, B. M. et al., 2002. Evaluation of potential impacts on Great Lakes water resources based on two GCM climate scenarios. *Journal of Great Lakes Research*. 28:537–554.

LTI, 2002. *Measurement of Burial Rates and Mixing Depths Using High Resolution Radioisotope Cores in the Lower Fox River*. In: *Comments of the Fox River Group on the Wisconsin Department of Natural Resources' Draft Remedial Investigation, Draft Feasibility Study, Baseline Human Health and Ecological Risk Assessment, and Proposed Remedial Action Plan, Appendix 10*. Prepared by Limno-Tech, Inc., Ann Arbor, Michigan.

Mortsch, L., 1998. Assessing the impact of climate change on the Great Lakes shoreline wetlands. *Climatic Change*. 40:391–416.

Master Comment 2.34

A commenter stated that the RI/FS and Proposed Plan overstate seiche effects and cited the RI as saying "the seiche occurs daily…" in OU 4. The commenter believes that the United States Geological Survey (USGS) data used were inaccurate.

Response

Section 3 (p. 33) of the RI states, "The seiche occurs daily, and, as evidenced by the Acoustical Velocity Meter (AVM) bay data, results in reversed stream flows in the lower reach of the river (Smith et al., 1988)."

The commenter appears to have misconstrued the definition of a seiche. The seiche — meaning the resonant oscillation of the water — does in fact occur daily and does involve flow reversals. However, depending upon the specific magnitude of the seiche, a flow reversal may or may not be observed by the AVM. For example, USGS hydrograph data document significant flow reversals on November 10, 1998; November 28, 1998; and December 13, 1999, at which time a flow reversal was recorded by the USGS during water column monitoring associated with the SMU 56/57 remediation project (USGS, 2000). The USGS maintains that the Lower Fox River has ever-changing flow and depth oscillation commonly associated with estuaries, and flow reversals such as the one that occurred on December 13, 1999, are common. During the SMU 56/57 project, the USGS AVM data varied by more than 4.2 feet. These increases in flow velocity of the Lower Fox River increase sediment resuspension to the fourth power (Jepsen et al., 1997). Flow, being the direction of the path of the water, does reverse itself, resulting in a seiche. The important point is that the seiching frequencies and velocities of the Lower Fox River do influence the nepheloid layer, resuspending previously deposited sediments.

References

Jepsen, R., J. Roberts, and W. Lick, 1997. Effects of bulk density on sediment erosion rates. *Water, Air and Soil Pollution*. 99:21–31.

Smith, P. L., R. A. Ragotzkie, A. W. Andren, and H. J. Harris, 1988. *Estuary Rehabilitation: The Green Bay Story*. University of Wisconsin Sea Grant Program Reprint (WIS-SG-88-864). Reprinted from *Oceanus*, 31(3):12–20.

USGS, 2000. *A Mass-Balance Approach for Assessing PCB Movement During Remediation of a PCB-Contaminated Deposit on the Fox River, Wisconsin.* Jeffrey J. Steuer. United States Department of the Interior, United States Geological Survey. December.

Master Comment 2.35

Commenters stated that Lake Winnebago functions as a large flood control reservoir that attenuates the severity of floods in the Lower Fox River.

Response

Dams at Menasha and Neenah control the Lake Winnebago water level. The dam and lock systems in place in the Lake Winnebago-Lower Fox River system are managed using the Linde Plan (USACE, 1998a) as a management guide; the dam and lock systems are primarily intended to provide water for hydropower and navigation while preserving or enhancing fish, wildlife, and wetland habitat and water quality in the Lower Fox River and the Lake Winnebago pool. The USACE Great Lakes Hydraulics and Hydrology Branch of the Detroit District has regulated the water level of Lake Winnebago using the Linde Plan since the early 1980s, and the target level represents a compromise reached between the needs of hydropower generation and navigation, not flood control.

Flooding can cause an erosive force that could influence hydrodynamic characteristics of the Lower Fox River Site. The issue of Lower Fox River dams and their potential to impact remedial considerations is addressed further in the RS for OUs 1 and 2 (Section 2.7) and *White Paper No. 4 – Dams in Wisconsin and on the Lower Fox River*.

USACE data indicate that rises in the Lake Winnebago water levels do commonly occur, resulting in the flooding of adjacent reaches (e.g., the Lower Fox River). Lake Winnebago water levels follow a seasonal pattern, rising in the spring, declining in the summer, staying level in the autumn, and declining again in the winter. However, floods have occurred during all seasons of the year in the adjacent reaches of the Wolf, Upper, and Lower Fox rivers and along the shores of Lake Winnebago. The most extensive flooding occurs in the spring, when inflows resulting from rainfall, snowmelt, and rainfall accompanied by snowmelt result in a gradual and sustained rise in the level of Lake Winnebago over a period of a few days to more than a week.

Management of Lake Winnebago pool elevation (as observed at Oshkosh) includes a maximum elevation that is not to be exceeded. If the maximum elevation is exceeded, flooding of communities and property adjacent to Lake Winnebago can be expected. If the maximum elevation is experienced, additional water is released through the Neenah and Menasha dams. Therefore, management of Lake Winnebago pool elevation does not represent unlimited storage capacity. Regulation of the water level cannot eliminate flooding potential in the Lower Fox River and may actually increase scour potential through the increased duration of high flows and the gradual release of floodwaters stored in Lake Winnebago.

Abrupt rises in the water level of Lake Winnebago do occur; rises have been associated with:

- Localized heavy precipitation on the water surface, causing a rapid rise in water elevation

- Flooding in the Lake Winnebago pool and/or the Lower Fox River (due to high outflows) during the snowmelt

- Frazil ice that clogs hydropower and industrial water intakes, causing plants to shut down and thus resulting in upstream flooding and reduction of downstream flow

- Wind actions (northeast, east, or southeast) causing a condition referred to as "wave run-up," which is a wave action causing flooding and erosion

Flooding of the Lower Fox River generally requires several days to develop. The graphical representations in Figures 1 and 2 from the USACE website (http://www.lre.usace.army.mil/index.cfm?chn_id=1072#Flood) indicate increases in the outflow of Lake Winnebago. Note that in the 1998 to 1999 period, maximum outflow for July indicates an event in which large water volume releases occurred from Lake Winnebago in an abrupt discharge, which suggests concern for flooding and excessive erosive force in the Lower Fox River.

Figure 1 Graphical Representation of Lake Winnebago Stages Comparing 2003 Levels vs. 2002 Levels in feet, Oshkosh

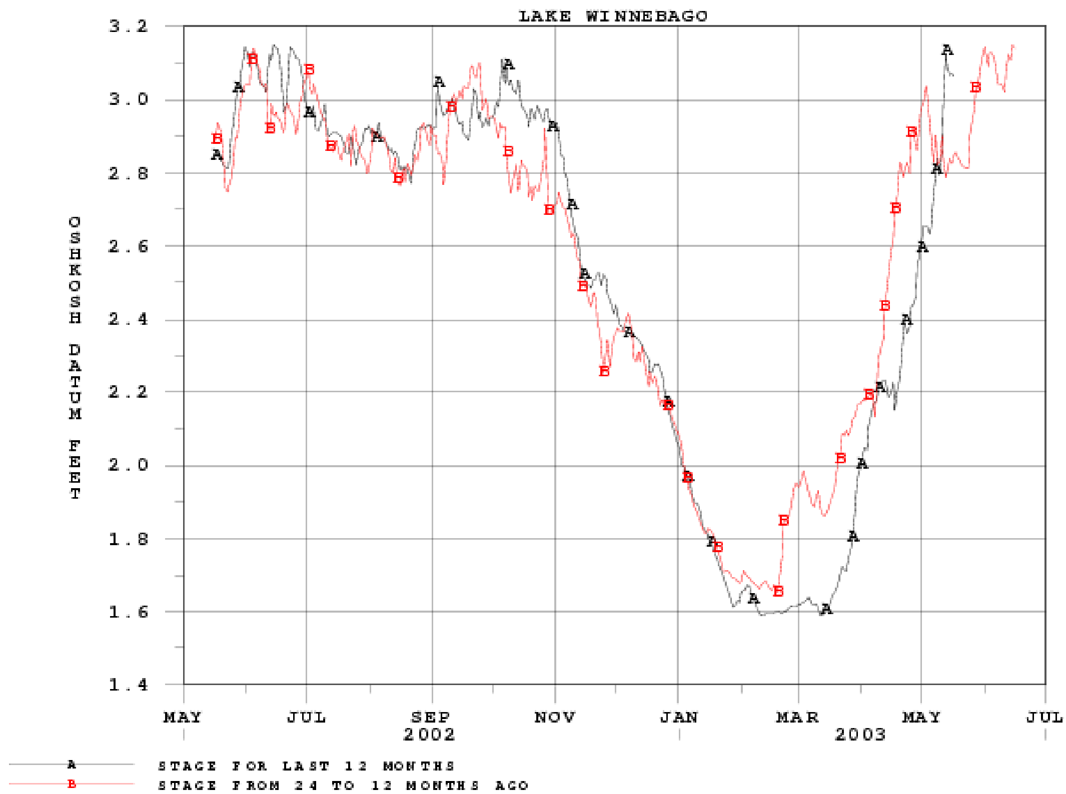
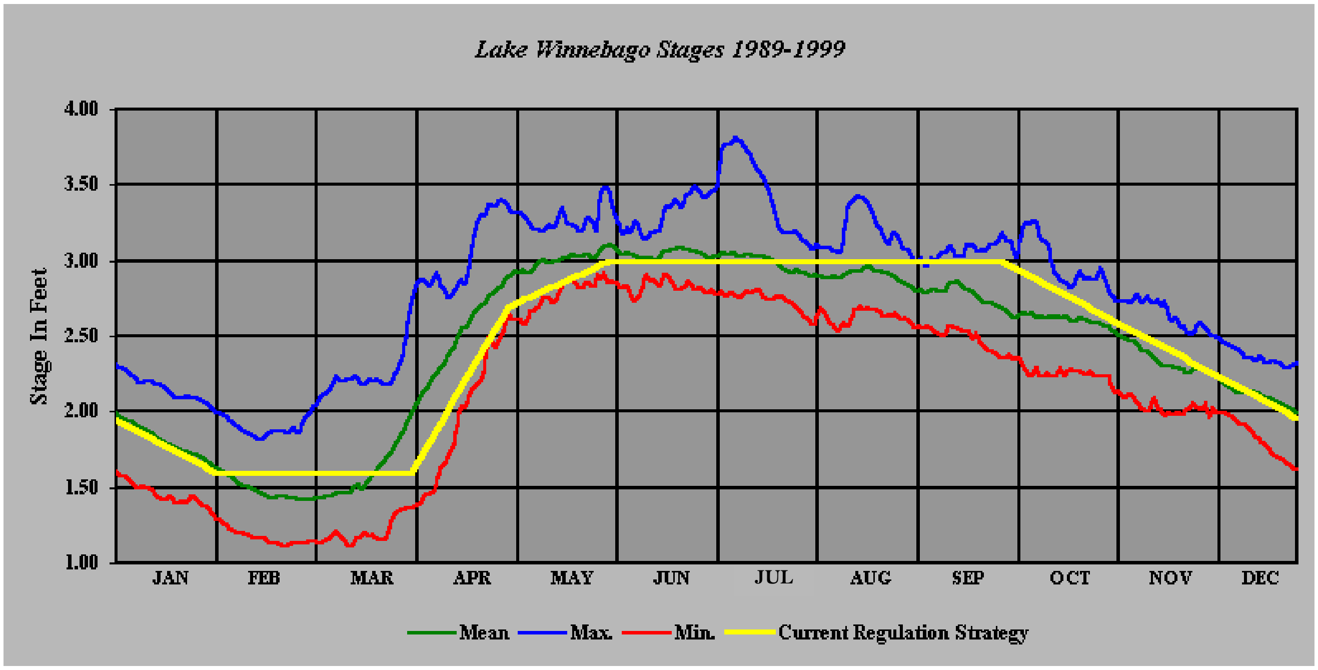


Figure 2 Graphical Representation of Lake Winnebago Mean, Maximum, Minimum, and Current Regulation Strategy for the 1989 to 1999 Period



References

USACE. United States Army Corps of Engineers Internet publication on Lake Winnebago Flooding at: http://www.lre.usace.army.mil/index.cfm?chn_id=1072#Flood.

USACE, 1998a. *Lake Winnebago Facts Book*. United States Army Corps of Engineers Internet publication at: http://www.lre.usace.army.mil/index.cfm?chn_id=1091&CFID=837994&CFTOKEN=44789620.

USACE, 1998b. *Great Lakes Erosion Fact Sheet.* United States Army Corps of Engineers Website: http://www.lre.usace.army.mil/index.cfm?chn_id=1131. August 10.

2.8 Adequacy of Data Collected to Support the RI/BLRA/FS

Master Comment 2.36

Commenters stated that past sampling in the downstream section of OU 4 was biased to nearshore areas, with minimal sampling in the dredged channel.

Response

A majority of the samples collected did focus on areas outside of the navigation channel in this portion of OU 4. The most thorough characterization of OU 4 occurred in 1995 during a project implemented by the Fox River Coalition. Areas outside of the navigation channel were specifically targeted, because information from samples taken within the area that had undergone routine dredging by the USACE would be of limited value. The purpose of the characterization was to document the lateral and vertical extent of contamination; because significant amounts of sediment have accumulated adjacent to the navigation channel, these areas were targeted. Furthermore, information from these areas provides data on the degree and extent of contamination from areas not affected by navigational dredging.

The analysis of data for the Lower Fox River did involve both a screening of historical data and interpolation of the data for each River reach. The methodology for mapping property distributions was developed jointly by the WDNR and the Fox River Group (FRG) and was documented in Technical Memorandum 2e in the Model Documentation Report. In order to use the most recent data available, the data were assigned to three different time periods: 1989 to 1992, 1993 to 1995, and 1996 to 1998. All of the data from the 1996 to 1998 period were considered sufficiently recent for use in the interpolation. As detailed in the RI, the sample frequency distribution and PCB results for each sediment deposit/SMU group/zone are plotted on Figure 5-1 of the RI, which illustrates where sediment samples have been collected and where elevated PCB concentrations have been detected. Sediment bed properties and bed mapping are further discussed in the RI. All areas of the Lower Fox River, including nearshore areas that were characterized as having soft sediments, were included in the mass and volume estimates.

Master Comment 2.37

Commenters expressed concern over the quantity and quality of the data for OU 5, including a concern that data gaps exist regarding the fate and transport of PCBs and the resulting PCB mass estimates in OU 5. A commenter requested permission to submit additional comments in the future if estimates of PCB mass and contaminated sediment volumes are revised for the Bay.

Response

The *Data Management Summary Report* (DMR), which is appended to the RI, identifies data sets used in the RI and explains how data quality issues were addressed. The EPA conducted an independent peer review of the data that evaluated whether the quality and quantity of the data are adequate to support remedial decisions. The peer review concluded that the data quality and quantity were adequate for making remedial decisions.

The Agencies recognize that uncertainties are associated with all present estimates of PCB mass and sediment volume in Green Bay and acknowledge that it is possible to develop multiple, apparently conflicting, mass and volume estimates. How the assembled data were used to generate PCB mass and sediment volume estimates for the River and Bay is explained in Technical Memoranda 2e and 2f, respectively, which are included in the Model Documentation Report. These memoranda discuss factors contributing to the mass and volume estimates, such as sediment occurrence, the depth of contamination in the sediment column, the concentration of PCBs throughout the sediment column, the bulk density of the contaminated sediments, the chronology of the sediment samples, and the interpolation model used.

The Agencies believe that Technical Memorandum 2f provides a reasonable upper-bound estimate of PCB mass in Green Bay. At the same time, a lower estimate of PCB mass and contaminated sediment volume can be obtained by interpolating based on the minimum possible values for each of the above-listed variables. The WDNR has reevaluated the data and methods used in Technical Memorandum 2f; the procedures and results of this work are discussed in *White Paper No. 18 – Evaluation of an Alternative Approach of Calculating Mass, Sediment Volume, and Surface Concentrations in Operable Unit 5, Green Bay*.

Despite the evaluations in Technical Memorandum 2f and White Paper No. 18, the WDNR conducted additional sampling in the southern part of Green Bay in responding to this and other comments and also considered additional data submitted during the comment period. The procedures and results of this work are discussed in *White Paper No. 19 – Estimates of PCB Mass, Sediment Volume, and Surface Sediment Concentrations in Operable Unit 5, Green Bay Using an Alternative Approach*. White Papers No. 18 and No. 19 demonstrate that the methods for calculating mass and volume are consistent and that the uncertainty regarding lower and upper bounds resides in the data used and in the areal extent and depth to which estimates are made for Green Bay.

The additional data and analyses do indicate a need for further consideration of Green Bay risks. Therefore, the final remedy for Green Bay includes additional analyses to ensure that the remedy decision is protective. If these evaluations indicate that the remedy should be reconsidered, the WDNR and EPA would issue a Proposed Plan recommending a different approach for Green Bay. Such a process would also include a public comment period prior to the issuance of a ROD Amendment by the Agencies.

Master Comment 2.38

Several commenters expressed concern about mass and volume estimates for total PCBs in OU 5, Green Bay. Specifically citing work conducted by University of Wisconsin researchers under the Green Bay Mass Balance program, the concern was that the WDNR overestimated the mass and volume by as much as 4.5 times.

Response

The WDNR and EPA recognize that there is uncertainty associated with any estimate of PCB mass and contaminated sediment volume in Green Bay. The Agencies further acknowledge that it is possible to develop a variety of PCB mass estimates for Green Bay depending on the assumptions and data used to generate base maps. The estimates of PCB mass in the Lower Fox River and Green Bay included in the RI/FS were generated from Technical Memoranda 2e and 2f, respectively, which are included in the Model Documentation Report.

The Agencies did confer with the University of Wisconsin researchers who previously conducted a mass balance estimate for Green Bay. On the basis of detailed discussions of the data with those researchers, the area covered in their estimates, and the exact method of mass determination, the WDNR staff was able to replicate the mass as previously reported by those researchers (Manchester-Neesvig et al., 1996).

Once the WDNR staff was confident it could replicate the work of the University of Wisconsin researchers, it was possible to conduct a side-by-side evaluation of the two methods used for estimating the mass and volume of PCBs in Green Bay. The procedures and results of this work are discussed in *White Paper No. 18 – Evaluation of an Alternative Approach of Calculating Mass, Sediment Volume, and Surface Concentrations in Operable Unit 5, Green Bay*.

The general findings of White Paper No. 18 are that the approaches used in Technical Memorandum 2f and by the University of Wisconsin researchers are both valid and have a good deal of similarity in the way mass and volume are estimated. The findings of White Paper No. 18 include:

- When parameters such as data, aerial coverage, and depth are equalized, the methods used by the University of Wisconsin and in Technical Memorandum 2f have similar results.

- The University of Wisconsin mass and volume estimates are lower than the previous estimates in part because they do not include any data from south of Long Tail Point. Subsequently, based on the receipt of new information from that area, more accurate mass and volume estimates have been made. These estimates are identified in White Paper No. 18 and *White Paper No. 19 – Estimates of PCB Mass, Sediment Volume, and Surface Sediment Concentrations in Operable Unit 5, Green Bay Using an Alternative Approach.*

- The University of Wisconsin mass and volume estimates were made using a more limited data set. The University of Wisconsin estimates were based only on those data for which there are synoptic measurements of PCB concentration and bulk density values. This resulted in the exclusion of some data that show PCB concentrations at depths greater than were used in the University of Wisconsin effort.

- The use of data from greater sediment depths leads to large increases in estimates of the volume of PCB-contaminated sediment.

- In addition to bulk density and PCB concentration, other parameters such as depth of analysis and extent of coverage also factor into PCB mass and contaminated sediment estimates.

- The PCB surface concentrations for the Green Bay zones are similar regardless of the method used.

The Agencies have concluded from these results that the differences in PCB mass estimates between the two methodologies do not result from the process or mathematical models, but depend on which data were included in the interpolation. Furthermore, the Agencies determined that the PCB mass estimates derived in White Paper No. 18 following the University of Wisconsin methodology likely represent a sound estimate of PCB mass in Green Bay.

In July 2002, the WDNR and EPA collected additional data from Green Bay; those data have been incorporated into new PCB distribution maps included in White Paper No. 19. The estimates of PCB mass and volume presented in White Paper No. 19 are based on the alternative methods outlined in White Paper No. 18. These estimates of PCB mass and contaminated sediment volume in Green Bay are 14,565 kg (32,116 pounds) and approximately 266,000,000 cubic meters (350,000,000 cy), respectively. The results of

White Paper No. 18 and White Paper No. 19 are part of this Responsiveness Summary.

Upon completion of the work outlined in White Paper No. 18 and White Paper No. 19, the results were discussed with University of Wisconsin researchers.

Reference

Manchester-Neesvig, Jon B., Anders W. Andren, and David N. Edgington, 1996. Patterns of mass sedimentation and deposition of sediment contaminated by PCBs in Green Bay. *Journal of Great Lakes Research*. 22(2):444–462.

Master Comment 2.39

Commenters suggested that estimates in the Proposed Plan of 30,000 kg (66,000 pounds) of PCBs in the Lower Fox River and 69,000 kg (152,000 pounds) of PCBs in Green Bay are not accurate. The FRG estimates there are 29,000 kg (64,000 pounds) of PCBs in the Lower Fox River and 18,000 kg (39,700 pounds) in Green Bay. The FRG believes that its estimates mean that today, 30 years after PCB releases have essentially stopped, PCBs are buried in significant portions of the River sediment and are not at all being flushed to the Bay.

Response

The Agencies' estimates of PCB mass in the Lower Fox River and Green Bay are generated from Technical Memoranda 2e and 2f, respectively, which are included in the Model Documentation Report. The difference between WDNR and FRG estimates of PCB mass in the River is small. The Agencies have reevaluated the data and methods used in Technical Memorandum 2f to estimate the PCB mass and contaminated sediment volume. In *White Paper No. 18 – Evaluation of an Alternative Approach of Calculating Mass, Sediment Volume, and Surface Concentrations in Operable Unit 5, Green Bay*, the WDNR evaluates different factors for the estimation of PCB concentration distribution, mass, and volume in Green Bay and includes July 2002 data from southern Green Bay in Bay and mass estimates. In *White Paper No. 19 – Estimates of PCB Mass, Sediment Volume, and Surface Sediment Concentrations in Operable Unit 5, Green Bay Using an Alternative Approach*, the WDNR employed the alternative approach described in White Paper No. 18 to produce estimates based on the additional data collected from Green Bay and addressed concerns about the relative lack of PCB sediment data for southern Green Bay.

The WDNR and EPA disagree with the FRG that all PCB mass in the River is buried. Numerous studies (e.g., Technical Memorandum 2f and the FIELDS

Team's *White Paper No. 3 – Fox River Bathymetric Survey Analysis*) have identified the riverbed as dynamic, and water column samples continue to show exceedances in water quality standards for PCBs, indicating that a source remains.

3 Risk Assessment

Section 3 of the RS for OUs 1 and 2 included the following subsections:

- *3.1 Baseline Human Health Risk Assessment*
- *3.2 Baseline Ecological Risk Assessment*
- *3.3 Peer Review Process and Response*
- *3.4 Sediment Quality Thresholds*

The RS for OUs 3, 4, and 5 follows the same general organization as the RS for OUs 1 and 2. However, many of the comments addressed in the RS for OUs 1 and 2 were generally applicable to the entire Lower Fox River and Green Bay Site and so are not repeated here. Because there are no new comments associated with Section 3.3, that section is not included in the RS for OUs 3, 4, and 5. Prior comments associated with that section can be found in the RS for OUs 1 and 2, which is available on the WDNR website, at the various information repositories, and in the Administrative Record for the Site. The WDNR's website address is: http://www.dnr.state.wi.us/org/water/wm/lowerfox/rifs/index.html.

Section 3 of the RS for OUs 1 and 2 included Master Comments 3.1 to 3.21. Master Comment 3.22 is therefore the first comment in the RS for OUs 3, 4, and 5.

3.1 Baseline Human Health Risk Assessment

Master Comment 3.22

Commenters stated that the BLRA overestimates the toxicity of PCBs in OU 4 because:

- The BLRA relied on toxic values calculated from animal studies and ignored evidence from more than 20 human epidemiological studies.
- The high-intake consumer threshold was added, because WDNR estimated that many of the recreational angler exposure thresholds would be met within 30 years without implementation of an active remedy.
- The risk assessment did not adequately differentiate risk in the upstream portion of OU 4 from risk in the downstream portion of OU 4.

Response

The Agencies addressed these general issues in Master Comment 3.1 of the RS for OUs 1 and 2. As stated there, the Agencies concluded that the use of EPA-derived toxicity criteria is appropriate for the human health risk assessment. These values were developed according to standard methodologies and, therefore, present a relative measure of the potential for adverse effects. Both the cancer slope factor (CSF) and the reference dose (RfD) used in the Lower Fox River human health risk assessment were also used by the EPA in the Hudson River risk assessment, where PCBs were also the primary contaminant of concern. In defense of these values, the EPA has prepared white papers on PCB carcinogenicity and noncancer toxicity as part of the Hudson River Responsiveness Summary Record of Decision (EPA, 2002); both of those white papers are attached to the RS for OUs 1 and 2. These white papers include reviews of new epidemiological and toxicological information, which is also summarized in the Hudson River Responsiveness Summary (Master Comments 571 and 541) (EPA, 2002). Specifically, the EPA defended its use of the current RfD for Aroclor 1254 (2×10^{-5}) based on EPA guidelines for selecting preferred toxicity values that are used in risk assessment (EPA, 1989) and because at the time that the RfD was developed, the information was both internally and externally peer-reviewed (EPA, 1993).

Comments received on the human health portion of the BLRA did not question the use of the CSF, but did question the use of the RfD. On behalf of the FRG, AMEC, an engineering services company, recommended that the RfD be 10 times higher (2×10^{-4}) based on the application of revised uncertainty factors associated with the extrapolation from effects in monkeys to effects in humans (AMEC, 2002). This revision was based on an analysis of human data and a comparison of human data to monkey data. The human data came from two capacitor manufacturing plants in New York State where workers had been exposed to Aroclor 1254. The two uncertainty factors that they recommended reducing were related to the extrapolation of subchronic to chronic data and for interindividual sensitivity. Currently, the EPA is conducting a reassessment of the noncancer health effects of Aroclor 1254; however, this reassessment has not been completed and it is not appropriate to use a reference dose that has not been adopted by the EPA. Preliminary findings of the reassessment indicate that the use of animal-to-human uncertainty factors is appropriate, citing results of studies that support greater sensitivity in humans than monkeys.

Use of the lower, current EPA-published reference dose is also supported in the Agency for Toxic Substances and Disease Registry's *Toxicological Profile for Polychlorinated Biphenyls (PCBs)* (ATSDR, 2002). This document presents detailed information from several studies that illustrate increased weight-of-evidence of noncancer effects (such as developmental, reproductive, immunological, and neurobehavioral effects) of PCBs at very low doses, especially in children (including fetuses and nursing infants). Inclusion of the high-intake consumer receptor is appropriate, because it represents an upper end of the population of exposed anglers. This does not overstate the toxicity of PCBs, as the comments suggest; it merely presents an upper-bound estimate of intake.

The WDNR and EPA believe the BLRA adequately differentiates risk for each reach/zone of the exposure area. Six different fish ingestion scenarios were evaluated: reasonable maximum exposure (RME) recreational angler with upper-bound concentrations; RME recreational angler with average concentrations; central tendency exposure (CTE) recreational angler with average concentrations; RME high-intake fish consumer with upper-bound concentrations; RME high-intake fish consumer with average concentrations; and CTE high-intake fish consumer with average concentrations. In addition, exposure point concentrations were calculated separately for each reach of the Lower Fox River and each zone of Green Bay. As previously stated, these various exposure scenarios present the range of PCB intakes, which is independent of PCB toxicity.

References

AMEC, 2002. *FRG's Alternative Human Health Risk Assessment of the Lower Fox River and Green Bay, Wisconsin*.

ATSDR, 2002. *Toxicological Profile for Polychlorinated Biphenyls (PCBs)*. Agency for Toxic Substances and Disease Registry.

EPA, 1989. *Risk Assessment Guidance for Superfund (RAGS), Volume 1. Human Health Evaluation Manual (Part A)*. EPA/540/I-89/002. United States Environmental Protection Agency, Office of Emergency and Remedial Response, Washington, D.C. December.

EPA, 1993. *Workshop Report on Developmental Neurotoxic Effects Associated with Exposure to PCBs*. EPA/630/R-92/004. United States Environmental Protection Agency, Risk Assessment Forum, Office of Research and Development, Washington, D.C. May.

EPA, 2002. *Responsiveness Summary Hudson River PCBs Site Record of Decision*. United States Environmental Protection Agency, Region 2 and United States Army Corps of Engineers, Kansas City District. January.

Master Comment 3.23

Commenters stated that there are differing levels of exposure and risks to human health, as well as to ecological receptors, within OU 4. They argued that the downstream section of OU 4 has less habitat and, therefore, there is less exposure of fish to PCBs in the downstream portion than in the upstream portion. In addition, commenters stated that OU 4B offers less fish area and access than do the upstream portions, thus lowering risks to humans.

Response

The Agencies believe that commenters' statements concerning fish exposure or risk in upstream and downstream OU 4, as well as comments on preferred fishing locations, are in error. Fish species are not confined to either the upstream or downstream portions of OU 4 (i.e., OU 4B or OU 4A); rather, they are exposed throughout the entire reach. Depending on the season and location of food items, the principal sport fish species (walleye, white bass, catfish, yellow perch) can be found in OU 4B. Adult walleye, for example, are frequently found associated with physical structures in OU 4B and pursue gizzard shad, which can be found in all areas of the River.

Concerning fishing location, most of the seasoned anglers attempting to catch larger walleye focus on the shipping channel and associated structures, even during the spawning period, because many large females can be found at these locations. Many of these sites are found in the downstream sections of OU 4B. While it is true that the highest fishing pressure for walleye occurs during the spawning period, anglers also seek walleye at other times of the year, particularly during late summer and fall, when the downriver areas can be especially productive. Furthermore, flathead catfish are sought throughout the summer months and anglers frequently fish for this species from shore along the walkway in downtown Green Bay. White bass and white perch, in particular, are attracted to the many warm-water discharges that can be found in OU 4B, especially during early spring and late fall. In addition, a very popular shore-based fishing point is the breakwater at the mouth of the River on the western shore. On any given day, numerous high-intake fishermen, along with their families, fish along that wall.

For these reasons, the Agencies conclude that managing OU 4 as a single Operable Unit, as discussed in the response to Master Comment 2.29, is also appropriate from a risk standpoint.

Master Comment 3.24

One commenter stated that remediation plans should be created for Green Bay to prevent recontamination of the Lower Fox River. In addition, the commenter felt that because fish freely migrate between Zone 1 (which is OU 4) and Zone 2 of Green Bay, the Bay should be actively remediated so that fish consumption advisories can be lifted in less than 50 years.

Response

The Agencies believe that the appropriate remedial plan for all of Green Bay is Monitored Natural Recovery (MNR). The Agencies are not aware of a mechanism that would result in basin-wide recontamination of the Lower Fox River as a result of sediment transport from Green Bay into the River. While the Agencies agree that some limited sediment transport could occur during seiche events, surface sampling in Green Bay Zone 2, which is described in White Paper No. 19, demonstrated that surface sediment concentrations of PCBs are less than 0.3 ppm. This, combined with other data collected in Zone 2, leads to an estimated surface-weighted average concentration (SWAC) of 262 parts per billion (ppb). Given these more recent data, Zone 2 appears to be at the PCB SWAC level that will be achieved in all reaches of the Lower Fox River after active remediation. Eliminating further River transport of PCBs to Green Bay will further reduce fish exposure to PCBs in Zone 2. Given these new data, the Agencies are planning to reevaluate all remedial alternatives for Green Bay. This evaluation will include reprojecting the 100-year fish tissue PCB concentrations using the information generated in White Paper No. 19. Once this work is completed, the Agencies will make the results public.

Regarding fish migration in Green Bay, the Agencies agree that fish do move freely between OU 4 and Green Bay and that, based on model projections, total PCB fish tissue concentrations for migrating fish do not fall below 60 ppb, the fish consumption advisory level, within the 100-year projections. Several different model scenarios were evaluated using the combined transport and bioaccumulation models. As documented in the Green Bay Food Chain Model (GBFood) appendix to the Model Documentation Report, a projection that combined a 1 ppm RAL in the River with No Action in Green Bay did result in significant reductions of PCB concentrations in fish tissue. For fish that are predominantly resident in OU 4, the PCB levels will drop below 60 ppb, but PCB levels will not fall below the fish consumption advisory level for Zone 2 fish. However, even with active remediation in Green Bay, the 100-year projections did not result in PCB concentrations in fish tissue that would lead to the lifting of fish consumption advisories within 100 years.

The Agencies concluded that because risk reduction goals would not be achieved even with active remediation, MNR, with planned monitoring and reevaluation of progress toward those goals, is the appropriate response for Green Bay. Monitored Natural Recovery should not be construed as “no action.” The Long-Term Monitoring Plan (LTMP) being developed by the Agencies uses changes in fish tissue PCB levels as an explicit metric for evaluating progress toward removal of the fish consumption advisories. After the reevaluation of Green Bay described above is completed, projections developed during that reevaluation may be compared to the measured fish tissue PCB concentrations as determined under the LTMP. With the MNR alternative, if progress is not being achieved, the Agencies can evaluate whether further active actions are warranted.

Master Comment 3.25

A commenter believes that corrections need to be made to include higher fish consumption rates for highly exposed populations, such as subsistence consumers and minorities, and that the "reduction factor" should be removed to protect individuals who do not properly clean and cook the fish.

Response

The WDNR and EPA do not believe that the BLRA needs corrections. The Agencies considered the time to achieve removal of fish consumption advisories, as well as the reduction in impacts to the ecosystem, when developing the BLRA. The exposure estimates used in the BLRA were carefully selected based on the literature as well as on communication with various Agency personnel. The use of the two West et al. (1989, 1993) studies for exposure estimates is further supported because these are regionally relevant data and because the studies were specifically discussed in detail in the EPA *Exposure Factors Handbook* (EPA, 1997). These data were also used to derive fish consumption rates for the Great Lakes Water Quality Criteria.

The number of "high-intake consumers" estimated in the BLRA is actually overstated, which does not affect the resulting calculated risks for a high-intake consumer. Although there may not be adequate data to evaluate specific subpopulations (e.g., low-income, native American), such an evaluation was not an objective of the BLRA. The objective was to estimate risks to a high-intake consumer, regardless of the number of people who fall into that category or what subpopulation they could be grouped into. A comparison of risk estimates based on the Wisconsin survey data (AMEC, 2002) and similar information from studies used in the BLRA indicates that consumption rates and risk estimates are not significantly different.

The WDNR performed an extensive Time Trends Analysis (RI, Appendix B), which indicated that fish tissue concentrations are not consistently declining for species that are routinely consumed by humans. In the absence of statistical confirmation that tissue concentrations are declining, exposure concentrations were assumed to be static. An assumption of declining fish concentrations would have to be well-supported by the data in order to be certain that human health was being adequately protected. Additionally, even if fish concentrations were found to be declining over time, people have potentially been exposed to historically higher concentrations in fish for the past 30 years. Given the uncertainty about whether fish tissue concentrations are declining and the uncertainty associated with how long people may have been exposed to historically high PCB concentrations, the WDNR used a static point estimate for fish tissue exposure concentrations. It is also important to note that the focused evaluation considered different species of sport fish individually, as well as combined species. This approach was deemed necessary to evaluate and be fully protective of recreational sport anglers who actively fish for certain species (e.g., walleye). Further discussion of the ecological and human health risks related to fish consumption appears in the response to Master Comment 3.23 of this RS.

References

AMEC, 2002. *FRG's Alternative Human Health Risk Assessment of the Lower Fox River and Green Bay, Wisconsin.*

EPA, 1997. *Exposure Factors Handbook (Update to Exposure Factors Handbook – May 1989)*. EPA/600/8-89/043. United States Environmental Protection Agency, Office of Research and Development, Washington, D.C.

West, P. C., M. J. Fly, R. Marans, and F. Larkin, 1989. *Michigan Sport Anglers Fish Consumption Survey*. Technical Report #1. Prepared for Michigan Toxic Substance Control Commission. Natural Resources Sociology Research Laboratory.

West, P. C., J. M. Fly, R. Marans, F. Larkin, and D. Rosenblatt, 1993. *1991–1992 Michigan Sport Anglers Fish Consumption Study*. Technical Report #6. Prepared by University of Michigan, School of Natural Resources for Michigan Department of Natural Resources, Ann Arbor, Michigan. University of Michigan. May.

Master Comment 3.26

A commenter stated that, for OU 4, an alternative human health risk assessment model predicts that the potential human health risk would actually increase slightly under the proposed remedy.

Response

The EPA and WDNR disagree with this statement. The FRG conducted an advanced form of Monte Carlo risk assessment, known as Microexposure Event (MEE) analysis, as the basis for its human health risk assessment (AMEC, 2002). This model was presented in opposition to the analysis presented in the BLRA, which is based on a point estimate as opposed to a probabilistic model (i.e., Monte Carlo). Please see the response to Master Comment 3.8 in the RS for OUs 1 and 2 (WDNR and EPA, 2002) for further discussion of the basis for selecting the risk analysis tools that were used to assess human health risks from PCB exposure in the Lower Fox River. (Note that the discussion in Master Comment 3.8 covers the entire River and is not limited to an analysis of OU 4.) As with the other models presented by the FRG, the MEE model was not subject to same degree of scientific scrutiny and peer review as was the whole Lower Fox River Model (wLFRM). More information on how the Agencies used models in making decisions can be found in *White Paper No. 9 – Remedial Decision-Making in the Remedy Selection for the Lower Fox River/Green Bay Remedial Investigation, Feasibility Study, and Proposed Remedial Action Plan*, which is part of the RS and ROD for OUs 1 and 2, and *White Paper No. 22 – Remedial Decision-Making for the Lower Fox River/Green Bay Remedial Investigation, Feasibility Study, Proposed Remedial Action Plan, and Record of Decision for Operable Units 3 through 5*.

In addition, the WDNR and EPA disagree with the foundation of this comment, which is that alternative models developed outside the collaborative and peer-reviewed process are better models than those used in the RI/FS. The models (FoxSim and the MEE model) cited by the commenter appear for the first time in the FRG's comments to the RI/FS and do not appear to have been subject to the same degree of scientific scrutiny and peer review as were the RI/FS models. The peer-reviewed process for model development is detailed in Master Comments 6.21 and 9.4 of the RS for OUs 1 and 2.

The Agencies also believe that the "increased human health risk" cited by the commenter is an artifact of worst-case assumptions made about post-removal sediment PCB concentrations and the resultant sediment transport conditions as predicted by FoxSim, not wLFRM. Therefore, the risk assertion is not made on a basis similar to conditions used in the RI/FS. The WDNR did, however, review the FoxSim model. The conclusions of that review can be found in *White Paper No. 15 – FoxSim Model Documentation*, which is part of the RS and ROD for OUs 1 and 2.

References

AMEC, 2002. *FRG's Alternative Human Health Risk Assessment of the Lower Fox River and Green Bay, Wisconsin.*

WDNR and EPA, 2002. *Record of Decision for Operable Unit 1 and Operable Unit 2, Lower Fox River and Green Bay, Wisconsin*. Wisconsin Department of Natural Resources, Madison and Green Bay, Wisconsin and United States Environmental Protection Agency, Region 5, Chicago, Illinois. December.

3.2 Baseline Ecological Risk Assessment

Master Comment 3.27

Commenters expressed concern that the portion of Green Bay known as Zone 2 is used for commercial fishing and that fish caught in Green Bay Zone 2 would be served at restaurants. Furthermore, the commenters do not believe the human health risk assessment has taken this concern into account.

Response

It is correct that there are commercially caught fish in Zone 2. Table 1 summarizes the types of fish targeted and the recorded catches during the 2000 to 2002 period.

Table 1 Commercially Caught Fish in Green Bay Zone 2

Fish	Year (number of fish captured)		
	2000	**2001**	**2002**
Lake Whitefish	61,233	71,095	40,298
Menominee Whitefish	22	3	80
Rainbow Smelt	34,280	12,121	680
Yellow Perch	46,148	31,952	18,229

Source: WDNR Bureau of Fisheries Management and Habitat Protection, April 11, 2003.

However, the comment is not correct in asserting that the human health risk assessment does not account for fish potentially consumed in restaurants. Exposure and intake assumptions used in the human health risk assessment are conservative and are consistent with standard and customary EPA approaches (see the first paragraph of the response to Master Comment 3.25 for a discussion of how the exposure estimates used in the human health risk assessment were selected). Although the human health risk assessment does not speak directly to the restaurant consumption of fish commercially caught in Zone 2, it did analyze various consumption scenarios, including high-intake consumption. (In fact, another commenter contends that the number of "high-intake consumers" estimated in the BLRA is overstated. However, that number does not affect the resulting calculated risks for a high-intake consumer.) The objective was to estimate risks to high-intake consumers, regardless of the number of people who fall into this category or what subpopulation they may be part of, including the subpopulation of people who eat fish in restaurants.

Although not directly relevant to the human health risk assessment, the WDNR does currently monitor the fish in Green Bay and issue fish consumption advisories (available at http://www.dnr.state.wi.us/org/water/fhp/fish/advisories/Index.htm) based on a comparison of PCB tissue concentrations to the Food and Drug Administration (FDA) limits for PCB exposure.

Master Comment 3.28

Commenters expressed the opinion that the ecological risk assessment in the BLRA is weak and inconsistent in stating that PCBs have caused reduced reproduction and increased deformities in Green Bay tern colonies. The commenters noted that tern habitat is limited to the mouth of the River and Renard Island. Studies have shown no current risk to these birds and the United States Fish and Wildlife Service (USFWS) concluded that Caspian terns have not been injured by PCBs.

Response

The Agencies disagree with this comment. Piscivorous birds rely primarily on fish for food. Of the bird populations present at the Site, piscivorous birds represent a high trophic level and, therefore, are more at risk from contaminants transferred through the food chain than are insectivores. Examples of piscivorous birds on the Lower Fox River and Green Bay include cormorants and terns. The BLRA used these species to represent all piscivorous birds that could use the Lower Fox River and Green Bay system.

To avoid confusion between the presence or absence of one species and risk to the entire assessment endpoint, it is important to recognize the distinction between the assessment endpoint and the measurement endpoint. For example, terns and cormorants were evaluated to represent the piscivorous bird assessment endpoint. To that end, adverse impacts to these species (the measurement endpoint) are meant to be representative of adverse impacts to all piscivorous birds (the assessment endpoint), because other species of piscivorous birds that were not specifically evaluated (e.g., gull, heron, egret) must also be protected if they are present. Therefore, it is imperative to be conservative, yet scientifically sound, when translating impacts on a given species to the assessment endpoint. That is, the lack of impact on one receptor species does not mean the assessment endpoint is not at risk. For that reason, the determination of risk to piscivorous bird reproduction and survival is inclusive of all piscivorous birds living and feeding from the Lower Fox River and from Green Bay.

The conclusion of the BLRA is that risk is present to the assessment endpoint. The assessment endpoint in the BLRA is "piscivorous bird reproduction and survival," and is not limited to risk to Caspian terns. The BLRA used several lines of evidence to reach this conclusion. These lines of evidence included modeling the food-chain uptake of contaminants, USFWS studies, and site-specific chemical information.

Master Comment 3.29

Some commenters believe that because of habitat limitations, sediments in areas of OU 4 are unlikely to contribute to PCB body burdens in the fish species preferred by most anglers (walleye, catfish, white perch, white bass, and yellow perch). Commenters stated that carp (which was referred to as an unpalatable "trash fish") is the only species in OU 4 identified by the WDNR as not showing substantially decreasing PCB concentrations.

Response

The species (walleye, catfish, white perch, carp, white bass, and yellow perch) noted in the comments do not confine themselves to subsections of OU 4. Depending on the season and the location of food items, all six of the named species can be found in all sections of OU 4. For examples, see the discussion of fish locations in the response to Master Comment 3.23.

The Time Trends Analysis (RI, Appendix B) does find that carp in OU 4 show a statistically significant increase in PCB concentration. As discussed in Master Comment 3.3 of the RS for OUs 1 and 2, people do eat carp, which is why the finding of increased tissue PCB concentrations is important to the Agencies' goal of protecting human health and the environment. That people consume carp is readily demonstrated by the number of websites dedicated to finding and preparing carp for human consumption (for example, www.carpanglersgroup.org, www.carp.net, www.carpuniverse.com, and www.carpdreamfishing.com).

The decision to proceed with active remediation was based on risk reduction and the time necessary to reduce or eliminate consumption advisories for fish. The Agencies concur that the processes involved in natural recovery are not amenable to an effective and expeditious remediation of the Lower Fox River. Natural processes would take more than 100 years for recovery, whereas a 1 ppm dredging remedy will lead to the removal of fish consumption advisories in an estimated 20 years.

Master Comment 3.30

Commenters expressed concern that no remedy will enable the removal of fish advisories for high-intake consumers (the most restrictive exposure scenario) because of contamination entering the Lower Fox River from Lake Winnebago and Green Bay from the River.

Response

Commenters are correct that fish consumption advisories exist for Lake Winnebago. These advisories, however, are less stringent than those for the

Lower Fox River and Green Bay. For instance, in Little Lake Butte des Morts and the rest of the Lower Fox River, all sizes of carp are “Do Not Eat” and no species of fish fall into the “unlimited” or “once per week” consumption categories. However, Lake Winnebago advisories allow for more frequent consumption of most species (“unlimited” or “once per week”) and limit only the consumption of large carp and large channel catfish to 12 meals a year. Lake Winnebago does not have any “Do Not Eat” or “Eat no more than six meals per year” restrictions.

Although it will not be possible to remove all consumption advisories once the remediation is complete, the WDNR and EPA do expect on the basis of computer modeling that as time passes the advisories will, at a minimum, be reduced if not completely eliminated. The WDNR and EPA will also require continued monitoring of fish to determine whether there are reductions in tissue concentrations.

Fish consumption advisories are effective only if fish consumers are aware of and choose to follow the advisory. The WDNR, in cooperation with the Wisconsin Division of Health, will revise the fish consumption advisories for the Lower Fox River and Green Bay according to the Great Lakes Task Force Protocol and will continue to provide that information using a variety of methods (e.g., publications, news releases, Internet sites). In addition, these Agencies plan to continue ongoing educational efforts, such as posting advisories at boat landings and providing literature on advisories in multiple languages.

The WDNR and EPA’s objectives are to eliminate consumption advisories for recreational anglers within 10 years and for high-intake fish consumers within 30 years of the completion of remediation.

Master Comment 3.31

Commenters contended that PCBs are not currently a cause of many use impairments or suspected impairments of the Lower Fox River and Green Bay system. Commenters stated that PCBs in the system do not cause: (1) degraded fish or wildlife populations; (2) tainted fish or wildlife flavors; (3) fish tumors or other deformities; (4) eutrophication or undesirable algae; (5) taste, odor, or consumption problems with drinking water; (6) beach closings; (7) the degradation of aesthetics; or (8) the loss of fish and wildlife habitat. Commenters assert that the causes of these impairments include nutrient loadings, suspended solids, stormwater runoff, turbidity, and land development.

Response

Please refer to the response to Master Comment 3.13 in the RS for OUs 1 and 2, which addressed this same issue for OUs 1 and 2 and is equally applicable to OUs 3, 4, and 5.

The WDNR and EPA do not claim that PCBs are the source of all impairments identified in the Proposed Plan for the Lower Fox River and Green Bay. However, the WDNR and EPA do believe that PCBs are the major contaminant contributing to consumption advisories and to unacceptable health risks for those who do not follow the advisories. PCBs are suspected to be an impairment related to degraded fish and wildlife; health-related alterations in fish; the degradation of benthos, as well as of populations of phytoplankton and zooplankton; restrictions placed on dredging activities; and additional costs to industry. The WDNR and EPA also believe: (1) that significant reduction in PCBs in the River will go a long way toward addressing other River impairments that affect use of the Lower Fox River and Green Bay, and (2) that after the PCB problem is addressed, it will make even greater sense to address remaining issues.

Master Comment 3.32

Commenters stated that the BLRA significantly overestimates current and future ecological risks presented by Green Bay because the BLRA does not use the full weight of evidence in quantifying risks for decision-making. Commenters further expressed their preference that the BLRA focus only on PCB congeners that contribute most significantly to ecological risk.

Response

The WDNR acknowledges that numerical weighting of lines of evidence is a type of evaluation that was not used, although it is not the only weight-of-evidence approach. The quantitative weight-of-evidence approach proposed by Menzie et al. (1996) has been used for risk characterization at few, if any, Superfund sites. However, although a numeric evaluation is intended to be more quantitative and explicit in the methods of risk ranking, the rationale for the determination of weighting factors assigned to each measurement endpoint was not clearly described or defended by Blasland, Bouck and Lee in their alternative risk assessment for the Lower Fox River (BBL, 2002). In addition, some of the weighting factors described in BBL (2002) were incorrectly recorded in the tables used to summarize numerical scores.

Both total PCB toxicity and congener-specific toxicity were evaluated in the BLRA. The WDNR and EPA believe that both evaluations were necessary and consistent with risk assessment guidance and with the recommendations of the National Research Council (NRC). For further discussion on this topic, please also see the response to Master Comment 3.11 in the RS for OUs 1 and 2.

References

BBL, 2002. *Baseline Ecological Risk Assessment of the Lower Fox River and Green Bay, Wisconsin*. Blasland, Bouck and Lee. January.

Menzie, C. M., H. Henning, J. Cura, K. Finkelstein, J. Gentile, J. Maughn, D. Mitchell, S. Petron, B. Potocki, S. Svirsky, and P. Tyler, 1996. Special report of the Massachusetts weight-of-evidence workshop: A weight-of-evidence approach for estimating ecological risks. *Human and Ecological Risk Assessment*. 6:181–201.

3.4 Sediment Quality Thresholds

Master Comment 3.33

A commenter expressed the opinion that the conceptual representation of the PCB problem at the Lower Fox River and Green Bay Site is factually inaccurate and that the Proposed Plan and supporting technical documents overstate the PCB problems.

Response

The WDNR and EPA disagree with this statement. The characterization of the Site defines sources, as well as current Site information and risks. A technical evaluation of remedial technologies is the appropriate level of detail at this point in the Superfund decision-making process. Additional sample collection and analysis will be conducted as part of the remedial design phase. The methods used to estimate PCB mass and contaminated sediment volumes in the River are identified in Technical Memorandum 2e.

4 RAOs, SQT, and RAL Selection

Section 4 of the RS for OUs 1 and 2 included the following subsections:

- *4.1 RAOs*
- *4.2 SQTs and SWACs*
- *4.3 Selection of RAL*

The RS for OUs 3, 4, and 5 follows the same general organization as the RS for OUs 1 and 2. However, many of the comments addressed in the RS for OUs 1 and 2 are generally applicable to the entire Lower Fox River and Green Bay Site and so are not repeated here. The RS for OUs 1 and 2 is available on the WDNR website, at the various information repositories, and in the Administrative Record for the Site. The WDNR's website address is: http://www.dnr.state.wi.us/org/water/wm/lowerfox/rifs/index.html.

Section 4 of the RS for OUs 1 and 2 included Master Comments 4.1 to 4.19. Master Comment 4.20 is therefore the first comment in the RS for OUs 3, 4, and 5.

4.1 RAOs

Master Comment 4.20

Commenters stated that there would be no real benefit to Green Bay from the remedies applied to the River and therefore concluded that remedial action objective (RAO) 4 is arbitrary.

Response

The WDNR and EPA disagree with this comment. RAO 4 provides for reduced PCB transport from the Lower Fox River to Green Bay. The selected remedy will remove PCBs from the River before they are able to migrate to the Bay. Further, the remedy is cost-effective, because it removes PCBs from the River, where they are more accessible for remedial management, rather than from the Bay, where they would be dilute and more expensive to remediate.

As discussed in the RI (Section 5.6), anywhere from 125 to 220 kg (275 to 485 pounds) of PCB mass is exported from the Lower Fox River to Green Bay annually. It is estimated, based on the WDNR's transport models, that there will be a greater than 90 percent reduction in annual loading of PCBs to the Bay if the remediation in the Proposed Plan is implemented.

Active remediation in the River and Bay will reduce long-term risks to human health and the environment. Contrary to the comment, the WDNR's modeling does show improvements to the Bay. For example, as documented in the FS (Table 8-10), a 1 ppm action level for the River and in the Bay reduces the time to the CTE cancer risk of 10^{-4} to 3 years. This compares to 83 years to achieve this risk level if no action is taken in the River and Bay.

RAO 4 also supports the Lake Michigan Lake-wide Management Plan's (LaMP) basic principle to "reduce loadings and emissions of LaMP critical pollutants to the Lake Michigan ecosystem and remediate contaminated sediments within the 10 Areas of Concern in the Lake Michigan basin; utilize the LaMP process to develop reduction targets (building on the Lake Michigan Mass Balance Study and the Binational Strategy); and achieve substantial reductions in human and ecological health risks in the basin" (EPA, 2000).

Reduction of the contaminant loading from the Lower Fox River to Green Bay and Lake Michigan is a fundamental goal of the remediation in the River and Bay. The remedy will reduce long-term risks to human health and the environment. Please also see the response to Master Comment 4.4 in the RS for OUs 1 and 2 for further discussion on this topic.

Reference

EPA, 2000. *Lake Michigan Lake-wide Management Plan*. United States Environmental Protection Agency Website: http://www.epa.gov/grtlakes/lakemich/.

4.2 SQTs and SWACs

Master Comment 4.21

A commenter stated that the use of SWAC may lead to the selection of a remedy that only appears protective and could result in final remedial action that does not reduce sediment surface concentrations.

Response

The WDNR and EPA disagree with this comment. The basis for the selection of the RAL was identified in the Proposed Plan and is further explained in the ROD. The Agencies gave careful consideration to what approach is needed to be protective and meet the RAOs. The WDNR and EPA chose to use the RAL-based approach for consistency among OUs. For all OUs, the resulting SWAC was evaluated to determine whether the RAL and resulting SWAC are protective of human health and the environment. The 1 ppm RAL and resulting SWAC do result in implementation of a remedy that is sufficient to meet this standard. The selection of the cleanup level is the outcome of a complete and scientifically based risk evaluation.

Derivation of the RALs, and corresponding SWACs, is discussed in the FS (Section 5). Remedial alternatives were developed for each River reach or Bay zone in the FS (Section 7) and evaluated for cost and risks, as well as compared to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) threshold and balancing criteria (FS, Sections 8 through 10). For the Proposed Plan, the EPA and WDNR selected an RAL of 1 ppm based on careful, deliberate consideration of the permanence, risk reduction, public acceptance, and costs discussed in the FS. In selecting the 1 ppm RAL, the WDNR and EPA considered RAOs, model forecasts of the time necessary to achieve risk reduction, the post-remediation SWAC, comparison of the residual concentration to sediment quality thresholds (SQTs) for human and ecological receptors, sediment volume and PCB mass to be managed, and the cost. This evaluation is discussed further in the ROD.

The WDNR and EPA selected the 1 ppm RAL based on an evaluation of action levels and the residual SWAC for each OU and the ability of the action level to meet the RAOs. The Agencies in particular considered the time to achieve the removal of fish consumption advisories, as well as the reduction in impacts to the ecosystem. The 1 ppm RAL is the best mechanism for achieving these goals consistent with the process identified in the Proposed Plan.

The WDNR and EPA carefully considered more and less stringent cleanup levels (RALs) before arriving at the 1 ppm level. In the FS, no action and multiple RALs ranging from 0.125 to 5 ppm were considered for each OU. The 1999 draft RI/FS called for an action level of 0.25 ppm. Model forecasts were used to compare the projected outcomes of the remedial alternatives using various action levels with the RAOs (primarily RAOs 2 and 3, which deal with protection of human health and the environment). On the basis of that analysis and to achieve the risk reduction objectives using a consistent action level, 1 ppm was agreed upon as the appropriate RAL. As presented in Table 1 of *White Paper No. 11 – Comparison of SQTs, RALs, RAOs and SWACs for the Lower Fox River*, the SWAC in OU 3 and OU 4 at a 1 ppm RAL is equal to or lower than the 0.25 ppm SWAC presented in the 1999 RI/FS. The 1 ppm RAL cleanup standard is a risk-based cleanup standard and is considered protective. The 0.25 ppm level from the February 1999 RI/FS was a preliminary number. The Agencies believe that the 1 ppm RAL is the best mechanism for achieving RAOs and removing fish consumption advisories.

4.3 Selection of RAL

Master Comment 4.22

The commenter believes that the proposed RAL of 1 ppm (1 milligram per kilogram [mg/kg] total PCBs) does not provide enough protection for human, wildlife, or aquatic health to remove fish consumption advisories.

Response

The WDNR and EPA disagree. The Agencies gave careful consideration to what is needed to be protective and meet the RAOs. The selection of the cleanup level is the outcome of a complete and scientifically based risk evaluation. The basis for selecting the RAL was clearly identified in the Proposed Plan and is further explained in the ROD. In selecting the 1 ppm RAL, the WDNR and EPA considered RAOs, model forecasts of the time necessary to achieve risk reduction, the post-remediation SWAC, comparison of the residual concentration to SQTs for human and ecological receptors, sediment volume and PCB mass to be managed, and cost. The WDNR and EPA carefully considered more and less stringent cleanup levels (RALs) before arriving at the 1 ppm level. No action and multiple RALs ranging from 0.125 to 5 ppm were considered for each OU. See the response to Master Comment 4.21.

The Agencies considered the time to achieve the removal of fish consumption advisories, as well as the reduction in impacts to the ecosystem. The exposure estimates used in the BLRA were carefully selected based on the literature as well as on communication with various Agency personnel. See the first paragraph of the response to Master Comment 3.25 for a discussion of how the exposure estimates used in the human health risk assessment were selected.

Master Comment 4.23

A commenter requested that the sediment cleanup standard for PCBs be strengthened to 0.25 ppm in the Bay as well as the Lower Fox River.

Response

The WDNR and EPA believe that MNR is the only feasible option for Green Bay given the limited risk reduction, substantial costs, and difficulties associated with implementing any other solution. In addition, the basis for selecting a 1 ppm RAL for the Lower Fox River was identified in the Proposed Plan and is further explained in the ROD. That selection process is also summarized in the response to Master Comment 4.21, above.

The selected cleanup standard is not arbitrary, and the Agencies gave careful consideration to what is needed to be protective and meet the RAOs. The selection of the cleanup level is the outcome of a complete and scientifically based risk evaluation. The 1 ppm RAL is the best mechanism for achieving RAOs consistent with the process identified in the Proposed Plan.

Master Comment 4.24

A commenter stated that the WDNR's remedy selection ignored OU-specific data by using a generalized value to derive an SQT specific to OU 4 (understanding that the characteristics of OU 1 are very different from OU 4 based on the government's initial work to calculate SQTs) and applying that SQT to the entire River, when water concentrations in OU 4 are 10 times higher than those of OU 1.

Response

In selecting the appropriate action level for OU 1, the WDNR and EPA applied an approach that balanced risk reduction for human health and the environment as well as the residual SWAC and the resulting human health and ecological SQT for each OU. For determination of RALs, the WDNR and EPA also considered cost and long-term effectiveness. For OU 1, the 1 ppm action level resulted in the most appropriate level of risk reduction. Sediment-to-water ratios were developed for all four reaches of the River and for Green Bay. The general term used to estimate SQTs was not from OU 4, as the commenter implies, but rather a value of 10^{-6} was determined to be a good estimation of the range of values observed. As documented in Section 7 of the BLRA, sediment-to-water ratios average between 10^{-4} and 10^{-7} for all Operable Units, with averages of 10^{-5} in OUs 3 and 4 to 10^{-6} in OUs 1 and 2 and Zone 2 of Green Bay. For more information, see Section 9.6 of the Proposed Plan and *White Paper No. 11 – Comparison of SQTs, RALs, RAOs, and SWACs for the Lower Fox River*.

Master Comment 4.25

A commenter stated that approximately 40,000 individuals in the Lower Fox River and Green Bay region are faced with PCB cancer risks similar to the risks of smoking two to three packs of cigarettes a day. This PCB exposure arises primarily through the consumption of contaminated fish and waterfowl.

Response

The WDNR and EPA disagree with this comment. The average smoker has been reported to have a cancer risk of about 1.2 in 1,000; in other words, about one in 1,000 smokers will ultimately develop cancer (Crouch and

Wilson, 1984). As determined in the BLRA, the average consumer of Lower Fox River (OU 4) fish has a cancer risk of 4.9 in 100,000; in other words, possibly five out of 100,000 people who might eat fish could develop cancer (Table 5-82 of the BLRA). These risks are about 25 times lower than the risks of the average smoker.

For the RME recreational angler, the cancer risks rise to 3.3 in 10,000 (Table 5-82 of the BLRA); for a high-intake angler, the cancer risks reach 7.8 in 10,000 (Table 5-86 of the BLRA). While the cancer risks to frequent fish consumers are high and are of concern to the WDNR and EPA, the risks are still lower than those found for average smokers and would be even lower if compared to cancer risks in heavy smokers.

Reference

Crouch and Wilson, 1984. "Inter-Risk Comparisons." In: *Assessment and Management of Chemical Risks*. Joseph Rodricks and Robert Tardiff (eds). American Chemical Society, Washington, D.C.

5 Technical Evaluation and Remedial Alternative Development

Section 5 of the RS for OUs 1 and 2 included the following subsections:

- *5.1 Effectiveness of Dredging*
- *5.2 In-Situ Sediment Caps*
- *5.3 Monitored Natural Recovery*
- *5.4 Remedy Selection*
- *5.5 Evaluation of Submitted Alternatives*

The RS for OUs 3, 4, and 5 follows the same general organization as the RS for OUs 1 and 2. However, many of the comments addressed in the RS for OUs 1 and 2 are generally applicable to the entire Lower Fox River and Green Bay Site and so are not repeated here. The RS for OUs 1 and 2 can be found on the WDNR website, at the various information repositories, and in the Administrative Record for the Site. The WDNR's website address is: http://www.dnr.state.wi.us/org/water/wm/lowerfox/rifs/index.html.

Section 5 of the RS for OUs 1 and 2 included Master Comments 5.1 to 5.70. Master Comment 5.71 is therefore the first comment in the RS for OUs 3, 4, and 5.

5.1 Effectiveness of Dredging

Master Comment 5.71

A commenter stated that the Proposed Plan did not quantify and report uncertainty in sediment bed mapping, volume estimation, and cost-effectiveness calculations.

Response

Supporting documents for the Proposed Plan provided details of uncertainties related to bed mapping and volume estimates. Specifically, Technical Memorandum 2g (Appendix A of the Model Documentation Report) attached to the FS provides a thorough analysis of the potential uncertainties of the bathymetry data. Additionally, *White Paper No. 2 – Evaluation of New Little Lake Butte des Morts PCB Sediment Samples*, attached to the ROD for OUs 1 and 2, also addresses potential uncertainties related to bathymetry data. These analyses support the conclusion that uncertainties related to bed mapping are relatively small and that the data support remedy decisions.

Nonetheless, in order to properly address the issues associated with sediment bed mapping, volume estimation, and cost-effectiveness calculations, the WDNR developed *White Paper No. 18 – Evaluation of an Alternative Approach of Calculating Mass, Sediment Volume, and Surface Concentrations in Operable Unit 5, Green Bay*; *White Paper No. 19 – Estimates of PCB Mass, Sediment Volume, and Surface Sediment Concentrations in Operable Unit 5, Green Bay Using an Alternative Approach*; and *White Paper No. 23 – Evaluation of Cost and Implementability of Alternative C2B for Operable Unit 3 and Operable Unit 4*.

The WDNR performed an alternative analysis of the PCB mass and volume estimates originally presented in *Technical Memorandum 2f: Estimates of Sediment Bed Properties for Green Bay*, which is appended to the Model Documentation Report. White Paper No. 18 was developed to respond to comments from the academic and regulated communities as well as other groups regarding the analytical procedures and assumptions about physical factors used in Technical Memorandum 2f. White Paper No. 18 evaluates a set of different factors on the estimation of concentration distribution, mass, and volume of PCBs in Green Bay.

As part of this evaluation, the WDNR devised a test to directly compare the results of the method outlined in Technical Memorandum 2f with the University of Wisconsin method to determine whether differences in PCB mass and estimates of contaminated sediment volume are attributable to differences between the two interpolation methods. The results of the method evaluation test show that differences between the University of Wisconsin's mass estimate and the mass estimate and contaminated sediment volume presented in Technical Memorandum 2f cannot be attributed to the Inverse Distance Weighting (IDW) interpolation algorithm. When parameters such as data, areal coverage, and depth are equalized, the methods used by the University of Wisconsin and in Technical Memorandum 2f yield similar results. The University of Wisconsin mass and volume estimates are low because they do not include any data south of Long Tail Point.

In addition, White Paper No. 19 employed the alternative approach described in White Paper No. 18 to produce estimates based on additional data collected from Green Bay in July 2002 and to address concerns about the relative lack of PCB sediment data for southern Green Bay. The additional data were collected from areas identified as potential open-water disposal areas.

Finally, the WDNR prepared White Paper No. 23 in response to comments on the Proposed Plan. This white paper addresses and reevaluates issues of implementation and cost-effectiveness concerning OUs 3 and 4.

Master Comment 5.72

Commenters expressed concern regarding resuspension and asserted that the Proposed Plan is unrealistic in that it assumes success at reaching the desired SWAC without recontamination problems associated with sediment resuspension during dredging. The commenters also suggested that dredging will likely result in the greatest short-term, in-River contaminant release and that the demonstration dredging projects have caused sediment resuspension and redistribution.

Response

The WDNR and EPA acknowledge that there will be sediment resuspension during remediation of the Lower Fox River. Currently, estimates of PCB mass export from the River to the Bay under a no action alternative range up to 220 kg (485 pounds) per year. Although short-term increases while dredging is taking place are possible, over the long run there will be a significant reduction (98 percent) in PCB load from the River to the Bay as a result of the remedy.

The Agencies believe that a high-end estimate of losses from dredging is the 2.2 percent estimate from the SMU 56/57 project. Applying the loss rates from that project would equate to a loss of 644 kg (1,420 pounds) of PCBs during the entire remediation of the Lower Fox River. On the other hand, the FRG offered that the annual PCB export from July 2000 to July 2001 was up to 106 kg (233 pounds) and that the rate of decline approximates a half-life of 9 years. If this rate of decline is accepted and applied to the next 20 years, it would mean that active remediation would result in almost 30 percent less PCBs resuspended and transported to Green Bay than would taking no action.

Because of technical advancements, numerous improvements have been made to dredging technologies. Results discussed in the *Sediment Technologies Memorandum* (Appendix B of the FS) indicate that dredging can be effectively implemented if the technology is designed and managed appropriately for Site conditions. Numerous improvements made to mechanical dredges (clamshell buckets) limit the release of excavated sediments, thereby minimizing sediment resuspension. Recent advances in dredge head construction and positioning technology enable accurate removal of sediment layers with minimal incidental overdredging to achieve target goals. As an example, for seven projects where overdredge was designed into the project plans, target goals were met in five cases. Hydraulic dredging can also be effectively used to control sediment resuspension. Because of unique characteristics presented by the River (bathymetry) and community (upland space for staging and processing areas), the Agencies are allowing flexibility in the implementation of dredging so that the contractor can implement the most efficient and cost-effective technology. Since both hydraulic and mechanical dredging technologies have been demonstrated to provide a protective and environmentally beneficial result (FS, Appendix B), either technology is appropriate for the removal of PCB-contaminated sediments from the Lower Fox River. In addition, the *Sediment Technologies Memorandum* provided a comprehensive evaluation of dredging projects and concluded that dredging has been successfully implemented at various sites and that considerable experience has been gained in dredging performed around the world over the last 100 years.

As stated in the FS, 17 of the 20 projects cited in Appendix B of the FS met short-term target goals that include sediment excavation to chemical concentration, mass, horizon, elevation, or depth compliance criteria. One such project, the 2000 SMU 56/57 project, demonstrated that surface concentrations similar to those assumed by the Agencies in the RI and FS can indeed be achieved. Please also see Master Comments 5.3 through 5.5 in the RS for OUs 1 and 2.

Master Comment 5.73

Commenters stated that to achieve the RAOs and minimize the potential for contaminant releases, dredging should be restricted to otherwise scheduled navigational dredging in portions of OU 4 near the mouth of the Lower Fox River and OU 5.

Response

The Agencies addressed many sediment resuspension issues in Master Comments found throughout Section 5 of the RS for OUs 1 and 2. In response to this specific comment: The WDNR and EPA chose a remedial approach based on risk reduction. To achieve this goal will require dredging of the River in areas adjacent to the navigation channel. Dredging within the navigation channel will be negligible considering previous dredging operations conducted by the USACE.

Resuspension of PCBs does occur during navigational dredging. The WDNR and EPA disagree with the commenters that current navigational dredging would be more effective at achieving RAOs than the environmental dredging identified in the ROD for OUs 3, 4, and 5. The position of the Agencies is based, in part, on the following considerations:

1) The FRG commented (page 227, Volume 1 of FRG comments) that "…clamshell may spill 20 to 30 percent of sediment during hoisting (NAS Report, p. 199–201)."

2) Navigational dredging in the Lower Fox River is currently performed mechanically using clamshells.

3) Documented losses from the SMU 56/57 project, which used hydraulic dredging, were only an estimated 2.2 percent of the PCB mass removed.

Master Comment 5.74

Commenters stated that the remedy in the Proposed Plan does not offer any significant benefit over natural attenuation for OUs 3, 4, and 5. Commenters stated that, in fact, the proposed remedy actually hinders the natural attenuation of Green Bay by causing more PCBs (beyond what would be expected under natural attenuation) to be exported to Green Bay. Commenters believe that such increased export would result in an increase in PCB concentrations in fish in Green Bay.

Response

The WDNR and EPA disagree with several elements of the commenters' statement. Analyses provided in the RI/FS, the BLRA, and the Proposed Plan all point to significant benefits for all Operable Units from active remediation. The independent API Panel also indicated that active remediation is needed in the Lower Fox River and will assist in the remediation of the Bay. The WDNR and EPA believe that the selected remedy will, in the long run, result in reductions in PCB concentrations in the water column and in the export of PCBs into Green Bay.

In addition, there is no evidence to support the proposition that natural attenuation is occurring within OU 3 and OU 4 sediments. The Site-specific Time Trends Analysis (TTA) conducted as part of the RI shows that while the estimated annual compound percent increase in PCB levels calculated for each deposit generally declines, in many cases the upper bound of the 95 percent confidence interval shows that concentrations could be stable or increasing. In addition, the commenters' supposition that natural attenuation is occurring assumes burial of contaminated sediments in perpetuity, which is untrue. The stability of PCBs currently buried in the sediment cannot be assured indefinitely. Sediment conditions in OU 3 depend on indefinite maintenance of the current dam and lock system. At OU 4, changes in lake levels may result in increased scour to sediments (LTI, 2002). Elevations in Lake Michigan are expected to be lower through this century as a result of changes to global climate (EPA, 2000). These conditions will result in an increase in PCB load to Green Bay.

Further, the TTA did point to a stabilization, or "breakpoint," in PCB concentrations for fish in Green Bay Zone 2. While there were steep declines in fish tissue PCB concentrations from the 1970s, significant breakpoints in declines for some species begin around 1980. A meta-analysis of the most recent time trends carried out for three reaches yielded 5 to 7 percent rates of decline per year averaged across species. Six species showed an increasing rate in their final slope, but only two of those rates were statistically significant. The existence of breakpoints and an additional analysis showing non-constant rates suggest that rates of change are not stable and could be different in the future. The TTA further points out that this observation is consistent across several different fish species throughout the Great Lakes.

Finally, the commenters did not provide a quantitative assessment showing that losses from the proposed remedy would be greater than losses from natural attenuation. For that reason, the details of the comment are insufficient to allow a direct response. However, an analysis provided by one of the commenters suggests that the total mass of PCBs lost under the natural attenuation option would exceed losses from removal (see the response to Master Comment 5.4 in the RS for OUs 1 and 2). Results of dredging at SMU 56/57, which the commenter acknowledged represents the most comprehensive data set available, indicate that PCB losses approximated 2.2 percent of the mass removed.

Even if loss rates from the most highly contaminated site on the River (i.e., SMU 56/57) are applied to the entire Lower Fox River, the proposed remediation would equate to a loss of 644 kg (1,420 pounds) of PCBs. On the other hand, the commenters offered that the annual PCB export from July 2000 to July 2001 was up to 106 kg (233 pounds) and that the rate of decline approximates a half-life of 9 years. If this rate of decline is accepted and applied to the next 20 years, it would mean that active remediation would result in almost 30 percent less PCBs resuspended and transported to Green Bay than would taking no action.

The Agencies believe that the analyses conducted for the RI/FS show that active remediation in OUs 3 and 4 offers significant benefits over natural attenuation, including the return of PCB levels in Green Bay to acceptable levels within a shorter time, leading in turn to greater protection of fish and other aquatic life in the Bay. The WDNR and EPA believe the selected remedy will, in the long run, result in reduced export of PCBs to Green Bay and lower PCB levels in fish tissue.

References

EPA, 2000. *Preparing for a Changing Climate: The Potential Consequences of Climate Variability and Change, Great Lakes – A Summary by the Great Lakes Regional Assessment Group for the U.S. Global Change Research Program*. United States Environmental Protection Agency, Office of Research and Development, Global Research Program. October.

LTI, 2002. *Measurement of Burial Rates and Mixing Depths Using High Resolution Radioisotope Cores in the Lower Fox River*. In: *Comments of the Fox River Group on the Wisconsin Department of Natural Resources' Draft Remedial Investigation, Draft Feasibility Study, Baseline Human Health and Ecological Risk Assessment, and Proposed Remedial Action Plan, Appendix 10*. Prepared by Limno-Tech, Inc., Ann Arbor, Michigan.

5.2 *In-Situ* Sediment Caps

Master Comment 5.75

Commenters expressed concerns about who retains the liability risk for a capping project if the integrity of the cap is compromised in the future.

Response

As discussed in *White Paper No. 6B – In-Situ Capping as a Remedy Component for the Lower Fox River* (included in the RS for OUs 1 and 2), fiduciary responsibilities for an *in-situ* cap are equivalent to those associated with any upland landfill or soil cap. Therefore, the Responsible Parties (RPs) retain long-term liability for maintaining the cap in perpetuity, which is also consistent with soil caps at brownfield sites when there is no transfer of liability for the site. The RPs also retain liability for any damages caused or additional cleanup needed if contaminants remaining beneath the cap are released in the future.

An additional fiduciary responsibility that will need to be considered for an *in-situ* cap at the Lower Fox River involves long-term monitoring and maintenance of the cap, as well as of dams on the River, and/or the potential for management of remnant deposits in the event of dam failure or removal. However, there are no specific state-mandated long-term financial proof mechanisms for coverings placed in waterways as there are for upland disposal facilities. Any negotiated settlement with the RPs in which *in-situ* capping is implemented should contain these fiduciary provisions and a limited release from liability.

Master Comment 5.76

Several commenters argued that an engineered cap less extensive than the single option considered in the FS should have been evaluated. They further stated that the draft FS rules out thin-layer capping as an option on the grounds that River velocities are too high, despite Lower Fox River stream velocity data presented in the draft FS itself showing that even 100-year flows in OUs 1 and 3 are within the range of USACE guidance for thin-layer capping.

Response

There appears to be some confusion over what sediment capping engineers mean by the term "thin-layer" cap and what the commenters are suggesting here. As discussed in the FS, thin-layer capping involves the placement of a thin (1- to 3-inch) layer of clean sediments; that layer is subsequently mixed with the underlying contaminated sediments to achieve acceptable concentrations of chemicals of concern and/or to enhance the natural attenuation process. The mixing results naturally from the activity (bioturbation) of benthic organisms. This approach is best suited to situations involving contaminants that naturally attenuate over time or in which contaminant concentrations are sufficiently low that "dilution" is the preferred alternative; examples include the West Eagle Harbor OU in Washington state and the Ward Cove, Alaska, Superfund site (see *White Paper No. 6B – In-Situ Capping as a Remedy Component for the Lower Fox River* for a discussion). Thin-layer capping, in this sense, has not been considered an acceptable alternative for the Lower Fox River, although the FS does discuss thin-layer capping.

As discussed in the response to Master Comment 5.14 in the RS for OUs 1 and 2, the cap design thickness used in each area will be a site-specific engineering determination made during the remedial design phase.

5.3 Monitored Natural Recovery

Master Comment 5.77

Commenters stated that they agreed with the recommendation made in the Proposed Plan of MNR for zones 3 and 4 of Green Bay; however, they do not agree with the selection of MNR for areas of elevated PCB concentrations within Zone 2 of Green Bay.

Response

The WDNR and EPA assessed numerous technologies for remediation of the Lower Fox River and Green Bay, including no action, MNR, capping in combination with other technologies, dredging, and numerous disposal and treatment options. Following that assessment, the WDNR and EPA considered the effectiveness of the technologies at reducing risk at various action levels, as well as their cost and implementability.

This comment, along with other concerns raised about Green Bay, led the Agencies to address concerns about the relative lack of PCB sediment data for southern Green Bay by collecting additional data. The Agencies also reevaluated the data and methods used in Technical Memorandum 2f to estimate PCB mass and contaminated sediment volume in Green Bay. *White Paper No. 18 – Evaluation of an Alternative Approach of Calculating Mass, Sediment Volume, and Surface Concentrations in Operable Unit 5, Green Bay* evaluates a set of different factors on the estimation of concentration distribution, mass, and volume of PCBs in Green Bay. The data collected from southern Green Bay in July 2002 was used to further refine Green Bay PCB mass and contaminated sediment volumes using the alternative approach described in White Paper No. 18; this undertaking is discussed in *White Paper No. 19 – Estimates of PCB Mass, Sediment Volume, and Surface Sediment Concentrations in Operable Unit 5, Green Bay Using an Alternative Approach*.

The ROD for OUs 3, 4, and 5 states that remediation will extend a short distance into Zone 2 of Green Bay to address an area of contaminated material adjacent to the mouth of the River. Further discussion on the remedy selection for OU 5 (zones 2 through 4 of Green Bay) can be found in Section 11.3 of the ROD for OUs 3, 4, and 5.

The proposed remediation of the Lower Fox River is expected to reduce future PCB loadings to Green Bay by 98 percent. The WDNR and EPA believe that, given the limited risk reduction and substantial costs and difficulties associated with implementing an active remedial solution in Green Bay, MNR combined with the reduction of PCB loadings from the Lower Fox River is the most feasible option for zones 2, 3, and 4 of Green Bay. However, acknowledging the substantial interest by the Lower Fox River and Green Bay communities, the Agencies are proceeding with further remedial evaluations of Green Bay, including conducting the GBTOXe and GBFood models using the lower mass and volume estimates derived from White Paper No. 19. Once this work is completed, the Agencies will make the results public.

Master Comment 5.78

Commenters suggested that MNR for the downstream portion of OU 4 would satisfy remedy selection and be more implementable. They suggested that dredging in OU 4B will not start until at least 15 years from now and that natural attenuation in the downstream portions of OU 4 will continue during the time required for any active remediation in the upstream portion. A commenter stated that within 17 years, the SWAC will be less than 1 mg/kg PCBs throughout the downstream portion of OU 4 and currently buried masses will be even more deeply buried.

Response

First, the Agencies do not agree with the underlying proposition that OU 4 should be divided into two segments. Please see the response to Master Comment 2.29 for a discussion of the Agencies' reasoning.

Second, there is no basis within the FS to support the comment. The Agencies expect that remediation of OUs 3 and 4 will take place simultaneously and be completed in less than 10 years, not 17 years as assumed in the comment. In addition, the cleanup level for OU 4 is not 1 ppm SWAC; the cleanup level is the removal of all contaminated sediment above 1 ppm, which will result in a SWAC of considerably less than 1 ppm. If all the contaminated sediment above the 1 ppm RAL is remediated, the SWAC is estimated to be 0.16 ppm for OU 4. Dredging to achieve a 1 ppm RAL is the appropriate remedy for OU 4. Once dredging has been completed, the natural processes of dispersion and burial may further assist the River in its recovery.

Third, given the significant changes in sediment bed elevations documented in Technical Memorandum 2g and *White Paper No. 3 – Fox River Bathymetric Survey Analysis*, the Agencies do not agree with the commenters' conclusion that the downstream portion of OU 4 will undergo only deposition of material, in perpetuity. The Agencies' selection of the MNR alternative for OU 5 is premised on a reduction of PCB loadings to Green Bay through remediation of Lower Fox River sediments. Leaving significant deposits of PCBs vulnerable to resuspension through natural (scour) or artificial forces (ship traffic) would require reconsideration of the remedial decision for OU 5.

Master Comment 5.79

Commenters expressed opposition to the proposed selection of the MNR alternative for Green Bay. Commenters stated that MNR in Green Bay does not reduce the risks as effectively as mass removal, is not adequately protective to the public and the environment, and represents the highest risk to human health and ecology.

Response

There are significant technical and practical concerns associated with implementing any remedial action alternative in Green Bay. There are also significant costs associated with dredging in the Bay. As presented in the FS (Section 8), to obtain any measurable risk reduction would require remediating the entirety of Green Bay. None of the RALs modeled would provide 100 percent protection immediately after remediation (or after initiation of MNR) for all of the human or ecological receptors in the Lower Fox River or Green Bay. In fact, none of the RALs modeled would achieve human health RAOs in Green Bay for more than 100 years after remediation (see Table 8-15 in the FS). Projections of the level of estimated risk reduction and the time it takes to achieve that risk reduction can be used as metrics for comparing the efficacy of the RALs in each River reach and Bay zone.

Remedial modeling forecasts (FS, Section 8) showed that remediating as much as 90 million cy of sediment in OU 5 would achieve only limited reductions in risk to human health and the environment. Therefore, the Agencies do not see a risk-reduction benefit commensurate with the cost. The WDNR and EPA believe that, given the limited risk reduction and the substantial costs and difficulties associated with an active remedial solution, MNR is the only feasible option for Green Bay. In addition, the proposed remediation of the Lower Fox River is expected to reduce future PCB loadings to Green Bay by 98 percent, which will be more cost-effective at reducing long-term risks in the Bay than would active remediation in any portion of the Bay.

The WDNR and EPA realize, however, that there will be continued risk in Green Bay with the selection of MNR. Because of that continued risk, institutional controls over fish consumption will remain in place for the foreseeable future. The Agencies are also going to proceed with further remedial evaluations on Green Bay, including conducting the GBTOXe and GBFood models using lower mass and volume estimates.

Master Comment 5.80

Commenters noted that better documentation of the distribution of sediment PCBs in Green Bay south of Long Tail Point and Point Sable is needed so that the feasibility and cost of remedial actions can be further considered for at least that area of the Bay.

Response

In general, the Agencies agree with the comment. However, the Agencies believe that MNR is still the appropriate remedy for Green Bay based on the current data. As discussed in Master Comment 2.38, one of the differences between PCB mass estimates made by University of Wisconsin researchers and those made by the WDNR is that the inner Bay, south of Long Tail Point, was not included in the University of Wisconsin's estimate because of a lack of synoptically collected sediment total PCB and bulk density measurements. In response to this and other comments about Green Bay, the Agencies decided to reexamine mass and volume estimates in Green Bay, and in particular southern Green Bay. Additional sampling was conducted in the southern Bay in July 2002, and two white papers were prepared: *White Paper No. 18 – Evaluation of an Alternative Approach of Calculating Mass, Sediment Volume, and Surface Concentrations in Operable Unit 5, Green Bay* and *White Paper No. 19 – Estimates of PCB Mass, Sediment Volume, and Surface Sediment Concentrations in Operable Unit 5, Green Bay Using an Alternative Approach*.

White Paper No. 18 compares the mass and volume estimates computed for the 2002 RI/FS with those computed in 1989 to 1990 by the University of Wisconsin during the Green Bay Mass Balance Study. Additional data sent to the Agencies as part of the comments received on the Proposed Plan by the FRG were included in that analysis.

The Agencies determined that even with the additional 2001 data in southern Green Bay, further resolution was required to: (1) better define the mass and volume estimates in Green Bay, and (2) determine if previous dredged material disposal areas used for maintenance dredging contained elevated levels of PCBs. To these ends, the Agencies coordinated further sediment sampling in southern Green Bay during the summer of 2002. The results of that sampling effort may be found on the WDNR website (http://www.dnr.state.wi.us/org/water/wm/lowerfox/reports.html) in a report entitled *Green Bay Sediment Results from July 2002 Survey, Green Bay, Wisconsin* (RETEC, 2002). A total of 99 samples were collected at 36 core locations. PCB concentrations ranged from non-detectable to 30 mg/kg (i.e., 30 ppm). High concentrations detected at Station GB02-33 reconfirmed concentrations determined for this location in 1995; those concentrations are associated with sediments adjacent to the navigation channel at the River mouth, not in Green Bay proper. Surface concentrations found in Green Bay samples (all stations except GB02-33) were less than 0.3 ppm (i.e., less than 300 micrograms per kilogram [μg/kg], equivalent to ppb) excepting subsurface concentrations at a single location (GB02-34), which were only as high as 1.4 ppm (1,400 ppb).

White Paper No. 19 documents revised PCB mass, volume, and SWACs for Green Bay, which were recalculated using the methods described in White Paper No. 18 and incorporating the 2002 data set. The conclusion of White Paper No. 19 was that even with the inclusion of the 2002 data, there are no major differences in mass, volume, or surface concentrations from those reported in White Paper No. 18.

The end result of this work on the Bay is twofold. First, the Agencies believe the work is adequate for decision-making purposes and, therefore, the Agencies are proceeding with selection of the remedy for OU 5, which is MNR. The MNR alternative relies on naturally occurring degradation, dispersion, and burial processes to reduce the toxicity, mobility, and volume of contaminants. In selecting MNR for the Bay, the Agencies considered Superfund guidance on the nine evaluation criteria for determining whether remediation is necessary or not.

Second, the Agencies plan to conduct further remedial evaluations for Green Bay, including use of the GBTOXe and GBFood models with the lower mass and volume estimates from White Paper No. 19. Once these evaluations are complete, the Agencies will make the results public. If the Agencies find there is reason to reconsider the MNR alternative for Green Bay, they will issue a ROD Amendment consistent with requirements of the NCP.

Reference

RETEC, 2002. *Green Bay Sediment Results from July 2002 Survey, Green Bay, Wisconsin*. Prepared for Wisconsin Department of Natural Resources by The RETEC Group, Inc., Madison, Wisconsin. December. Available at Wisconsin Department of Natural Resources website: http://www.dnr.state.wi.us/org/water/wm/lowerfox/reports.html.

5.4 Remedy Selection

Master Comment 5.81

A commenter stated that the FS and Proposed Plan largely failed to present and analyze combinations of alternatives.

Response

The WDNR and EPA disagree with this comment. The FS clearly evaluated numerous technologies and combinations of technologies for identification of remedial alternatives. These technology evaluations and remedial alternative assessments were conducted on an OU basis for each OU. This evaluation appears in Sections 6 and 7 of the FS and is further discussed in the Proposed Plan. The following table summarizes the combinations of alternatives considered in the FS for each OU. The approach used for this assessment was consistent with Superfund guidance for conducting feasibility studies (EPA, 1988).

Alternative	OU 3	OU 4	OU 5-Zone 2	OU 5-Zone 3A	OU 5-Zone 3B	OU 5-Zone 4
A	X	X	X	X	X	X
B	X	X	X	X	X	X
C1	X	X	X	X		
C2A	X	X	X	X		
C2B	X	X	X	X		
C3	X	X	X	X		
D	X	X	X	X	X	
E	X	X				
F	X	X				
G			X	X	X	

Notes:

A No Action
B Monitored Natural Recovery and Institutional Controls
C Dredge and Off-site Disposal (Alternatives C1, C2, C3)
C1 C with Passive Dewatering
C2 C with Mechanical Dewatering
C2A C2 with Hydraulic Dredging (with a long slurry pipeline to a dedicated NR 500 monofill for slurry)
C2B C2 with Intermediate Passive Dewatering Pond (prior to disposal at an existing NR 500 commercial disposal facility)
C3 Hydraulic Dredging, Mechanical Dewatering, and Ground Transportation to a Commercial Landfill
D Dredge to a Confined Disposal Facility (CDF)
E Dredge and Thermal Treatment
F *In-Situ* Capping
G Dredge to a Confined Aquatic Disposal (CAD) Facility

This table illustrates that combinations of alternatives were evaluated. For instance, Alternative F in the FS (Cap Sediment to Maximum Extent Possible and Dredge Remaining Sediment to CDF) is typically a combination of both capping and dredging. Given the criteria in the FS for placement of a cap and the need for active remediation to reduce risk, F is not an alternative that relies solely on capping. Also, as discussed in Section 8 of the FS, these combinations of alternatives were evaluated at numerous RALs, and each alternative included an additional period for the alternative to achieve all RAOs.

Reference

EPA, 1988. *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA*. Interim Final. EPA/540/G-89/004. United States Environmental Protection Agency.

Master Comment 5.82

Commenters stated that when evaluating risk and remedial approaches, the Agencies should consider that navigational dredging continues to manage contaminated sediments deposited in the downstream portion of OU 4 from upstream.

Response

The Agencies considered the following when evaluating the combination of navigational dredging and MNR as a remedial approach:

- Navigational dredging will not sufficiently reduce the contamination from the soft sediment mass that is adjacent to the navigational channel. Areas in downstream OU 4 contain significant PCB mass outside of the navigational channel. On average, the USACE dredges at rates of approximately only 103,750 cy per year from the De Pere to Green Bay Reach and 1,275 cy per year from areas of the Lower Fox River above the De Pere dam. The navigational dredging is limited to the federally authorized areas of the channel. However, most of the material targeted for remediation is located outside of the navigational channel and, consequently, is not impacted by the USACE's navigational dredging.

- In OU 4, natural attenuation would require, at a minimum, 100 years to achieve the level of action for human health risks achieved in 20 years by active remediation (FS, Figure 10-2 for 1 ppm removal).

- PCB concentrations greater than 1 ppm are an unacceptable risk to human and ecological health, and the current risk is unacceptable to both the EPA and WDNR.

- The stability of PCBs currently buried in sediment cannot be assured indefinitely. Active remediation is a more effective measure for protecting human health and will more quickly reduce the PCB export into Green Bay.

- Bathymetry data indicate that resuspension will lead to reexposure of contaminants, for which natural attenuation does not provide an acceptable level of protection.

- The sediments of the Lower Fox River are not a secure location for the long-term storage of PCBs.

- Analyses in the RI/FS, BLRA, and Proposed Plan all point to significant benefits from active remediation in OU 4, including the achievement of acceptable PCB levels within a shorter time, reduced water column concentrations, reduced human and ecological risks, and an increased level of protection.

- The API Panel of independent experts agrees that active remediation is needed in the Lower Fox River.

- Active remediation will immediately reduce sediment loading (loading from the Lower Fox River will be reduced by over 90 percent after active remediation).

- It has been demonstrated that environmental dredging can lower concentrations without the release of significant quantities of contaminated sediments.

Master Comment 5.83

Commenters stated that decisions for OU 3 and OU 4 must be reach-specific and must reflect input from downriver discharges. Commenters stated that the Proposed Plan did not include reach-specific analysis of alternatives.

Response

Although the WDNR and EPA agree that Site-specific analysis is very important, the Agencies disagree with this statement. The Agencies based their remedy decision on an individual assessment of the degree and extent of contamination at each OU, as detailed in the RI.

Site-specific determinations are required for Superfund sites. Site conditions and characteristics, as well as available data, are critical considerations in determining cleanup levels appropriate for each site. These considerations include impacted media and potential exposures, contaminant toxicities and concentrations, the nature of risks to human health and the environment, and the quality and type of available data. Characteristics specific to sediment sites also include horizontal and vertical contaminant distribution, sediment thickness and physical characteristics, relationships between media (i.e., sediments, groundwater, surface water, biota, air), and the potential for releases and exposures. All these are factors in determining the most effective and protective use of available information to estimate and measure potential site risks. For OU 3 and OU 4 of the Lower Fox River and Green Bay Site, an RAL defining a specific vertical and horizontal target area was determined to be the most appropriate, protective, and feasible approach for estimating and measuring Site risks.

The basis for the selection of the technology and the RAL in the remedy for the Lower Fox River is stated in the Proposed Plan. Feasibility, cost, risk, and reach-specific approaches were all considered, as discussed in the RI/FS, BLRA, and Model Documentation Report that support the Proposed Plan. These considerations are also part of the formal Superfund evaluation process (i.e., the nine "threshold, balancing, and modifying" criteria).

In developing the RI/FS, BLRA, and Proposed Plan, the WDNR followed EPA guidance and worked closely with the EPA. The FS evaluated numerous technologies and combinations of technologies for remedial purposes. These technology evaluations and assessments appear in Sections 6 and 7 of the FS and are discussed in the Proposed Plan. In the FS, predictive simulations made using computer models were successfully used to assist in the assessment of specific management scenarios and the selection of specific remedial actions and Site-specific goals for the protection of human and ecological health. The Agencies believe the remedy selected in the ROD for OUs 3, 4, and 5 will be technically feasible and cost-effective and will achieve the Site-specific RAOs.

Master Comment 5.84

Commenters expressed the opinion that OU 4 is a natural depositional zone in which cleaner sediments bury the deposited PCBs and there is little or no scouring. Further, the commenters stated that the Proposed Plan focuses on PCB mass removal rather than on minimizing exposure to PCBs. The commenters disagreed with the remedial proposal for OU 4 and expressed the opinion that dredging should be the last choice for remediation of this reach.

Response

The WDNR and EPA disagree with these statements. The Agencies believe it is incorrect to characterize OU 4 as a continuous depositional area. Further, the Proposed Plan presented by the Agencies is in fact based on risk reduction, not on PCB mass removal.

The WDNR demonstrated, in Technical Memorandum 2g in the Model Documentation Report, that the riverbed in OU 4 is dynamic in nature and can have significant changes in bed elevation throughout the OU. The EPA documented significant changes in sediment bed elevation over time in *White Paper No. 3 – Fox River Bathymetric Survey Analysis*, which is appended to the ROD for OUs 1 and 2.

In recommending and selecting the dredge alternative for OU 4, the Agencies have followed the appropriate Superfund guidance. The Superfund process focuses on protection of human health and the environment through the cleanup and remediation of environmental hazards. By following Superfund guidance, a complete analysis of the nature and extent of the contamination was conducted. In the BLRA and FS, existing risk was evaluated, risk reduction estimates were developed, and appropriate remedial technologies and RALs were selected. In the Proposed Plan and in the ROD, the remediation is clearly set forth to inform the public.

The Proposed Plan is based on risk reduction, not mass removal, as explained in Section 9 of the Proposed Plan and further illustrated in Section 10 of the ROD for OUs 3, 4, and 5. The RAL of 1 ppm is based on risk reduction, not mass removal, as presented in Section 8 of the FS. The WDNR and EPA selected the 1 ppm RAL based on an evaluation of action levels and the residual SWAC for each OU and the ability of the action level to meet the RAOs. For further discussion, please review the supporting document that explains the relationship of the RAL to the SWAC and *White Paper No. 11 – Comparison of SQTs, RALs, RAOs, and SWACs for the Lower Fox River.*

Master Comment 5.85

Commenters stated that the cleanup should be as comprehensive and effective as possible and should include the removal of contaminated sediments from Green Bay.

Response

The Agencies believe that the remedial alternatives selected for OUs 3, 4, and 5 are comprehensive and will be effective in remediating the Lower Fox River and Green Bay to the maximum extent practicable.

To address concerns raised about Green Bay, the WDNR undertook several actions. These included reevaluating the PCB mass and contaminated sediment volume in the Bay, conducting additional sampling in the south end of the Bay, and conducting modeling to evaluate removal of contaminated sediments. These actions are discussed further in responses to Master Comments 2.37, 2.38, 2.39, 5.77, and 5.80.

5.5 Evaluation of Submitted Alternatives

Master Comment 5.86

Commenters stated that vitrification should be considered if it can be shown to be an effective and cost-effective means of totally destroying PCBs. If that is the case, then the Agencies should work with potential corporate partners to incorporate this technology into the ROD wherever practicable.

Response

The Agencies continue to work on demonstrating both the cost-effectiveness and treatment effectiveness of vitrification. Identification of the technology and vendor selection occur subsequent to the ROD, such as during the remedial design phase. In the FS, vitrification was included as a representative process option for thermal treatment in Sections 7.4 (OU 3) and 7.5 (OU 4). The results of a multiphase study conducted by the WDNR demonstrate that thermal treatment is a feasible option for the treatment of dredged sediment, as data generated by the EPA's Superfund Innovative Technology Evaluation program shows that vitrification (also referred to as glass furnace technology) does not generate dioxins and furans in the off-gases and effectively destroys PCBs at greater than 99.9999 percent efficiency. The results from the multiphase study are discussed in Section 6 of the FS and also detailed in Appendix G of the FS. Figure 7-6 of the FS provides a schematic of the generic dredge and thermal treatment remedial alternative. Vitrification was also included in the ROD for OUs 1 and 2 as an acceptable alternative to landfills. There is a discussion of vitrification in Section 13.8 of the ROD for OUs 3, 4, and 5.

Master Comment 5.87

Several commenters expressed concerns related to the Panel Report and a preference for removal rather than capping in OUs 3 and 4. As previously addressed in Section 5.5 of the RS for OUs 1 and 2, the Panel Report (The Johnson Company, 2002) was submitted as part of the comments during the public response period. The Panel Report includes a plan for long-term monitoring of cap integrity (physical, chemical) and habitat; a long-term institutional/financial stewardship plan (operations and maintenance); and an appendix with cost-supporting information for the API Panel's capping proposal, which presents different capping designs for different deposits/SMUs in OUs 1, 3, and 4; however, the API Panel's capping proposal does not cover capping in Green Bay.

Comments received from the public on the Panel Report stated:

- That the API Panel's plan ignored the high health risks and substantial PCB mass in Zone 2 of lower Green Bay when it stated that the plan would be sufficient to meet public health needs.

- That the API Panel did not consider that cap material erosion increases the clogging of downstream locks, shipping channels, and marinas, increasing maintenance problems and costs.

- That the total mass of PCBs will remain toxic; therefore, the last 3.5 River miles warrant remediation.

Response

Appleton Papers, Inc. (API) provided funding to assemble a panel of professors and scientists to evaluate the Proposed Plan. The API Panel completed a report entitled *Ecosystem-Based Rehabilitation Plan – An Integrated Plan for Habitat Enhancement and Expedited Exposure Reduction in the Lower Fox River and Green Bay* (referred to herein as the “Panel Report”) dated January 17, 2002 (The Johnson Company, 2002). The Panel Report was submitted as part of the comments during the public response period for OUs 1 and 2. As part of the RS for OUs 1 and 2, a series of white papers were written specific to the Panel Report, and Section 5.5 of the RS for OUs 1 and 2 addresses comments received from the Fox River RPs and the general public on the Panel Report. Master Comments based primarily on the Panel Report are also discussed in Master Comments 5.87 thru 5.89 of this RS.

Comments about the Panel Report are not directly applicable to the Proposed Plan, RI/FS, or BLRA on which the WDNR and EPA sought public comment. Although the WDNR and EPA appreciate the input and comments from the API Panel, whose members have impressive credentials and years of experience, the Agencies regret that the API Panel was not engaged earlier in the process and was not given an opportunity to work with the WDNR and EPA prior to the release of its report. Specific issues raised in the Panel Report were addressed in the RS for OUs 1 and 2 and throughout the series of white papers developed for that RS.

Although several parties supported the API Panel’s capping plan, the WDNR and EPA believe that capping could be a remedial component, but not the sole component. Furthermore, the Agencies believe that the design provided by the API Panel is not technically sound; the design is based on computer models and has never been implemented. The API Panel cannot point to a single cap with this design that has been implemented successfully in any environment, much less a river environment.

In addition to the comments on the Panel Report contained in the RS for OUs 1 and 2, the WDNR and EPA believe that some of the conclusions bear repeating in relation to OUs 3, 4, and 5. In and of itself, the API Panel proposal is considered insufficiently protective for the following reasons:

- The Panel Report proposal does not achieve the RAOs or the risk reduction goals set by the Agencies for any of the OUs. The risk reduction aspects of the Panel Report are examined in *White Paper No.*

5A – Responses to the API Panel Report, which is part of the RS for OUs 1 and 2. The SWAC achieved with the API Panel capping proposal is up to four times greater than the SWAC achieved with the remedy selected in the ROD.

- The Agencies judged the Panel Report's capping design to be technically deficient and too broadly applied. However, a summary of all capping projects to date (provided in *White Paper No. 6B – In-Situ Capping as a Remedy Component for the Lower Fox River*, which is part of the RS for OUs 1 and 2) shows that the caps built to date average within the 2- to 3-foot range of sand thickness. All of these caps are in lakes, estuaries, or deeper water not subject to erosional actions.

- The WDNR and EPA agree that risk reduction should be the ultimate goal of any sediment remediation project, whether the program involves MNR, capping, or removal. The WDNR and EPA have chosen a remedial approach based on risk reduction. Given the circumstances of the Lower Fox River, this approach also results in significant PCB mass removal in OUs 3 and 4. However, the remedy selected for OU 5 is not a mass removal activity. The selected remedy is risk-based, in that following remediation, the residual SWAC based on the RAL of 1 ppm will result in significant risk reduction.

Reference

The Johnson Company, 2002. *Ecosystem-Based Rehabilitation Plan – An Integrated Plan for Habitat Enhancement and Expedited Exposure Reduction in the Lower Fox River and Green Bay*. Prepared for the Appleton Paper, Inc. Panel by The Johnson Company, Inc. January 17.

Master Comment 5.88

Comments were received on claims made concerning the API Panel's capping plan. These claims included:

- Capping would reduce the SWACs faster than a dredging remedy would.

- The API Panel's plan would require an enormous volume of locally excavated sand and gravel to be transported and placed in the River with heavy equipment.

- The API Panel's plan would offset any River habitat enhancement.

- The API Panel's plan would reduce the future use of shallow areas.
- The API Panel's plan would clog downstream locks, shipping channels, and marinas with eroded material.
- In-water capping in OU 3 and OU 4 was not fully or fairly evaluated by the API Panel's plan.
- The long-term permanence of in-water caps was not fully considered by the API Panel's plan.

Response

The WDNR and EPA appreciate the input from the API Panel and agree with many of the API Panel's statements. The Agencies, which learned about the API Panel only after the Proposed Plan was released, regret that the API Panel was not engaged earlier in the process and was not given an opportunity to work with the WDNR and EPA prior to the release of its report. Although the Agencies agree with many statements made by the API Panel, the Agencies find that some conclusions are incorrect or reflect problematic regulatory or Site-specific knowledge. The WDNR and EPA believe that although capping is and can be an appropriate part of a remedial design, it should be a remedy component, not the sole component. Furthermore, the Agencies believe that the design provided by the API Panel is not technically sound. The WDNR considered capping in Alternative F in the FS; Table 7-2 in the FS shows that Alternative F involved capping 416,370 cy in OU 3 and 1,833,253 cy in OU 4.

The WDNR and EPA determined in their evaluation of the Panel Report that the API Panel's capping proposal does not meet the risk reduction goals of the Proposed Plan. The WDNR and EPA agree that risk reduction should be the ultimate goal of any sediment remediation project, whether the program involves MNR, capping, or removal. However, the SWAC achieved with the API Panel capping proposal is up to four times greater than the SWAC achieved with the selected remedy. Even accepting the API Panel's calculations, the estimated SWAC is 0.5 ppm on a River-wide basis. In the Proposed Plan, SWACs estimated for dredging are 0.264 and 0.156 ppm for OUs 3 and 4, respectively, which are significantly more protective. Although the Panel Report did not estimate a time frame for the removal of fish advisories after capping, such time frame would be longer than under the recommended alternative, because the API Panel proposes to leave a significantly greater amount of material untreated than in the Proposed Plan.

The WDNR agrees with the comment that the API Panel's plan does not consider the method for placing large volumes of capping material in the River. *White Paper No. 6B – In-Situ Capping as a Remedy Component for the*

Lower Fox River, which is part of the RS for OUs 1 and 2, demonstrates several representative mechanisms for cap placement. In most caps constructed to date, split-hull barges, a technology inappropriate to the Lower Fox River, have been used.

As articulated in White Paper No. 6B, the necessary minimal engineering design evaluations include:

- Modeling to assess consolidation
- An evaluation of the potential for advective and diffusive flux from either consolidation or from groundwater intrusion
- An evaluation of local capping material and iterative design testing to ensure that the cap design is effective at chemical isolation
- An evaluation of the 100-year shear-stress forces at the sediment/water interface to effectively evaluate physical stability and design an armoring layer as necessary
- An evaluation, as required by Wisconsin law, of whether cap placement would result in an alteration to the flood channel

The same principles would be applied to any cap proposal for OUs 3 and 4. What's more, these are only some of the technical considerations and do not include the regulatory, public acceptance, land use, and long-term fiduciary responsibility issues.

As a commenter noted, erosion is also a concern. Caps in lakes, estuaries, and deeper water are not subject to erosional actions; however, because of the factors that affect mass movement in the Lower Fox River, erosional actions must be taken into consideration for this Site. The API Panel's discussion of cap permanence did not consider how Lower Fox River hydraulics would be modified by the placement of a 1-foot cap in the River, which would reduce the River's cross-sectional area and therefore increase water flow velocities and potential scour. Because the API Panel's plan considered remedial activity in any area of the River with a depth of less than 3 feet, ice scour would also become a concern. Ice scour is a considerable erosional factor for caps placed in water depths of 3 feet or less. For these reasons, the WDNR concluded that the API capping plan places caps at physically inappropriate areas of OU 4. A summary of all capping projects to date (provided in White Paper No. 6B) demonstrates that the caps built to date average within the 2- to 3-foot range of sand thickness. In addition, WDNR fisheries biologists indicate that as a habitat consideration, a minimum water depth of 3 feet should be maintained to discourage carp.

The calculations for resuspension of capping materials in the Panel Report do not consider mass movement processes—that is, the movement of sediments as a slurry or by siltation processes. Such processes mean that capping material could be disrupted without necessarily being resuspended. In addition, *White Paper No. 6A – Comments on the API Panel Report* and White Paper No. 6B point out that long-term lake level changes (from +5 to -1 feet) should be accounted for in designing for the restrictions at OU 4. The potential (especially long-term potential) for erosion resulting from lower lake levels, which are anticipated in the Great Lakes because of global warming, was not considered. Lower lake levels are already occurring, and expert climatologists estimate a Lake Michigan lake level that is lower by 1.5 to 3 feet over the next three decades and lower by up to 8 feet by the end of this century (see Executive Summary and Report Cover for the Report of the Great Lakes Regional Assessment Group, U.S. Global Change Research Program, Great Lakes Overview, October 2000). The Report of the Great Lakes Regional Assessment Group also predicts the likelihood of greater variability and severity of storm (e.g., flooding) events. Given all of the data cited above, the Agencies judge the Panel Report design to be technically deficient and too broadly applied, at least across OU 4.

References

Palermo, M. R., J. E. Clausner, M. P. Rollings, G. L. Williams, T. E. Myers, T. J. Fredette, and R. E. Randall, 1998a. *Guidance for Subaqueous Dredged Material Capping*. Technical Report DOER-1. United States Army Corps of Engineers Waterways Experiment Station, Vicksburg, Mississippi. Website: http://www.wes.army.mil/el/dots/doer/pdf/trdoer1.pdf.

Palermo, M. R., J. Miller, S. Maynord, and D. Reible, 1998b. *Assessment and Remediation of Contaminated Sediments (ARCS) Program Guidance for In-Situ Subaqueous Capping of Contaminated Sediments*. EPA 905/B-96/004. Prepared for the Great Lakes National Program Office, United States Environmental Protection Agency, Chicago, Illinois. Website: http://www.epa.gov/glnpo/sediment/iscmain.

Master Comment 5.89

Comments by the API Panel and others expressed concerns with construction and operation of the proposed dredged slurry pipeline, including:

- Feasibility of the proposed slurry pipeline
- Permits for pipeline transport of sediments
- Local opposition to the pipeline
- Lack of availability of landfill location(s) to receive pipeline slurries

Response

The WDNR and EPA believe that the proposed pipeline alternative for the transport of dredged slurry, which was investigated thoroughly in the FS, is a technically feasible alternative. A project-specific example of the feasibility of this technology is the White Rock Lake sediment dredging project, described in the FS (Section 6) as a 20-mile-long pipeline project in Texas in which 3 million cy of sediment was hydraulically dredged in 1 year.

The WDNR and EPA believe that the level of detail in the Proposed Plan and FS is appropriate at this stage of the project. The FS identified potential locations for support facilities to allow an analysis of equipment requirements and the development of conceptual engineering plans and cost estimates for the remedial alternatives. Potential locations were determined based on screening-level field observations made from an engineering perspective. For final design of the process and disposal facility, additional analyses will be performed to gather more detailed information regarding slurry characteristics. The WDNR and EPA plan to utilize an experienced expert technical review team to further assess planning for, operation of, and construction of the pipeline.

The end location(s) of the pipeline will be determined during the project's design stage. The locations selected in the FS represent reasonable assumptions with regard to distance from the dredging work.

While pursuing the purchase of an abandoned railroad right-of-way for the Fox River Trail, the WDNR negotiated with the railroad for use of the trail's right-of-way to retain the option of locating a pipeline to transport dredged sediments to potential landfill sites in southern Brown County. While the specific pipeline route has yet to be chosen, it is possible that the pipeline will be a combination of in-water and out-of-water pipeline technologies and that a portion of the Fox River Trail right-of-way may be used for the pipeline. These decisions will be made during the design phase of the project. The state did negotiate use of the trail's right-of-way.

The WDNR knows of no state or federal permits that would prevent construction of a pipeline for dredge slurry transfer; however, local building permits may be necessary. Negotiations will also take place regarding public access and right-of-way, and public input may be sought prior to any pipeline construction. Information about the proposed facilities, technologies considered, and public comment/input will be considered in the final design. A dredge slurry pipeline would minimize equipment traffic in areas adjacent to the Lower Fox River.

Local landfills with sufficient capacity to receive contaminated sediment from OUs 3 and 4 exist. In fact, local landfills may be interested in contracting for the disposal of sediments, because the sediments represent a long-term waste stream. Potential disposal locations exist in the Greenleaf and Holland town areas. Identifying actual landfills to accept the sediment will occur in the remedial design phase. Public input would be considered as part of the siting process for any disposal facility.

As documented in *White Paper No. 23 – Evaluation of Cost and Implementability of Alternative C2B for Operable Unit 3 and Operable Unit 4,* technical and cost issues associated with the possible use of a pipeline to remove dredge slurry from the River have been addressed by the WDNR. It was determined that Alternative C2B (use of a pipeline to transfer dredge slurry) is an implementable and technically feasible alternative.

6 Modeling Development and Application

Section 6 of the RS for OUs 1 and 2 included the following subsections:

- *6.1 Modeling Development and Application*
- *6.2 wLFRM*
- *6.3 FRFood*
- *6.4 FoxSim (the Fox River Group Model)*

The RS for OUs 3, 4, and 5 follows the same general organization as the RS for OUs 1 and 2. However, many of the comments addressed in the RS for OUs 1 and 2 are generally applicable to the entire Lower Fox River and Green Bay Site and so are not repeated here. Because there are no new comments associated with Sections 6.1 and 6.4, those sections are not included in the RS for OUs 3, 4, and 5. Prior comments associated with those sections can be found in the RS for OUs 1 and 2, which is available on the WDNR website, at the various information repositories, and in the Administrative Record for the Site. The WDNR's website address is: http://www.dnr.state.wi.us/org/water/wm/lowerfox/rifs/index.html.

Section 6 of the RS for OUs 1 and 2 included Master Comments 6.1 to 6.21. Master Comment 6.22 is therefore the first comment in the RS for OUs 3, 4, and 5. Comments addressing the GBTOXe model appear in Section 6.2; comments addressing the GBFood model appear in Section 6.3. The titles of those sections have been modified to reflect these additions.

6.2 wLFRM and GBTOXe

Note: Comments concerning GBTOXe are included in this section.

Master Comment 6.22

A commenter expressed concern that wLFRM contains errors that create an increase in OU 4 PCB concentrations initially, resulting in an underestimation of the degree to which natural attenuation is taking place.

Response

The WDNR addressed this issue in Section 6.2 of the RS for OUs 1 and 2. The commenter incorrectly implies that the wLFRM model, or any model, was used solely to make remedial decisions. The WDNR and EPA agree that no model can predict future conditions with a high degree of accuracy.

Models are only one component of the remedial decision-making process, and were used only to help compare relative differences between the various alternatives and action levels described in the FS. *White Paper No. 9 – Remedial Decision-Making in the Remedy Selection for the Lower Fox River/Green Bay Remedial Investigation, Feasibility Study, and Proposed Remedial Action Plan* describes how information from many different sources and supporting studies was employed to identify the need to implement an active remediation strategy for the Lower Fox River and Green Bay Site. No single source of information was relied on in remedy selection. The combined findings of numerous supporting studies provide the clear weight of evidence that supports remedy selection. This decision-making process is consistent with the nine CERCLA criteria, as discussed in Master Comment 6.3 of the RS for OUs 1 and 2. With regard to the technical concerns raised by commenters about wLFRM, these are addressed in responses to other Master Comments in Section 6.2 of the RS for OUs 1 and 2.

Master Comment 6.23

Commenters stated that areas of OU 4 where wLFRM predicts erosion are actually areas that the USACE dredges to keep the channel open for commercial traffic. They assert that the evidence of new deposits that require dredging refutes the prediction about this reach's erosional character.

Response

The WDNR and EPA disagree with this comment. The commenters are incorrect regarding the location and the extent of dredging in OU 4. The only areas where dredging has routinely occurred are the Fort James (Georgia Pacific) and East River turning basins. As documented in Technical Memorandum 2g, much of the navigation channel has not been dredged in 30 years. In the few locations where dredging has occurred, many areas have been dredged only once. In fact, in the analysis of Lower Fox River sediment data prepared by Limno-Tech (LTI, 2002), Section 2.6.3 states that by 1967 dredging was unnecessary in areas upstream of the Fort James Paper Company and had not been conducted prior to 1983. The reason dredging has not occurred in much of the navigation channel is that sediment bed elevations have either been relatively constant or have decreased over time.

Monitoring of OU 4 indicates that it is both erosional and depositional over time. Technical Memorandum 2g documents sediment bed elevation changes in the River, including OU 4, using River hydrographic surveys from 1977 to 1998. Average bed elevation changes over time for the selected long-term (USACE) cross-channel range lines ranged from –5.5 to +5.4 centimeters per year (see Table 7 of Technical Memorandum 2g). These results document the dramatic changes in sediment bed elevations that can occur as the bed of the Lower Fox River is continuously reshaped by the wide range of flows and loads the River experiences.

Bed elevation changes in the De Pere to Fort James reach were further examined through recent hydrographic surveys completed by the USACE. Data for the 1997, 1998, and 1999 surveys were available in a form that permitted calculation of bed elevation changes for all locations. The De Pere to Fort James (Georgia Pacific) channel has not been dredged since the 1960s, so changes in bed elevation reflect the natural channel-forming dynamics of the River. This pattern is also documented by bed elevation data collected by the USACE. These profiles show that large changes in sediment bed elevation can occur. Additionally, a recent study also suggests that portions of the sediment bed downstream of the De Pere dam may be subjected to increased erosion (observed as decreased sediment bed elevations) in response to declining water levels in Green Bay/Lake Michigan. As a side note, the accuracy of the USACE hydrographic surveys was confirmed by field tests at SMU 56/57 in August 1999; it was determined that the combined vertical accuracy achieved by the USACE Kewaunee Office was approximately ±4 cm.

Please also see *White Paper No. 3 – Fox River Bathymetric Survey Analysis* and the responses to Master Comments 6.2 and 6.7 in the RS for OUs 1 and 2.

Reference

LTI, 2002. *Measurement of Burial Rates and Mixing Depths Using High Resolution Radioisotope Cores in the Lower Fox River*. In: *Comments of the Fox River Group on the Wisconsin Department of Natural Resources' Draft Remedial Investigation, Draft Feasibility Study, Baseline Human Health and Ecological Risk Assessment, and Proposed Remedial Action Plan, Appendix 10*. Prepared by Limno-Tech, Inc., Ann Arbor, Michigan.

Master Comment 6.24

Several commenters stated that computer modeling supporting the RI/FS and Proposed Plan's analysis is flawed. Specifically, these commenters argued that the GBTOXe model: (1) relies on a "flawed" prediction of loadings to Green Bay because of its dependence on the wLFRM model, and (2) relies on an inaccurate description of mass in the Green Bay bed maps. Identifying these issues as "fundamental flaws," commenters argue that the GBTOXe cannot accurately predict future conditions and should not be used to make remedial decisions.

Response

Regarding the commenters' first point, that the GBTOXe model relies on the wLFRM model, which is "flawed:" The WDNR and EPA believe that the GBTOXe, coupled with wLFRM and the Green Bay bed maps, provides an appropriate transport model evaluation for use in conjunction with the other tools cited in the response to Master Comment 6.3 in the RS for OUs 1 and 2. The models used in the RI/FS were developed over multiple years in a collaborative process that involved scientists and mathematicians from the Agencies as well as scientists in the public sector and with the FRG. The model process was reviewed thoroughly and broadly. This review included input from the USGS, USFWS, USACE, and researchers and scientists from the University of Wisconsin, University of Connecticut, and Manhattan College. The models were peer-reviewed by a panel assembled by the EPA, as well as by an independent panel assembled by the American Geological Institute.

The position of the Agencies is that the wLFRM accurately represents the critical features of Lower Fox River Site conditions. The Agencies previously responded to critiques of the wLFRM in Section 6.2 of the RS for OUs 1 and 2 and in *White Paper No. 16 – wLFRM Development and Calibration for the Lower Fox River/Green Bay Remedial Investigation, Feasibility Study, Proposed Remedial Action Plan, and Record of Decision*. Those documents note that the wLFRM is the product of more than 10 years of field study and four generations of model development and performance assessment, including the direct, collaborative involvement of the FRG and consultants through their participation in the Model Evaluation Workgroup (Workgroup). The development histories of the model framework, IPX 2.7.4, and its application to the Lower Fox River have been extensively documented through numerous reports and peer-reviewed journal publications, and development of the wLFRM is consistent with information put forward by the Workgroup in a series of technical memoranda (included in the Model Documentation Report). Alternative models proposed by the commenters have not been subjected to the same level of scrutiny and thus are not adequate for use in lieu of wLFRM. These arguments are presented in *White Paper No. 15 – FoxSim Model Documentation*.

Regarding the commenters' second point, that the GBTOXe model relies on an inaccurate description of mass in the Green Bay bed maps: PCB concentrations assigned as initial conditions in the sediment segments of GBTOXe are based on information contained in the sediment bed maps; differences in mass do not equate to differences in predictions in transport and bioaccumulation. Mass estimate differences in the PCB bed maps are presented and discussed in *White Paper No. 18 – Evaluation of an Alternative Approach of Calculating Mass, Sediment Volume, and Surface Concentrations* *in Operable Unit 5, Green Bay*. The white paper looks at the potential differences in mass estimates derived using the approach outlined in Technical Memorandum 2f or the approach taken by the University of Wisconsin researchers (Manchester et al., 1996). As presented in both Technical Memorandum 2f and the University of Wisconsin method, it is possible to develop a variety of PCB mass estimates for Green Bay based solely on the magnitude of the factors influencing PCB mass. White Paper No. 18 concludes that the factors influencing mass estimates are: (1) the depth to which PCBs are thought to exist, and (2) decisions about which data are/are not included in the mass estimates. An evaluation following University of Wisconsin procedures provides a sound estimate of PCB mass in Green Bay. *An equally important conclusion is that regardless of the method used, the PCB surface concentrations for the zones in Green Bay are similar.*

Surface sediment concentration, not mass, contributes to model projections made using GBTOXe. The commenters incorrectly imply that differences in mass would lead to different conclusions about sediment, water column, and ultimately fish tissue concentrations over time. However, differences in the concentrations in the upper layers of the sediment would have more of an effect on exposure concentrations for benthic and pelagic organisms, while differences in PCB mass (made using different estimates of the extent of contamination at depth) would have less of an effect on tissue concentrations in benthic and pelagic organisms. As noted above, differences in mass estimates are largely attributable to how deep the PCBs are assumed to be in the sediment column; differences in surface concentrations between the two methods are negligible.

One additional important insight provided by the enhanced PCB fate calculations is that the rate of decline in water column PCB concentrations in Green Bay is slower than predicted in previous estimates. Computations made with GBHYDRO, a fine-grid hydrodynamic model, indicate that estimates of flushing times computed by GBTOXe were exaggerated because of numerical mixing resulting from the coarse segmentation. Lower PCB concentrations in the surface sediment layer would reduce computed water column PCB concentrations; however, the rate of decline in these concentrations would be relatively slow.

Reference

Manchester-Neesvig, Jon B., Anders W. Andren, and David N. Edgington, 1996. Patterns of mass sedimentation and deposition of sediment contaminated by PCBs in Green Bay. *Journal of Great Lakes Research*. 22(2):444–462.

Master Comment 6.25

Some commenters stated that GBTOXe cannot accurately predict future conditions in Green Bay because: (1) a subroutine "used in the model to predict sediment resuspension was discarded because it predicted PCB concentrations in the water column an order of magnitude above those measured," and (2) the available calibration data (for a 17-month period) is inadequate for a 100-year projection.

Response

The WDNR and EPA believe that both statements are inaccurate. Regarding the commenters' first point, that a subroutine used in the model to predict sediment resuspension was discarded: GBTOXe results from an effort to enhance and reevaluate the previous Green Bay PCB fate model, GBTOX, which was developed by Bierman et al. (1992) and updated by De Pinto et al. (1993). The process for evaluating the models used in the Lower Fox River and Green Bay RI, BLRA, and FS was established through an agreement between the WDNR and the FRG in January 1997. Enhancements were made to GBTOX as part of this project, resulting in the model referred to as GBTOXe. The enhancements included development of a new model segmentation, incorporation of water column circulation and mixing processes from a high-resolution hydrodynamic model (GBHYDRO), and incorporation of sediment resuspension and sediment solids flux rates from a high-resolution sediment transport model (GBSED).

Water column circulation included in GBTOXe is based on results from GBHYDRO, a high-resolution, three-dimensional hydrodynamic model (HydroQual, 1999) that contains over 10,000 water column segments. Analyses conducted during the development of GBHYDRO indicated that transport described in the 12 water column segments of GBTOX underestimated the residence time in Green Bay. Computational resource constraints associated with 100-year contaminant fate projection analyses necessitated an aggregation of the GBHYDRO grid, resulting in a GBTOXe segmentation that contains 1,490 water column segments. Hydrodynamic information from GBHYDRO was aggregated onto the GBTOXe grid. This represents a substantial improvement of the description of the transport in this large body of water.

A sediment transport model, GBSED, coupled to GBHYDRO, was developed (HydroQual, 1999) and used to calculate the transport of cohesive solids in Green Bay. GBSED results indicate that wind-driven waves are the dominant factor affecting resuspension of PCB-contaminated sediments in Green Bay, particularly in the shallow portions of the lower Bay near the mouth of the Lower Fox River. Incorporation of the results of this more detailed approach to solids transport represents an important refinement to the process of evaluating the fate of PCBs in Green Bay. The comment that "one of the subroutines used in the model to predict sediment resuspension was discarded because it produced PCB concentrations in the water column an order of magnitude above those measured" is not true. The decision to develop and use the results of a more detailed sediment transport model was made and implemented on technical merits before GBTOXe development was initiated.

Regarding the commenters' second point, that the available calibration data are inadequate to support a 100-year projection: GBTOXe was calibrated for a 17-month period from January 1989 through May 1990 using data from the GBMBS, as was done in the calibration of GBTOX (De Pinto et al., 1993). An ideal PCB calibration data set would include sediment data from at least two comprehensive monitoring programs separated in time by roughly 10 years, as well as detailed spatial and temporal water column measurements collected throughout the interval between the sediment sampling. A data set of this type is not common nor was one available for Green Bay. The 17-month period used for calibration represents the most data-rich period available.

References

Bierman, V. J., J. V. De Pinto, T. C. Young, P. W. Rodgers, S. C. Martin, R. Raghunathan, and S. C. Hintz, 1992. *Development and Validation of an Integrated Exposure Model for Toxic Chemicals in Green Bay, Lake Michigan*. Prepared for United States Environmental Protection Agency, Large Lakes and Rivers Research Branch, Environmental Research Laboratory, Duluth, Michigan. September 1.

De Pinto, J. V., V. J. Bierman, and T. C. Young, 1993. *Recalibration of GBTOX: An Integrated Exposure Model for Toxic Chemicals in Green Bay, Lake Michigan*. Prepared for United States Environmental Protection Agency, Large Lakes and Rivers Research Branch, Environmental Research Laboratory, Grosse Ile, Michigan. December 31.

HydroQual, 1999. *Hydrodynamics, Sediment Transport and Sorbent Dynamics in Green Bay*. HydroQual, Inc., Mahwah, New Jersey. March.

Master Comment 6.26

Commenters stated that wLFRM treats SMUs in the center of the channel of OU 4 as erosional, when the River is depositional. The commenters further assert that this error does not exist in the FRG's alternative FoxSim model.

Response

This comment contains two separate elements. On the basis of extensive investigation, it is the Agencies' position that:

- The SMUs in the central channel of OU 4 are both erosional and depositional, as is the River.
- wLFRM is the most appropriate model for predicting the fate and transport of PCBs in the River and Bay.

Regarding the commenters' first point, that the River is depositional: The Agencies contend that OU 4 SMUs contain both erosional and depositional environments. The evidence to support this position is presented in the Agencies' response to Master Comment 6.23, which also references Technical Memorandum 2g. Technical Memorandum 2g, which examined sediment bed elevation changes in the River, documents that dramatic changes in sediment bed elevations can occur as the bed of the Lower Fox River is continuously reshaped by the wide range of flows and loads the River experiences.

On the basis of results from the 1997 to 1999 USACE hydrographic surveys of the River navigation channel between the De Pere and Fort James (Georgia Pacific) turning basins, the average sediment bed elevation change over a specific time period was used to estimate a net rate of sediment accumulation. As discussed in Section 2.3 of *White Paper No. 16 – wLFRM Development and Calibration for the Lower Fox River/Green Bay Remedial Investigation, Feasibility Study, Proposed Remedial Action Plan, and Record of Decision*, (attached to the RS for OUs 1 and 2), increases in average sediment bed elevation occurred over a 2-year period in this section of the River. Also see *White Paper No. 3 – Fox River Bathymetric Survey Analysis* and responses to Master Comments 2.19 and 6.4 in the RS for OUs 1 and 2.

Regarding the commenters' second point, that wLFRM treats SMUs in the central channel of OU 4 as erosional, while FoxSim does not: see the response to Master Comment 6.24 for a brief history of the wLFRM model and its development. The Model Documentation Report, which includes a series of technical memoranda developed by the Model Evaluation Workgroup, in which the FRG was a collaborative participant, also provides detailed analyses of key aspects of model development such as solids and PCB loads, sediment transport dynamics, and initial conditions.

The wLFRM describes PCB transport in all 39 miles of the Lower Fox River, from Lake Winnebago to the River mouth at Green Bay, in a single spatial domain. During the comment period, the FRG provided a new hydrodynamic model (FoxSim) for the first time. FoxSim was not subject to the same degree of scientific scrutiny and peer review as was wLFRM. The WDNR reviewed

FoxSim and found that it contained high uncertainties in its ability to predict PCB fate and transport in OU 4. In addition, the WDNR found that the model has a bias because it was constructed to "evaluate the ongoing and future natural attenuation of the system," which is accomplished through the model's prediction of deposition of clean sediments and less scour of contaminated sediments. However, as stated above and supported in the response to Master Comment 6.23, OU 4 is both depositional and erosional. The conclusions of the WDNR's review of FoxSim can be found in *White Paper No. 15 – FoxSim Model Documentation*, which is attached to the RS for OUs 1 and 2.

The WDNR and EPA believe that the wLFRM model is the appropriate transport model for the Lower Fox River and Green Bay Site. With respect to the ability of the wLFRM to appropriately track sediment PCB concentrations during the calibration period, White Paper No. 16 noted that simulated reach-averaged surface sediment PCB levels in the wLFRM fall within, and never exceed, the 95 percent confidence intervals of observed PCB levels. Considering the area between the De Pere dam and the River mouth (OU 4), the upper 95 percent confidence limit of the observations is more than 60 percent larger than the average. Model results for OU 4 never exceed the 95 percent confidence limit of observed PCB levels for this reach. The small (~1 ppm) difference in model results over time is more a reflection of the spatial heterogeneity of the observations than any failure of the model to appropriately track surface sediment PCB levels.

For further discussion of this topic, please also see response to Master Comment 6.7 in the RS for OUs 1 and 2.

Reference

WDNR, 1999. *Technical Memorandum 2g: Quantification of Lower Fox River Sediment Bed Elevation Dynamics through Direct Observations*. Wisconsin Department of Natural Resources, Madison, Wisconsin. July 23.

6.3 FRFood and GBFood Models

Note: Comments concerning GBFood are included in this section.

Master Comment 6.27

Some commenters stated that the data in the FRFood model, used for developing sediment-to-water ratios, indicate that there could be a trend of decreasing ratios moving downstream (ratio around 10^{-6} upstream of Little Rapids; around 10^{-5} below Little Rapids). Based on this analysis, the commenters assert that the upstream sections of the River are the source and the downstream sections are the sink for PCBs.

Response

As documented in the BLRA and in the Fox River Food (FRFood) Model Documentation Report, sediment-to-water ratios were developed as a generalized term. These ratios relate the concentration of total PCBs in filtered water relative to that found in the sediments. The same water and sediment data used to calibrate the mass balance for the Lower Fox River were used to estimate these ratios. The commenters appear to be referring to Table 3-7 in the FRFood documentation memorandum based on their inference that there is a decreasing trend in ratios from upstream to downstream. The ratios were developed from the average sediment values computed for the calibration period of 1989 through 1990. For the Lower Fox River, the data suggest that the non-particulate water PCB concentration is between 10^{-6} and 10^{-7} of the bedded sediment concentration. For the De Pere to Green Bay Reach (Green Bay Zone 1), the value lies between 10^{-4} and 10^{-6}, which is the opposite of the conclusion the commenters reached. Using the general term (10^{-6}) in FRFood, the model calibrated very well to the observed data in all reaches of the River. The FRFood report also acknowledged the uncertainty associated with the sediment-to-water ratio and noted that SQTs could differ by an order of magnitude. For example, No Observed Adverse Effects Concentration SQTs for walleye based on a sediment-to-water ratio of 10^{-5} are eight times less than SQTs based on a sediment-to-water ratio of 10^{-6} and 25 times less than an SQT based on a sediment-to-water ratio of 10^{-7}. Please also see the response to Master Comment 3.20 in the RS for OUs 1 and 2.

Master Comment 6.28

A commenter stated that GBFood cannot accurately represent the trends in fish tissue PCB concentrations in Green Bay, because it is based on “errors” in wLFRM and the Green Bay sediment bed map interpolation, compounded by “errors” in GBTOXe.

Response

The Agencies believe that the combined bed maps and transport models for the River and Green Bay provide an adequate basis for the forecasts from the GBFood model. The commenter does not specifically state or list inadequacies with GBFood, but rather points to alleged problems in wLFRM, GBTOXe, and the Green Bay bed maps. The summary position of the Agencies is that the combined models and bed maps accurately represent the critical features of the overall Site conditions. The Agencies previously responded to critiques of the wLFRM model in Section 6.2 of the RS for OUs 1 and 2 and *in White Paper No. 16 – wLFRM Development and Calibration for the Lower Fox River/Green Bay Remedial Investigation, Feasibility Study, Proposed Remedial Action Plan, and Record of Decision*. Issues related to GBTOXe are addressed in the responses to Master Comments 6.24 and 6.25. Bed map inputs to the modeling process are addressed in the responses to Master Comments 5.71 and 6.24.

Master Comment 6.29

Commenters stated that neither FRFood nor GBFood should be used to derive SQTs.

Response

The WDNR and EPA disagree with this comment. The commenters are in error in stating that GBFood was used to set SQTs; only FRFood was used to derive SQTs. As noted in Master Comment 6.15 of the RS for OUs 1 and 2, the underlying Gobas algorithms applied in FRFood have been successfully applied at several Superfund sites and in the development of the Great Lakes Water Quality Initiative criteria. The Agencies believe that the Gobas algorithms are demonstrably applicable in evaluating bioaccumulation.

The Agencies also believe that FRFood is appropriately applied to setting SQTs. Guidance from EPA Region 5 was provided on the use of bioaccumulation models for setting sediment cleanup goals in the Great Lakes (Pelka, 1998). However, it is important to note that SQTs are not sediment cleanup goals. SQTs should be considered as receptor-specific point estimates (i.e., SQTs are calculated for a specific sediment location, pathway, and receptor). The SQTs themselves are not cleanup criteria, but are a good approximation of protective sediment thresholds and were considered to be “working values” from which cleanup goals were selected. SQTs do not vary by OU, but may vary by Superfund site, given the type of contamination, the types of species, site-specific exposure potential, the location-specific information available at a specific Superfund site, and other factors. The WDNR and EPA believe that the SQTs developed for the Lower Fox River and Green Bay Site are specific Site-wide.

See also the response to Master Comment 4.8 of the RS for OUs 1 and 2 and *White Paper No. 11 – Comparison of SQTs, RALs, RAOs, and SWACs for the Lower Fox River*.

Reference

Pelka, A., 1998. Bioaccumulation models and applications: Setting sediment cleanup goals in the Great Lakes. *Proceedings of the National Sediment Bioaccumulation Conference*. 5-9–5-30.

7 Potential In-River Risks from Remedial Activities

Section 7 of the RS for OUs 1 and 2 included the following subsections:

- *7.1 Habitat Impacts from Dredging and Capping*
- *7.2 Water Quality*

The RS for OUs 3, 4, and 5 follows the same general organization as the RS for OUs 1 and 2. However, many of the comments addressed in the RS for OUs 1 and 2 are generally applicable to the entire Lower Fox River and Green Bay Site and so are not repeated here. Because there are no new comments associated with Section 7.1, that section is not included in the RS for OUs 3, 4, and 5. Prior comments associated with that section can be found in the RS for OUs 1 and 2, which is available on the WDNR website, in the various information repositories, and in the Administrative Record for the Site. The WDNR's website address is: http://www.dnr.state.wi.us/org/water/wm/lowerfox/rifs/index.html.

Section 7 of the RS for OUs 1 and 2 included Master Comments 7.1 to 7.23. Master Comment 7.24 is therefore the first comment in the RS for OUs 3, 4, and 5.

7.2 Water Quality

Master Comment 7.24

Commenters expressed concern that dredging would increase PCB concentrations in Green Bay fish. Their concerns included localized sources of recontamination from PCB resuspension (resulting from dredging and sloughing of side slopes) and resettling of suspended solids and subsequent export to Green Bay.

Response

There is little empirical evidence on the percentage of PCB loss during dredging or the effects of such losses. In dredging at SMU 56/57, which is the most comprehensive data set available, the PCB loss approximated 2.2 percent of the mass removed. The Agencies believe that 98 percent of the PCB mass will be contained during dredging (i.e., a 2 percent PCB loss), which is acceptable.

As shown in the FS, if loss rates from the most highly contaminated site on the River are applied to the entire Lower Fox River, proposed remediation would equate to a loss of 644 kg (1,420 pounds) of PCBs. On the other hand, the FRG offered that the annual PCB export from July 2000 to July 2001 was up to 106 kg (233 pounds) and that the rate of decline approximates a half-life of 9 years. If this rate of decline is accepted and applied to the next 20 years, it would mean that active remediation would result in almost 30 percent less PCBs resuspended and transported to Green Bay than would taking no action.

During the SMU 56/57 demonstration project, the FRG documented increased turbidity and directly measured elevated PCB concentrations resulting only from movement of the coal boat. The authors concluded that “vessel movement is a continuing PCB transport mechanism regardless of dredging operations” (USGS, 2000). Because the sediment is the only possible source of the elevated suspended solids and PCBs, these data document that commercial ship traffic has the potential to locally scour sediments.

The Agencies have therefore concluded that a 2 percent contribution of PCBs to the downstream bed sediments is insignificant compared to the mass of PCBs already contained in the surface sediments. Similar comments, and appropriate responses, were also presented in the Hudson River Responsiveness Summary, Master Comment 587. See also *White Paper No. 8 – Habitat and Ecological Considerations as a Remedy Component for the Lower Fox River,* which is attached to the RS for OUs 1 and 2, as well as the responses to Master Comments 7.14 and 7.15 in the RS for OUs 1 and 2.

Reference

USGS, 2000. *A Mass Balance Approach for Assessing PCB Movement During Remediation of PCB-Contaminated Deposit on the Fox River, Wisconsin, SMU 56/57 1999 Dredging Demonstration Project*. United States Geological Survey Water Resources Investigation Report No. 00-4245. December.

8 Implementability of Remedial Alternatives

Section 8 of the RS for OUs 1 and 2 included the following subsections:

- *8.1 Implementability of Dredging*
- *8.2 Dredging Schedule and Production Rates*
- *8.3 Dredge Material Disposal*
- *8.4 Safety Concerns and Community Concerns*

The RS for OUs 3, 4, and 5 follows the same general organization as the RS for OUs 1 and 2. However, many of the comments addressed in the RS for OUs 1 and 2 are generally applicable to the entire Lower Fox River and Green Bay Site and so are not repeated here. Because there are no new comments associated with Section 8.3, that section is not included in the RS for OUs 3, 4, and 5. Prior comments associated with that section can be found on the WDNR website, at the various information repositories, and in the Administrative Record for the Site. The WDNR's website address is: http://www.dnr.state.wi.us/org/water/wm/lowerfox/rifs/index.html.

Section 8 of the RS for OUs 1 and 2 included Master Comments 8.1 to 8.39. Master Comment 8.40 is therefore the first comment in the RS for OUs 3, 4, and 5.

8.1 Implementability of Dredging

Master Comment 8.40

A commenter requested that the WDNR strengthen measures to reduce the volatilization of PCBs into the air during dredging and at the final disposal site.

Response

The WDNR and EPA recognize the potential for loss of PCBs to the atmosphere during removal, handling, and disposal of River sediments. However, the identification, use, and implementation of control measures to minimize volatilization are more appropriately addressed during the remedial design phase, following issuance of the ROD. Hydraulic dredging can be effectively engineered to minimize volatilization, and hydraulic and mechanical dredging technologies have been demonstrated to provide a protective and environmentally beneficial result (FS, Appendix B). Therefore, either technology is appropriate for the removal of PCB-contaminated sediments from the Lower Fox River. In addition, air monitoring will be incorporated into the various on-water and upland activities during implementation to address community and workers' concerns.

Recognizing the results of the air monitoring conducted during the dredging project at SMU 56/57 (WDNR, 2000), the Agencies have determined that activities associated with implementing the Proposed Plan will not result in unacceptable risk as a result of PCB losses to the atmosphere. Ambient concentrations observed during the 24-hour sampling regime ranged from less than 0.2 nanograms per cubic meter (ng/m^3) to 79.7 ng/m^3 during the dredging and sediment processing. Ambient concentrations within the property boundaries of the remediation area ranged from approximately 0.7 ng/m^3 to 79.7 ng/m^3, while off-property concentrations reached a maximum of only 3.6 ng/m^3. The highest concentration recorded on site was less than 80 percent of the conservative risk level, while off-site risks never exceeded 4 percent. Twenty-nine of 31 samples collected adjacent to the landfill accepting the dredge material from SMU 56/57 had no detectable PCBs. In the two samples in which PCBs were detected, PCB concentrations were not significantly different from concentrations in background samples also collected in the area.

These data show that during remediation of the most highly contaminated sediments in the Lower Fox River (SMU 56/57), volatilization did not reach a level that posed a risk to human health. The FRG concluded that "although increases in ambient air PCB concentrations were observed near the sediment dewatering area, estimated PCB emissions and resulting concentrations were found to be relatively small and insignificant relative to human exposure and risk" (BBL, 2000).

At SMU 56/57, sediments averaged 20.8 grams PCBs per cubic yard (g/cy) based on the reported PCB mass of 654 kg (1,442 pounds) and an *in-situ* sediment volume removed of 31,500 cy. In contrast, the proposed remedial plan averages only 4 g/cy (29,259 kg [64,516 pounds]/7.25 million cy). If one assumes a volatilization rate equal to that observed during the SMU 56/57 dredging project, the sediments to be handled during the entire remediation are less than one-fifth as concentrated; therefore, the mass of PCBs lost during the entire remediation period (125 kg [275 pounds]) would be less than that estimated in the GBMBS for just 1989/1990 (154 kg [340 pounds]).

Despite these considerations, which indicate that volatilization is readily controllable and should not result in a significant release, monitoring would be conducted as a final measure to ensure protectiveness of the selected remedy.

References

BBL, 2000. Major Contaminated Sediment Site Database. Last updated August 1998. Website: http://www.hudsonvoice.com.

WDNR, 2000. Fox River Remediation Air Monitoring Report, Ambient PCBs During SMU 56/57 Demonstration Project, August–November 1999. WDNR Publication Number PUBL-AM-310-00. Wisconsin Department of Natural Resources.

Master Comment 8.41

A commenter stated that remedy effectiveness relies on the unstated assumption that dredging efforts can be expected to be 100 percent efficient at removing contaminated sediments to specified action limits.

Response

The WDNR acknowledges that some sediment loss will occur during dredging operations; however, such loss will be minimal. At SMU 56/57, the PCB loss approximated 2.2 percent of the mass removed. The WDNR and EPA believe that this loss rate is the most applicable rate for the entire Lower Fox River. Applying the loss rate from SMU 56/57 to the proposed remediation would equate to a total loss of approximately 644 kg (1,420 pounds) of PCBs (2.2 percent of 29,259 kg [64,516 pounds] PCBs). In Appendix B of the FS, the *Sediment Technologies Memorandum* provided a comprehensive evaluation of dredging projects and concluded that dredging has been successfully implemented at various sites. There have been over 100 years of experience with dredging projects around the world.

As stated in the FS, 17 of the 20 projects cited in Appendix B met the short-term target goals that included sediment excavation to chemical concentration, mass, horizon, elevation, or depth compliance criteria. Seven projects had "overdredge" designed into the project plans. In five out of seven cases where overdredge could occur, target goals were met. The Port of Los Angeles hydraulically dredged and landfilled about 29 million cy of sediment for the Pier 400 construction project (1994 through 2000). Projects at Minamata Bay, Japan, and Lake Ketelmeer, Netherlands, two of the largest international contaminated sediment dredging projects known to the WDNR and EPA, involved dredging 1 million cy of mercury-impacted sediment in 4 years and 1.9 million cy of impacted sediment in 1 year, respectively. The Ketelmeer project covers a larger area and volume than does the proposed action for the Lower Fox River and is already well into the construction phase (Roukema et al., 1998). Other large contaminated sediment management projects include the Slufter Depot for the Port of Rotterdam and restoration of Lake Tunis in

Tunisia. Sediment remedial projects in the United States that will be similar in scale to the Lower Fox River project include the removal action on the Hudson River in New York, the Hylebos and Thea Foss waterways in Washington, and the Kalamazoo River in Michigan. The "lessons learned" from these dredging projects were considered while preparing the FS. Based on the experiences at previous dredging projects, hydraulic (cutterhead suction dredge) and mechanical dredge (clamshell bucket) were considered in the FS.

Results from the *Sediment Technologies Memorandum* (Appendix B of the FS) indicate that dredging can be implemented in an effective way if the technology is designed and managed appropriately for Site conditions. In addition, the WDNR and EPA have determined that removal and disposal of approximately 780,000 cy of contaminated sediments in OU 1 is protective, implementable, and cost-effective. The ROD for OUs 3, 4, and 5 provides for the removal by dredging of 586,800 cy of contaminated sediments containing 1,111 kg (2,444 pounds) of PCBs from OU 3 and the removal of Deposit DD from OU 2 as part of the OU 3 remedy. Deposit DD adds approximately 9,000 cy of contaminated sediment and 31 kg (68 pounds) of PCB mass to the OU 3 project. It is estimated that OU 4 contains approximately 26,650 kg (58,620 pounds) of PCBs in 8,491,400 cy of sediment. The ROD for OUs 3, 4, and 5 provides for the removal by dredging of 5,879,500 cy of contaminated sediments containing 26,433 kg (58,150 pounds) of PCBs from OU 4.

Reference

Roukema, D. C., J. Driebergen, and A. G. Fase, 1998. *Realisation of the Ketelmeer Storage Depot.* Terra et Aqua 71. Website: http://www.iadc-dredging.com/terra%2Det%2Daqua/1998/71%2D3.htm.

Master Comment 8.42

Commenters expressed concerns over the technical feasibility of the removal remedy for OU 3 and OU 4 in the Proposed Plan. The commenters also expressed concern over the dredging costs and that they would be significantly more than MNR in the downstream portion of OU 4.

Response

The WDNR and EPA disagree with this comment. Projects that utilize at least one of the basic components of the alternative offered in the Proposed Plan — dredging, pipeline, and passive dewatering followed by disposal — are commonly implemented. Navigational dredging projects commonly dredge large volumes of sediment in short time frames. Typically, about 4 million cy of sediments are dredged by the USACE each year from Great Lakes harbors and channels, which is only a portion of the 300 to 350 million cy dredged by the USACE nationwide annually. On average, the USACE spends about $20 million annually for dredging and dredged material management in the Great Lakes basin (USACE website: http://www.lrd.usace.army.mil/gl/dredge.htm). Other large international and U.S. projects are described in the response to Master Comment 8.41 and detailed in Appendix B of the FS.

Pipeline technology has been used to transfer sediment dredge slurry over long distances, a common practice in mining facilities and at dredging operations. An example is the White Rock Lake project in Dallas, Texas. In this project, a 20-mile pipeline was used to transport dredged sediments over land. At the USX portion of the Grand Calumet River project, a 3-mile in-water pipeline with an 18-inch diameter is being used. In a Wisconsin case, hydraulically dredged sediments were transferred via pipeline from the Grubers Bay Grove sediment project, part of the U.S. Army Badger Army Ammunition Plant remediation, to the on-site disposal location, a distance of about 0.7 mile. Although it's important to note that no route has yet been selected for the pipeline for the Lower Fox River project, it is possible to place the pipeline adjacent to an existing recreational route, in the River, or along public rights of way (or at some combination of the three). Pipeline routing will be a challenge. The specific route and details concerning the design and construction of a pipeline along any specific route or combination of routes is a design consideration that will be addressed in the final remedial design phase of the project.

Passive dewatering and disposal represent a feasible "low-tech" approach for dewatering sediments. In this particular alternative, the technology application relies on gravity settlement of solids, which would be conducted in upland ponds. This approach is consistent with the approach used at Brown County's Bayport facility for the management of navigational dredge materials in conjunction with mechanical dredging. Use of passive dewatering cells can lead to a need for large land areas; finding a location for such a facility will be undertaken during the remedial design phase.

Concerning the cost of dredging, the WDNR has reviewed the overall cost estimates for the OUs 3 and 4 remedy, as described in the Proposed Plan. This cost evaluation is documented in *White Paper No. 23 – Evaluation of Cost and Implementability of Alternative C2B for Operable Unit 3 and Operable Unit 4,* which is attached to this RS. As a result of that cost evaluation, the cost estimates for the OUs 3 and 4 alternative increased by about 42 percent, from an estimated $200.5 million to approximately $284 million. The Agencies believe that these cost estimates are reasonable and provide a protective remedy. The estimated costs proposed for the remediation are within an acceptable range per federal Superfund guidance. The WDNR and EPA are confident that the proposed costs of the remediation and monitoring activities are within the cost estimation criteria of –30 percent to +50 percent found in Superfund guidance.

Critical to the success of this alternative is linking these technologies together. The inability to implement any individual portion (such as pipeline or passive dewatering cells) could result in increased cost for this approach.

Reference

Roukema, D. C., J. Driebergen, and A. G. Fase, 1998. *Realisation of the Ketelmeer Storage Depot*. Terra et Aqua 71 Website: http://www.iadc-dredging.com/terra%2Det%2Daqua/1998/71%2D3.htm.

Master Comment 8.43

A commenter stated that daily effective production in OU 3 and OU 4 cannot reasonably be greater than 12 hours because OU 3, OU 4, and the surrounding areas where land-based dewatering, staging, and trucking operations will occur are in residential neighborhoods. Consequently, the proposed remedy cannot meet its goal in a timely way.

Response

As indicated in the FS, the dredge operations for OUs 3 and 4 are limited to 12 hours per day. Dredge and disposal via pipeline allows for 24-hour dewatering operations. However, the dewatering operations will be limited to a location in proximity to the disposal facility to minimize or avoid the impact of remediation activities on host communities. The case studies presented in Appendix B of the FS indicate that the dredge rates suggested in the Proposed Plan are not unreasonable. The commenters assume that only one dredge will operate at any single time in either OU 3 or OU 4. This is incorrect. There are no restrictions to prevent multiple dredges. The FS describes two 12-inch cutterhead dredges operating simultaneously 12 hours per day, 7 days per week, 26 weeks per year, and a dredge rate of 120 cubic yards per hour (cy/hr) per dredge (240 cy/hr for two dredges). The resulting dredge duration is 102 days or 0.7 year. For OU 4, the FS describes two 12-inch cutterhead dredges operating simultaneously 12 hours per day, 7 days per week, 26 weeks per year, and a dredge rate of 120 cy/hr per dredge (240 cy/hr for two dredges). The resulting dredge duration is 1,019 days or 6.8 years. Please also see the FS and the response to Master Comment 8.15 in the RS for OUs 1 and 2. See the response to Master Comment 8.15 in the RS for OUs 1 and 2 for further discussion of the issue of dredge production rates.

Master Comment 8.44

Commenters believe the FS and Proposed Plan recognize the possibility of effective combinations of natural attenuation, capping, dredging, and off-site disposal. However, the commenters do not believe that alternative treatment technologies (such as detoxification through high-temperature thermal desorption) and combinations of other alternatives were adequately considered.

Response

The WDNR and EPA disagree with this assessment. The remedy decision is based on risk reduction, and the RI/FS is an objective, unbiased approach to analyzing remedial alternatives. The level of detail provided in the FS and the supporting documents is consistent with Superfund guidance. The FS provides thorough evaluations of the feasible and applicable technological alternatives. The FS technology evaluation is followed by the development of feasible alternatives prior to selection of a remedy and further Site-specific design of the selected remedial alternative. The FS looked at and evaluated numerous technologies and combinations of technologies for remedial purposes. These technology evaluations and alternative assessments are in Sections 6 and 7 of the FS and are also discussed in the Proposed Plan.

Furthermore, Section 7.6 of the FS identifies vitrification as the representative thermal treatment process option. Also discussed in Section 6 of the FS is a multiphase study conducted by the WDNR on sediment from the Lower Fox River to determine operational data, treatment effectiveness, and cost-effectiveness of vitrification. The results from the multiphase study demonstrate that thermal treatment is a feasible option for the treatment of dredged sediment. Data generated by the EPA's Superfund Innovative Technology Evaluation program shows that vitrification does not generate dioxins and furans in the off-gases from these technologies and is greater than 99.9999 percent effective at destroying PCBs.

Master Comment 8.45

Comments were received concerning the presence of and importance of taking into consideration various physical obstacles, such as water intakes, outfalls, piles, cables, and pipelines, in upstream and downstream portions of OU 4 in planning for a remedial action. Commenters submit that the FS and Proposed Plan did not evaluate the impact on the proposed remedy of any of these obstacles with regard to cost, effectiveness, and implementability.

Response

The WDNR acknowledges that there will be physical obstructions in the downstream portion of the Lower Fox River that will need to be dealt with in any implemented remedial alternative. However, two environmental dredging pilot projects performed on the River over the period 1998 to 2000, as well as detailed monitoring of the River and of the water withdrawn by nearby industries, have shown no risk to the quality of water withdrawn for industrial uses. The WDNR and EPA have conducted the pilot projects to demonstrate that dredging can be accomplished on the River in an effective fashion with minimal disruption of industry or the community. The WDNR is unaware of any industrial water intake quality issues in the River associated with either navigational or environmental dredging projects on the Lower Fox River. The USACE performs regular navigational dredging on the lower portion of the River, and the WDNR has not been notified of any problems concerning water intakes, outfalls, piles, cables, pipelines, etc. In addition, as part of the pre-design phase of this project, the WDNR and EPA, in cooperation with various utility companies and municipalities, are identifying areas of the River and Bay that could contain obstructions.

The *Sediment Technologies Memorandum* documented that debris management is an important component of remedy design. In the draft FS, obstruction removal was not specifically accounted for. In the final FS, the costs associated with debris sweeps have been specifically accounted for.

Master Comment 8.46

Several commenters expressed concern over the use of silt curtains to control resuspension losses during dredging in OU 4. Included were comments that support the use of anchored silt curtains at all sites, as outlined in the FS. Other commenters stated that silt curtains would be difficult to implement, would not provide additional protection, and have a poor application record at the demonstration projects.

Response

These issues were addressed specifically for OU 1 in the response to Master Comment 8.8 in the RS for OUs 1 and 2; that response is also relevant for OU 3 and OU 4 and so is cross-referenced here. Although the use of silt curtains was applied throughout the FS as a process option for the entire River when developing the alternatives and costs, the FS did indicate that silt curtains may not be appropriate at all sites. Silt curtains were also applied during the demonstration project at SMU 56/57. As commenters correctly point out, factors such as currents, the ability to anchor, obstructions, and interference with navigation will need to be considered in the final design.

Whether silt curtains are needed or should be used in the Lower Fox River is a design issue and will be determined by the design engineer and dredge contractor.

8.2 Dredging Schedule and Production Rates

Master Comment 8.47

Commenters stated that the Proposed Plan's estimated dredging rates are too optimistic and are not typical of environmental dredging rates for OU 3 and OU 4. The commenters assert that more appropriate rates would be 200 cy/hr for "first pass" dredging and 100 cy/hr for "cleanup pass" dredging, which would also include 8 inches of overdredged sediment. Based on their estimates, commenters stated that OU 3 would require 2.9 years for removal and OU 4 would require 22.1 years. A key assumption was that only one hydraulic dredge can operate at each reach in order to minimize turbidity, total suspended solids and PCB resuspension, and interference with boat and ship traffic.

Response

The case studies presented in Appendix B of the FS indicate that the dredge rates in the Proposed Plan are not unreasonable for environmental dredging. For example, dredge production rates at the SMU 56/57 demonstration project averaged 60 cy/hr and 294 cy/day.

Two types of hydraulic dredges were considered in the FS cost estimates for the Lower Fox River. The average dredge production rate for a 10-inch cutterhead dredge in a 10-hour shift is 105 cy/hr and the average dredge production rate for a 12-inch cutterhead dredge in a 12-hour shift is 120 cy/hr. These dredge rates are within the estimates used by the FRG model (100 to 200 cy/hr) to account for "first pass" and "cleanup pass" dredging.

For OU 3, the FRG assumes one hydraulic dredge operating 12 hours per day, 6 days per week, and 26 weeks per year. This results in a dredge time frame of 454 days or 2.9 years (based on a 156-day dredge year: 26 weeks × 6 days per week). For OU 3, the FS describes two 12-inch cutterhead dredges operating simultaneously 12 hours per day, 7 days per week, 26 weeks per year, and a dredge rate of 120 cy/hr per dredge (240 cy/hr for two dredges). The resulting dredge duration is 102 days or 0.7 year, lower than the FRG's time frame due to a higher dredge rate.

For OU 4, the FRG assumes one hydraulic dredge operating 12 hours per day, 6 days per week, and 26 weeks per year. This results in a dredge time frame of 3,448 days or 22.1 years. For OU 4, the FS describes two 12-inch cutterhead dredges operating simultaneously 12 hours per day, 7 days per week, 26 weeks per year, and a dredge rate of 120 cy/hr per dredge (240 cy/hr for two dredges). The resulting dredge duration is 1,019 days or 6.8 years, lower than the FRG's time frame due to a higher dredge rate.

The commenters' argument that only one dredge can operate at any single time in either OU 3 or OU 4 is not a supportable position; there are no restrictions to prevent multiple dredges from operating in any OU. The ROD recognized that expediting activities and possible work in multiple OUs within the Lower Fox River and mouth of the Bay is highly desirable. See the response to Master Comment 8.15 in the RS for OUs 1 and 2 for further discussion of the issue of dredge production rates.

The WDNR acknowledges that some sediment loss will occur during dredge operations; however, such loss will be minimal. At SMU 56/57, the PCB loss approximated 2.2 percent of the mass removed. The WDNR and EPA believe that this loss rate is the most applicable rate for the entire Lower Fox River. On the basis of experiences at previous dredging projects, hydraulic (cutterhead suction dredge) and mechanical dredge (clamshell bucket) were both considered in the FS. Results from the *Sediment Technologies Memorandum* (Appendix B of the FS) indicate that dredging can be implemented in an effective way if the technology is designed and managed appropriately for the Site conditions.

As noted in the response to Master Comment 8.51, the Agencies do not believe that dredging in OU 4 will restrict or otherwise obstruct commercial shipping or docking activities. The WDNR and EPA have conducted the pilot projects to demonstrate that dredging can be done on the River in an effective fashion with minimal disruption of industry or the community.

8.4 Safety Concerns and Community Concerns

Master Comment 8.48

A commenter stated that cleanup work must begin as soon as possible, with multiple dredging crews working simultaneously at several sites along the River and in the Bay, to make the cleanup as speedy as physically possible.

Response

The WDNR and EPA would also like to see active in-water remediation take place quickly. Toward that end, the WDNR and EPA have conducted pilot projects to demonstrate that dredging can be accomplished on the River in an effective fashion with minimal disruption of industry or the community. The ROD recognized that expediting activities and possible work in multiple OUs in the Lower Fox River and mouth of the Bay is highly desirable. The Agencies believe that addressing continuing PCB discharge into Green Bay will assist in reducing the long-term risks in Green Bay.

Master Comment 8.49

A commenter suggested that a remedy tailored to the upstream and downstream conditions of OU 4 should be selected. The commenter also expressed concern that dredging may pose substantial risk to the community and workers, given the amount of materials handling involved.

Response

Implementation of the selected remedy for OU 4 (Alternative C2B – dredging followed by passive dewatering and disposal into a monofill) will be operationally the same for all of OU 4. Although some characteristics in this reach of the River vary, the fundamental nature of the River and the River sediments is essentially the same. Thus, the selected technology can be applied to upstream and downstream areas within OU 4, and there is no reason for separate remedies within this reach.

Risks to the community and to workers were considered in the FS and will be addressed via proper project design and a health and safety plan. Worker and community safety is routinely considered during Superfund projects and can be readily addressed with proper site management and planning.

Master Comment 8.50

Commenters stated that dredging could disrupt the small amount of habitat present in OU 4 for years to come.

Response

Many aspects of the concerns expressed by these commenters are addressed in the response to Master Comment 7.3 in the RS for OUs 1 and 2. Locations of and potential impacts and enhancements to habitat and wildlife resulting from removal are also evaluated in Section 2 of the BLRA, Section 8 of the RS for OUs 1 and 2, and in *White Paper No. 8 – Habitat and Ecological Considerations as a Remedy Component for the Lower Fox River,* which is attached to the RS for OUs 1 and 2. The potential impacts on Lower Fox River habitats have been realistically characterized and evaluated. Habitat loss was considered during remedy selection. It has been determined that potential impacts on terrestrial habitat are nonexistent. It has also been determined that fish in the Lower Fox River will not experience impacts from any remedy that has been proposed.

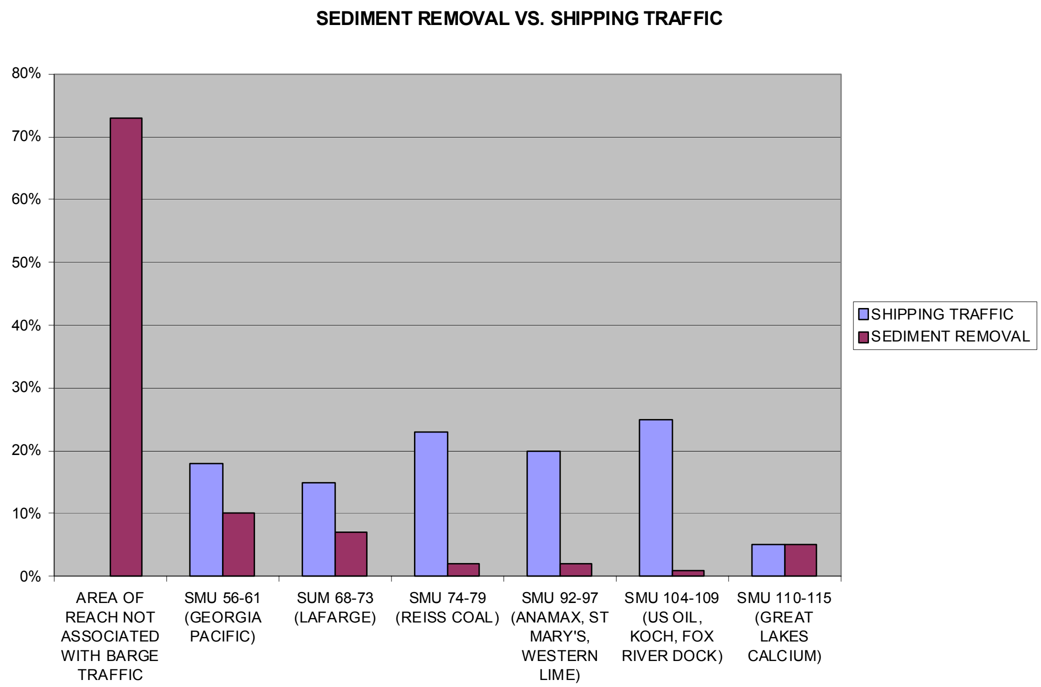
The WDNR and EPA have stated that ecosystem restoration and rehabilitation are critical components for the Lower Fox River and Green Bay Site. As discussed in White Paper No. 8, fish in the Lower Fox River utilize open substrate such as cobble with high dissolved oxygen for spawning and adult habitat. These areas are not targeted for dredging. Areas targeted for dredging or capping in the Lower Fox River are predominantly soft, aqueous, and silty sediments. Further, as previously noted in Master Comment 7.4 of the RS for OUs 1 and 2, "the NRDA [Natural Resources Damage Assessment] restoration will target habitat enhancements, which are consistently called for by WDNR. Habitat enhancements contained in the remedy support the diversification of the fish assemblages within the River and the creation of more nearshore, shallow littoral habitat." Dredging and capping remedies have been shown to have rapid recovery and minimal impact on aquatic communities. The commenters have suggested that risk will be increased by remediation, when actually the risk will not increase — the remedy will present less risk potential than the level of risk currently present.

Master Comment 8.51

Commenters stated that environmental dredging would have a significant impact on commercial shipping in OU 4 due to obstruction of commercial docks. They also stated that the resuspension of sediments from environmental dredging has the potential to interfere with industrial processes requiring clean intake water. These commenters also expressed concern about shoreline stability and recreation.

Response

The Agencies do not believe that dredging in OU 4 will restrict or otherwise obstruct commercial shipping or docking activities. Dredging would occur in a relatively small area at any given time and would not likely block a commercial shipping area or docking facility for very long. Regarding the possible obstruction of commercial dock traffic, only 27 percent of sediment to be removed from OU 4 is in SMUs having commercial facilities that receive shipping traffic. Based on 2001 and 2002 data from the Green Bay Port Authority, SMUs with the highest traffic are located close to the mouth of the River, and more than 50 percent of the River traffic is limited to within the first River mile (SMU Groups 92–115). In fact, more than 50 percent of the shipping traffic occurs where less than 10 percent of the contaminated sediment targeted for removal in OU 4 is found (see figure below).



The scope of remedial work in OU 4 will require dredging of the River in areas adjacent to the navigation channel, but dredging within the navigable channel will be negligible considering previous dredging operations conducted by the USACE. The depth of the River in the area of commercial traffic is such that the dredge will be maneuverable outside of the shipping channel, thus enabling the dredge to operate along the edges of the waterway outside of the navigation channel. Therefore, environmental dredging will not impede shipping traffic within the ship channel.

All appropriate and mandatory marking devices, navigation notices, and communication links will be of standard and legal operating protocol to properly notify incoming traffic.

In areas of high shipping traffic and where slips may be blocked, submerging the dredge pipe is an option. In the SMU 56/57 project, submersion of the dredge pipeline across the Fort James boat slip was considered, although a conscious design choice was made not to submerge the dredge pipe, thus requiring disruption of dredging operations during entry and departure of the coal boat. Taking this into account, the volume of dredging that will occur in high traffic areas may call for sinking the dredge pipe to ensure efficient use of the waterway by both shipping and dredge operations.

Although dredging will occur during the entire shipping season, 73 percent of the scope of the dredging is targeted for areas of the River with commercial ship traffic. The frequency of traffic coming into each port has been taken into consideration, and coordination of shipping traffic and dredging operations can be scheduled. The design and route of the dredge pipeline will be considered during the remedial design phase, as will the scheduling of dredging activities to coordinate with ship arrivals and departures when working in the vicinity of active docks. Past navigational and environmental (pilot project) dredging have been performed without interference to commercial navigation. The WDNR and EPA have every reason to believe that future dredging projects can be implemented in a manner that fully accommodates commercial shipping needs.

The two environmental dredging pilot projects performed on the River at Deposit N and SMU 56/57 provided detailed monitoring information for the River and of the water withdrawn by nearby industries; that monitoring information shows no decrease to the quality of water withdrawn for industrial uses. No large industrial water users have raised concerns to the WDNR about actual problems with the quality of incoming water or their ability to withdraw water from the River arising out of either navigational or environmental dredging projects. The WDNR and EPA recognize the need to protect industrial water intakes and measures to do so will be incorporated into the remedial design.

The USACE performs regular navigational dredging on the lower portion of the River; the WDNR has not been notified by water users of any problems associated with that dredging. EPA experience on other dredging projects has demonstrated that with proper design and monitoring, these risks can be readily addressed. A January 2002 white paper for the Hudson River Site, “Resuspension of PCBs During Dredging,” shows that for five projects representing 388 observations, the average contaminant loss was 0.11 percent. Lower Fox River projects would utilize similar equipment and protective measures and would expect similar results.

Considering the length of shoreline that will be affected by the remedy, the WDNR and EPA estimate minimal change, if any, in shoreline stability. Monitoring of the shoreline and bulkheads at both pilot dredging projects showed no problems with sediment removal close to these structures.

Regarding recreational facilities, marinas, boat landings, and boatlifts, there are four primary recreational areas. The Green Bay Yachting Club and McDonald Marina are both located near the River mouth, where very little sediment removal is targeted. The East River Holiday Inn City Center Marina also is in an area that requires minimal remediation. The Allouez Yacht Harbor is located in an area of the River where 7 percent of the remediation will take place; however, considering the length of shoreline that will be affected, the inconvenience will be minimal. All of the sediment removal targeted for areas around these marinas can be scheduled for periods of inactivity during the design phase of the project.

Reference

Brown County Port and Solid Waste Department website:
http://www.co.brown.wi.us/solid_waste/port/index.htm.

Master Comment 8.52

Some commenters stated that they oppose dredging of the Green Bay Harbor shipping channel between the De Pere dam and the mouth of the Lower Fox River for several reasons, including:

- This section of the River contains roughly 90 percent of all PCBs in the entire Lower Fox River.
- The USACE channel maintenance equipment is not designed for remedial toxic cleanups.
- The USACE does not have a disposal site that complies with the EPA's Toxic Substances Control Act exemption requirements; the USACE dredges a relatively small quantity of sediment from the channel each year.

Response

This comment seems to combine several issues. The Agencies agree that OU 4 contains a large percentage of the contaminated sediment and PCB mass in the River. However, much of this material is located outside of the navigation channel and consequently is not impacted by the USACE's navigational dredging. Furthermore, there are no plans at this time to utilize the USACE's personnel or navigational dredge equipment or the dredge solids management facility operated by Brown County as part of the remedial action for Green Bay.

The fact that much of the PCB-contaminated sediment is located outside of the navigation channel is key to this issue, as the PCB contamination in the sediments in OU 4 presents an unacceptable risk to human health and the environment. As a result, the scope of the remedial work for OU 4 will require dredging of the River in areas adjacent to the navigable channel, but dredging within the navigable channel will be negligible considering previous dredging operations conducted by the USACE. The depth of the River is such that the dredge will be maneuverable outside of the shipping channel. Dredging vessels typically draw 3 to 15 feet of water, thus enabling the dredge to operate along the edges of the waterway. Therefore, environmental dredging will not impede shipping traffic within the ship channel.

Regarding the concern of possible obstruction of commercial dock traffic by remedial dredging operations, a minimal amount of sediment removal in the De Pere to Green Bay Reach is necessary in SMUs that have commercial facilities receiving shipping traffic. Six SMU Groups in this reach receive barge traffic. Based on data from 2001 and 2002, the SMU Groups with the highest volume of barge traffic are SMUs 104–109, 92–97, and 74–79. The highest traffic SMUs are located close to the mouth of the River, reducing total River traffic by 50 percent. Based on an analysis of traffic on the Lower Fox River, most shipping traffic occurs close to the mouth of the River; the percentage of sediment removal within these high-traffic areas is minimal.

9 Selection of Remedy

Section 9 of the RS for OUs 1 and 2 included the following subsections:

- *9.1 General Comments*
- *9.2 Cost*
- *9.3 Long-Term Monitoring*

The RS for OUs 3, 4, and 5 follows the same general organization as the RS for OUs 1 and 2. However, many of the comments addressed in the RS for OUs 1 and 2 are generally applicable to the entire Lower Fox River and Green Bay Site and so are not repeated here. The RS for OUs 1 and 2 can be found on the WDNR website, at the various information repositories, and in the Administrative Record for the Site. The WDNR's website address is: http://www.dnr.state.wi.us/org/water/wm/lowerfox/rifs/index.html.

Section 9 of the RS for OUs 1 and 2 included Master Comments 9.1 to 9.24. Master Comment 9.25 is therefore the first comment in the RS for OUs 3, 4, and 5.

9.1 General Comments

Master Comment 9.25

Commenters expressed support for reconstruction of the cap on the Renard Island Confined Disposal Facility (CDF) as part of the remediation of OU 5.

Response

The WDNR and EPA support the appropriate closure of the Renard Island CDF. However, closure of the CDF is the responsibility of the USACE and the local sponsor, Brown County, under the Rivers and Harbor Act and the Water Resources Development Act. The WDNR recognizes that appropriate closure of the CDF includes ensuring that it is properly capped, monitored, and maintained and that it does not become a source of PCBs back into Green Bay. WDNR Waste Program staff will work with the USACE and Brown County to see that the site is properly closed. Closure of Renard Island is not part of the ROD for OU 5.

Master Comment 9.26

Commenters stated that closure of the Renard Island CDF is not properly included in the Superfund process and cannot be identified as part of a remedy for OU 4 or OU 5. Other commenters suggested that the selected remedy for

OU 4 or OU 5 should include the costs of Brown County's financial responsibility for managing Renard Island as well as costs for the Bayport facility operated by the county.

Response

The WDNR and EPA acknowledge that closure of the CDF and operation of the Bayport facility are responsibilities of the USACE and the local sponsor, Brown County, under the Rivers and Harbor Act and the Water Resources Development Act and, as such, are not included in the ROD. Since neither facility was identified in the BLRA as a specific source of risk and since the facilities are subject to other state and federal jurisdiction, the ROD cannot require any remedial action at these facilities.

Brown County has expressed interest in exploring the appropriate closure and long-term care of Renard Island and Bayport as part of the overall Lower Fox River cleanup. Costs for closure of Bayport and the Renard Island CDF are included in Sections 7.5 and 7.6 of the FS along with the cost of constructing a new CDF. Final closure of Renard Island must be agreed to by the USACE, Brown County, and the WDNR. One element of CDF closure will be ensuring that the CDF is properly capped, monitored, and maintained and that it does not become a source of PCBs back into Green Bay.

Master Comment 9.27

A commenter stated that the Bayport facility may be filled within 20 years and that the Proposed Plan is incomplete by not taking into account impacts on operation of the Bayport facility.

Response

The Agencies agree that over time, as navigational dredge material is removed from the River and Bay, there will be less capacity at the Bayport facility. As the local sponsor for the Port of Green Bay, the county has agreed to provide for the disposal of navigational dredge material as part of an operational agreement with the USACE to continue navigational dredging. This agreement with the USACE would be necessary regardless of sediment contamination. However, because of the amount of material to be removed during the remedial effort, less dredging should be required for some time into the future, and it is anticipated that material from the navigational channel will be included in the remedial action, thus extending the life of the Bayport facility. Nonetheless, impacts to operation of the Bayport facility are not an element of the remediation of the Lower Fox River and Green Bay Site.

Master Comment 9.28

Commenters stated that the MNR alternative proposed for OU 5 will leave areas of PCB-impacted sediments that will drift into the navigation channel for decades.

Response

The Agencies have selected MNR for OU 5. In choosing MNR for the Bay, the Agencies considered Superfund guidance on the nine evaluation criteria to determine whether remediation is needed or not. The Agencies considered other information as well.

Data from the Green Bay Port Authority documents that navigational dredge material from Green Bay contains very low levels of PCBs. With significant reductions in the transport of PCBs to Green Bay from the Lower Fox River, PCB concentrations in the southern portion of Green Bay, including the navigation channel, will continue to decline. Sediment drift into the navigation channel is not a compelling reason to require dredging of the southern Bay. Continued navigational dredging coupled with MNR may allow for continued dispersion of contaminated sediment within the lower Bay. In addition, if dredging to a 1 ppm action level occurred within the southern Bay, it is likely that PCB contamination of navigational dredge material would continue.

To address concerns raised about Green Bay, the WDNR undertook several actions, which included reevaluating the PCB mass and contaminated sediment volume in the Bay (documented in *White Paper No. 18 – Evaluation of an Alternative Approach of Calculating Mass, Sediment Volume, and Surface Concentrations in Operable Unit 5, Green Bay*); conducting additional sampling in the south end of the Bay (documented in *White Paper No. 19 – Estimates of PCB Mass, Sediment Volume, and Surface Sediment Concentrations in Operable Unit 5, Green Bay Using an Alternative Approach,* which also provides estimates of PCB mass and contaminated sediment volume incorporating the new data); and conducting additional modeling to evaluate removal of contaminated sediments (documented in *White Paper No. 20 – Green Bay Modeling Evaluation of the Effects of Sediment PCB Bed Map Revisions on GBTOXe Model Results* and *White Paper No. 21 – Green Bay Modeling Evaluation of a Hypothetical Open-Water Disposal Site for Navigational Dredged Material in Southern Green Bay*). All four white papers are appended to this RS.

Results from the additional sampling and the evaluations discussed in White Paper No. 18 and White Paper No. 19 indicate that there were no areas in the southern Bay with elevated concentrations of PCBs.

The modeling results discussed in White Paper No. 20 reveal that changes to PCB mass in Zone 2 of OU 5 do affect the initial conditions for the GBTOXe model; however, the effect is to make those initial conditions more consistent with zones 3A, 3B, and 4 of OU 5. White Paper No. 21 evaluated how sediments dredged from the federally maintained navigation channel and disposed of in the open-water disposal areas that were operated up until the 1970s might have affected PCB distribution in the Bay. That work illustrated how PCBs within a hypothetical dredge material disposal site would be initially high in Zone 2 but would tend to become less appreciable within a 10-year time frame. Furthermore, there is no appreciable impact to sediment and water column PCB concentrations for zones 3A, 3B, and 4. Collectively, these results demonstrate that concerns about elevated PCBs from dredged material disposal are unfounded.

Finally, limited dredging is part of the Green Bay remedy. This dredging will be performed near the mouth of the River, where the highest concentrations in the Bay are located.

Master Comment 9.29

Commenters indicated that siting and constructing a landfill dedicated to the disposal of Lower Fox River sediment would be difficult in southern Brown County; that the cost of shipping dredged sediment out of state would be prohibitive; and that options for siting the pipeline or selecting preferred routes for conveyance of dredged sediment were not addressed.

Response

The WDNR and EPA share these concerns about the potential impacts that this action, as well as future actions, could have on the Fox River Valley and Green Bay community. The WDNR believes that building a disposal facility is feasible; larger landfills do exist in Wisconsin. While siting may be difficult, it can be accomplished with the cooperation of the many parties involved in this effort, including local parties, county and state officials, and the EPA.

The WDNR agrees that tipping and transportation costs would be high if dredged sediments were shipped out of state. However, the WDNR does not foresee this scenario. The WDNR and EPA believe that one of the keys to minimizing remedial costs is to work with the local community and businesses. To begin addressing these concerns, the WDNR has supported legislation to indemnify municipal landfills and publicly owned treatment works that accept sediment and leachate from sediment remediation projects (S. 292.70 Wisconsin State Statutes). Local landfills with sufficient capacity to receive contaminated sediment from OUs 3 and 4 exist. In fact, local landfills may be interested in contracting for the disposal of sediments, because the sediments represent a long-term waste stream.

Securing a disposal facility is crucial to implementing this cleanup. Without a local disposal option, costs to remediate the River may increase so much that it would be necessary to reexamine remedial options. The WDNR recognizes that landfill disposal of the sediments necessitates finding sufficient property and then successfully negotiating with local waste facility disposal siting committees. It may be necessary to use existing landfills to expedite sediment disposal if the siting process is delayed. Some members of the FRG also possess landfills.

During purchase and development of the abandoned railroad right-of-way for the Fox River Trail, the WDNR negotiated with the railroad for use of the trail's right-of-way to retain the option of locating a pipeline to transport dredged sediments to potential landfill sites in the Greenleaf and Holland town area. Negotiating this right-of-way will help to avoid the time, cost, and difficulties associated with locating another pipeline route.

Master Comment 9.30

A commenter observed that natural and anthropogenic forces acting on the River and the Bay, the permanence of any solution, and the need for long-term monitoring should all be considered when evaluating remedial options.

Response

The WDNR and EPA agree with this comment and believe these items have been considered in the selection of a remedial alternative.

9.2 Cost

Master Comment 9.31

Commenters assert that the Port of Green Bay will continue to incur costs associated with the disposal of PCB-contaminated sediments as long as appreciable amounts of PCB-impacted sediments remain in the Lower Fox River and Green Bay.

Response

The need to manage navigational dredge material is a function of having an operational commercial port in Green Bay. The fact that the navigational dredge material is contaminated with PCBs is a complicating factor. Even if the dredge material were clean, it would still need to be managed and expenses would be incurred, although more management options would be available. Brown County, as the local sponsor for the Port of Green Bay, has agreed to provide for the disposal of navigational dredge material as part of their agreement with the USACE to continue dredging the navigation channel. Over time, as navigational dredge material is removed from the River and Bay, there will be less capacity at the Bayport facility.

However, as a result of remedial activities, the amount of PCB-impacted sediments to be removed in the future should be reduced, and the costs associated with disposing of PCB-impacted sediments may therefore be considerably less after remediation is complete. In addition, less navigational dredging should be necessary for some time into the future, because material from the navigation channel is included in the remedial action. This in turn should extend the life of the Bayport facility.

Master Comment 9.32

A commenter stated that in the evaluation of cost-effectiveness, the expected reduction in PCB concentration was compared to the cost of the remedy as a means of evaluating and ranking remedial alternatives. The commenter suggested that the analysis of cost-effectiveness is based on interpolated PCB mass, which may result in overly optimistic estimates of the effectiveness of the alternatives.

Response

Concerns were raised during the comment period on the Proposed Plan about the possible use and cost of a pipeline to remove dredge slurry from the River, as well as about the size and cost of the dewatering and disposal cells recommended in the Proposed Plan. In response to these comments, the WDNR reviewed technical and cost issues associated with the Proposed Plan for OUs 3 and 4 by preparing *White Paper No. 23 – Evaluation of Cost and Implementability of Alternative C2B for Operable Unit 3 and Operable Unit 4*.

Based on the evaluations in White Paper No. 23, it can be concluded that costs are reduced by selecting the same remedial alternative for OUs 3 and 4. In addition, the basis for establishing unit costs for the cost estimates is reasonable, and the cost estimates are within the –30 to +50 percent range set forth in EPA guidance for feasibility studies.

In addition, it was determined that Alternative C2B is implementable and technically feasible. However, the dewatering and disposal facilities are land intensive and could be difficult to site because of issues associated with the availability and acquisition of land. Siting of the disposal facility will need to follow the state siting laws, and technical issues as well as operational, monitoring, and closure plans must be addressed.

Finally, the Agencies recognize that current PCB mass and contaminated sediment volume estimates will need to be refined as part of the final project design. However, the WDNR and EPA do believe that the current estimates are adequate for initial cost estimates necessary for the FS.

Master Comment 9.33

Although some commenters stated that the total estimated cost of $310 million is reasonable, others expressed concerns that the FS and Proposed Plan do not adequately evaluate the cost of dredging and that the projected cost of the proposed dredging remedy is underestimated and misleading.

Response

The WDNR and EPA agree that the estimated costs are reasonable and will provide a protective remedy with significant benefits. The Agencies strongly disagree with the comment that the FS and Proposed Plan do not adequately evaluate the cost of dredging.

The detailed cost estimate for the Lower Fox River and Green Bay Site presented in Appendix H of the FS, which was developed based on cost estimates from previous dredging projects, adequately evaluated the cost of dredging. Landfill capacity and disposal costs in Wisconsin were included in the cost estimates. As shown in Appendix B of the FS, the dredging cost per cubic yard for the 17 projects reviewed ranged from approximately $6/cy to $507/cy. The dredging cost per cubic yard generally decreased as the volume of sediment removed increased (regardless of removal method). The dredging unit costs developed in the FS are within the range of the unit costs represented by these 17 projects. In addition, projects such as Oakland Harbor were implemented at unit costs comparable to costs in the FS for the Lower Fox River and Green Bay Site. Cost development is also discussed in Section 9.2 of the RS for OUs 1 and 2.

To assure that cost estimates were adequate and not misleading, the WDNR prepared *White Paper No. 23 – Evaluation of Cost and Implementability of Alternative C2B for Operable Unit 3 and Operable Unit 4*. Based on the evaluations in White Paper No. 23, it can be concluded that costs are reduced by selecting the same remedial alternative for OUs 3 and 4. The basis for establishing unit costs for the cost estimates is reasonable and the cost estimates are within the –30 to +50 percent range set forth in EPA guidance for feasibility studies.

9.3 Long-Term Monitoring

Master Comment 9.34

Commenters stated that the costs for long-term monitoring as outlined in the draft Model Long-Term Monitoring Plan (LTMP) (draft FS, Appendix C, October 2001) are excessive and unnecessary.

Response

The draft Model LTMP was prepared to ensure that the selected remedy adequately mitigates risk and achieves project RAOs. The purpose of the draft Model LTMP is to verify reduced risk to human and ecological receptors following remedial activities. The draft Model LTMP is based on a thorough and careful review of existing state, regional, and national monitoring programs. The WDNR and EPA also believe that the draft Model LTMP complies with requirements of the National Contingency Plan (NCP) under which Superfund efforts are conducted, because the draft Model LTMP was developed during the FS to confirm the effectiveness of the selected remedy at reducing risks to receptors from PCBs.

The WDNR and EPA believe that cost estimates for conducting the remediation and monitoring activities fall within the –30 to +50 percent range set forth in EPA guidance for this stage of the Superfund process. The WDNR and EPA also believe that a local solution is key to keeping costs from increasing. It is also quite likely that this money will have a direct, positive effect on the local economy.

A final LTMP, a Sampling and Analysis Plan, and a Quality Assurance Project Plan have been drafted and are undergoing evaluation by the WDNR, EPA, and others. These documents, which are based on the draft Model LTMP, will allow for refinement of costs. When those costs are known, they will be made public.

Master Comment 9.35

Commenters stated that the draft Model LTMP as described in the FS hinges on an unduly optimistic assumption of the time required for active remediation and that it fails to recognize that natural attenuation is occurring in areas the FS and the Proposed Plan designated for active remediation.

Response

The Agencies believe that Monitored Natural Recovery is an acceptable remedial alternative for Green Bay as well as to supplement the active remediation in OUs 3 and 4. The draft Model LTMP was prepared to ensure that the selected remedy adequately mitigates risk and achieves project RAOs. The purpose of the draft Model LTMP is to verify reduced risk to human and ecological receptors following remedial activities. See the response to Master Comment 9.34 for a discussion of how the draft Model LTMP complies with the NCP and Superfund guidance.

The draft Model LTMP addresses the Monitored Natural Recovery alternative, including a 40-year monitoring program for measuring PCB levels in water, sediment, fish, and birds to effectively determine progress toward achieving the RAOs. MNR relies on natural processes such as degradation, burial, dispersion, and dilution to reduce contaminant concentrations to the point where they are no longer of concern.

A final LTMP, a Sampling and Analysis Plan, and a Quality Assurance Project Plan are being prepared by the WDNR in cooperation with EPA and the Natural Resource Damage trustees. These documents, which are modeled after the draft Model LTMP, take into consideration direct input from resource agencies in the states of Wisconsin and Michigan, the EPA, the USFWS, the National Oceanic and Atmospheric Administration (NOAA), and the independent Menominee and Oneida nations. The LTMP will also undergo a 5-year review process by the EPA and can be modified and extended as necessary based upon that review and the monitoring data collected.

Master Comment 9.36

Commenters stated that the proposed LTMP for Green Bay is overly broad and inconsistent with the NCP and that RAO exit criteria have already been met. The commenters stated that PCB levels are currently below baseline (pre-remedial) conditions and noted that human and ecological health are no longer at risk.

Response

The Agencies disagree with this comment. RAOs have not been met, as evidenced by the BLRA, and conditions must be monitored to determine whether RAOs are met in the future. The draft Model LTMP was prepared to ensure that the selected remedy adequately mitigates risk and achieves the Site-specific project RAOs. The draft Model LTMP was designed to document reductions in exposure to PCBs and is being used as a model for a final LTMP that will be used to verify reduced risk to human and ecological receptors following remediation. The draft Model LTMP incorporates monitoring activities relevant to demonstrating progress toward achieving the RAOs, regardless of the remedy implemented.

In developing the draft Model LTMP, the WDNR and EPA followed the appropriate guidance in assessing risk, and the Agencies stand by the risks as identified in the BLRA. Relevant discussion on the topic of risk determination can be found in the response to Master Comment 3.3 in the RS for OUs 1 and 2 RS and in *White Paper No. 12 – Hudson River Record of Decision PCB Carcinogenicity White Paper* and *White Paper No. 13 – Hudson River Record of Decision PCB Non-Cancer Health Effects White Paper*, which are attached to the RS for OUs 1 and 2.

The draft Model LTMP was drafted based on a thorough and careful review of existing state, regional, and national monitoring programs. The WDNR and EPA believe that the draft Model LTMP is consistent with the NCP and will lead to the development of a final LTMP that is also compliant with the NCP. When completed (during the remedial design stage), the final LTMP will be implemented for all Operable Units and will be modified as necessary to be consistent with the remedy for each OU.

10 Postcards, Form Letters, and Emails Sponsored by Groups

During the public comment period on the Proposed Plan for the Lower Fox River and Green Bay Site, the WDNR received many comments in the form of postcards, form letters, and emails. These items appeared to have been sponsored by different groups, two of which are the FRG and the Sierra Club. The comments submitted on postcards for these two groups reflect the range of concerns expressed in all postcards, form letters, and emails submitted. The WDNR and EPA have prepared individual responses to each of the postcard comments submitted by parties on behalf of these two organizations. For all these general concerns, more detailed responses to comments can be found throughout this RS for OUs 3, 4, and 5 and in the earlier published RS for OUs 1 and 2. The Agencies encourage those who submitted postcards, form letters, and emails to review the complete RS and not just this section.

Master Comment 10.1

Approximately 2,200 postcards were received as a result of a mailing effort sponsored by the FRG. In addition, approximately 160 form letters having the same content were submitted. The content of these submittals reads as follows:

"DNR – Proposed Plan Has Too Much Dredging! I want a restoration plan that:

- *Protects the environmental and economic health of Northeast Wisconsin.*
- *Relies on a sensible mixture of natural recovery, capping and dredging based on sound scientific data from the Fox River.*
- *Contains requirements for the monitoring of results and the performance of scientific evaluations as projects proceed to make sure that the cleanup measures are safe and effective.*
- *Contains valid realistic cost estimates and work schedules so an appropriate and informed decision can be made about the right mix of natural recovery, capping and dredging for the Fox River."*

Response

Individual responses to each of these points follow.

FRG Bullet No. 1 – Protects the environmental and economic health of Northeast Wisconsin.

Wisconsin statutes and the NCP both require that the selected remedy be protective of human health and the environment and the selected remedy fulfills this requirement.

The WDNR and EPA followed appropriate guidance in assessing risk and believe that the BLRA adequately differentiates the risks involved for each reach/zone of the exposure area. The WDNR and EPA have determined that the exposure and intake assumptions used in the BLRA are appropriately conservative, relevant to the Site, and consistent with standard and customary EPA approaches. The exposure estimates used in the BLRA were carefully selected based on the literature as well as on communication with various Agency personnel. The ecological risk assessment in the BLRA, specifically, was prepared with the assistance of the Site-specific Biological Technical Assistance Group (BTAG) and EPA's national expert on ecological risk assessment. One of the responsibilities of the BTAG and the national expert was to ensure that the BLRA followed EPA guidance. Whenever inconsistencies were noted, they were corrected so that the final document was in fact in accordance with EPA guidance.

In addition, the Agencies believe that other sediment remediation projects have resulted in economic improvements after completion of sediment cleanup. Although preparation of a specific economic analysis and educational material is beyond the scope of the RI/FS and ROD, the WDNR and EPA are mindful of the economic consequences on the local economy of a large-scale, multi-year cleanup project in the Fox River Valley. Both Agencies have publicly stated that the selected remedy for the Lower Fox River should not be unnecessarily harmful to the local economy, and it is the Agencies' belief that the remedy selected in the ROD will fulfill this concept.

A project of the magnitude called for in the ROD will bring many jobs and paychecks to the Fox River Valley. While the Agencies have not specifically quantified the economic benefits, certainly many local suppliers of material needed for the remediation will see an increase in orders. To be sure, the remedy called for in the ROD is expensive, but these are dollars that will be spent in the Fox River Valley—on equipment, fuel, supplies, hotels, restaurants, etc.—all of which will have beneficial economic impacts on the valley. At the conclusion of the cleanup work, a clear but intangible benefit will be a cleaner River for all citizens of the valley to enjoy. Increased tourism should result as the Fox River Valley becomes a more attractive destination and the world-class fishery of the River is rehabilitated. The Agencies have reviewed the financial health of the several companies likely to be most impacted financially by the ROD and have concluded that they can undertake the financing for a project of this magnitude without unnecessary harm (see *White Paper No. 17 – Financial Assessment of the Fox River Group*).

FRG Bullet No. 2 – Relies on a sensible mixture of natural recovery, capping and dredging based on sound scientific data from the Fox River.

The WDNR and EPA agree with this comment and believe these items have been considered in the selection of a remedial alternative. As part of the Agencies' evaluation of comments on the RI/FS and Proposed Plan, the costs associated with the 1 ppm cleanup level were reviewed again. For the present phase of the project, the WDNR and EPA believe that cost estimates fall within the acceptable range per federal Superfund guidance. The WDNR and EPA do consider the cost-effectiveness of a remedy when choosing that remedy. That is, the WDNR and EPA chose the remedy that will provide the needed level of protection for the least amount of money.

The remedy for this Site is large and therefore expensive. As with any large construction project, the cost estimates will have uncertainty. However, the WDNR and EPA believe that the remedy will significantly reduce risks in the Lower Fox River, as discussed in the sections of this RS dealing with risk and selection of the RAL.

Selection of a site remedy is based on protection of human health and the environment. The FS (Sections 6 and 7) looked at and evaluated numerous technologies and combinations of technologies for remedial purposes, as also discussed in the Proposed Plan. For instance, the alternative in the Proposed Plan is a combination of dredging and MNR for the residual sediment in the OU where dredging is selected. The ROD in fact reflects a mixture of remedies, including removal and natural recovery along with provisions for capping or thermal treatment alternatives where appropriate.

FRG Bullet No. 3 – Contains requirements for the monitoring of results and the performance of scientific evaluations as projects proceed to make sure that the cleanup measures are safe and effective.

The design of the remedy selected for each OU of the River will include performance measures and monitoring to assure that the remedy achieves and maintains the cleanup goal. The Agencies are currently developing a final LTMP, a Sampling and Analysis Plan, and a Quality Assurance Project Plan, which are based on the draft Model LTMP, that will address the commenters' specific issues and contain the level of clarity and detail requested by the commenters. These documents will be based on a thorough and careful review of existing state, regional, and national monitoring programs. The

WDNR and EPA believe that the draft Model LTMP is consistent with the NCP, in that it was developed as part of the FS to confirm the effectiveness of the selected remedy at reduce risks to receptors from PCBs as well as other chemicals of concern. In addition, the draft Model LTMP took into consideration direct input from resource agencies in the states of Wisconsin and Michigan, as well as the EPA, USFWS, NOAA, and the independent Menominee and Oneida nations. These resource agencies determined that, given the magnitude of PCB contamination in Green Bay, MNR could not be selected as the remedial alternative without a comprehensive, Bay-wide program that monitors all important species, not just fish. The LTMP is to be implemented for all OUs and will be modified in the remedial design stage to be consistent with the remedy selected for each individual OU. For further discussion, refer to the response to Master Comment 8.3 in the RS for OUs 1 and 2.

FRG Bullet No. 4 – Contains valid realistic cost estimates and work schedules so an appropriate and informed decision can be made about the right mix of natural recovery, capping and dredging for the Fox River.

The WDNR and EPA agree with this comment and believe these items have indeed been considered in the selection of a remedial alternative. The Agencies believe the estimated costs are reasonable and will provide a protective remedy with significant benefits. In preparing the RI/FS, the Proposed Plan, and the ROD, the WDNR, with assistance from the EPA, followed all the appropriate guidance for completing these documents. The level of detail afforded in these documents is consistent with what Superfund guidance calls for at this stage in the process, including cost estimates within the –30 to +50 percent range. For instance, the detailed cost estimate for the Lower Fox River and Green Bay Site presented in Appendix H of the FS was developed based on cost estimates from previous dredging projects. Landfill capacity and disposal costs in Wisconsin were determined and included in the cost estimates, and Appendix B of the FS details the total dredging cost per cubic yard for 17 projects reviewed. It is apparent that the dredging unit costs developed in the FS are within the range of the unit costs represented by the 17 projects. In addition, the costs associated with the 1 ppm cleanup level were reviewed again as part of the Agencies' evaluation of comments on the RI/FS and Proposed Plan.

It is important to recognize that at this point, the WDNR and EPA are selecting an option, not formally adopting a fully designed engineering remediation plan. With the completion of the ROD, the WDNR and EPA will begin the detailed engineering design, which will refine the FS cost estimates. For further discussion, refer to the response to Master Comment 9.8 in the RS for OUs 1 and 2.

Master Comment 10.2

Approximately 900 postcards were received as a result of a mailing effort sponsored by the Sierra Club. In addition, approximately 80 form letters and approximately 1,000 emails with similar content were submitted. It is unclear who sponsored the later form letters and emails. The content of the postcard from the Sierra Club reads as follows:

"Thank you for the opportunity to comment on the Fox River cleanup plan. I applaud the decision to remove the majority of the PCBs from the river where they threaten public health and the environment, though I urge you to make the following changes:

- *Change the action level to 0.25 ppm. The FS indicates that 0.25 ppm will meet as many human health and wildlife objectives as possible, while the current 1 ppm level is not protective enough. A 0.25 ppm action level meets 7 of 8 human health goals for average exposures while 1 ppm only meets 1 of the 8 goals. For wildlife, 1 ppm meets only 4 of 9 goals; 0.25 ppm will meet 7 of the 9. Finally, the FS notes that for all reaches, 0.25 ppm is "the most cost effective action level that meets protective thresholds."*

- *Dredge the mouth of Green Bay (Zone 2). The RI indicates that Zone 2 contains almost half of all the PCBs in Green Bay – more than are in the entire Fox River. According to the FS, it will cost less per pound of PCBs to clean up this zone of the Bay than it will cost to clean up the river. We cannot ignore such a large, readily accessible mass of PCBs and still consider this a complete cleanup, particularly when Green Bay is a major source of PCBs both to the air and to Lake Michigan.*

- *Complete a more thorough assessment of Green Bay. Previous research indicates that there may be hotspots that are not adequately characterized, especially along the eastern shore of the Bay.*

- *Dredge deposit DD in the Appleton to Little Rapids reach when remediating the adjacent Operational Unit 3. It makes sense to use every opportunity to remove PCBs from the ecosystem."*

Response

Individual responses to each of these points follow.

Sierra Club Bullet No. 1 – Change the action level to 0.25 ppm. The FS indicates that 0.25 ppm will meet as many human health

and wildlife objectives as possible, while the current 1 ppm level is not protective enough. A 0.25 ppm action level meets 7 of 8 human health goals for average exposures while 1 ppm only meets 1 of the 8 goals. For wildlife, 1 ppm meets only 4 of 9 goals; 0.25 ppm will meet 7 of the 9. Finally, the FS notes that for all reaches, 0.25 ppm is "the most cost effective action level that meets protective thresholds."

The basis for selection of the RAL was identified in the Proposed Plan and is further explained in the ROD. The WDNR and EPA selected the 1 ppm RAL based on an evaluation of multiple action levels with the residual SWAC for each OU and the ability of the action level to meet the RAOs. The Agencies in particular considered the time to achieve removal of fish consumption advisories, as well as the reduction in impacts to the ecosystem. The WDNR and EPA carefully considered more and less stringent cleanup levels (RALs) before arriving at the 1 ppm level in the ROD. Multiple RALs considered for each OU include no action and 0.125, 0.25, 0.5, 1, and 5 ppm. Model forecasts were used to compare the projected outcomes of the remedial alternatives under various action levels with the RAOs, primarily with RAOs 2 and 3, which deal with protection of human health and the environment. On the basis of that analysis and to achieve the risk reduction objectives using a consistent action level, 1 ppm was selected by the Agencies as the appropriate RAL.

The 1999 draft RI/FS called for an action level of 0.25 ppm or a 0.25 ppm SWAC, with neither being selected. The WDNR and EPA do not believe the 1 ppm RAL is inconsistent with what was called for in the 1999 draft RI/FS. As presented in Table 1 of *White Paper No. 11 – Comparison of SQTs, RALs, RAOs, and SWACs for the Lower Fox River*, the SWAC in OU 3 and OU 4 at the 1 ppm RAL results in a SWAC equal to or lower than the 0.25 ppm SWAC presented in the 1999 draft RI/FS.

This cleanup standard is not arbitrary, and the Agencies gave careful consideration to what is needed to be protective and meet the RAOs. The selection of the cleanup level is the outcome of a complete and scientifically based risk evaluation. In selecting the 1 ppm RAL, the WDNR and EPA considered RAOs, model forecasts of the time necessary to achieve risk reduction, the post-remediation SWAC, comparison of the residual concentration to SQTs for human and ecological receptors, sediment volume and PCB mass to be managed, and cost. The 1 ppm RAL is the best mechanism for achieving these goals. This is consistent with the process identified in the Proposed Plan.

Sierra Club Bullet No. 2 – Dredge the mouth of Green Bay (Zone 2). The RI indicates that Zone 2 contains almost half of all the

PCBs in Green Bay – more than are in the entire Fox River. According to the FS, it will cost less per pound of PCBs to clean up this zone of the Bay than it will cost to clean up the river. We cannot ignore such a large, readily accessible mass of PCBs and still consider this a complete cleanup, particularly when Green Bay is a major source of PCBs both to the air and to Lake Michigan.

The GBMBS data estimated that during the 1989 to 1990 period up to 24 kg/yr (53 pounds/year) of PCBs volatilized from the River and up to 150 kg/yr (331 pounds/year) of PCBs volatilized from Green Bay. The Agencies believe that addressing the continuing PCB discharge from the Lower Fox River to Green Bay will lead to the reduction of long-term risks in Green Bay.

There are significant technical and practical concerns associated with implementing any remedial action alternative in Green Bay, as well as significant costs associated with dredging in the Bay. As presented in Section 8 of the FS, it would be necessary to remediate the entirety of a Green Bay zone for any measurable risk reduction to be obtained. The proposed remediation of the Lower Fox River is expected to reduce future PCB loadings by 98 percent. Through this PCB load reduction, the Lower Fox River and Green Bay will have the opportunity to stabilize, and volatilization and atmospheric transport will be less of an issue. The WDNR and EPA also believe the selected remedy goes a long way toward protecting Lake Michigan, in that the remedy in the ROD will reduce the single largest source of PCBs being discharged into Lake Michigan, the Lower Fox River. This effort, along with the combined effects of successful remediation at other remedial sites along the shoreline and tributaries to Lake Michigan, will contribute to the lake's overall protection.

The Agencies believe that addressing the continuing PCB discharge to Green Bay is more cost-effective at reducing the long-term risks in Green Bay than would be active remediation in any portion of the Bay. As demonstrated in Table 11-17 of the ROD, remediating the 29,322,250 cy volume in Zone 2 of Green Bay, would cost an estimated $698 million to $814 million. According to information gathered for the FS, CAD construction is estimated for Zone 2 at $358,700,000 and $54,600,000 for action levels of 500 and 5,000 ppb, respectively, and only $15,500,000 for disposal at the Renard Island CDF (including closure). Although Renard Island is the more cost-effective disposal alternative indicated in the FS for Zone 2 of Green Bay, the WDNR and EPA have not pursued the siting of an in-water disposal facility due to the impracticalities, such as the lack of existing disposal capacity, environmental concerns, and the difficulty of obtaining public approval and support. In a recent court case involving an attempted expansion of Renard Island by Brown County and the USACE, it was decided that water quality and oxygen levels could become threatened. The level of public comment received in opposition to expansion of Renard Island, as well as numerous comments opposing the use of confined disposal facilities (see the RS for OUs 1 and 2), indicates that use of an in-water disposal facility is not implementable.

Furthermore, the Agencies are undertaking a reevaluation of the extent of the contaminated area adjacent to the River mouth. The Agencies will more clearly define the extent of contamination from the River's mouth into Green Bay during the first stage of the remedial design phase as part of the Pre-design Sediment Characterization, which will delineate the area that will be included in the remedy for OU 4. As part of the remediation effort for OU 4, all contaminated sediment with a PCB concentration of greater than 1 ppm extending into the River mouth will also be subject to removal. Currently, the Agencies do not have a sufficient delineation of the sediment volume or PCB mass in this area, although the Agencies do not expect the volume of material to exceed a few thousand cubic yards.

Sierra Club Bullet No. 3 – Complete a more thorough assessment of Green Bay. Previous research indicates that there may be hotspots that are not adequately characterized, especially along the eastern shore of the Bay.

To address concerns raised about Green Bay, the WDNR undertook several actions, which included reevaluating the PCB mass and contaminated sediment volume in the Bay (documented in *White Paper No. 18 – Evaluation of an Alternative Approach of Calculating Mass, Sediment Volume, and Surface Concentrations in Operable Unit 5, Green Bay*); conducting additional sampling in the south end of the Bay (documented in *White Paper No. 19 – Estimates of PCB Mass, Sediment Volume, and Surface Sediment Concentrations in Operable Unit 5, Green Bay Using an Alternative Approach,* which also provides estimates of PCB mass and contaminated sediment volume incorporating the new data); and conducting additional modeling to evaluate removal of contaminated sediments (documented in *White Paper No. 20 – Green Bay Modeling Evaluation of the Effects of Sediment PCB Bed Map Revisions on GBTOXe Model Results* and *White Paper No. 21 – Green Bay Modeling Evaluation of a Hypothetical Open-Water Disposal Site for Navigational Dredged Material in Southern Green Bay*). All four white papers are appended to this RS.

Collectively, the results of these white papers reveal that PCB mass and volume estimates may change dramatically depending upon assumptions made in estimating these values, but also show that surface concentrations do not change significantly. The results of the July 2002 sampling in the southern Bay showed that there were no areas with high elevations of PCBs. The results of the additional modeling reveal that changes to mass in Zone 2 of OU 5 do affect the initial conditions for the GBTOXe model results but result in Zone 2 PCB projections that are more consistent with zones 3A, 3B, and 4 of OU 5 (White Paper No. 20). The second model white paper (White Paper No. 21) evaluated how sediments dredged from the federally maintained navigation channel and disposed of in the open-water disposal areas that were operated up until the 1970s might have affected PCB distribution in the Bay. That work illustrated how PCBs within a hypothetical dredge material disposal site would be initially high in Zone 2 but would tend to become less appreciable within a 10-year time frame. Furthermore, there is no appreciable impact to sediment and water column PCB concentrations for zones 3A, 3B, and 4. In addition to the modeling work, additional samples collected within those areas did not show any detectable PCBs. Collectively, these results demonstrate that concerns about elevated PCBs from dredged material disposal are unfounded.

The Agencies have also initiated a Pre-design Sediment Characterization project that will provide a more accurate delineation of the extent of sediment contamination throughout OUs 1, 3, and 4. This pre-design characterization is the last step necessary before the actual remedy design can begin. In OU 4, the characterization will extend beyond the River mouth into Zone 2 of Green Bay. This data collection activity will provide the final delineation of the PCB-contaminated sediment that will be addressed during implementation of the OU 4 remediation.

Sierra Club Bullet No. 4 – Dredge deposit DD in the Appleton to Little Rapids reach when remediating the adjacent Operational Unit 3. It makes sense to use every opportunity to remove PCBs from the ecosystem.

The WDNR and EPA have evaluated and addressed sediment Deposit DD, which is located in OU 2, the reach from Appleton to Little Rapids. The ROD for OUs 3, 4, and 5 provides for the removal by dredging of 586,800 cy of contaminated sediments containing 1,111 kg (2,444 pounds) of PCBs from OU 3. In addition, the ROD calls for the removal of Deposit DD from OU 2 as part of the OU 3 remedy. Deposit DD adds approximately 9,000 cy of contaminated sediment and 31 kg (68 pounds) of PCB mass above the 1 ppm RAL to the OU 3 project. Therefore, totals for OU 3 and Deposit DD are 1,142 kg (2,512 pounds) of PCBs and 595,800 cy of contaminated sediment.

WDNR AND USEPA FOX RIVER RI/FS ADMINISTRATIVE RECORD

G	C	SC	FC	ID	End Date	Author	Document Name
03	A	01	391.00	10781	December 2002	Prepared for: WDNR	Final Feasibility Study Lower Fox River and Green Bay, Wisconsin, Remedial Investigation and Feasibility Study, Volume 1 - Sections 1 through 11
03	A	01	391.01	10784	December 2002	Prepared for: WDNR	Final Feasibility Study Lower Fox River and Green Bay, Wisconsin, Remedial Investigation and Feasibility Study, Volume 2 - Appendices A through H
03	A	01	391.02	10785	December 2002	Prepared for: WDNR	Final Remedial Investigation Report Lower Fox River and Green Bay, Wisconsin
03	A	06	390.00	10776	2002	PUBLIC	Fox River Proposed Plan Comments Spreadsheet
04	A	01	425.00	10782	December 2002	Prepared for: WDNR	Final Baseline Human Health and Ecological Risk Assessment Lower Fox River and Green Bay, Wisconsin, Remedial Investigation and Feasibility Study, Volume 1 - Sections 1 through 8
04	A	01	425.01	10786	December 2002	Prepared for: WDNR	Final Baseline Human Health and Ecological Risk Assessment Lower Fox River and Green Bay, Wisconsin, Remedial Investigation and Feasibility Study, Volume 2 - Appendices A through C
06	B	01	797.00	10783	December 2002	Prepared for: WDNR	Final Model Documentation Report Lower Fox River and Green Bay, Wisconsin, Remedial Investigation and Feasibility Study, Volume 1
06	B	01	797.01	10787	December 2002	Prepared for: WDNR	Final Model Documentation Report Lower Fox River and Green Bay, Wisconsin, Remedial Investigation and Feasibility Study, Volume 2
07	A	01	801.00	2684	December 18, 2002	WDNR; USEPA	Record of Decision (ROD) for Operable Units 1 and 2, Lower Fox River and Green Bay, Wisconsin; Consists of Responsiveness Summary, Administrative Record Index and White Papers
01	A	00	112.00	9772	August 14, 2001		United States of America and the State of Wisconsin vs. Appleton Papers Inc. and NCR Corporation; Complaint, Plaintiff's Notice of Lodging of Consent Decree, Consent Decree, $40 million agreement news release
01	A	00	113.00	11	July 1, 1999	Travers, M.	Subject: Table 2. Deposit N Dredging Demonstration Project Caged Fish Fox River Project; to be inserted in FRG comments to RI/FS (Volume 10) Exhibit 35
01	A	00	113.00	15	June 4, 1999	Travers, M.	Subject: Comments on Draft Technical Memorandum 2g, Lower Fox River, Wisconsin; request May 21, 1999 comment to TM2g be placed in Administrative Record
01	A	00	113.00	16148	April 28, 2003	Stone, R.M.	RE: Lower Fox River and Green Bay Site; Writing to Menasha Corporation and counsel for U.S. Paper Mills Corp. and the letter is intended to afford Menasha Corp. and U.S. Paper an opportunity to engage in discussions with the responsible government agencies
01	A	00	114.00	29	January 18, 1999	Travers, Mark	Subject: Lower Fox River RI/FS - Chapter 5: Comments on RETEC Draft Contaminated Sediment Ranking Technical Memorandum and 2 attachments outline alternative approach
01	A	00	114.00	64	February 23, 1998	Meyer, George	RE: Conditionally approving the contract, reiterating state has final approval authority
01	A	00	114.00	70	January 30, 1998	Meyer, George	RE: Deferring legal action in global settlement, continuing Agreement and requesting renewed commitment to negotiation process, sent to members of FRG

WDNR AND USEPA FOX RIVER RI/FS ADMINISTRATIVE RECORD

G	C	SC	FC	ID	End Date	Author	Document Name
01	A	00	114.00	9781	June 24, 1998	Lynch, Ed	Subject: Fox River - Screening Level Risk Assessment; Forwarding copy (not included here)
01	A	00	114.00	9852	February 28, 2000	Travers, Mark	Subject: Peer Review of the Human Health and Ecological Risk Assessments, Lower Fox River, Wisconsin; Forwarding the letter of agreement between the FRG and AEHS for conducting the peer review, including the Statement of Work (Attachment 1)
01	A	00	114.00	9853	April 27, 2000	Travers, M.	Subject: American Geological Institute Peer Review, Lower Fox River, Wisconsin
01	A	00	115.00	10159	January 17, 2002	Lynch, E.; Hahnenberg, J.	Request to further extend the public comment period is denied
01	A	00	115.00	10160	January 9, 2002	Travers, Mark	RE: Administrative Record, Lower Fox River NRDA/PCB Releases Site, Wisconsin; Requesting documents be added to the administrative record for a second time
01	A	00	115.00	10777	January 17, 2002	Travers, Mark	RE: Administrative Record, Lower Fox River and Green Bay RI/FS; Stating that USEPA's Chicago office Administrative Record Index have not been updated
01	A	00	115.00	10778	January 11, 2002	Travers, Mark	Re: Request for Information, Lower Fox River Remedial Investigation and Feasibility Study (RI/FS); Attachment: January 11, 2002 letter from Mark Travers (Environ) to James Hahnenberg (USEPA) and Ed Lynch (WDNR) re: Availability of Materials - Request
01	F	01	156.00	234	September 10, 1999	RETEC	Supplemental Scope of Work and Budget Estimate to Complete the Lower Fox River RI/FS Data Management, Remedial Investigation/Feasibility Study, and Risk Assessment, September 10, 1999; Attached cover letter dated September 29, 1999, to Jim Hahnenberg
01	F	01	156.00	235	March 10, 1998	RETEC	Draft Scope of Work and Budget Estimate, Data Management, Remedial Investigation/Feasibility Study, and Risk Assessment for the Fox River Projects, March 10, 1998; Attached cover letter dated March 10, 1998, to Ed Lynch (WDNR) from Paul Putzier (RETEC)
01	H	01	189.00	10146	October 29, 2001	Coyle, Kimberly	RI/FS Proposed Plan Public Meeting Transcripts - Lower Fox River Proposed Cleanup Plan, Public Meeting, Holiday Inn Select, Appleton, WI, October 29, 2001, 6:30 PM
01	H	01	189.00	10147	October 29, 2001	Spoehr, Jeanne	RI/FS Proposed Plan Public Meeting Transcripts - Public Comments Regarding the Proposed Fox River Cleanup Plan, Monday, October 29, 2001, Holiday Inn Select, 150 Nicolet Road, Appleton, Wisconsin
01	H	01	189.00	10148	October 30, 2001	Francois & Baux Reporting	RI/FS Proposed Plan Public Meeting Transcripts - EPA/DNR Public Hearings, Fox River Cleanup Project, Green Bay, Wisconsin 10-30-01, Afternoon Session, Condensed
01	H	01	189.00	10149	October 30, 2001	Francois & Baux Reporting	RI/FS Proposed Plan Public Meeting Transcripts - EPA/DNR Public Hearings, Fox River Cleanup Project, Green Bay, Wisconsin 10-30-01, Evening Session, Condensed
01	H	01	189.00	10150	October 30, 2001	Francois, Fay	RI/FS Proposed Plan Public Meeting Transcripts - Lower Fox River Proposed Cleanup Plan Public Meeting, Radisson Convention Center, October 30, 2001

G	C	SC	FC	ID	End Date	Author	Document Name
01	H	01	189.00	10151	October 30, 2001	Francois, Fay	RI/FS Proposed Plan Public Meeting Transcripts - Lower Fox River Proposed Cleanup Plan Public Meeting, Radisson Convention Center, October 30, 2001
01	H	01	189.00	10152	October 30, 2001	Francois & Baux Reporting	RI/FS Proposed Plan Public Meeting Transcripts - EPA/DNR Public Hearings, Fox River Cleanup Project, Green Bay, Wisconsin 10-30-01
01	H	01	189.00	10153	October 30, 2001	Francois & Baux Reporting	RI/FS Proposed Plan Public Meeting Transcripts - EPA/DNR Public Hearings, Fox River Cleanup Project, Green Bay, Wisconsin 10-30-01, Afternoon presentation session
01	H	01	189.00	10154	October 29, 2001	Appleton Court Reporters	RI/FS Proposed Plan Public Meeting Transcripts - EPA/DNR Public Hearings, Fox River Cleanup Project, Appleton, Wisconsin 10-29-01, Evening comment session moderated by: George Boronow, WDNR
01	H	01	189.00	10155	October 29, 2001	Appleton Court Reporters	RI/FS Proposed Plan Public Meeting Transcripts - EPA/DNR Public Hearings, Fox River Cleanup Project, Appleton, Wisconsin 10-29-01, Condensed, Evening comment session moderated by: George Boronow, WDNR
01	H	01	189.00	10156	October 29, 2001	Coyle, Kimberly	RI/FS Proposed Plan Public Meeting Transcripts - Lower Fox River Proposed Cleanup Plan Public Meeting, Holiday Inn Select, Appleton, Wisconsin, October 29, 2001, 6:30 PM
01	H	01	189.00	10157	October 30, 2001	Francois & Baux Reporting	RI/FS Proposed Plan Public Meeting Transcripts - EPA/DNR Public Hearings, Fox River Cleanup Project, Green Bay, Wisconsin 10-30-01, Afternoon Session and Evening Session
01	H	01	189.00	11031	January 27, 2003	Kennedy, John	RE: Record of Decision Public Meetings; The Science & Technical Advisory Committee (STAC) of the Lower Fox River and Green Bay Remedial Action Plan (RAP) with the Record of Decision (ROD) on the meeting agenda
01	H	02	191.00	10161	January 2002	WDNR; USEPA	WDNR and USEPA Announce Additions to the Administrative Record Index, Lower Fox River Site
01	H	02	191.00	10779	February 22, 2002	Volkmer, Deborah	RE: Newspaper Advertisements; Cover letter forwarding photocopies of newspaper advertisements in the Green Bay Press-Gazette and The Post-Crescent (Appleton, WI)
01	H	02	191.00	10780	July 26, 2000	USEPA	Newspaper advertisement regarding a Public Meeting To Discuss the Cleanup of Sediment Management Unit (SMU) 56/57 on August 3, 2000 at the Brown County Library; Placed in The Post-Crescent (Appleton, WI), News-Chronicle (Green Bay, WI), and Green Bay Press-Gazette (Green Bay, WI)
01	H	02	191.00	10914	January 10, 2003	WDNR; USEPA	The Wisconsin Department of Natural Resources and the U. S. Environmental Protection Agency Announce a Record of Decision (ROD) for the Lower Fox River and Green Bay PCB Cleanup Site, Operable Units 1 and 2; Placed in The Green Bay Press-Gazette
01	H	02	191.00	11029	January 9, 2003	WDNR; USEPA	The Wisconsin Department of Natural Resources (WDNR) and the U.S. Environmental Protection Agency (USEPA) announce a Record of Decision (ROD) for the Lower Fox River and Green Bay PCB Cleanup Site, Operable Units 1 and 2 (OU1 and OU2)

G	C	SC	FC	ID	End Date	Author	Document Name
01	H	02	191.00	11030	February 14, 2003	Volkmer, Deborah	RE: Newspaper Advertisements; Letter submitting copies of newspaper advertisements published in The Post-Crescent and the Press-Gazette announcing public meeting on January 29, 2003 in Appleton to discuss the Record of Decision (ROD)
01	H	02	191.00	11038	January 10, 2003	WDNR; USEPA	The Wisconsin Department of Natural Resources (WDNR) and the U.S. Environmental Protection Agency (USEPA) announce a Record of Decision (ROD) for the Lower Fox River and Green Bay PCB Cleanup Site, Operable Units 1 and 2 (OU1 and OU2)
01	H	03	197.00	10170	October 2001	WDNR; USEPA	Proposed Remedial Action Plan Lower Fox River and Green Bay
02	A	00	200.00	960	August 11, 1998	Lynch, Ed	Subject: Fox River Hazard Ranking System (HRS) Scoring Package; Requesting review and comments on the scoring package
02	A	00	200.00	965	September 29, 1998	FRG	Comments of the Fox River Group on the United States Environmental Protection Agency's Hazard Ranking System Report for the "Fox River NRDA/PCB Releases" Site and the Proposal for Inclusion of the Site on the National Priorities List
02	A	02	21.00	898	1996	Manchester-Neesvig, J.B.; Andren, A.W.; Edgington, D.N.	Reference 24a - Patterns of Mass Sedimentation and of Deposition of Sediment Contaminated by PCBs in Green Bay, 1996; J. Great Lakes Research 22(2): 444-462
02	A	02	43.00	932	April 23, 1991	WDNR; USEPA	Reference 39c - Summer 1989 Predator Fish Sampling, Summary of Results, Raw Data and QA/QC
02	A	02	43.00	933	April 22, 1991	WDNR; USEPA	Reference 39d - Fall 1989 Predator Fish Sampling, Summary of Results, Raw Data and QA/QC
02	A	02	43.00	934		WDNR; USEPA	Reference 39e - 1989 Predator Fish PCB Fillet Sampling, Summary of Results, Raw Data and QA/QC
02	A	03	3.00	863	December 14, 1990		Federal Register, Part II (2), Environmental Protection Agency (USEPA); 40 CFR Part 300 Hazard Ranking System; Final Rule - Reference 1 of Scoring Package
02	A	03	3.00	9829	June 29, 1998	USEPA	Federal Register, Part IV (4), Environmental Protection Agency (USEPA); 40 CFR Parts 750 and 761 Disposal of Polychlorinated Biphenyls (PCBs); Final Rule
03	A	00	372.00	9713	July 19, 2001	Hahnenberg, James	USEPA Region 5 Fields Group Information; Includes annual bathymetric maps for the navigation channel for the De Pere to Green Bay reach of the Lower Fox River for 1995 to 2000; Data summary tables for volumes scoured, deposited, and dredged; Also included: Historical Streamflow Daily Values for the Fox River at Rapid Croche Dam Near Wrightstown by the USGS; Annual Report/Contract Dredging Report by the USACE, Detroit District, Project Operations System
03	A	00	378.00	9839	June 15, 2001	Hainsworth, G.; Topel, J.	RE: Cost Tables; RETEC has provided the current cost tables to WDNR. These tables are not final, but changes have been made to the Fox River Feasibility Study cost tables since submittal of the Pre-Draft Feasibility Study
03	A	00	378.00	9840	January 31, 2001	Hainsworth, G.; Topel, J.	RE: Cost Tables (not final); Fox River Feasibility Study

G	C	SC	FC	ID	End Date	Author	Document Name
03	A	00	378.00	9841	January 30, 2001	Johnson, Margaret	Subject: De Pere - Green Bay revision 2, Alternate C2, 125 ppb action level; 2nd revised cost estimate for C2 with a 24 hour/day, 7 days/week operation
03	A	00	378.00	9843	September 27, 2000	Olsiewski, Bob	Subject: Intertek Testing Services; Attachments: E-mail with The Wall Street Journal article regarding the investigation of the Intertek Testing Services for potentially falsifying analytical results
03	A	00	378.00	9844	December 4, 2000	Tremaglio, Richard	RE: Field Duplicate Assessment Considerations
03	A	00	378.00	10349	June 5, 2001	Rasmussen, Paul	Regarding Model Documentation Report, Appendix B of wLFRM Report; Subject: Estimating Trends in Lower Fox River and Sediment PCB Concentrations
03	A	00	380.00	10089	December 19, 2001	Lynch, Ed	Reference Request - Subject: December 5, 2001 Information Request; Fulfilling information request concerning hydrodynamic and sediment transport modeling. Also attached: December 5, 2001 Request for Information Letter from Mark Travers (Environ) to Ed
03	A	00	387.00	10771	November 27, 2002	Killian, Jim	Subject: 2002 Benthic and Sediment Sampling at Fox River Remediation Site Hotspot 56/57
03	A	00	387.00	10772	November 14, 2002	Thompson, Timothy	Subject: SWAC Numbers
03	A	01	337.00	2733	February 1999	NRT	Draft Remedial Investigation, Lower Fox River, Wisconsin, NRT Project No.: 1300
03	A	01	366.00	2736	February 1999	WDNR	Draft Feasibility Study, Lower Fox River, Wisconsin, RETEC Project No.: 3-3584-540
03	A	01	376.00	9847	October 2001	Prepared for: WDNR	Draft Feasibility Study; Lower Fox River and Green Bay, Wisconsin, Remedial Investigation and Feasibility Study, Volume I (1) - Sections 1 through 11
03	A	01	376.01	9848	October 2001	Prepared for: WDNR	Draft Feasibility Study; Lower Fox River and Green Bay, Wisconsin, Remedial Investigation and Feasibility Study, Volume II (2) - Appendices A through G
03	A	01	376.02	9851	October 2001	Publication: Prepared for WDNR	Draft Remedial Investigation Report; Lower Fox River and Green Bay, Wisconsin
03	A	01	388.00	10773	December 30, 2000	Tetra Tech, Inc.	Overview of Sediment-Contaminant Transport and Fate Models for Use in Making Site-Specific Contaminated Sediment Remedial Action Decisions
03	A	02	315.00	10004	April 12, 1999	FRG	Comments on the Fox River Group on the Wisconsin Department of Natural Resources' Draft Remedial Investigation, Baseline Human Health and Ecological Risk Assessment and Draft Feasibility Study for the Lower Fox River, Volume 1 of 12
03	A	02	315.01	10005	April 12, 1999	FRG	Comments on the Fox River Group on the Wisconsin Department of Natural Resources' Draft Remedial Investigation, Baseline Human Health and Ecological Risk Assessment and Draft Feasibility Study for the Lower Fox River, Volume 2 of 12 and Volume 3 of 12
03	A	02	315.02	10006	April 12, 1999	FRG	Comments on the Fox River Group on the Wisconsin Department of Natural Resources' Draft Remedial Investigation, Baseline Human Health and Ecological Risk Assessment and Draft Feasibility Study for the Lower Fox River, Volume 4 of 12

G	C	SC	FC	ID	End Date	Author	Document Name
03	A	02	315.03	10007	April 12, 1999	FRG	Comments on the Fox River Group on the Wisconsin Department of Natural Resources' Draft Remedial Investigation, Baseline Human Health and Ecological Risk Assessment and Draft Feasibility Study for the Lower Fox River, Vol. 5 of 12, Vol. 6 of 12, 7 of 12
03	A	02	315.04	10008	April 12, 1999	FRG	Comments on the Fox River Group on the Wisconsin Department of Natural Resources' Draft Remedial Investigation, Baseline Human Health and Ecological Risk Assessment and Draft Feasibility Study for the Lower Fox River, Volume 8 of 12
03	A	02	315.05	10009	April 12, 1999	FRG	Comments on the Fox River Group on the Wisconsin Department of Natural Resources' Draft Remedial Investigation, Baseline Human Health and Ecological Risk Assessment and Draft Feasibility Study for the Lower Fox River, Volume 9 of 12, Volume 10 of 12
03	A	02	315.06	10010	April 12, 1999	FRG	Comments on the Fox River Group on the Wisconsin Department of Natural Resources' Draft Remedial Investigation, Baseline Human Health and Ecological Risk Assessment and Draft Feasibility Study for the Lower Fox River, Volume 11 of 12, Volume 12 of 12
03	A	02	315.07	10016	April 1999	Environmental Resources Management	Comments on the Fox River Group - Arrowhead Park Landfill Evaluation P.H. Glatfelter Company Neenah, Wisconsin, April 1999, ERM Project No. 98276
03	A	05	344.01	10181	December 1, 2001	Minergy Corporation	Final Report on Sediment Melter Demonstration Project for Wisconsin Department of Natural Resources, Glass Aggregate Feasibility Study, December 1, 2001
03	A	05	377.00	9838	September 25, 2001	Lynch, Ed	Subject: Data on Little Lake Butte des Morts; Attached are several items provided by WTMA and P.H. Glatfelter at a February 7, 2001 meeting with WDNR and USEPA representatives
03	A	06	312.00	2689	April 13, 1999	Muno, William	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 1 - Group Comments
03	A	06	312.00	2690	April 12, 1999	Errington, William	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 1 - Group Comments
03	A	06	312.00	2691	April 12, 1999	Goeks, J. Todd	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 1 - Group Comments
03	A	06	312.00	2692	April 6, 1999	Moriarty, Marvin	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 1 - Group Comments
03	A	06	312.00	2693	April 9, 1999	Larsheid, Charles	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 1 - Group Comments
03	A	06	312.00	2694	April 7, 1999	Doxtator, Deborah	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 1 - Group Comments
03	A	06	312.00	2695	April 8, 1999	Delacenserie, R.; Kent, P.	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 1 - Group Comments
03	A	06	312.00	2696	April 12, 1999	Travers, Mark	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 1 - Group Comments
03	A	06	312.00	2697	April 9, 1999	Reimer, Mark	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 1 - Group Comments

G	C	SC	FC	ID	End Date	Author	Document Name
03	A	06	312.00	2698	April 9, 1999	Missimer, C.L.	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 1 - Group Comments
03	A	06	312.00	2699	April 12, 1999	Peterson, Nancy	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 1 - Group Comments
03	A	06	312.00	2700	March 24, 1999	Buth, Douglas	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 1 - Group Comments
03	A	06	312.00	2701	April 12, 1999	Green, Emily	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 1 - Group Comments
03	A	06	312.00	2702	April 12, 1999	Kennedy, John	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 1 - Group Comments
03	A	06	312.00	2703	April 13, 1999	Ryan, Jeff	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 1 - Group Comments
03	A	06	312.00	2704	April 12, 1999	Sanvidge, Helen	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 1 - Group Comments
03	A	06	312.00	2705	April 9, 1999	Fash, John	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 1 - Group Comments
03	A	06	312.00	2706	April 12, 1999	Hanaway, John	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 1 - Group Comments
03	A	06	312.00	2707	April 9, 1999	Sewell, Michael	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 1 - Group Comments
03	A	06	312.00	2708	April 12, 1999	Scheid, Ronald	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 1 - Group Comments
03	A	06	312.00	2709	April 1, 1999	Arndt, Mark	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 1 - Group Comments
03	A	06	312.00	2710	March 26, 1999	Reigel, Lyle	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 1 - Group Comments
03	A	06	312.00	2711	March 20, 1999	Boegh, Jim	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 1 - Group Comments
03	A	06	312.00	2712	April 10, 1999	Acker, William	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 1 - Group Comments
03	A	06	312.00	2713	April 9, 1999	Welch, William	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 1 - Group Comments
03	A	06	312.00	2714	April 8, 1999	Dennick, Robert	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 1 - Group Comments
03	A	06	312.00	2715	April 8, 1999	Casper, John	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 1 - Group Comments
03	A	06	312.00	2716	April 5, 1999	Carroll, Terrence	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 1 - Group Comments
03	A	06	312.00	2717	April 12, 1999	Horace Mann Middle School - 8th Grade	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 1 - Group Comments
03	A	06	312.00	2718	April 9, 1999	Dovichi, M.; Miller, D.	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 1 - Group Comments

G	C	SC	FC	ID	End Date	Author	Document Name
03	A	06	312.00	2719	April 5, 1999	Kelly, Peter	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 1 - Group Comments
03	A	06	312.00	2720	March 3, 1999	Kandler, Harvey	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 1 - Group Comments
03	A	06	312.00	2721	NA	PUBLIC	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 1 - Group Comments
03	A	06	312.00	2722	April 8, 1999	Apesanahkwat	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 1 - Group Comments
03	A	06	312.00	2723	April 1999	Shenandoah Newsletter	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 1 - Group Comments
03	A	06	314.00	2724	April 12, 1999	Abitz, Stephen	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10537	April 5, 1999	Anderson, Tor	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10538	April 7, 1999	Andersen, Curt	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10539	April 4, 1999	Arant, Mary	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10540	March 29, 1999	NA	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10541	April 11, 1999	Baeten, Paul	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10542	March 23, 1999	Bartol, Sheila	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10543	April 13, 1999	Beilfuss, Mark & Peg	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10544	March 28, 1999	Berggren, Russ	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10545	March 29, 1999	Blair, Jack	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10546	February 26, 1999	Blitzer, Eleanor	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10547	March 16, 1999	Bluma, Michael	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10548	March 25, 1999	Bons, Linda	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10549	April 12, 1999	Bougie, Clifford	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10550	April 12, 1999	Calewarts, Wayne	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10551	March 3, 1999	Calewarts, Wayne	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments

G	C	SC	FC	ID	End Date	Author	Document Name
03	A	06	314.00	10552	March 23, 1999	Christensen, Jerald	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10553	April 12, 1999	Churchill, Donald	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10554	April 12, 1999	Dedick, Gene	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10555	March 16, 1999	Giles, Clark	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10556	March 25, 1999	Collier, Mark	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10557	April 12, 1999	Copeland, Travis	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10558	March 25, 1999	Coulthurst, Scott	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10559	April 12, 1999	Custer, James	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10560	April 5, 1999	De Groot, Carol	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10561	April 12, 1999	Decher, Kip	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10562	March 5, 1999	Deigan, Kate	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10563	April 8, 1999	Doule, Gordon	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10564	April 7, 1999	Duerkop, Sharon	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10565	March 23, 1999	Dunwiddie, William	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10566	April 9, 1999	Eckert, Judith	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10567	April 6, 1999	Elman, William	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10568	April 11, 1999	Falkenhagen, Ron	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10569	April 11, 1999	Farin, Bill	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10570	April 10, 1999	Femal, Jeff	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10571	April 12, 1999	Fiscus, Marianne & Carl	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10572	April 9, 1999	Gabrielson, Dan	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments

G	C	SC	FC	ID	End Date	Author	Document Name
03	A	06	314.00	10573	April 12, 1999	Golla, Terrence	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10574	April 11, 1999	Goshing, John	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10575	April 10, 1999	Grassman, Mark	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10576	April 11, 1999	Haling, Bill	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10577	March 26, 1999	Hammond, Ed	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10578	April 11, 1999	Haugnen, John	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10579	April 12, 1999	Hayford, Don	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10580	April 12, 1999	Heezen, Donna	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10581	April 6, 1999	Hermanson, John	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10582	April 11, 1999	Holmes, Marilyn	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10583	April 12, 1999	Hultman, Jack	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10584	April 12, 1999	Isaacson, Kathy	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10585	April 11, 1999	Jansch, Edward	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10586	March 25, 1999	Janssen, Sarah	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10587	March 23, 1999	Jansen, Larry	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10588	April 2, 1999	Jay, Geraldine	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10589	April 8, 1999	Johnson, Robert	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10590	April 12, 1999	Kees, Tom	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10591	April 12, 1999	Kempen, Gary	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10592	March 16, 1999	Keyser, Robert	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10593	April 6, 1999	Keyser, Robert	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments

G	C	SC	FC	ID	End Date	Author	Document Name
03	A	06	314.00	10594	April 2, 1999	Kime, Sharon	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10595	April 6, 1999	Kime, Robert	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10596	March 15, 1999	Klein Jr., Wayne	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10597	NA	Klenke, Jill	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10598	April 13, 1999	Kohel, Steve	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10599	March 2, 1999	Kohls, Robert	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10600	April 11, 1999	Kolb, Donna	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10601	March 31, 1999	Kolosso, Joe	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10602	April 13, 1999	Kondus, William	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10603	March 29, 1999	Krabbe, Donald	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10604	April 11, 1999	Krause Jr., Clarence	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10605	March 29, 1999	Kuehl, Julie	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10606	April 12, 1999	LaMere, Bruce	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10607	April 7, 1999	Lehman, Dudley	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10608	April 1, 1999	Lehman, Rebecca	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10609	April 12, 1999	Lehrer, Jan	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10610	April 12, 1999	Lemanski, Michael	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10611	April 19, 1999	Lenczuk, Mike	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10612	March 26, 1999	Lepak, Michelle	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10613	April 3, 1999	Linck, Robert	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10614	April 7, 1999	Long, Carly	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments

G	C	SC	FC	ID	End Date	Author	Document Name
03	A	06	314.00	10615	April 12, 1999	Marieque, Mitchell	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10616	April 3, 1999	Marson, Bruce	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10617	April 11, 1999	McGoey, Thomas	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10618	March 23, 1999	McKeown, Daniel	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10619	April 9, 1999	McMillen, Robert	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10620	April 12, 1999	Miller, Lynn	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10621	April 15, 1999	Miller, R.	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10622	February 28, 1999	Mittelstaedt, Craig	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10623	April 14, 1999	Montgomery, Polly	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10624	March 27, 1999	Moorhead, Mark	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10625	April 11, 1999	Nebel, John	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10626	March 30, 1999	Nelson, Ted	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10627	March 23, 1999	Nesbitt, Jerry	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10628	April 12, 1999	Oliva, Mrs. Edward	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10629	March 15, 1999	Olmsted, James	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10630	March 29, 1999	O'Neil, Daniel	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10631	March 25, 1999	Oskar, Mona	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10632	April 14, 1999	Ottman, J.	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10633	March 25, 1999	Perry, Joy	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10634	March 23, 1999	Peters, John	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10635	April 12, 1999	Pfotenhauer, Louise	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments

G	C	SC	FC	ID	End Date	Author	Document Name
03	A	06	314.00	10636	April 7, 1999	Pierre, Ann	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10637	March 30, 1999	Plautz, Mark	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10638	April 13, 1999	Pollen, Patricia	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10639	April 13, 1999	Pollock, Scott	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10640	April 8, 1999	Presnell, Richard	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10641	April 5, 1999	Proft, Mara	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10642	April 2, 1999	Purtell, Dic	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10643	March 6, 1999	Reed, Larry	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10644	April 9, 1999	Reif, George	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10645	August 30, 1998	Reif, George	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10646	April 7, 1999	Tom, J.; Reuss, P.	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10647	April 7, 1999	Riedi, James	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10648	March 11, 1999	Rogers, Charlene	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10649	March 25, 1999	Rohm, Barbara	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10650	March 2, 1999	Rosera, Ervin	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10651	April 12, 1999	Sabel, Randy	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10652	April 12, 1999	Sanders, John	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10653	March 22, 1999	Sanders, John	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10654	April 19, 1999	Bernard Schaber, Penny	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10655	April 13, 1999	Schaeffer, Nora	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10656	March 21, 1998	Schleicher, Don	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments

G	C	SC	FC	ID	End Date	Author	Document Name
03	A	06	314.00	10657	March 3, 1999	Schleis, Ray	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10658	March 24, 1999	Schley, Otto	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10659	April 13, 1999	Schmitz, Robert	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10660	April 10, 1999	Seidl, Charles	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10661	March 12, 1999	Shillinglaw, Fawn	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10662	April 7, 1999	Shillinglaw, Fawn	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10663	March 9, 1999	Shillinglaw, Fawn	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10664	April 12, 1999	Shillinglaw, Fawn	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10665	April 9, 1999	Shillinglaw, Fawn	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10666	April 2, 1999	Shumway, Bernice	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10667	March 31, 1999	Smith, J.; Mandler, D.	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10668	February 28, 1999	Spangenberg, Ivan	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10669	April 8, 1999	Stellmach, Susan & James	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10670	April 7, 1999	Strauss, Kyle	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10671	March 31, 1999	Swifka, Alisa	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10672	April 12, 1999	Tennessen, Donald	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10673	April 3, 1999	Trester, John	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10674	April 15, 1999	Tucker-Kees, Patricia	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10675	March 29, 1999	Van Thiel, Daniel	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10676	April 14, 1999	Vanderslice, Claire	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10677	March 18, 1999	VanLaanen, Jim	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments

G	C	SC	FC	ID	End Date	Author	Document Name
03	A	06	314.00	10678	April 13, 1999	Vissers, Ken	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10679	March 16, 1999	NA	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10680	May 19, 1999	Ward, Robert	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10681	April 13, 1999	Kade, Warner	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10682	March 24, 1999	Weyers, Lori	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10683	March 25, 1999	Wiley Jr., A. Joley	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10684	March 4, 1999	Wilquet, Lyle	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10685	April 7, 1999	Wilz, Claren	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10686	April 11, 1999	Wussow, Craig	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10687	March 28, 1999	Zeitler, Paul	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10688	April 12, 1999	Zuern, Frank	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10689	April 11, 1999	Lotzer, Clarence	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10690	March 22, 1999	Ullmer, Russ	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10691	March 22, 1999	Arendt, Charlotte	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10692	April 5, 1999	Baumgart, Paul	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
03	A	06	314.00	10693	March 23, 1999	NA	Lower Fox River Public Comments on Draft RA and RI/FS; Volume 2 - Individual Comments
04	A	01	400.01	4534	December 14, 2000		Automated License Issuance System (ALIS) County Approval Totals Report 1999 License Year, Sales as of 12-14-2000 (Statistics on Numbers of Fishing Licenses in Wisconsin by County, Provided by David Webb)
04	A	01	400.02	4536	September 1997	USDHHS	Toxicological Profile for Polychlorinated Biphenyls (Update) September 1997
04	A	01	400.03	4537	June 15, 1998	Prepared for: WDNR	Screening Level Human Health and Ecological Risk Assessment Lower Fox River Site Wisconsin
04	A	01	420.00	9849	October 2001	Publication: Prepared for WDNR	Draft Baseline Human Health and Ecological Risk Assessment; Lower Fox River and Green Bay, Wisconsin, Remedial Investigation and Feasibility Study, Volume I (1) - Sections 1 through 8

G	C	SC	FC	ID	End Date	Author	Document Name
04	A	01	420.00	9850	October 2001	Publication: Prepared for WDNR	Draft Baseline Human Health and Ecological Risk Assessment; Lower Fox River and Green Bay, Wisconsin, Remedial Investigation and Feasibility Study, Volume II (2) - Appendices A through 8 (Cover pages only)
04	A	01	501.00	6213	1999 Pub Date: February 24, 1999	Publication: Prepared for WDNR	Baseline Human Health and Ecological Risk Assessment: Lower Fox River, Wisconsin. Report #: ThermoRetec (RETEC) Project No.: 3-3584-435
04	A	05	400.21	4555	March 1998	USEPA	Daily Average Per Capita Fish Consumption Estimates Based on the Combined USDA 1989, 1990, and 1991 Continuing Survey of Food Intakes by Individuals (CSFII), Volume I (1): Uncooked Fish Consumption National Estimates (March 1998) and Volume II (2): As Consumed Fish Consumption National Estimates (March 1998)
04	B	01	400.26	4560	October 31, 1994	Cox, M.; Cantilli, B.	RE: Calculation of Consumption Weighted Percent Mean Lipid Value for Human Health Using the 1993 West Study
04	B	01	406.00	1132	December 12, 1998	Clark, J. Milton	Subject: New PCB Health Paper; Forwarding draft copy of Public Health Implications of Exposure to Polychlorinated Biphenyls (PCBs)
04	B	01	406.00	1133	December 18, 1998	Clark, J. Milton	Subject: Articles on Transformation, Biodegradation and Volatilization of PCBs in Sediments; Including: "Reductive Dechlorination of Preexisting Sediment Polychlorinated Biphenyls With Long-Term Laboratory Incubation" (Sokol, Bethoney, and Rhee), "Effect of Aroclor 1248 Concentration on the Rate and Extent of Polychlorinated Biphenyl Dechlorination" (Sokol, Bethoney, and Rhee), "Volatilization of Extensively Dechlorinated Polychlorinated Biphenyls From Historically Contaminated Sediments
04	C	01	400.18	4552	February 2000	Sprenger, M. (ERT); Kracko, K. (Response Engineering and Analytical Contract/ERT)	Focused Ecological Risk Assessment for the Upper Green Bay Portion of the Fox River, Green Bay, Wisconsin
04	C	01	400.19	4553	May 1993	West, P.; Fly, J.; Marans, R.; Larkin, F.; Rosenblatt, D.	1991-92 Michigan Sport Anglers Fish Consumption Study, Final Report to the Michigan Great Lakes Protection Fund, Michigan Dept. of Natural Resources
04	C	01	400.20	4554	September 1, 1997	American Fisheries Society	Recommendations for the Second Federal-State Action Plan for Fish Consumption Advisories
04	C	01	400.22	4556	September 1, 1993	Great Lakes Sport Fish Advisory Task Force	Protocol for a Uniform Great Lakes Sport Fish Consumption Advisory
04	C	01	400.23	4557		Fiore, B.; Anderson, MD, H.; Hanrahan, MS, L.; Olson, PhD, L. (Section of Environmental Health, WI Division of Health); Sonzogni, PhD, W.; Wisconsin Laboratory of Hygiene	Sport Fish Consumption and Body Burden Levels of Chlorinated Hydrocarbons: A Study of Wisconsin Anglers
04	C	01	400.25	4559	September 1, 1987	WI Department of Health and Social Services	WI Division of Health and the State Laboratory of Hygiene (SLOH) Study of Sport Fishing and Fish Consumption Habits and Body Burden Levels of PCBs, DDE, and Mercury of Wisconsin Anglers, Final Report to Study Participants
04	C	01	408.00	1149	February 1996	Dykstra, C. (USFWS); Meyer, M. (WDNR)	Subject: Green Bay/Fox River Bald Eagle Research; Cover letter from Mike Meyer to Susan Sylvester (dated March 19, 1998) forwarding the interim report "Effects of Contaminants of Reproduction of Bald Eagles on Green Bay, Lake Michigan" February 1996

WDNR AND USEPA FOX RIVER RI/FS ADMINISTRATIVE RECORD

G	C	SC	FC	ID	End Date	Author	Document Name
06	A	00	708.02	10378	September 17, 2001	Statz, G. Fritz	Technical Memorandum 2f (TM2f) - Subject: Response to EPA Fields Comments
06	A	00	715.02	10379	November 28, 2001	Vandervest, Brian	Technical Memorandum 2d (TM2d) - RE: Documents from the Administrative Record; Madison Quarles & Brady office inadvertently sent back the copies instead of the original documents
06	A	00	715.02	10383	May 12, 2000	Katz, Maureen	Technical Memorandum 2d (TM2d) - RE: Fox River/Green Bay: P.H. Glatfelter; Enclosing a report on the United States' "Preliminary Estimates of PCB Discharges to the Fox River, 1954 to 1985"; Attachment enclosed
06	A	00	715.02	10384	May 12, 2000	Katz, Maureen	Technical Memorandum 2d (TM2d) - RE: Fox River/Green Bay: NCR/Appleton Paper; Enclosing a report on the United States' "Preliminary Estimates of PCB Discharges to the Fox River, 1954 to 1985"; Attachment not enclosed here
06	A	00	715.02	10385	May 12, 2000	Katz, Maureen	Technical Memorandum 2d (TM2d) - RE: Fox River/Green Bay: Fort James Corporation; Enclosing a report on the United States' "Preliminary Estimates of PCB Discharges to the Fox River, 1954 to 1985"; Attachment not enclosed here
06	A	00	715.02	10386	May 12, 2000	Katz, Maureen	Technical Memorandum 2d (TM2d) - RE: Fox River/Green Bay: Wisconsin Tissue Mills; Enclosing a report on the United States' "Preliminary Estimates of PCB Discharges to the Fox River, 1954 to 1985"; Attachment not enclosed here
06	A	00	715.02	10387	May 12, 2000	Katz, Maureen	Technical Memorandum 2d (TM2d) - RE: Fox River/Green Bay: Riverside Paper Company; Enclosing a report on the United States' "Preliminary Estimates of PCB Discharges to the Fox River, 1954 to 1985"; Attachment not enclosed here
06	A	00	715.02	10388	May 12, 2000	Katz, Maureen	Technical Memorandum 2d (TM2d) - RE: Fox River/Green Bay: U.S. Paper Mills Corporation; Enclosing a report on the United States' "Preliminary Estimates of PCB Discharges to the Fox River, 1954 to 1985"; Attachment not enclosed here
06	A	00	715.02	10389	May 12, 2000	Katz, Maureen	Technical Memorandum 2d (TM2d) - RE: Fox River/Green Bay: Proctor & Gamble; Enclosing a report on the United States' "Preliminary Estimates of PCB Discharges to the Fox River, 1954 to 1985"; Attachment not enclosed here
06	A	00	715.02	10390	May 12, 2000	Katz, Maureen	Technical Memorandum 2d (TM2d) - RE: Fox River/Green Bay: Green Bay Packaging; Enclosing a report on the United States' "Preliminary Estimates of PCB Discharges to the Fox River, 1954 to 1985"; Attachment not enclosed here
06	A	00	715.02	10391	May 12, 2000	Katz, Maureen	Technical Memorandum 2d (TM2d) - RE: Fox River/Green Bay: Consolidated Papers; Enclosing a report on the United States' "Preliminary Estimates of PCB Discharges to the Fox River, 1954 to 1985"; Attachment not enclosed here

G	C	SC	FC	ID	End Date	Author	Document Name
06	A	00	715.02	10392	May 12, 2000	Katz, Maureen	Technical Memorandum 2d (TM2d) - RE: Fox River/Green Bay: Kimberly-Clark Corp.; Enclosing a report on the United States' "Preliminary Estimates of PCB Discharges to the Fox River, 1954 to 1985"; Attachment not enclosed here
06	B	01	701.45	6989	April 14, 2000	American Geological Institute (AGI)	Peer Review of Models Predicting the Fate and Export of PCBs in the Lower Fox River Below De Pere Dam, A Report of the Lower Fox River Fate and Transport of PCBs Peer Review Panel, Administered by the American Geological Institute (AGI)
06	B	01	726.00	9845	October 2001	Prepared for: WDNR	Draft Model Documentation Report; Lower Fox River and Green Bay, Wisconsin, Remedial Investigation and Feasibility Study, Volume 1; Cover pages only - drafts became final when released in December 2002 with the exception to pages herein
06	B	01	726.01	9846	October 2001	Prepared for: WDNR	Draft Model Documentation Report; Lower Fox River and Green Bay, Wisconsin, Remedial Investigation and Feasibility Study, Volume II (2); Cover pages only - drafts became final when released in December 2002 with the exception to pages herein
07	A	02	812.00	10774	2002	PUBLIC	Subject: Please do not split the Record of Decision for PCB cleanup (ROD); Public comments submitted regarding 2002 ROD
07	B	01	808.00	11052	December 2002	Prepared for: WDNR; USEPA	Green Bay Sediment Results from July 2002 Survey, Green Bay, Wisconsin
07	B	01	809.00	16273	June 30, 2003	WDNR; USEPA	Record of Decision (ROD) Operable Unit 3, Operable Unit 4, and Operable Unit 5 (OU3, OU4, OU5), Lower Fox River and Green Bay, Wisconsin; Attachments: Responsiveness Summary (RS) and White Papers
07	B	01	817.00	16275	May 30, 2003	Prepared for: WDNR	Revised Unit Cost Study For Commercial-Scale Sediment Melter Facility, Glass Furnace Technology
07	B	01	817.00	16276	May 30, 2003	Prepared for: WDNR	Supplemental Sediment Handling Characterization Report, Glass Furnace Technology
07	B	01	817.00	16277	May 30, 2003	Prepared for: WDNR	Permitting Review for Sediment Melter Facility
08	A	02	939.00	9842	September 28, 1998	Delacenserie, D.; Kuhlmann, W.; on behalf of City of Appleton, City of DePere, Grand Chute Menasha West Sewerage Commission, Green Bay Metropolitan Sewerage District, Heart of the Valley Metropolitan Sewerage District, City of Neenah, City of Menasha, N	Natural Resource Damage Assessment (NRDA) Public Comments - RE: Fox River NRDA/PCB Releases, TDD S05-9706-023
09	B	01	10279.00	2532	December 1997	WDNR	Deposit N - Fox River Deposit N Removal Project Pre-Design Phase, Quality Assurance Project Plan (QAPP), Category 2 Project, Scope ID: 97W027, December 1997
09	B	01	10280.00	2529	January 1999	WDNR	Deposit N - Report, Interim Project Report, Fox River Deposit N, Scope ID: 97W027, Division Project No. 97746, January 1999
09	C	00	10490.00	10171	November 14, 2000	Travers, Mark	Subject: Sediment Management Units 56 and 57, Lower Fox River, Wisconsin; Letter submitted on behalf of Appleton Papers, Inc., NCR Corp., P.H. Glatfelter Co., Riverside Paper Corp., and WTM I, to confirm intent to collect sediment samples from SMU 56/57

WDNR AND USEPA FOX RIVER RI/FS ADMINISTRATIVE RECORD

G	C	SC	FC	ID	End Date	Author	Document Name
09	C	00	10490.00	10970	January 31, 2003	Grimes, Roger	RE: Fox River Administrative Order on Consent; In the Matter of Lower Fox River and Green Bay Site Contaminant Delineation, Respondents: Fort James Corporation and Fort James Operating Company
09	C	01	10005.00	9856	September 2001	Prepared for: FRG and WDNR	Final Summary Report, Sediment Management Unit (SMU) 56/57 Demonstration Project, Fox River, Green Bay, Wisconsin, September 2001, Project No. 1242291/2082057.01470101
09	C	01	10404.00	2184	July 1998	Prepared by: Montgomery Watson	WPDES Permit Application, Sediment Removal Demonstration Project, Sediment Management Unit 56/57 (SMU 56/57), Fox River, Green Bay, Wisconsin, July 1998
09	C	01	10450.00	2173	August 1999	Prepared by: Montgomery Watson	Operational Monitoring Quality Assurance Project Plan (QAPP), Sediment Removal Demonstration Project, Sediment Management Unit 56/57 (SMU 56/57), Fox River, Green Bay, Wisconsin, August 1999
09	C	01	10500.00	10162	November 6, 2000	Pham, Dong-Son	Forwarding draft interim reports for SMU 56/57; A Benthos Inventory of the Lower Fox River, Sediment Management Unit 56/57, 2nd Post-Dredging Survey, 2000, Project 5025, Interim Report Three to BBL, October 26, 2000, Draft; Also, 1st Post-Dredging Survey, 2000, Project 5025, Interim Report Two, May 15, 2000, Draft; Also, Pre-Dredging Conditions, 1999, Project 5025, Interim Report One, May 5, 2000, Draft
10	A	01	1160.00	6568	February 1994	Woodward-Clyde Consultants (WWC)	Estimate of PCB Losses During Remediation, Little Lake Butte Des Morts, Deposit A Winnebago County, Wisconsin; Project Number 15605-12
10	A	01	1162.00	2482		EWI Engineering Associates, Inc.	Dep A- Little Lake Butte Des Morts/ Remedial Investigation and Feasibility Study (Proposal) March 1991
10	A	01	1164.00	2491	September 1993	Woodward-Clyde Consultants (WWC)	Deposit A - Final Report, Little Lake Butte Des Morts (LLBDM) Proposed Plan, September 1993
10	A	01	1164.00	2492	October 1994	Woodward-Clyde Consultants (WWC)	Deposit A - Draft Design Report, Little Lake Butte Des Morts (LLBDM), Deposit A, Winnebago County, Wisconsin, October 1994
10	A	01	1164.00	2493	November 11, 1994	Woodward-Clyde Consultants (WWC)	Deposit A - Construction Plans for Environmental Cleanup - Deposit A, Little Lake Butte Des Morts (LLBDM), Neenah/Menasha, Wisconsin, DFD Project #91624, Drawing C-1 / C-7 (Maps)
10	A	01	1167.00	6439	November 1991		Task 3: Sediment Transport: Deposit A, Little Lake Butte des Morts Report #: Technical Memorandum Project No. 15605.00
10	A	01	11166.00	2494	December 1994	Woodward-Clyde Consultants (WWC)	Deposit A - Draft Report, Little Lake Butte Des Morts, Neenah Slough Sediment Contamination and Transport Analysis, Neenah, Wisconsin, December 1994
10	B	01	1103.00	2201	September 24, 1996	GAS; SAIC	Appendices, Remedial Investigation Report for Contaminated Sediment Deposits on the Fox River (Little Lake Butte Des Morts to the De Pere Dam), September 24, 1996 (unbound copy)
10	B	01	1103.00	2202	September 24, 1996	GAS; SAIC	Remedial Investigation Report for Contaminated Sediment Deposits on the Fox River (Little Lake Butte Des Morts to the De Pere Dam), September 24, 1996 (unbound copy)
10	B	01	1104.00	2203	April 1997	GAS; SAIC	Feasibility Study Report for Deposits POG and N on the Fox River, Final Draft, April 1997 (unbound copy)

WDNR AND USEPA FOX RIVER RI/FS ADMINISTRATIVE RECORD

G	C	SC	FC	ID	End Date	Author	Document Name
10	B	01	1105.00	2204	April 1997	GAS; SAIC	Feasibility Study Report for Deposits POG and N on the Fox River, Final Draft, April 1997 (bound copy)
11	A	00	1201.00	15967	NA	USDOI, USFWS	Pamphlet: Beyond Cleanup--Restoring America's Natural Heritage; Facts About Superfund's Natural Resource Damage Assessment and Restoration Program
11	A	00	1201.00	15968	NA	USEPA, GLNPO	Environmental Fact Sheet Re: Contaminated Sediments
11	A	00	1201.00	15969	NA	USEPA; WDNR	Blank Questionnaire re: Lower Fox River and Green Bay Environment
11	A	00	1201.00	15970	NA	USEPA	Fact Sheet: Fox River and Green Bay Natural Resource Damage Assessment
11	A	00	1201.00	15971	NA	USEPA	Fact Sheet: Polychlorinated Biphenyls (PCBs)
11	A	00	1201.00	15972	NA	USEPA	Fact Sheet: NPL Listing of the Lower Fox River–Questions and Answers About Providing Public Comments
11	A	00	1201.00	15973	NA	USEPA	Maps/Photographs/Tables: Change in the Lower Fox River True Elevation 1995-2000 w/ Summary of Field Analysis
11	A	00	1201.00	15974	NA	WDNR	Pamphlet: Fox River Deposit N Removal
11	A	00	1201.00	15975	NA	WDNR	Informational Bulletin: Frequently Asked Questions Concerning the Fox River
11	A	00	1201.00	15976	1966	U.S. Geological Survey (USGS)	Surface Water Features Map for Escanaba, WI Quadrangle
11	A	00	1201.00	15977	March 1976	USEPA, Office of Toxic Substances (OTS)	Conference Proceedings: National Conference on Polychlorinated Biphenyls (November 1975)
11	A	00	1201.00	15978	September 21, 1976	Kleinert, Stanton	The PCB Problem in Wisconsin
11	A	00	1201.00	15979	February 25, 1977	Versar, Inc.	PCBs Involvement in the Pulp and Paper Industry, Report No. EPA 560/6-77-005
11	A	00	1201.00	15980	April 15, 1977	Easty, Dwight	RE: Report on the Polychlorinated Biphenyls Obtained for the Influent and Effluent Samples Collected at the Bergstrom Paper Company
11	A	00	1201.00	15981	June 20, 1978	Mueller, George	RE: Forwarding Copy of WPDES Permit Application
11	A	00	1201.00	15982	June 23, 1978	Fort Howard Paper Company	WPDES Permit Renewal Application for the Fort Howard Paper Company
11	A	00	1201.00	15983	June 28, 1978	WDNR	Wastewater Discharge Permit Application for the American Can Company
11	A	00	1202.00	15984	September 1978	USEPA, GLNPO	Investigation of Chlorinated and Nonchlorinated Compounds in the Lower Fox River Watershed; EPA-905/3-78-004
11	A	00	1202.00	15985	1982	USGS	Surface Water Features Map for Sturgeon Bay/Shawano, WI Quadrangles
11	A	00	1202.00	15986	June 7, 1982	Shah, Bharat	RE: Effluent PCB Data Since 1973
11	A	00	1202.00	15987	November 3, 1982	Larsen, Mike	RE: PCB Levels vs. Pounds Per Day Suspended Soils
11	A	00	1202.00	15988	1984	USGS	Quadrangle Map for Appleton, WI
11	A	00	1202.00	15989	1984	USGS	Topographic Map for Appleton, WI
11	A	00	1202.00	15990	1984	USGS	Topographic Map for Shawano, WI
11	A	00	1202.00	15991	October 26, 1984	Federal Register	Rules and Regulations: Appendix B to Part 136 (Definition and Procedure for the Determination of the Method Detection Limit-Revision 1.11; Federal Register, Vol. 49, No. 209 (Cont.)
11	A	00	1202.00	15992	July 3, 1986	WDNR	Wisconsin Wetlands Inventory–Brown County
11	A	00	1202.00	15993	July 5, 1986	WDNR	Wisconsin Wetlands Inventory–Winnebago County
11	A	00	1202.00	15994	September 1986	WDNR	Method 8080, Organochlorine Pesticides and PCBs

G	C	SC	FC	ID	End Date	Author	Document Name
11	A	00	1202.00	15995	March 11, 1988	Swackhamer, Deborah L., University of Minnesota	Quality Assurance Project Plan for the Green Bay Mass Balance Study
11	A	00	1202.00	15996	June 1988	Prepared by: Terry Lohr	Lower Fox River and Green Bay Harbor PCB Sediment Sampling Data
11	A	00	1202.00	15997	1990	WDNR	PCB Discharge Outfall 001 (1976-1990) and PCB Discharge Combination Outfall for the Fort Howard Corporation
11	A	00	1202.00	15998	December 14, 1990	USEPA, Federal Register	Hazard Ranking System; Final Rule (40 CFR Part 300)
11	A	00	1203.00	15999	April 24, 1991	Call, D.J.; Edstrom, R.; Markee, T.P.; Lindberg, C.A. (UW-Superior)	RE: Submission of Congener-Specific PCB Reports for the Dissolved and Particulate Fractions of Water Samples Collected by the USEPA GLNPO (June 1989, Cruise #3)
11	A	00	1203.00	16000	April 25, 1991	Behrens, Robert	RE: List of Facilities Believed to have Discharged PCBs into the Fox River and Estimates of PCB Discharges to Green Bay and Lake Michigan
11	A	00	1203.00	16001	June 3, 1991	Getty, Kathleen	RE: New Superfund Chemical Data Matrix for HRS Preparation w/Attachments
11	A	00	1203.00	16002	July 17, 1991	Call, D.J.; Edstrom, R.D.; Markee, T.P.; Lindberg, C.A. (UW-Superior)	RE: Submission of Congener-Specific PCB Reports for the Dissolved and Particulate Fractions of Water Samples Collected by EPA (July 1989, Cruise #4)
11	A	00	1204.00	16003	August 14, 1991	Call, D.J.; Edstrom, R.D.; Markee, T.P.; Lindberg, C.A. (UW-Superior)	RE: Submission of Congener-Specific PCB Reports for the Dissolved and Particulate Fractions of Water Samples Collected by EPA (September 1989, Cruise #5)
11	A	00	1204.00	16004	1992	USGS	Quadrangle Map for Neenah, WI
11	A	00	1204.00	16005	1992	DeLorme Mapping Company	Photocopies of Topographical Maps from Wisconsin Atlas & Gazetteer
11	A	00	1204.00	16006	August 5, 1992	WDNR	Wisconsin Wetlands Inventory–Brown County (Revised)
11	A	00	1204.00	16007	November 2, 1992	WDNR	Wisconsin Wetlands Inventory–Brown County (Revised)
11	A	00	1204.00	16008	December 1992	Prepared by: Robert F. Beltran	Green Bay/Fox River Mass Balance Study: Preliminary Management Summary
11	A	00	1205.00	16009	February 1999 - July 1999	Various Newspapers	Newspaper Clippings for the Period 1993 to 2001 re: Lower Fox River NRDA Site
11	A	00	1206.00	16010	2000	Various Newspapers	Newspaper Clippings for the Period 1993 to 2001 re: Lower Fox River NRDA Site
11	A	00	1206.00	16011	2001	Various Newspapers	Newspaper Clippings for the Period 1993 to 2001 re: Lower Fox River NRDA Site
11	A	00	1207.00	16012	September 1998 - February 1999/Jul 1998 - Dec 1998	Various Newspapers	Newspaper Clippings for the Period 1993 to 2001 re: Lower Fox River NRDA Site
11	A	00	1207.00	16013	October 27, 1999 - January 18, 2000	Various Newspapers	Newspaper Clippings for the Period 1993 to 2001 re: Lower Fox River NRDA Site
11	A	00	1208.00	16014	1993 - Present	Various Newspapers	Newspaper Clippings for the Period 1993 to 2001 re: Lower Fox River NRDA Site
11	A	00	1209.00	16015	1993 - Present	Various Newspapers	Newspaper Clippings for the Period 1993 to 2001 re: Lower Fox River NRDA Site
11	A	00	1210.00	16016	February 1993	WDNR	Document for Development of Sediment Quality Objective Concentrations for PCBs in Deposit A, Little Lake Butte Des Morts

G	C	SC	FC	ID	End Date	Author	Document Name
11	A	00	1210.00	16017	July 8, 1993	Baker, Bruce	RE: Use of Point Source Discharge Data from the Green Bay Mass Balance Study
11	A	00	1210.00	16018	1994	WDNR	Fact Sheet: 1994 Update to Toxic Chemical Series for Polychlorinated Biphenyls (PCBs)
11	A	00	1210.00	16019	August 1994	Agency for Toxic Substances and Disease Registry (ATSDR)	Fact Sheet re: ATSDR
11	A	00	1210.00	16020	August 1994	USEPA, OERR	Fact Sheet: Common Chemicals Found at Superfund Sites
11	A	00	1210.00	16021	September 1994	WDNR	Method 8081: Organochlorine Pesticides and PCBs as Aroclors by Gas Chromatography: Capillary Column Technique
11	A	00	1210.00	16022	1995	House, Leo B.	Distribution and Transport of Polychlorinated Biphenyls in Little Lake Butte Des Morts, Fox River, Wisconsin, April 1987 - October 1988
11	A	00	1210.00	16023	1995	USGS	Water Resources Data for Wisconsin–Water Year 1995
11	A	00	1211.00	16024	May 1995	WDNR	A Deterministic PCB Transport Model for the Lower Fox River Between Lake Winnebago and De Pere, Wisconsin; PUBL WR 389-95
11	A	00	1211.00	16025	September 22, 1995	Walz, K.; Paulson, R.	Quality Assurance Project Plan for the Assessment of PCBs in Sediment of the Lower Fox River from De Pere to Green Bay
11	A	00	1211.00	16026	October 4, 1995	WDNR	Wisconsin Wetlands Inventory–Brown County (Revised)
11	A	00	1211.00	16027	October 26, 1995	WDNR	PCB in Fish from the Lower Fox River and Green Bay
11	A	00	1211.00	16028	1996	Manchester-Neesvig, J.B.; Andren, A.W.; Edgington, D.N.	Patterns of Mass Sedimentation and of Deposition of Sediment Contaminated by PCBs in Green Bay (International Association for Great Lakes Research); J. Great Lakes Res. 22(2):444-462
11	A	00	1212.00	16029	March 25, 1996	WDNR	Predator Fish Data Summary for Spring 1989 w/ Comments
11	A	00	1212.00	16030	April 3, 1996	Holzknecht, George	RE: Riverside's Request for Information Concerning Contamination of the Lower Fox River, Green Bay and Lake Michigan
11	A	00	1212.00	16031	August 1996	Prepared by: Hagler Bailly Consulting, Inc.	Assessment Plan: Lower Fox River/Green Bay NRDA
11	A	00	1212.00	16032	September 24, 1996	Prepared by: GAS; SAIC	Remedial Investigation Report for Contaminated Sediment Deposits on the Fox River (Little Lake Butte Des Morts to the De Pere Dam)
11	A	00	1213.00	16033	September 24, 1996	USEPA	Preliminary Assessment of Feasible Remedial Techniques for the Fox River RI/FS
11	A	00	1213.00	16034	1997	WDNR; WDH	Important Health Information for People Eating Fish from Wisconsin Waters
11	A	00	1213.00	16035	March 11, 1997	Jaeger, Steve	RE: 1995 Fox River Sediment Data
11	A	00	1213.00	16036	April 8, 1997	USEPA	USEPA/Sea Grant Green Bay Mass Balance Project Summary of Stations Occupied 1987-1990
11	A	00	1213.00	16037	July 1997	USEPA	U.S. EPA's Superfund Role in the Lower Fox River Cleanup
11	A	00	1213.00	16038	July 31, 1997	Donovan, Robin	RE: Boat Launches and Fishing Areas on the Fox River
11	A	00	1213.00	16039	July 31, 1997	Donovan, Robin	Common Fishing Areas near Little Chute
11	A	00	1213.00	16040	July 31, 1997	Donovan, Robin	RE: Fishing at Little Lake Butte des Mortes
11	A	00	1213.00	16041	July 31, 1997	USEPA	PCS DMR Data Retrieval Lead Limits and Measurements, Facility Permits and Outfall Locations for the Fox River NRDA Site
11	A	00	1213.00	16042	August 11, 1997	Donovan, Robin	RE: Fish Spawning Area on the Fox River near De Pere Dam
11	A	00	1213.00	16043	August 11, 1997	Donovan, Robin	RE: Endangered Species Habitat on the Fox River
11	A	00	1213.00	16044	August 11, 1997	Donovan, Robin	RE: Common Fishing Areas on the Fox River
11	A	00	1213.00	16045	August 20, 1997	Robin, Donovan	RE: Use of Fox River in the Area of Appleton

G	C	SC	FC	ID	End Date	Author	Document Name
11	A	00	1213.00	16046	August 28, 1997	Robin, Donovan	RE: Endangered Avian Species on Green Bay
11	A	00	1213.00	16047	August 29, 1997	Robin, Donovan	RE: Bald Eagle Nesting Areas on the Fox River
11	A	00	1213.00	16048	September 1997	Prepared for: USDHHS/PHS/ATSDR	Toxicological Profile for Polychlorinated Biphenyls (Update)
11	A	00	1213.00	16049	September 1997	USEPA	Should I Eat the Fish I Catch? A Guide to Healthy Eating of the Fish You Catch
11	A	00	1213.00	16050	September 2, 1997	Robin, Donovan	RE: Harvest and Catch Data on the Creel Survey
11	A	00	1213.00	16051	September 4, 1997	Robin, Donovan	RE: Fox River Fishery SMU
11	A	00	1213.00	16052	September 11, 1997	Kreis Jr., Russell	RE: Quality Assurance Information for the Fox River/Green Bay Mass Balance Study
11	A	00	1213.00	16053	September 18, 1997	Robin, Donovan	RE: Sampling Methods and Interpretation of Data for the Green Bay Mass Balance Project
11	A	00	1213.00	16054	September 18, 1997	Robin, Donovan	RE: Sampling Methods and Interpretation of Data for the Green Bay Mass Balance Project w/Attachments
11	A	00	1213.00	16055		Robin, Donovan	RE: Neenah Paper-Badger Globe Facility
11	A	00	1213.00	16056	October 28, 1997	Robin, Donovan	RE: Dams on the Fox River
11	A	00	1213.00	16057	December 14, 1998	Gilbertsen, Robert	Monthly Work Assignment Status Reports (Technical) for the Fox River NRDA Site for the Period October 24, 1998 - November 20, 2000
11	A	00	1213.00	16058	1998 - 2001	Lower Fox River Intergovernmental Partnership	Fox River Current Newsletters for the Period Fall 1998 - June 2001
11	A	00	1213.00	16059	1998	WDNR	Creel Survey of the Wisconsin Waters of Lake Michigan
11	A	00	1213.00	16060	1998	WDNR	Upcoming Public Meetings and Comment Periods for the Lower Fox River NRDA Site
11	A	00	1213.00	16061	February 2, 1998	Code of Federal Regulations	CFR Part 17: Endangered and Threatened Wildlife and Plants
11	A	00	1213.00	16062	February 4, 1998	McLennan, Brendan	RE: The Consolidated Papers Appleton Facility
11	A	00	1213.00	16063	February 9, 1998	Skare, Steven	RE: Industrial and Municipal Users for the Neenah Menasha Publicly Operated Treatment Works
11	A	00	1213.00	16064	February 9, 1998	Skare, Steven	RE: Data Used for HRS Scoring
11	A	00	1213.00	16065	February 24, 1998	WDNR	U.S. Geological Survey Daily Mean Discharge Data for the Period October 10, 1988 - December 31, 1993 for the Fox River at Appleton, WI
11	A	00	1213.00	16066	February 24, 1998	WDNR	U.S. Geological Survey Daily Mean Discharge Data for the Period October 10, 1988 - September 30, 1990 for the Fox River at State Highway 55 at Kaukauna, WI
11	A	00	1213.00	16067	February 24, 1998	WDNR	U.S. Geological Survey Daily Mean Discharge Data for the Period October 10, 1988 - September 30, 1990 for the Fox River at Little Rapids, WI
11	A	00	1213.00	16068	February 24, 1998	WDNR	U.S. Geological Survey Daily Mean Discharge Data for the Period October 10, 1988 - December 31, 1993 for the Fox River at Rapide Croche Dam near Wrightstown, WI
11	A	00	1213.00	16069	February 24, 1998	WDNR	U.S. Geological Survey Daily Mean Discharge Data for the Period October 10, 1988 - September 30, 1990 for the Fox River at De Pere, WI
11	A	00	1213.00	16070	February 24, 1998	WDNR	U.S. Geological Survey Daily Mean Discharge Data for the Period October 10, 1988 - December 31, 1993 for the Fox River at Oil Tank Depot at Green Bay, WI

G	C	SC	FC	ID	End Date	Author	Document Name
11	A	00	1213.00	16071	April 14, 1998	Skare, Steven	RE: Sediment and Surface Water Sampling for the Green Bay Mass Balance Study w/ Attachments
11	A	00	1213.00	16072	April 27, 1998	USEPA	April 27, 1998 Presentation–Restoring the Lower Fox: Perspectives on PCBs and Public Health
11	A	00	1214.00	16073	May 28, 1998	USEPA	Hazard Ranking System Report for Fox River NRDA/PCB Releases, Winnebago, Oconto, and Brown Counties, Wisconsin
11	A	00	1214.00	16074	July 1998	WDNR	Lower Fox River Cleanup Assessment Near Completion
11	A	00	1214.00	16075	July 1998	USEPA	Fact Sheet: PCB's: Lower Fox River Impacts
11	A	00	1214.00	16076	July 9, 1998	Browner, Carol	Oral Statement of Carol M. Browner, USEPA Administrator, before the Committee on Environmental Conservation, New York State Assembly, July 9, 1998
11	A	00	1214.00	16077	July 21, 1998	Fox River Intergovernmental Partners	July 21, 1998 Informational Meeting for an Update on the Lower Fox River/Green Bay Cleanup and Restoration
11	A	00	1214.00	16078	July 21, 1998	WDNR	Environmental Dredging Demonstration
11	A	00	1214.00	16079	July 23, 1998	Griffin, Jeanne	Cover Letter; RE: Fox River NRDA/PCB Releases Hazard Ranking System (HRS) Scoring Package
11	A	00	1214.00	16080	July 23, 1998	Griffin, Jeanne	Fox River NRDA/PCB Releases Hazard Ranking System (HRS) Scoring Package
11	A	00	1214.00	16081	July 27, 1998	USEPA	July 27, 1998 Presentation; Restoring the Lower Fox: Perspectives on PCBs and Public and Ecological Health
11	A	00	1214.00	16082	July 27, 1998	USEPA	July 27, 1998 Meeting for the Lower Fox River NRDA Site
11	A	00	1214.00	16083	July 28, 1998	USEPA	Fact Sheet: U.S. Environmental Protection Agency NPL Proposal Announcement for the Fox River NRDA Site
11	A	00	1214.00	16084	July 29, 1998	Ecology and Environment, Inc. (E&E)	HRS References for the Fox River
11	A	00	1214.00	16085	August 1998	Produced for: WDNR; FRG	Sediment Removal Demonstration Project for Sediment Management Unit (SMU) 56/57 at the Lower Fox River NRDA Site
11	A	00	1214.00	16086	August 11, 1998	Lynch, Ed	RE: Fox River Hazard Ranking System (HRS) Scoring Package for the Fox River NRDA Site
11	A	00	1214.00	16087	August 20, 1998	Griffin, Jeanne	RE: HRS Scoring Documentation Records for the Period October 30 - November 5, 1997
11	A	00	1214.00	16088	August 21, 1998	Lynch, Ed	Subject: Fox River HR Package; Request for Comments on the HRS Scoring Package for the Fox River NRDA Site and Note on Missing Pages
11	A	00	1214.00	16089	August 24, 1998	Griffin, Jeanne	RE: Missing Pages for the HRS Scoring Package for the Fox River NRDA Site
11	A	00	1214.00	16090	August 25, 1998	Burnett, John	Subject: Fox River NRDA/PCB Releases HRS Score; Documentation Record for the Fox River NRDA Site
11	A	00	1214.00	16091	August 28, 1998	USEPA	Statement of Work for the Remedial Investigation/Feasibility Study Oversight ("Peer Review") for the Fox River NRDA Site
11	A	00	1214.00	16092	September 1998	USEPA	Fact Sheet: USEPA's Superfund Role in Lower Fox River Cleanup
11	A	00	1214.00	16093	September 2, 1998	USEPA	RE: September 2, 1998 Availability Sessions Concerning the Lower Fox River Proposed Listing on the National Priorities List (NPL)
11	A	00	1214.00	16094	September 4, 1998	Pastor, Susan	RE: September 2-3, 1998 Public Meeting for the Fox River NRDA Site

G	C	SC	FC	ID	End Date	Author	Document Name
11	A	00	1214.00	16095	September 24, 1998	USEPA	Public Information Forum Videotape: The ABCs of PCBs - Options for Cleaning Up the Lower Fox River
11	A	00	1214.00	16096	September 29, 1998	FRG	FRG's Comments on USEPA's Hazard Ranking System Report for the Fox River NRDA/PCB Releases Site and the Proposal for Inclusion of the Site on the National Priorities List
11	A	00	1214.00	16097	November 19, 1998	Warchall, James	RE: Fox River RI/FS and Risk Assessment–PCB Cancer Risk
11	A	00	1214.00	16098	January 25, 1999	USEPA	RE: January 25 - February 5, 1999 Community Interview Process for the Lower Fox River NRDA Site
11	A	00	1214.00	16099	January 27, 1999	Travers, Mark	RE: Peer Review Plans for the Fox River
11	A	00	1214.00	16100	March 1999	WDNR	Fact Sheet: Disposal of PCB Contaminated Wastes in Wisconsin Landfills
11	A	00	1214.00	16101	March 1999	WDNR	Fact Sheet: DNR Seeks Public Input on Draft Cleanup Studies for the Lower Fox River
11	A	00	1214.00	16102	March 1999	WDNR	Fact Sheet: Draft Studies Completed on Cleanup of PCBs in Lower Fox River Sediments
11	A	00	1214.00	16103	March 5, 1999	Travers, Mark	RE: USEPA's Response to FRG's December 8, 1998 Modeling Presentation for the Lower Fox River NRDA Site
11	A	00	1214.00	16104	March 29, 1999	The Green Bay News-Chronicle	RE: March 29, 1999 Public Meeting for the Lower Fox River Project with Attached Agenda
11	A	00	1214.00	16105	March 29, 1999	USEPA	RE: March 29, 1999 Public Meeting for the Lower Fox River NRDA Site
11	A	00	1214.00	16106	July 1999	USEPA	Fact Sheet: The Lower Fox River and the Remedy Review Board–Questions and Answers
11	A	00	1214.00	16107	July 15, 1999	FRG	RE: FRG's Objections to Proceedings Before the National Remedy Review Board Concerning Potential Remedies for the Fox River NRDA Site
11	A	00	1214.00	16108	July 15, 1999	Katers, Rebecca	RE: CWAC's Comments to the NRRB on Potential Remedies for the Fox River PCB Contamination Problem
11	A	00	1214.00	16109	July 16, 1999	Allen II, P. David	RE: Federal/Tribal Trustees Support of the NRRB Remedy Selection Briefing Package for the Lower Fox River NRDA Site
11	A	00	1214.00	16110	July 27, 1999	USEPA	RE: Announcement of July 26-28, 1999 USEPA Superfund Workshop
11	A	00	1214.00	16111	July 28, 1999	USEPA; WDNR	National Remedy Review Board Remedy Selection Briefing Package for the Fox River NRDA Site: Volume 1 of 2 (Text, Tables and Figures)
11	A	00	1215.00	16112	July 28, 1999	USEPA; WDNR	National Remedy Review Board Remedy Selection Briefing Package for the Fox River NRDA Site: Volume 2 of 2 (Exhibits)
11	A	00	1215.00	16113	July 29, 1999	USEPA	Lower Fox River Remedy Review Board Briefing
11	A	00	1215.00	16114	September 28, 1999	Gilbertsen, R.; Burton, J.	RE: Peer Review of Draft Feasibility Study for the Lower Fox River NRDA Site
11	A	00	1215.00	16115	October 7, 1999	AGI	AGI Newsletter: AGI Forms Peer Review Panel to Examine Models of the Fox River in Wisconsin
11	A	00	1215.00	16116	October 7, 1999	Gilbertsen, R.; Burton, J.	RE: Peer Review of the Remedial Investigation and Data Management Reports for the Lower Fox River NRDA Site
11	A	00	1215.00	16117	November 30, 1999	WDNR	Update to Environmental Dredging for the Fox River NRDA Site
11	A	00	1215.00	16118	January 19, 2000	USEPA	Announcement of January 19, 2000 Fox River Intergovernmental Partners Meeting

G	C	SC	FC	ID	End Date	Author	Document Name
11	A	00	1215.00	16119	January 25, 2000	Pastor, S.; Bill, B.	Subject: January 19, 2000 Superfund Workshop and Municipal Officials Meeting Trip Report for the Lower Fox River NRDA Site
11	A	00	1215.00	16120	February 11, 2000	Heimbuch, Joseph	RE: FRG's Comments on the Supplemental Scope of Work and Budget Estimate to Complete the Lower Fox River RI/FS
11	A	00	1215.00	16121	March 2000	WDNR	Fact Sheet: Revised Information on Toxic Chemicals for Polychlorinated Biphenyls
11	A	00	1215.00	16122	April 14, 2000	Keane, Christopher	AGI Report: Peer Review of Models Predicting the Fate and Export of PCBs in the Lower Fox River Below De Pere Dam with Cover Letter
11	A	00	1216.00	16123	May 25, 2000	Fort James Corporation	Dredging Announcement
11	A	00	1216.00	16124	June 5, 2000	Schlickman, J. Andrew	RE: PCB Contamination in the Sediments of the Fox River
11	A	00	1216.00	16125	June 28, 2000	Prepared for: FRG	Peer Review Panel Report for the Fox River Human and Ecological Risk Assessments
11	A	00	1216.00	16126	June 29, 2000	Hanebutt, Pamela	RE: PCB Contamination in the Sediments of the Fox River w/ Attachments
11	A	00	1216.00	16127	July 2000	USEPA	Fact Sheet: Cleanup Planned for SMU 56/57 at the Lower Fox River NRDA Site
11	A	00	1216.00	16128	July 14, 2000	Schlickman, J. Andrew	RE: Appleton Papers/NCR Corporation's Comments on the Preliminary Estimates of PCB Discharges to the Fox River Report with Exhibits 1-3
11	A	00	1216.00	16129	August 2000	USEPA	City of Appleton Publicly-Owned Treatment Works–Total Suspended Solids Removal Efficiency 1954-1971 for the Fox River Project
11	A	00	1217.00	16130	August 2000	USEPA	Attachments to City of Appleton Publicly-Owned Treatment Works-Total Suspended Solids Removal Efficiency 1954-1971 for the Fox River Project
11	A	00	1218.00	16131	August 2000	USEPA	Estimate of Emulsion Loss to the Appleton Coated Papers Facility for 1970-1971 for the Fox River Project
11	A	00	1218.00	16132	August 21, 2000	Schlickman, J. Andrew	RE: Appleton Papers/NCR Corporation's Additional Comments on the Preliminary Estimates of PCB Discharges to the Fox River Report with Exhibits 1-10
11	A	00	1218.00	16133	September 13, 2000	USEPA	RE: September 13, 2000 Open House to Discuss the Cleanup of SMU 56/57 at the Lower Fox River NRDA Site
11	A	00	1218.00	16134	September 19, 2000	Pastor, Susan	RE: September 19, 2000 Fox River SMU 56/57 Availability Session
11	A	00	1218.00	16135	October 2000	USEPA	Information Sheet: Fox River PCB Contamination Cleanup for SMU 56/57
11	A	00	1218.00	16136	October 12, 2000	USEPA	RE: October 12, 2000 Open House for the Lower Fox River NRDA Site
11	A	00	1218.00	16137	December 5, 2000	USEPA	RE: December 5, 2000 Project Wrap-up Meeting for the Lower Fox River NRDA Site
11	A	00	1218.00	16138	December 13, 2000	Pastor, Susan	RE: December 5, 2000 Media Event and Public Meeting for SMU 56/57 at the Lower Fox River NRDA Site
11	A	00	1218.00	16139	May 2001	USEPA	Community Involvement Plan for the Lower Fox River NRDA Site
11	A	00	1218.00	16140	August 2001	USEPA	Fact Sheet: Intergovernmental Partners Negotiate Fox River Interim Agreement
11	A	00	1218.00	16141	August 14, 2001	Castleberg, Jill	RE: Administrative Record for the Fox River Project
11	A	00	1218.00	16142	August 24, 2001	Kreis, Russell	RE: Lower Fox River/Green Bay Mass Balance Study - Modeling Overview
11	A	00	1218.00	16143	September 28, 2001	Hahnenberg, James	RE: Response to Peer Review of the Remedial Investigation and Data Management Reports for the Lower Fox River NRDA/PCB Releases Site

WDNR AND USEPA FOX RIVER RI/FS ADMINISTRATIVE RECORD

G	C	SC	FC	ID	End Date	Author	Document Name
11	A	00	1218.00	16144	September 28, 2001	Hahnenberg, James	RE: Response to Peer Review of the Feasibility Study for the Lower Fox River NRDA/PCB Releases Site
11	A	00	1218.00	16145	October 2, 2001	Muno, William	RE: Lower Fox River and Green Bay Site Conformity with Draft Sediment Management Principles
11	A	00	1218.00	16146	October 2, 2001	Muno, William	RE: USEPA Region 5 Response to NRRB's Recommendations for the Lower Fox River Superfund Site

White Paper No. 18 – Evaluation of an Alternative Approach of Calculating Mass, Sediment Volume, and Surface Concentrations in Operable Unit 5, Green Bay

Response to Comments on the

Remedial Investigation for the Lower Fox River and Green Bay, Wisconsin, Feasibility Study for the Lower Fox River and Green Bay, Wisconsin Proposed Remedial Action Plan for the Lower Fox River and Green Bay, and Record of Decision for Operable Unit 1 and Operable Unit 2

This Document has been Prepared by the
Wisconsin Department of Natural Resources
Madison, Wisconsin

June 2003

TABLE OF CONTENTS

SECTION **PAGE**

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

ABSTRACT

The paper was developed to addresses concerns raised during the public comment period for the *Final Remedial Investigation for the Lower Fox River and Green Bay, Wisconsin* (RI) (RETEC, 2002a), the *Final Feasibility Study for the Lower Fox River and Green Bay, Wisconsin* (FS) (RETEC, 2002b), and the *Proposed Remedial Action Plan, Lower Fox River and Green Bay* (Proposed Plan) (WDNR and EPA, 2001), on the differences in polychlorinated biphenyl (PCB) mass and contaminated sediment volume on Green Bay. Specifically, concerns were raised concerning estimates previously made by the University of Wisconsin and those presented by the Wisconsin Department of Natural Resources (WDNR) in Technical Memorandum 2f (TM 2f). These two approaches to estimating Bay properties were evaluated and compared and an alternative to both approaches was developed. This alternative method was then used to estimate PCB mass and contaminated sediment volume in Green Bay using data received during the public comment period.

1 INTRODUCTION AND BACKGROUND

The purpose of this paper is to present the results of an alternative analysis of the PCB mass and volume estimates originally presented in TM 2f *Estimates of Sediment Bed Properties for Green Bay* (WDNR, 2000). This work was undertaken in response to comments received on the RI (RETEC, 2002a), the FS (RETEC, 2002b) and Proposed Plan (WDNR and EPA, 2001), in which TM 2f PCB mass and volume estimates were presented. TM 2f is included as part of Appendix A to the *Final Model Documentation Report for the Lower Fox River and Green Bay, Wisconsin* (MDR) (WDNR and RETEC, 2002).

Numerous investigations of Green Bay sediments provide information about sediment bed properties at discrete points in space (and time). However, no investigation can provide information about sediment properties through the entire spatial and volumetric extent of the sediment bed without additional analysis. The results of these studies must be interpolated in a consistent and technically sound manner to provide a continuous representation of sediment bed properties. TM 2f, developed collaboratively between the state and the Fox River Group (FRG) (LTI, 1999), presented a methodology to estimate sediment bed properties from the results of field investigations and applied those methodologies to Green Bay. A specific intent of TM 2f was to provide a single, consistent set of interpolated sediment bed properties for use in model evaluation and Superfund (CERCLA) RI/FS and Risk Assessment (RA) efforts.

TM 2f developed a method to evaluate sediment conditions across the whole of Green Bay, based on data collected at specific points. These properties could then be used to evaluate risks to human health and the environment based on PCB distribution in sediments, as well as provide a means for estimating the mass and volume of PCB-contaminated sediments in the Bay.

This white paper is necessary to respond to comments from the academic and regulated communities as well as other groups regarding the analytical procedures and assumptions of physical factors used in TM 2f. These comments expressed concerns covering areas such as:

- Overestimates PCB mass and contaminated sediment volume in Green Bay
- The analytical procedures and assumptions of physical factors used in the creation of TM 2f
- That incorrect data used in the initial TM 2f analysis including depth of contamination and the areal extent of the coverage

This white paper evaluates these different factors on the estimation of concentration distribution, mass, and volume of PCBs in Green Bay.

2 COMPARISON OF TECHNIQUES USED TO ESTIMATE GREEN BAY PCB MASS AND VOLUME

Estimates of PCB mass, PCB concentration, as well as PCB-contaminated sediment volume properties of Green Bay were developed by WDNR staff. Using methods developed by Limnotech, Inc. (LTI) on behalf of the FRG (LTI, 1999), the results of this work is presented in TM 2f. TM 2f presents a methodology to estimate sediment bed properties, and applies this methodology to devise estimates of PCB mass, PCB concentrations within sediments, and PCB-contaminated sediment volumes for Green Bay. As TM 2f readily identifies, there are numerous approaches to estimating sediment bed properties. During the development of Technical Memorandum 2e (TM 2e), *Estimation of Lower Fox River Sediment Bed Properties* (WDNR, 1999), WDNR technical staff tested several different surface weighting and data interpolation techniques to determine the most appropriate method for estimating sediment bed properties for the Lower Fox River. These same techniques were subsequently used in the generation of TM 2f.

Another estimate of PCB mass and sediment bed properties, developed by researchers at the University of Wisconsin-Madison Environmental Chemistry and Technology Program and the University of Wisconsin-Milwaukee Water Institute (UW) for the purpose of the Green Bay Mass Balance Study (GBMBS) was presented by Manchester et al. (Manchester-Neesvig et al., 1996) and was the focus of comments.

The basic mechanics of these two approaches (TM 2f and UW) are reviewed in the following subsections. Differences between the methodologies and the variables that may contribute to the different estimates of PCB mass are also identified.

2.1 UW's Methods of PCB Mass and Contaminated Sediment Volume Estimation in Green Bay

The approach used by the UW was developed on prior sediment sampling experience in Green Bay. Based on their experience, the UW used a 25-square-kilometer (km^2) grid (5-kilometer [km] by 5-km cells) to establish a regular pattern of sample locations across the entire Bay. The 25-km^2 grid was augmented by a 1-km^2 grid at station 26. Sediment samples were taken at the center of each grid cell and used to define the existence and location of historic sediments based on the presence or absence of organic carbon in the samples. A total of 64 sample locations was identified as having historic sediments. Because PCBs have been shown to be associated with sediments having high organic carbon content, core samples were taken at each of these 64 grid cells (Figure 1). Sediment cores were segmented into 1-centimeter (cm), 2-cm, and 5-cm thickness layers. These samples were then analyzed for a number of physical and chemical constituents, including total mass, porosity, volume, PCB-homologue, cesium-137, and lead-210. The bulk density of each sample was measured, and used in conjunction with the PCB concentration measurements to calculate depth-weighted PCB mass-per-unit-volume estimates for each core location. This value was then extrapolated or "scaled" to the 25-km^2 area of the representative cell to estimate PCB mass within each of the 64 cells. By summing all cells, the UW generated a Green Bay mass estimate totaling 8,483 kilograms (kg) of PCBs.

2.2 WDNR METHODS OF PCB MASS ESTIMATION IN GREEN BAY USED IN TM 2F

A number of Geographic Information System (GIS)-based interpolation frameworks were evaluated as part of TM 2e for the Lower Fox River. From this evaluation, it was determined that a raster-based interpolation framework (i.e., a regular grid network) is better suited for estimating sediment bed properties than a vector-based (irregular polygon network) approach. For consistency, these same raster methods were selected for use in the development of TM 2f.

Using ArcView 3.1 with Spatial Analyst 1.1 as the selected GIS, the raster-based Inverse Distance Weighting (IDW) interpolation algorithm was used to interpolate Green Bay sediment bed properties. Through IDW interpolation, values for an unsampled location are estimated as an average of known sample values within its vicinity. Because this technique uses a distance-dependent weighting factor, the influence of surrounding known values decreases with distance from the location being estimated.

As part of TM 2f development, a literature search was conducted and the results used to construct a data set of physical and chemical sediment data parameters for Green Bay spanning a period from 1968 to 1998. The data source components of this data set, which include the sediment data developed by the UW for the GBMBS, are stored in the Fox River Environmental Database (www.tecinfodex.com/frdb/).

Because sediment sample segmentation schemes varied from data source to data source, it was necessary to assimilate all PCB concentration and bulk density into a consistent sediment-layering scheme accomplished by use of a thickness-weighted-averaging computer program. This layering scheme was based on the prescribed sediment layers used as input in the sediment toxicity transport model GBTOX.

FIGURE 1 UW/GBMBS SAMPLE LOCATIONS AND 25-KM² CELL COVERAGE

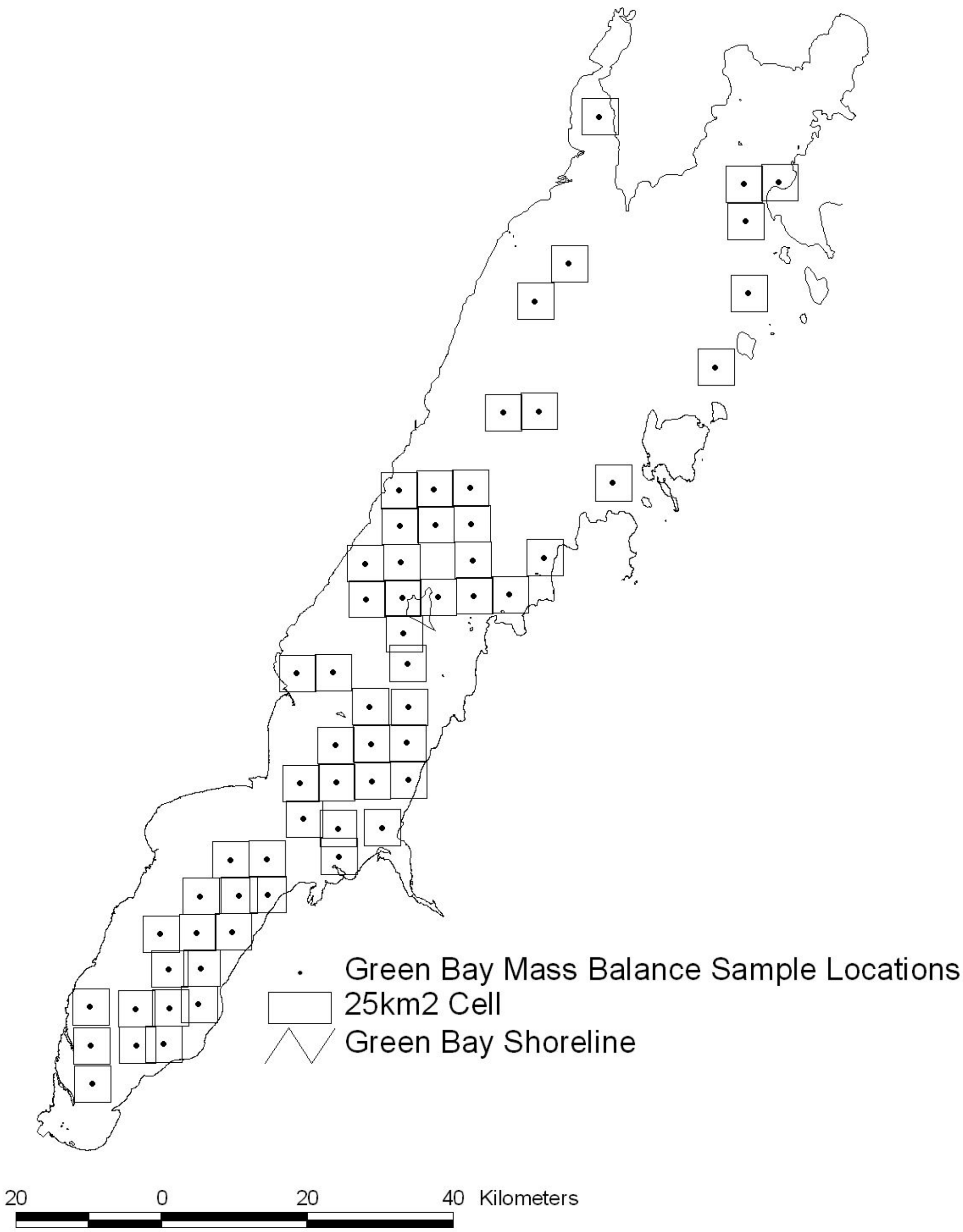


TABLE 1 SEDIMENT LAYER INPUT STRUCTURE FOR TM 2F

TM 2f Layer Structure	Sediment Depth (cm)
1	0–2
2	2–4
3	4–6
4	6–10
5	>10

IDW-based GIS interpolations of sediment PCB concentration and bulk density were generated using an 8,000-meter radius of influence and a polynomial power function of 2, over a 100-meter by 100-meter grid division of the Bay. As discussed in TM 2f, these IDW parameters were determined to generate estimates that minimized root-mean-square errors. For each of the five sediment layers, a resulting 100-meter by 100-meter gridded GIS "coverage" was generated for each parameter. The PCB concentration coverage was then multiplied with the associated bulk density coverage to produce a PCB mass-per-unit-volume coverage for each sediment layer. Each of these coverages was then multiplied with a coverage of interpolated sediment thickness (depth of analysis) to produce a final coverage for each sediment layer displaying PCB mass estimates for each 100-meter by 100-meter grid cell. These cells were then summarized across a bounding GIS coverage (area of analysis) depicting the occurrence of soft sediment in the Bay, resulting in an estimated total of 69,955 kg of PCBs in Green Bay. For more information, please review TM 2f in its entirety.

2.3 DIFFERENCES IN METHODS

There are differences between the two approaches described above. While the physical and chemical parameters used for estimating PCB mass and sediment volume are the same for both approaches, the differences in PCB mass and contaminated sediment volume estimates may be attributable to:

1. The interpolation method applied to these parameters. WDNR's use of IDW assumes an exponential trend of sediment parameter values throughout an 8-km radius from an interpolated sample point, whereas UW's approach assumes a linear representation of sediment parameter values throughout an entire 25-km^2 cell.

2. The parameter values themselves, which includes differences in the data sets used in the interpolations, the horizontal and vertical areas over which the interpolations are applied, and the estimates of contaminant depth.

3 EVALUATION OF METHODS

In order to determine if differences in PCB mass and contaminated sediment volume estimates are attributable to the differences between these two interpolation methods, WDNR devised a test to directly compare the results of the TM 2f method with those of the UW. This evaluation involved comparing the TM 2f and UW methods by using the same data, over the same area and the same sediment thickness. Prior to conducting this evaluation, it was first necessary to define any differences in the other PCB mass calculation parameters and refine these values so that they were consistent between the two methods. Included in Appendix A of this white paper is a data directory (CD:\GreenBay\alternative_analysis\) that provides details on this test.

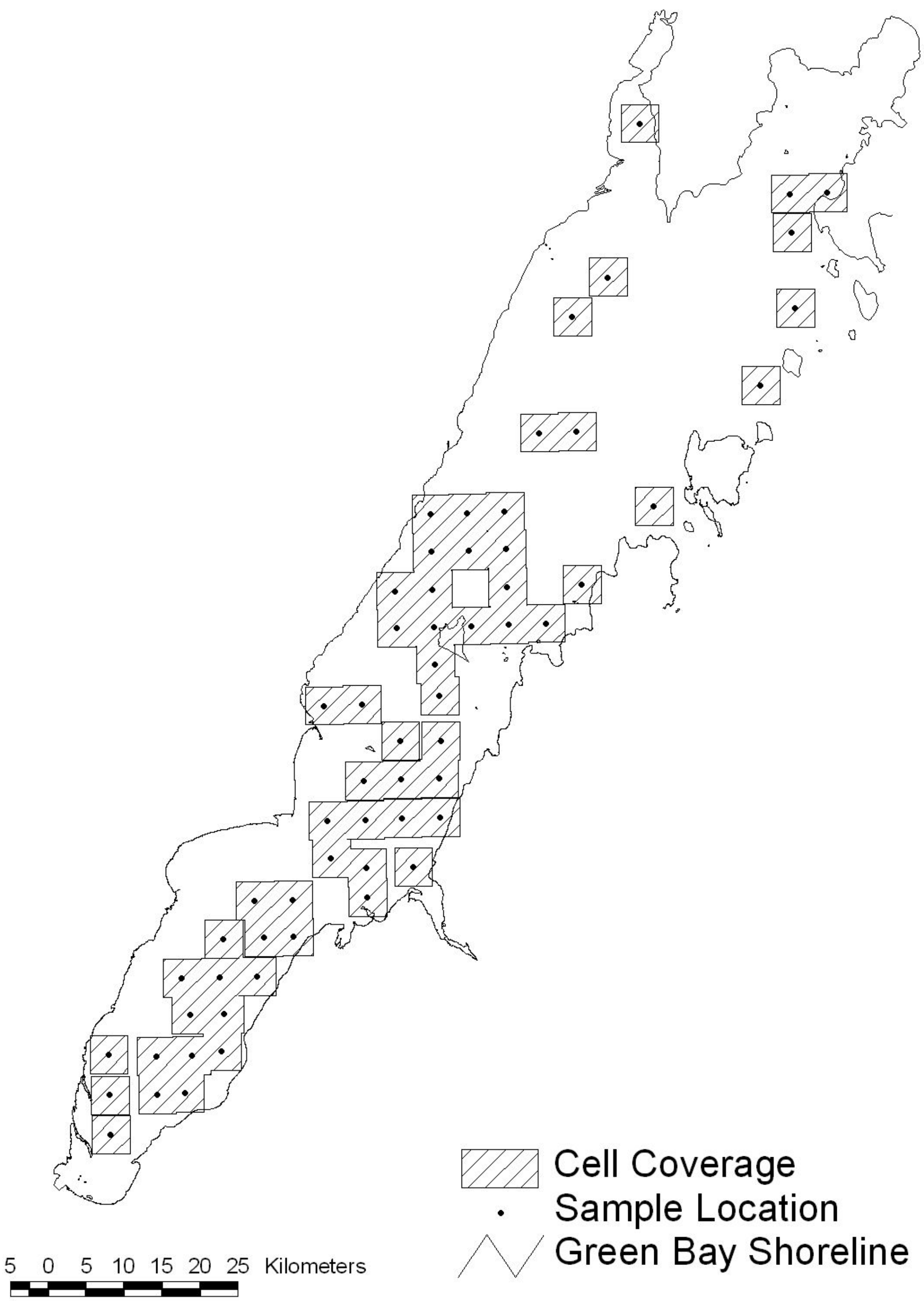
3.1 PARAMETERS CONSIDERED IN COMPARATIVE EVALUATION

Sediment Data: The data set used in this evaluation was the same data set used by UW. This included locational, bulk density, PCB concentration, and segmentation information for each of the 64 sediment core samples (Appendix A, data CD).

Spatial Extent/Area of Analysis: The spatial extent of the Green Bay sediment bed used in this evaluation was identical to that used by UW. To do this, WDNR created a GIS coverage of the outline of the 25-km^2 GBMBS cells (Figure 2). This coverage was then used as an interpolation barrier that limited the spatial extent of the IDW calculations.

Sediment Thickness/Depth of Analysis: For purposes of this method comparison, the evaluation test was conducted using sediment information for the top 1 cm (0 to 1 cm data) only.

FIGURE 2 GBMBS 25-KM^2 CELL OUTLINE; AREA OF ANALYSIS USED FOR METHOD TEST



3.2 RESULTS

The interpolation method evaluation test produced an initial map coverage of PCB mass estimates for the top (0 to 1 cm) layer of sediment in Green Bay (Figure 3) as well as a quantitative summary of total PCB mass (Table 2). When compared to the mapped mass results generated by the UW, the WDNR map displays a "saddle" of high PCB mass in an area located between relatively low PCB concentration and high bulk density measurements. This phenomena is an artifact of the IDW interpolation. Further analysis confirmed that, by multiplying together interpolated values of PCB mass and bulk density, the IDW approach could result in PCB mass estimates between cores that are higher than the bounding known PCB mass values. Figure 3 displays a "saddle" artifact in the southern portion of the Bay. Quantitatively, this artifact accounts for a 14 percent difference (increase) in PCB mass compared to that put forth by the UW (Table 2).

Based on these results, an additional GIS interpolation was conducted to directly compare the differences between the assumptions of the relationship between sediment PCB mass and bulk density. For this comparison, IDW interpolations were conducted on PCB mass values calculated for each sediment sample location. This interpolation produced an additional map coverage (Figure 4) showing a clear absence of the artifact saddle. The PCB mass summary defined by this coverage shows that these estimates, computed by use of a GIS-based IDW algorithm, are the same as that produced by the UW in their linear-scaled approach to estimating Green Bay PCB mass (Table 2).

TABLE 2 RESULTS OF IDW-INTERPOLATED PCB MASS, GBMBS DATA (0 TO 1 CM)

Method	PCB Mass		PCB Mass	
	Sum of GBMBS 25-km^2 Cells (kg)	Sum of GBMBS 25-km^2 Cells (% difference)	Alternative Analysis GBMBS Cell Outline "Area of Analysis" (kg)	Alternative Analysis GBMBS Cell Outline "Area of Analysis" (% difference)
UW/GBMBS	585	0	Not Applicable	Not Applicable
WDNR TM 2f IDW Method [1]	676	+14	627	+7
WDNR Evaluation IDW Method [2]	590	+0.81	544	-7

Notes:

1 Bulk density and PCB concentration were interpolated independently, and the resulting grid coverages multiplied together to compute PCB mass.

2 Bulk density and PCB concentration were first multiplied to compute PCB mass at each sample location, then these mass values were interpolated to result in a grid coverage of PCB mass.

Table 2 is a summary of both of WDNR's IDW interpolation results compared to UW's results. Note that, when summarized over the same area as the UW study ("Sum of GBMBS 25-km^2 cells"), WDNR's mass-interpolated evaluation results differ from UW's by less than 1 percent. The IDW approach used in TM 2f, in which sediment bulk density and PCB concentration are interpolated as independent variables, causes interpolation artifacts which result in PCB mass estimates 14 percent higher than UW's estimates.

In considering the area-of-analysis polygon created from an outline of the UW's GBMBS cells, WDNR's PCB mass summaries differ by 7 percent.

The results of the method evaluation test show that differences in UW's mass estimate and the mass estimate and contaminated sediment volume presented in TM 2f can not be attributed to the IDW interpolation algorithm.

FIGURE 3 RESULTS OF METHOD TEST; PCB MASS (0 TO 1 CM) AS A RESULT OF SEDIMENT BULK DENSITY AND PCB CONCENTRATION INTERPOLATED SEPARATELY

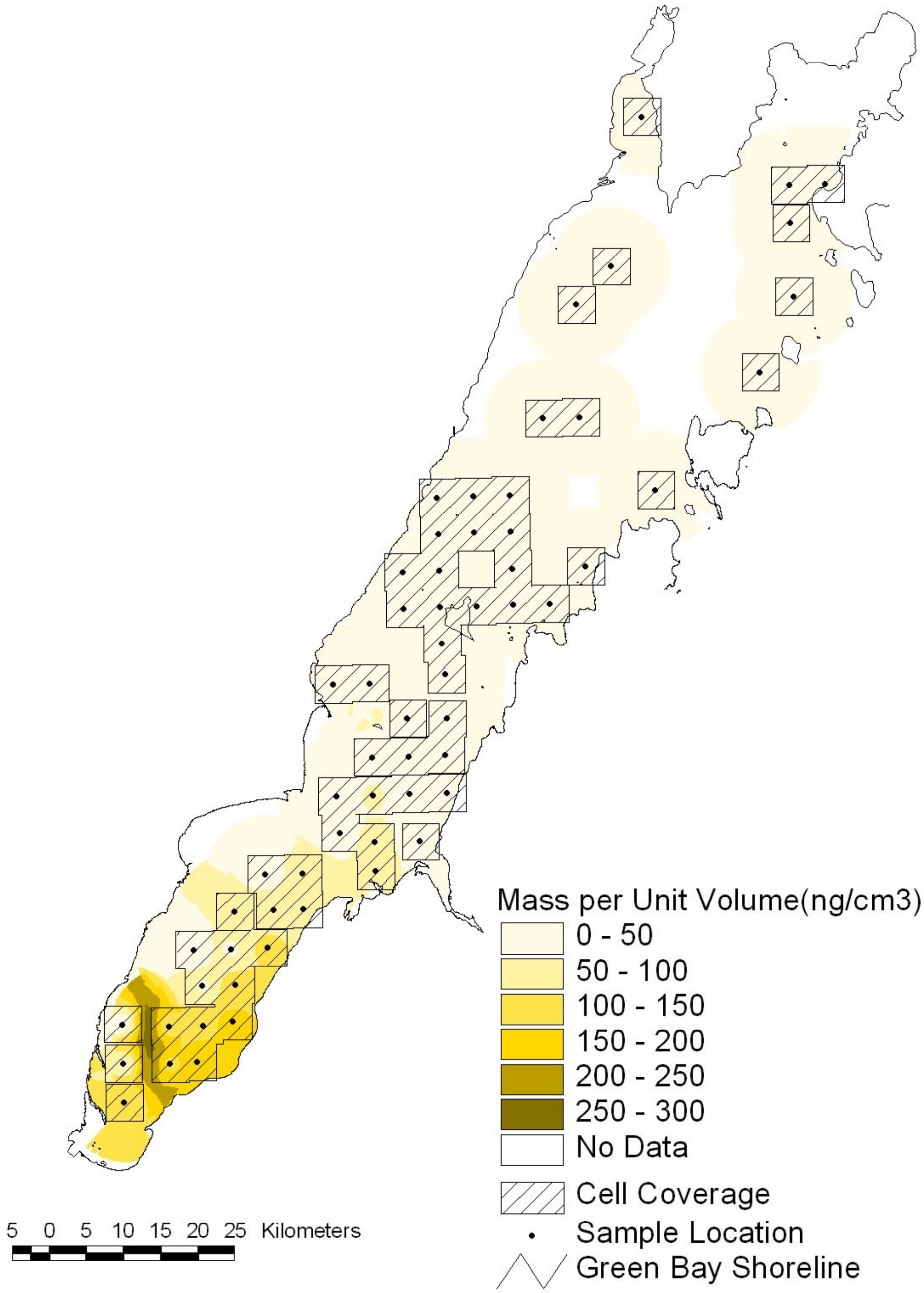
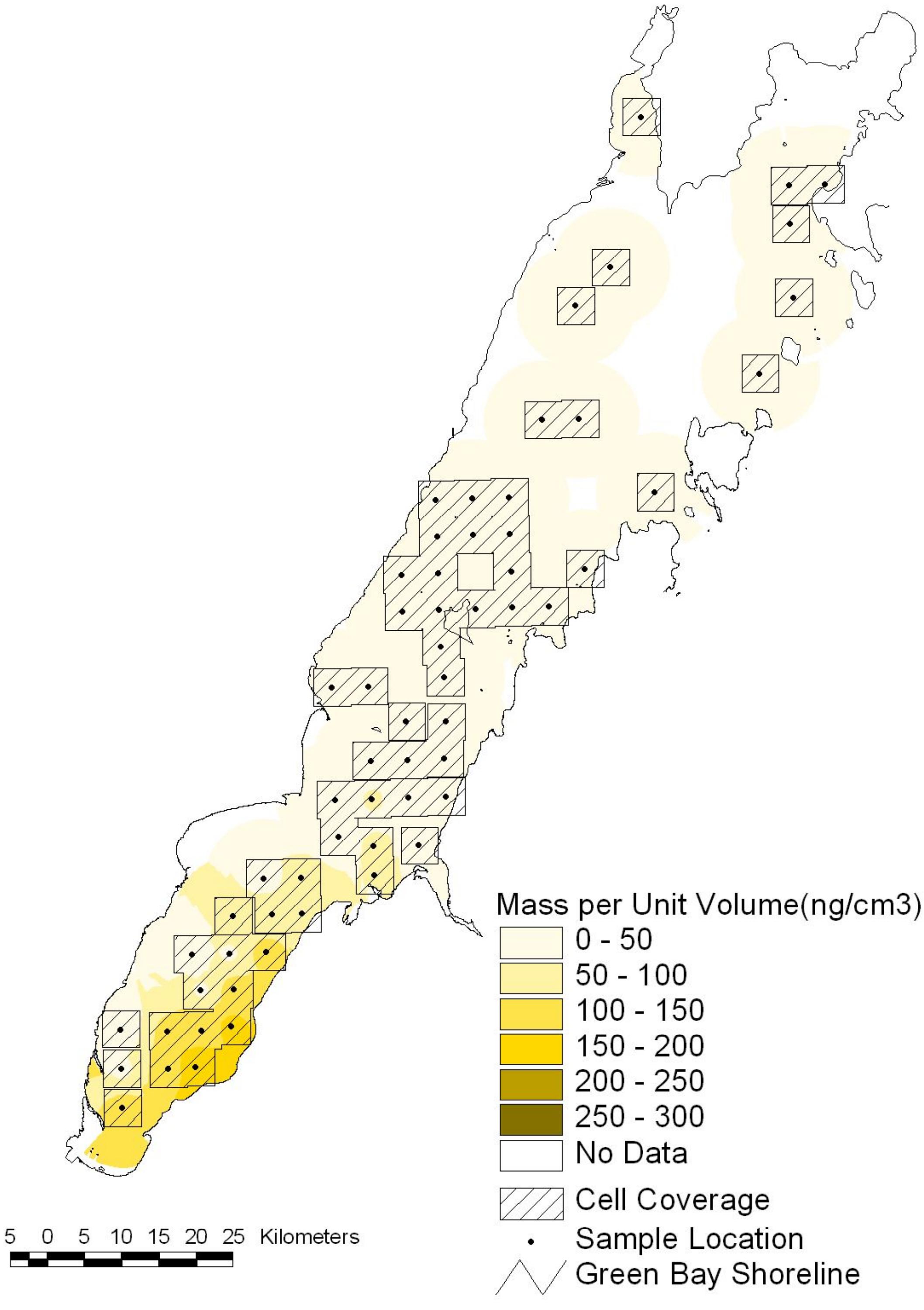


FIGURE 4 RESULTS OF METHOD TEST; PCB MASS (0 TO 1 CM) AS A RESULT OF PCB MASS INTERPOLATED



4 COMPARISON OF INPUT DATA

As a result of the analysis done in Section 3, it was necessary to consider the influence of other parameters on the interpolation results. This parameter evaluation identified the need to have a consistent method for GIS-based techniques to estimate PCB mass and contaminated sediment volume in Green Bay. WDNR developed this alternative method for estimating PCB mass and contaminated sediment volume following the consideration of these parameters. This alternative method is based on the TM 2f IDW approach while identifying specific criteria data must meet to be used. This alternative method also identifies a larger area for the interpolation than was included in the initial UW effort. Included in Appendix A of this white paper is a data directory (CD:\GreenBay\methodtest\) that provides details on this work.

4.1 INTERPOLATION DIFFERENCES

Generally speaking, the differences in mass estimates can be explained by differences in the values assigned to sediment parameters, and the way in which these parameters are combined in the IDW interpolation. Results of the method evaluation test show that, by interpolating separately across PCB concentration and bulk density values, isolated areas of high-PCB mass may be predicted to exist between areas of known low PCB concentration and high bulk density. This interpolation artifact has the potential to cause over-estimates of PCB mass throughout Green Bay. Table 2 shows that this phenomena can lead to mass estimates ranging between 0.8 and 14 percent. The following is a discussion of significant influences brought about by the other mass-estimate variables.

4.1.1 Data Used

More validated data from the Fox River Database was used in the original TM 2f than by the UW. This is primarily due to the fact that the UW method only used data from the GBMBS taken at the center of the 25-km^2 grids while TM 2f made use of a larger data set of validated information for all of Green Bay. The GBMBS data from the center of the 25-km^2 grid is referred to as “at core” samples and represent data points with both PCB concentration and bulk density from the same sample location. These are referred to as “matched pair” data. This matched pair data is not available at all sample locations, thus limiting the size of the database used.

Once it was determined that generally the TM 2f approach was different, but fundamentally equivalent to the UW method for estimating mass, the next step was to evaluate the impact of newer data on the interpolations. To be consistent, it was decided to carry out GIS interpolations on calculated “at core” PCB sample locations. The use of sediment sample data was therefore restricted to information containing PCB concentration values paired with bulk density values from the same sample segment. These restrictions limited the original PCB concentration and bulk density data used in TM 2f to a select number of data sets containing paired data of concentration and bulk density values. The data sets used in this alternative method are: 1989 GBMBS, 1995 WDNR, 1998 BBL, and 2001 BBL (Figure 5 and Appendix A). These data are all identified in the Data Management Report (Appendix A to the RI) (RETEC, 2002a).

A review of the 1995 WDNR data set resulted in the elimination of one sample point (DNR95-106) because it was found to be located within the confines of the regularly dredged federal navigation channel. The 2001 BBL data set was made available for this analysis through comments received on the Proposed Plan.

4.1.2 Area of Analysis

The PCB mass estimates generated by UW covered an area of Green Bay of 1,600 square km and did not include the Bay south of Long Tail Point. For TM 2f, the GIS area-of-analysis coverage covered 1,800 square km, and did include the southern Bay. The IDW approach used in this analysis is consistent with TM 2f, as is discussed in Section 2.2.

Upon review of the coverage area, it was noted that not all of the GBMBS data points were in a representative area in TM 2f. For this alternative method, the area of analysis was adjusted by creating 5-km by 5-km grid cells around those GBMBS points in the north Bay not originally located in the TM 2f area-of-analysis coverage (Figure 6). Note that this cell size is the same as UW's representative cell size.

As mentioned above, the UW did not include Green Bay south of Long Tail Point in its analysis. This area was included in TM 2f. However, for the work conducted in TM 2f, the southern Bay was data-sparse, and therefore, application of the IDW method resulted in large areas of this region being influenced by a select few sediment data points near the Bay head. As part of the comments received on the Proposed Plan, the FRG submitted data collected in 2001 by the consulting firm of Blasland, Bouck and Lee (BBL) for the southern bay south of Long Tail Point. The inclusion of the 2001 BBL data set in this alternative approach resulted in a refinement of the southern Bay area of analysis.

A separate GIS coverage of the southern Bay (south of Long Tail Point) was created and populated with the 1995 WDNR and 1998 BBL sediment data used in TM 2f, as well as the 2001 BBL sediment data set (Figure 6). Following the same logic that was used to determine the IDW radius of influence in the north Bay, a radius of 4,000 meters was used in this alternative approach for interpolations in the south Bay because it maximized the inter-point spatial coverage. From this work, it was determined that an IDW power function of 4 would yield accurate PCB mass estimates while minimizing interpolation error.

For the alternative method, the PCB mass and contaminated sediment volume for the northern area and southern area were calculated separately and then combined to provide an overall mass and volume estimate for the entire Bay.

FIGURE 5 TM 2F ALTERNATIVE APPROACH: DATA SOURCES

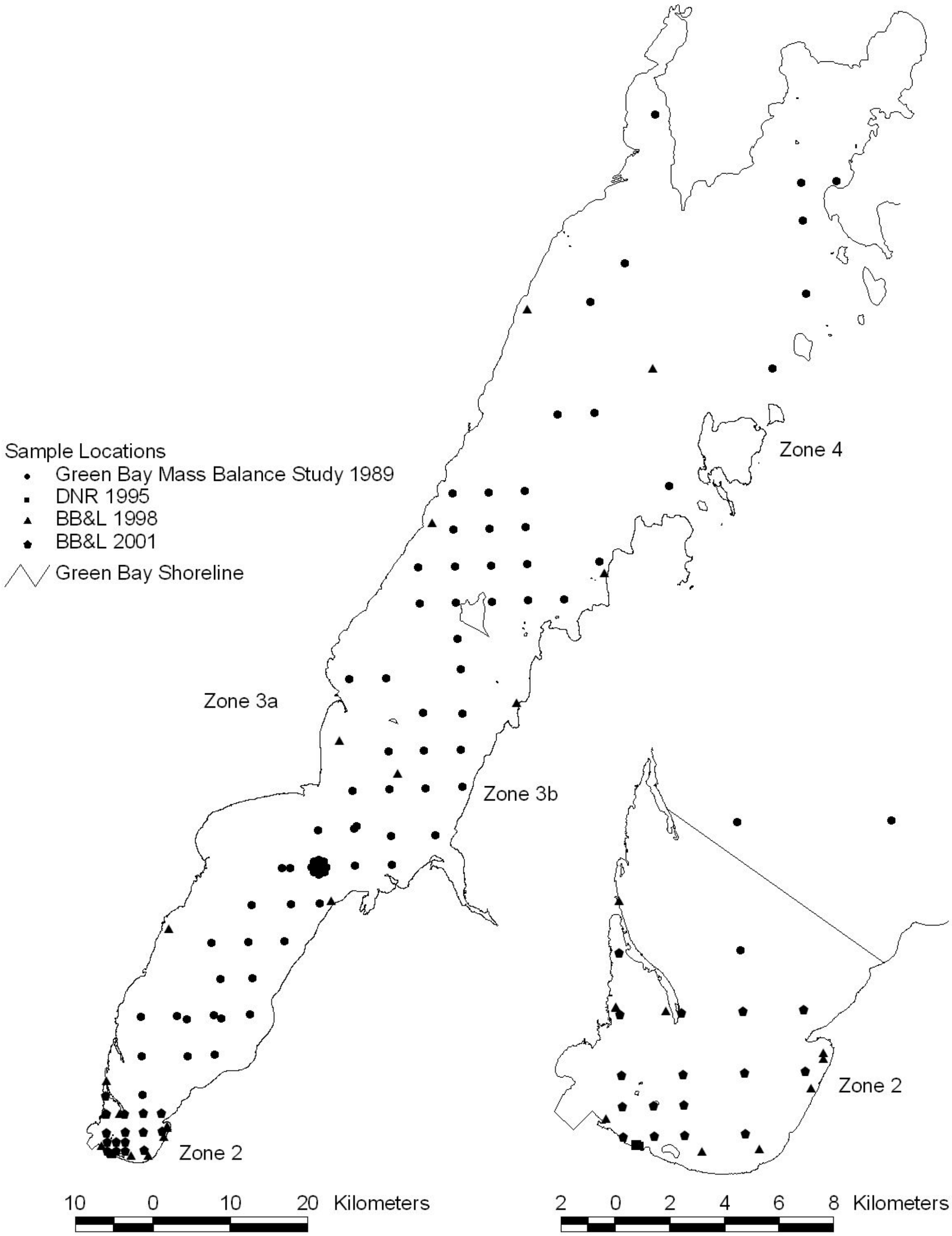


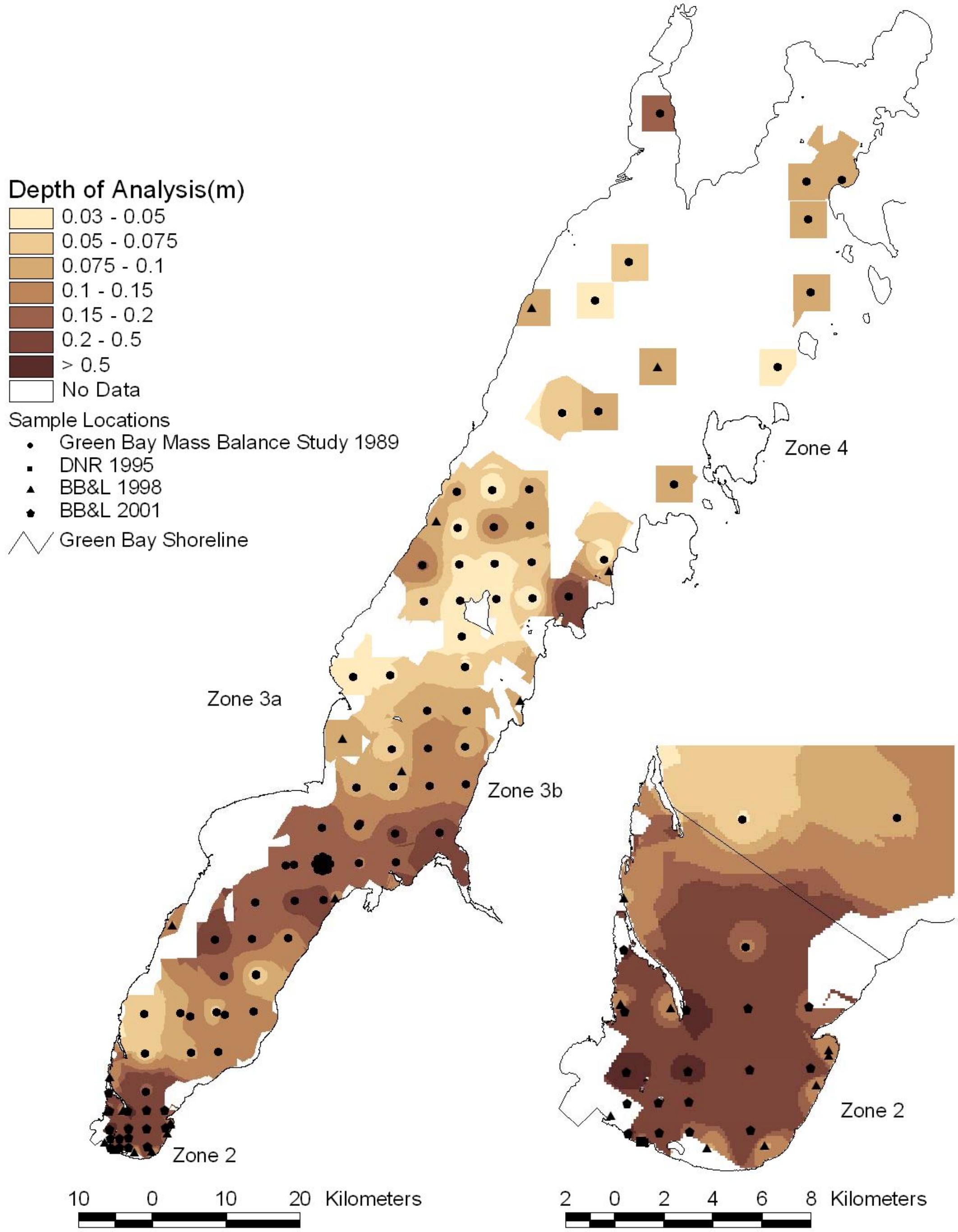
FIGURE 6 TM 2F ALTERNATIVE APPROACH AREA OF ANALYSIS COVERAGE

4.1.3 Depth of Analysis

In computations of mass and volume estimates, the depth of sediment can be a significant factor. The sediment profile depths used by UW to calculate thickness-weighted average mass estimates at each core location were defined by measured values for PCB concentrations. In TM 2f, the maximum depth at which bulk density measures were observed defined the analysis depth at each sample location. In many cases, this was as deep as 30 cm or more. Because the measured bulk density values were often deeper in the sediment profile than accompanying or neighboring PCB concentration measures, "last known" PCB concentrations were assumed to extend to the bottom of the sediment profile. In TM 2f, a large volume of PCB-contaminated sediment was estimated to exist in the final layer of interpolation (Model Layer 5, greater than 10 cm).

For the alternative method, a new GIS coverage of Green Bay sediment depth-of-analysis was generated by using PCB sample results, rather than bulk density values, to define sample core depths (Figure 7). This approach to contaminated sediment depth is based on the assumption that PCBs detected at the bottom of core samples do not extend deeper into underlying un-sampled sediments.

FIGURE 7 TM 2F DEPTH OF ANALYSIS GIS GRID COVERAGE



4.2 RESULTS OF ALTERNATIVE ANALYSIS

Figure 8 is a map of Green Bay depicting the interpolated results of PCB concentrations in the top layer (0 to 2 cm) of sediment. It is important to note that, compared to the PCB concentration maps presented in TM 2f (Figure 5-7), the revised concentration estimates differ only slightly overall. In the north Bay (zones 3A, 3B, and 4), concentration patterns and magnitudes remain essentially the same, while in the south Bay (Zone 2) there is a reduction in the concentration pattern. This difference is due to a bounding affect on the interpolation caused by the shallow, low-concentration PCB data collected by BBL in conjunction with the modified distance-weighting factor of the south-Bay IDW model.

Table 3 is a summary of PCB mass estimates and approximate surface concentrations-by-method for all of Green Bay. The surface concentrations are based on the 0- to 2-cm depth and are essentially the same. Differences in these mass estimates are due to minimizing the depth-of-analysis interpolation parameter and interpolating on sample-specific PCB mass, rather than multiplying resultant interpolations of PCB concentration and sediment bulk density. In the south Bay, mass differences are apparent in all sediment layers, due to the IDW model changes and the bounding-affect of the BBL PCB data. Throughout the remainder of the Bay, minor differences in PCB mass exist as a result of excluding “stand-alone” bulk density data points from the analysis.

FIGURE 8 TM 2F ALTERNATIVE APPROACH; PCB SURFACE CONCENTRATIONS (0 TO 2 CM)

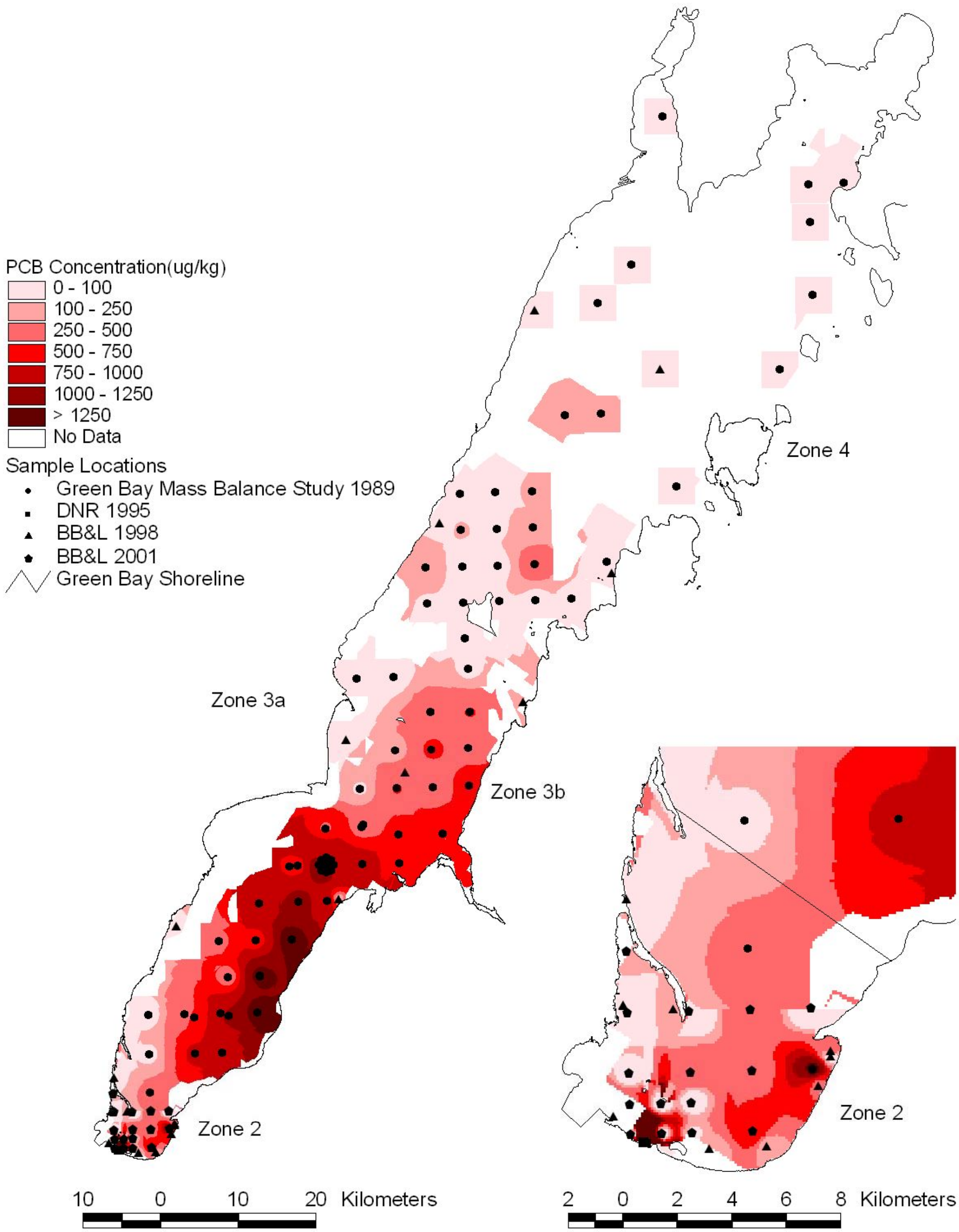


TABLE 3 GREEN BAY PCB MASS ESTIMATES (KG) AND SURFACE CONCENTRATIONS BY SOURCE AND METHODOLOGY

Source	PCB Mass Estimate (kg)	PCB Surface Concentration (ppm)
UW GBMBS	8,483	0.388
WDNR TM 2f	69,955	0.351
WDNR Alternative Method	14,603	0.353

4.2.1 Comparison of PCB Mass and Contaminated Sediment Volume

Table 4 is a summary of PCB mass estimate-by-sediment layer for each of the four zones in Green Bay using the alternative method. By comparing these results to the results in Table 5 (generated from TM 2f, Table B-4), 76 percent of the PCB mass difference is attributable to the large differences in sediment column fifth layer (greater than 10 cm). These differences are due primarily to minimizing the depth of analysis interpolation parameter and interpolating on "at core" PCB mass.

TABLE 4 GREEN BAY PCB MASS ESTIMATES (KG) BY SEDIMENT LAYER BAY ZONE USING ALTERNATIVE METHOD

Sediment Layer	Zone 2	Zone 3A	Zone 3B	Zone 4	Total
0–2 cm	351	582	929	307	**2,170**
2–4 cm	342	671	1,255	260	**2,528**
4–6 cm	393	761	1,218	261	**2,633**
6–10 cm	741	976	1,656	295	**3,668**
>10 cm	2,504	437	638	26	**3,605**
Total	**4,331**	**3,427**	**5,696**	**1,150**	**14,603**

TABLE 5 GREEN BAY PCB MASS ESTIMATES (KG) BY SEDIMENT LAYER BAY ZONE USING TM 2F (GENERATED FROM TM 2F, TABLE B-4)

Sediment Layer	Zone 2	Zone 3A	Zone 3B	Zone 4	Total
0–2 cm	1,471	1,746	1,709	390	**5,316**
2–4 cm	1,442	1,601	1,372	286	**4,701**
4–6 cm	1,442	1,601	1,372	286	**4,701**
6–10 cm	2,884	3,202	2,744	572	**9,402**
>10 cm	24,810	9,485	11,120	420	**45,835**
Total	**32,049**	**17,635**	**18,317**	**1,954**	**69,955**

Table 6 is a summary of PCB-contaminated sediment volume and mass estimates for each zone in Green Bay using the alternative method. Compared to results displayed in Table 7 (generated from TM 2f, Table B-5), there is nearly a 380,000,000 cubic meter difference in the estimates of total contaminated sediment volume. This difference is evident in all zones and appears to be primarily due to minimizing the depth of analysis across the whole Bay.

TABLE 6 PCB-CONTAMINATED SEDIMENT VOLUME AND MASS BY ZONE USING ALTERNATIVE METHOD

Bay Zone	Volume of Contaminated Sediment (m^3)	% Total Volume	PCB Inventory (kg)	% Total PCB Inventory
2	28,710,478	12	4,331	30
3A	64,487,652	27	3,427	23
3B	83,151,447	34	5,696	39
4	66,193,726	27	1,150	8
Total	**242,543,303**	**100**	**14,603**	**100**

TABLE 7 PCB-CONTAMINATED SEDIMENT VOLUME AND MASS BY ZONE USING TM 2F (GENERATED FROM TM 2F, TABLE B-5)

Bay Zone	Volume of Contaminated Sediment (m^3)	% Total Volume	PCB Inventory (kg)	% Total PCB Inventory
Zone 2	39,582,000	6	32,049	46
Zone 3A	244,617,000	39	17,635	25
Zone 3B	191,629,000	31	18,317	26
Zone 4	146,525,000	24	1,954	3
Total	**622,353,000**	**100**	**69,955**	**100**

4.2.2 Comparison of PCB Surface Concentrations

Table 8 is based on Figure 8 and provides a comparison of PCB surface concentrations in the top layer (0 to 2 cm) of sediment using the TM 2f approach and the alternative method. The revised concentration estimates in the north Bay (zones 3A, 3B, and 4) have similar magnitudes and remain essentially the same using the alternative method while in the south Bay (Zone 2) there is a reduction in the concentration. This difference in Zone 2 is due to a bounding affect on the interpolation caused by the shallow and low-concentration PCB data in the south Bay.

TABLE 8 PCB SURFACE CONCENTRATIONS BY ZONE AND MODEL SEGMENT IN THE 0- TO 2-CM PROFILE

Bay Zone	TM 2f (µg/kg)	Alternative Method (µg/kg)	Model Segment	TM 2f (µg/kg)	Alternative Method (µg/kg)
2	0.76	0.32	1 2 3	2,010 273 674	418 182 377
3A	0.34	0.37	4 5 8	274 609 531	347 741 625
3B	0.57	0.69	6 7	776 359	1,060 382
4	0.1	0.08	9	92	82

5 CONCLUSIONS

Given the expansiveness of the Bay, reliable sediment data is still sparse in many areas and there is some uncertainty associated with any method of estimating existing PCB mass and contaminated sediment volume in the Bay. As presented in both TM 2f and the UW method, it is possible to develop a variety of PCB mass estimates for Green Bay. This alternative method developed as part of this evaluation provides a sound estimate of PCB mass in Green Bay. The following conclusions can be reached:

- When parameters such as data, areal coverage, and depth are equalized, the methods used by the UW and in TM 2f have similar results. Both the TM 2f method and the UW method in the GBMBS are legitimate techniques for estimating PCB mass, contaminated sediment volumes, and PCB surface concentrations in Green Bay.

- The UW mass and volume estimates are low because the estimates do not include any data south of Long Tail Point. Consequently, based on receipt of new information presented in this white paper from that area allows for a mass and volume estimate for that area.

- There is a large scientifically valid data set for Green Bay. Since this data is not made up completely of matching PCB concentration and bulk density values, it can not all be used in the alternative method. This data provides for information on varying PCB concentration values, differing depths, ranges of bulk density, etc. Selection of input data plays a significant role in PCB mass and contaminated sediment volume estimates of the techniques selected.

- Sediment depth and bulk density values can greatly impact PCB mass and contaminated sediment volume estimates.

- In addition to bulk density and PCB concentration, other parameters such as depth of analysis and extent of coverage also factor into PCB mass and contaminated sediment estimates.

- Regardless of method used, the PCB surface concentration for the zones in Green Bay are similar.

6 REFERENCES

Fox River Environmental Database. www.tecinfodex.com/frdb/.

LTI, 1999. *Draft Fox River and Green Bay Fate and Transport Model Evaluation, Technical Memorandum 2f: Estimation of Sediment Bed Properties for Green Bay.* LTI Environmental Engineering. October.

Manchester-Neesvig, Jon B., Anders W. Andren, and David N. Edgington, 1996. Patterns of mass sedimentation and deposition of sediment contaminated by PCBs in Green Bay. *Journal of Great Lakes Research*. 22(2):444–462.

RETEC, 2002a. *Final Remedial Investigation for the Lower Fox River and Green Bay, Wisconsin*. Prepared for Wisconsin Department of Natural Resources by The RETEC Group, Inc., St. Paul, Minnesota. December.

RETEC, 2002b. *Final Feasibility Study for the Lower Fox River and Green Bay, Wisconsin*. Prepared for Wisconsin Department of Natural Resources by The RETEC Group, Inc., Seattle, Washington. December.

WDNR, 1999. *Technical Memorandum 2e: Estimation of Lower Fox River Sediment Bed Properties*. Wisconsin Department of Natural Resources, Bureau of Watershed Management, Madison, Wisconsin.

WDNR, 2000. *Technical Memorandum 2f: Estimation of Sediment Bed Properties for Green Bay*. Wisconsin Department of Natural Resources, Bureau of Watershed Management, Madison, Wisconsin. December 15.

WDNR and EPA, 2001. *Proposed Remedial Action Plan, Lower Fox River and Green Bay*. Wisconsin Department of Natural Resources, Madison and Green Bay, Wisconsin and United States Environmental Protection Agency, Region 5, Chicago, Illinois. October.

WDNR and RETEC, 2002. *Final Model Documentation Report for the Lower Fox River and Green Bay, Wisconsin.* Wisconsin Department of Natural Resources, Madison, Wisconsin and The RETEC Group, Inc., Seattle, Washington. December.

APPENDIX A

CD DIRECTORY LIST AND DATA CD

CD DIRECTORY LIST

CD:\GreenBay\ReadMe.txt

CD:\GreenBay\alternative_analysis\aa2fsurfconczones.xls
CD:\GreenBay\alternative_analysis\allpcbbd.xls
CD:\GreenBay\alternative_analysis\cliptopoly.ave
CD:\GreenBay\alternative_analysis\dpthnlys.txt
CD:\GreenBay\alternative_analysis\GBAltrnAppr.doc
CD:\GreenBay\alternative_analysis\gbaybarr.dbf
CD:\GreenBay\alternative_analysis\gbaybarr.sbn
CD:\GreenBay\alternative_analysis\gbaybarr.sbx
CD:\GreenBay\alternative_analysis\gbaybarr.shp
CD:\GreenBay\alternative_analysis\gbaybarr.shx
CD:\GreenBay\alternative_analysis\gbfpsegments.dbf
CD:\GreenBay\alternative_analysis\gbfpsegments.sbn
CD:\GreenBay\alternative_analysis\gbfpsegments.sbx
CD:\GreenBay\alternative_analysis\gbfpsegments.shp
CD:\GreenBay\alternative_analysis\gbfpsegments.shx
CD:\GreenBay\alternative_analysis\Layers.exe
CD:\GreenBay\alternative_analysis\mass_calc_bay.ave
CD:\GreenBay\alternative_analysis\massummary.xls
CD:\GreenBay\alternative_analysis\merge.ave
CD:\GreenBay\alternative_analysis\muvlayered1.txt
CD:\GreenBay\alternative_analysis\muvlayered2.txt
CD:\GreenBay\alternative_analysis\muvlayered3.txt
CD:\GreenBay\alternative_analysis\muvlayered4.txt
CD:\GreenBay\alternative_analysis\muvlayered5.txt
CD:\GreenBay\alternative_analysis\muvlyrinp.txt
CD:\GreenBay\alternative_analysis\pcbsurfconcave.xls
CD:\GreenBay\alternative_analysis\southbay.dbf
CD:\GreenBay\alternative_analysis\southbay.sbn
CD:\GreenBay\alternative_analysis\southbay.sbx
CD:\GreenBay\alternative_analysis\southbay.shp
CD:\GreenBay\alternative_analysis\southbay.shx
CD:\GreenBay\alternative_analysis\sum0_2.txt
CD:\GreenBay\alternative_analysis\sum2_4.txt
CD:\GreenBay\alternative_analysis\sum4_6.txt
CD:\GreenBay\alternative_analysis\sum6_10.txt
CD:\GreenBay\alternative_analysis\sumgt10.txt
CD:\GreenBay\alternative_analysis\volumesummary.xls

CD:\GreenBay\alternative_analysis\dpthnlys\baydpthnlys\dblbnd.adf
CD:\GreenBay\alternative_analysis\dpthnlys\baydpthnlys\hdr.adf
CD:\GreenBay\alternative_analysis\dpthnlys\baydpthnlys\log
CD:\GreenBay\alternative_analysis\dpthnlys\baydpthnlys\sta.adf
CD:\GreenBay\alternative_analysis\dpthnlys\baydpthnlys\w001001.adf
CD:\GreenBay\alternative_analysis\dpthnlys\baydpthnlys\w001001x.adf

CD:\GreenBay\alternative_analysis\dpthnlys\info\arc0000.dat
CD:\GreenBay\alternative_analysis\dpthnlys\info\arc0000.nit
CD:\GreenBay\alternative_analysis\dpthnlys\info\arc0001.dat
CD:\GreenBay\alternative_analysis\dpthnlys\info\arc0001.nit
CD:\GreenBay\alternative_analysis\dpthnlys\info\arc.dir

CD:\GreenBay\alternative_analysis\muv0_2\baymuv0_2\dblbnd.adf
CD:\GreenBay\alternative_analysis\muv0_2\baymuv0_2\hdr.adf
CD:\GreenBay\alternative_analysis\muv0_2\baymuv0_2\log
CD:\GreenBay\alternative_analysis\muv0_2\baymuv0_2\sta.adf
CD:\GreenBay\alternative_analysis\muv0_2\baymuv0_2\w001001.adf
CD:\GreenBay\alternative_analysis\muv0_2\baymuv0_2\w001001x.adf

CD:\GreenBay\alternative_analysis\muv0_2\info\arc0000.dat
CD:\GreenBay\alternative_analysis\muv0_2\info\arc0000.nit
CD:\GreenBay\alternative_analysis\muv0_2\info\arc0001.dat
CD:\GreenBay\alternative_analysis\muv0_2\info\arc0001.nit
CD:\GreenBay\alternative_analysis\muv0_2\info\arc.dir

CD:\GreenBay\alternative_analysis\muv2_4\baymuv2_4\dblbnd.adf
CD:\GreenBay\alternative_analysis\muv2_4\baymuv2_4\hdr.adf
CD:\GreenBay\alternative_analysis\muv2_4\baymuv2_4\log
CD:\GreenBay\alternative_analysis\muv2_4\baymuv2_4\sta.adf
CD:\GreenBay\alternative_analysis\muv2_4\baymuv2_4\w001001.adf
CD:\GreenBay\alternative_analysis\muv2_4\baymuv2_4\w001001x.adf

CD:\GreenBay\alternative_analysis\muv2_4\info\arc0000.dat
CD:\GreenBay\alternative_analysis\muv2_4\info\arc0000.nit
CD:\GreenBay\alternative_analysis\muv2_4\info\arc0001.dat
CD:\GreenBay\alternative_analysis\muv2_4\info\arc0001.nit
CD:\GreenBay\alternative_analysis\muv2_4\info\arc.dir

CD:\GreenBay\alternative_analysis\muv4_6\baymuv4_6\dblbnd.adf
CD:\GreenBay\alternative_analysis\muv4_6\baymuv4_6\hdr.adf
CD:\GreenBay\alternative_analysis\muv4_6\baymuv4_6\log
CD:\GreenBay\alternative_analysis\muv4_6\baymuv4_6\sta.adf
CD:\GreenBay\alternative_analysis\muv4_6\baymuv4_6\w001001.adf
CD:\GreenBay\alternative_analysis\muv4_6\baymuv4_6\w001001x.adf

CD:\GreenBay\alternative_analysis\muv4_6\info\arc0000.dat
CD:\GreenBay\alternative_analysis\muv4_6\info\arc0000.nit
CD:\GreenBay\alternative_analysis\muv4_6\info\arc0001.dat
CD:\GreenBay\alternative_analysis\muv4_6\info\arc0001.nit
CD:\GreenBay\alternative_analysis\muv4_6\info\arc.dir

CD:\GreenBay\alternative_analysis\muv6_10\baymuv6_10\dblbnd.adf
CD:\GreenBay\alternative_analysis\muv6_10\baymuv6_10\hdr.adf
CD:\GreenBay\alternative_analysis\muv6_10\baymuv6_10\log
CD:\GreenBay\alternative_analysis\muv6_10\baymuv6_10\sta.adf
CD:\GreenBay\alternative_analysis\muv6_10\baymuv6_10\w001001.adf
CD:\GreenBay\alternative_analysis\muv6_10\baymuv6_10\w001001x.adf

CD:\GreenBay\alternative_analysis\muv6_10\info\arc0000.dat
CD:\GreenBay\alternative_analysis\muv6_10\info\arc0000.nit
CD:\GreenBay\alternative_analysis\muv6_10\info\arc0001.dat
CD:\GreenBay\alternative_analysis\muv6_10\info\arc0001.nit
CD:\GreenBay\alternative_analysis\muv6_10\info\arc.dir

CD:\GreenBay\alternative_analysis\muvgt10\baymuvgt10\dblbnd.adf
CD:\GreenBay\alternative_analysis\muvgt10\baymuvgt10\hdr.adf
CD:\GreenBay\alternative_analysis\muvgt10\baymuvgt10\log
CD:\GreenBay\alternative_analysis\muvgt10\baymuvgt10\sta.adf
CD:\GreenBay\alternative_analysis\muvgt10\baymuvgt10\w001001.adf
CD:\GreenBay\alternative_analysis\muvgt10\baymuvgt10\w001001x.adf

CD:\GreenBay\alternative_analysis\muvgt10\info\arc0000.dat
CD:\GreenBay\alternative_analysis\muvgt10\info\arc0000.nit
CD:\GreenBay\alternative_analysis\muvgt10\info\arc0001.dat
CD:\GreenBay\alternative_analysis\muvgt10\info\arc0001.nit
CD:\GreenBay\alternative_analysis\muvgt10\info\arc.dir

CD:\GreenBay\alternative_analysis\north\depthnlysn\dpthnlysn\dblbnd.adf
CD:\GreenBay\alternative_analysis\north\depthnlysn\dpthnlysn\hdr.adf
CD:\GreenBay\alternative_analysis\north\depthnlysn\dpthnlysn\log
CD:\GreenBay\alternative_analysis\north\depthnlysn\dpthnlysn\sta.adf
CD:\GreenBay\alternative_analysis\north\depthnlysn\dpthnlysn\w001001.adf
CD:\GreenBay\alternative_analysis\north\depthnlysn\dpthnlysn\w001001x.adf

CD:\GreenBay\alternative_analysis\north\depthnlysn\info\arc0000.dat
CD:\GreenBay\alternative_analysis\north\depthnlysn\info\arc0000.nit
CD:\GreenBay\alternative_analysis\north\depthnlysn\info\arc0001.dat
CD:\GreenBay\alternative_analysis\north\depthnlysn\info\arc0001.nit
CD:\GreenBay\alternative_analysis\north\depthnlysn\info\arc.dir

CD:\GreenBay\alternative_analysis\north\muv0_2n\muv0_2n\dblbnd.adf
CD:\GreenBay\alternative_analysis\north\muv0_2n\muv0_2n\hdr.adf
CD:\GreenBay\alternative_analysis\north\muv0_2n\muv0_2n\log
CD:\GreenBay\alternative_analysis\north\muv0_2n\muv0_2n\sta.adf
CD:\GreenBay\alternative_analysis\north\muv0_2n\muv0_2n\w001001.adf
CD:\GreenBay\alternative_analysis\north\muv0_2n\muv0_2n\w001001x.adf

CD:\GreenBay\alternative_analysis\north\muv0_2n\info\arc0000.dat
CD:\GreenBay\alternative_analysis\north\muv0_2n\info\arc0000.nit
CD:\GreenBay\alternative_analysis\north\muv0_2n\info\arc0001.dat
CD:\GreenBay\alternative_analysis\north\muv0_2n\info\arc0001.nit
CD:\GreenBay\alternative_analysis\north\muv0_2n\info\arc.dir

CD:\GreenBay\alternative_analysis\north\muv2_4n\muv2_4n\dblbnd.adf
CD:\GreenBay\alternative_analysis\north\muv2_4n\muv2_4n\hdr.adf
CD:\GreenBay\alternative_analysis\north\muv2_4n\muv2_4n\log
CD:\GreenBay\alternative_analysis\north\muv2_4n\muv2_4n\sta.adf
CD:\GreenBay\alternative_analysis\north\muv2_4n\muv2_4n\w001001.adf
CD:\GreenBay\alternative_analysis\north\muv2_4n\muv2_4n\w001001x.adf

CD:\GreenBay\alternative_analysis\north\muv2_4n\info\arc0000.dat
CD:\GreenBay\alternative_analysis\north\muv2_4n\info\arc0000.nit
CD:\GreenBay\alternative_analysis\north\muv2_4n\info\arc0001.dat
CD:\GreenBay\alternative_analysis\north\muv2_4n\info\arc0001.nit
CD:\GreenBay\alternative_analysis\north\muv2_4n\info\arc.dir

CD:\GreenBay\alternative_analysis\north\muv4_6n\muv4_6n\dblbnd.adf
CD:\GreenBay\alternative_analysis\north\muv4_6n\muv4_6n\hdr.adf
CD:\GreenBay\alternative_analysis\north\muv4_6n\muv4_6n\log
CD:\GreenBay\alternative_analysis\north\muv4_6n\muv4_6n\sta.adf
CD:\GreenBay\alternative_analysis\north\muv4_6n\muv4_6n\w001001.adf
CD:\GreenBay\alternative_analysis\north\muv4_6n\muv4_6n\w001001x.adf

CD:\GreenBay\alternative_analysis\north\muv4_6n\info\arc0000.dat
CD:\GreenBay\alternative_analysis\north\muv4_6n\info\arc0000.nit
CD:\GreenBay\alternative_analysis\north\muv4_6n\info\arc0001.dat
CD:\GreenBay\alternative_analysis\north\muv4_6n\info\arc0001.nit
CD:\GreenBay\alternative_analysis\north\muv4_6n\info\arc.dir

CD:\GreenBay\alternative_analysis\north\muv6_10n\muv6_10n\dblbnd.adf
CD:\GreenBay\alternative_analysis\north\muv6_10n\muv6_10n\hdr.adf
CD:\GreenBay\alternative_analysis\north\muv6_10n\muv6_10n\log
CD:\GreenBay\alternative_analysis\north\muv6_10n\muv6_10n\sta.adf
CD:\GreenBay\alternative_analysis\north\muv6_10n\muv6_10n\w001001.adf
CD:\GreenBay\alternative_analysis\north\muv6_10n\muv6_10n\w001001x.adf

CD:\GreenBay\alternative_analysis\north\muv6_10n\info\arc0000.dat
CD:\GreenBay\alternative_analysis\north\muv6_10n\info\arc0000.nit
CD:\GreenBay\alternative_analysis\north\muv6_10n\info\arc0001.dat
CD:\GreenBay\alternative_analysis\north\muv6_10n\info\arc0001.nit
CD:\GreenBay\alternative_analysis\north\muv6_10n\info\arc.dir

CD:\GreenBay\alternative_analysis\north\muvgt10n\muvgt10n\dblbnd.adf
CD:\GreenBay\alternative_analysis\north\muvgt10n\muvgt10n\hdr.adf
CD:\GreenBay\alternative_analysis\north\muvgt10n\muvgt10n\log
CD:\GreenBay\alternative_analysis\north\muvgt10n\muvgt10n\sta.adf
CD:\GreenBay\alternative_analysis\north\muvgt10n\muvgt10n\w001001.adf
CD:\GreenBay\alternative_analysis\north\muvgt10n\muvgt10n\w001001x.adf

CD:\GreenBay\alternative_analysis\north\muvgt10n\info\arc0000.dat
CD:\GreenBay\alternative_analysis\north\muvgt10n\info\arc0000.nit
CD:\GreenBay\alternative_analysis\north\muvgt10n\info\arc0001.dat
CD:\GreenBay\alternative_analysis\north\muvgt10n\info\arc0001.nit
CD:\GreenBay\alternative_analysis\north\muvgt10n\info\arc.dir

CD:\GreenBay\alternative_analysis\south\dpthnlys\dpthnlyss\dblbnd.adf
CD:\GreenBay\alternative_analysis\south\dpthnlys\dpthnlyss\hdr.adf
CD:\GreenBay\alternative_analysis\south\dpthnlys\dpthnlyss\log
CD:\GreenBay\alternative_analysis\south\dpthnlys\dpthnlyss\sta.adf
CD:\GreenBay\alternative_analysis\south\dpthnlys\dpthnlyss\w001001.adf
CD:\GreenBay\alternative_analysis\south\dpthnlys\dpthnlyss\w001001x.adf

CD:\GreenBay\alternative_analysis\south\dpthnlys\info\arc0000.dat
CD:\GreenBay\alternative_analysis\south\dpthnlys\info\arc0000.nit
CD:\GreenBay\alternative_analysis\south\dpthnlys\info\arc0001.dat
CD:\GreenBay\alternative_analysis\south\dpthnlys\info\arc0001.nit
CD:\GreenBay\alternative_analysis\south\dpthnlys\info\arc.dir

CD:\GreenBay\alternative_analysis\south\dpthnlyscs\dpthnlyscs\dblbnd.adf
CD:\GreenBay\alternative_analysis\south\dpthnlyscs\dpthnlyscs\hdr.adf
CD:\GreenBay\alternative_analysis\south\dpthnlyscs\dpthnlyscs\log
CD:\GreenBay\alternative_analysis\south\dpthnlyscs\dpthnlyscs\sta.adf
CD:\GreenBay\alternative_analysis\south\dpthnlyscs\dpthnlyscs\w001001.adf
CD:\GreenBay\alternative_analysis\south\dpthnlyscs\dpthnlyscs\w001001x.adf

CD:\GreenBay\alternative_analysis\south\dpthnlyscs\info\arc0000.dat
CD:\GreenBay\alternative_analysis\south\dpthnlyscs\info\arc0000.nit
CD:\GreenBay\alternative_analysis\south\dpthnlyscs\info\arc0001.dat
CD:\GreenBay\alternative_analysis\south\dpthnlyscs\info\arc0001.nit
CD:\GreenBay\alternative_analysis\south\dpthnlyscs\info\arc.dir

CD:\GreenBay\alternative_analysis\south\muv0_2cs\muv0_2cs\dblbnd.adf
CD:\GreenBay\alternative_analysis\south\muv0_2cs\muv0_2cs\hdr.adf
CD:\GreenBay\alternative_analysis\south\muv0_2cs\muv0_2cs\log
CD:\GreenBay\alternative_analysis\south\muv0_2cs\muv0_2cs\sta.adf
CD:\GreenBay\alternative_analysis\south\muv0_2cs\muv0_2cs\w001001.adf
CD:\GreenBay\alternative_analysis\south\muv0_2cs\muv0_2cs\w001001x.adf

CD:\GreenBay\alternative_analysis\south\muv0_2cs\info\arc0000.dat
CD:\GreenBay\alternative_analysis\south\muv0_2cs\info\arc0000.nit
CD:\GreenBay\alternative_analysis\south\muv0_2cs\info\arc0001.dat
CD:\GreenBay\alternative_analysis\south\muv0_2cs\info\arc0001.nit
CD:\GreenBay\alternative_analysis\south\muv0_2cs\info\arc.dir

CD:\GreenBay\alternative_analysis\south\muv0_2s\muv0_2s\dblbnd.adf
CD:\GreenBay\alternative_analysis\south\muv0_2s\muv0_2s\hdr.adf
CD:\GreenBay\alternative_analysis\south\muv0_2s\muv0_2s\log
CD:\GreenBay\alternative_analysis\south\muv0_2s\muv0_2s\sta.adf
CD:\GreenBay\alternative_analysis\south\muv0_2s\muv0_2s\w001001.adf
CD:\GreenBay\alternative_analysis\south\muv0_2s\muv0_2s\w001001x.adf

CD:\GreenBay\alternative_analysis\south\muv0_2s\info\arc0000.dat
CD:\GreenBay\alternative_analysis\south\muv0_2s\info\arc0000.nit
CD:\GreenBay\alternative_analysis\south\muv0_2s\info\arc0001.dat
CD:\GreenBay\alternative_analysis\south\muv0_2s\info\arc0001.nit
CD:\GreenBay\alternative_analysis\south\muv0_2s\info\arc.dir

CD:\GreenBay\alternative_analysis\south\muv2_4cs\muv2_4cs\dblbnd.adf
CD:\GreenBay\alternative_analysis\south\muv2_4cs\muv2_4cs\hdr.adf
CD:\GreenBay\alternative_analysis\south\muv2_4cs\muv2_4cs\log
CD:\GreenBay\alternative_analysis\south\muv2_4cs\muv2_4cs\sta.adf
CD:\GreenBay\alternative_analysis\south\muv2_4cs\muv2_4cs\w001001.adf
CD:\GreenBay\alternative_analysis\south\muv2_4cs\muv2_4cs\w001001x.adf

CD:\GreenBay\alternative_analysis\south\muv2_4cs\info\arc0000.dat
CD:\GreenBay\alternative_analysis\south\muv2_4cs\info\arc0000.nit
CD:\GreenBay\alternative_analysis\south\muv2_4cs\info\arc0001.dat
CD:\GreenBay\alternative_analysis\south\muv2_4cs\info\arc0001.nit
CD:\GreenBay\alternative_analysis\south\muv2_4cs\info\arc.dir

CD:\GreenBay\alternative_analysis\south\muv2_4s\muv2_4s\dblbnd.adf
CD:\GreenBay\alternative_analysis\south\muv2_4s\muv2_4s\hdr.adf
CD:\GreenBay\alternative_analysis\south\muv2_4s\muv2_4s\log
CD:\GreenBay\alternative_analysis\south\muv2_4s\muv2_4s\sta.adf
CD:\GreenBay\alternative_analysis\south\muv2_4s\muv2_4s\w001001.adf
CD:\GreenBay\alternative_analysis\south\muv2_4s\muv2_4s\w001001x.adf

CD:\GreenBay\alternative_analysis\south\muv2_4s\info\arc0000.dat
CD:\GreenBay\alternative_analysis\south\muv2_4s\info\arc0000.nit
CD:\GreenBay\alternative_analysis\south\muv2_4s\info\arc0001.dat
CD:\GreenBay\alternative_analysis\south\muv2_4s\info\arc0001.nit
CD:\GreenBay\alternative_analysis\south\muv2_4s\info\arc.dir

CD:\GreenBay\alternative_analysis\south\muv4_6cs\muv4_6cs\dblbnd.adf
CD:\GreenBay\alternative_analysis\south\muv4_6cs\muv4_6cs\hdr.adf
CD:\GreenBay\alternative_analysis\south\muv4_6cs\muv4_6cs\log
CD:\GreenBay\alternative_analysis\south\muv4_6cs\muv4_6cs\sta.adf
CD:\GreenBay\alternative_analysis\south\muv4_6cs\muv4_6cs\w001001.adf
CD:\GreenBay\alternative_analysis\south\muv4_6cs\muv4_6cs\w001001x.adf

CD:\GreenBay\alternative_analysis\south\muv4_6cs\info\arc0000.dat
CD:\GreenBay\alternative_analysis\south\muv4_6cs\info\arc0000.nit
CD:\GreenBay\alternative_analysis\south\muv4_6cs\info\arc0001.dat
CD:\GreenBay\alternative_analysis\south\muv4_6cs\info\arc0001.nit
CD:\GreenBay\alternative_analysis\south\muv4_6cs\info\arc.dir

CD:\GreenBay\alternative_analysis\south\muv4_6s\muv4_6s\dblbnd.adf
CD:\GreenBay\alternative_analysis\south\muv4_6s\muv4_6s\hdr.adf
CD:\GreenBay\alternative_analysis\south\muv4_6s\muv4_6s\log
CD:\GreenBay\alternative_analysis\south\muv4_6s\muv4_6s\sta.adf
CD:\GreenBay\alternative_analysis\south\muv4_6s\muv4_6s\w001001.adf
CD:\GreenBay\alternative_analysis\south\muv4_6s\muv4_6s\w001001x.adf

CD:\GreenBay\alternative_analysis\south\muv4_6s\info\arc0000.dat
CD:\GreenBay\alternative_analysis\south\muv4_6s\info\arc0000.nit
CD:\GreenBay\alternative_analysis\south\muv4_6s\info\arc0001.dat
CD:\GreenBay\alternative_analysis\south\muv4_6s\info\arc0001.nit
CD:\GreenBay\alternative_analysis\south\muv4_6s\info\arc.dir

CD:\GreenBay\alternative_analysis\south\muv6_10cs\muv6_10cs\dblbnd.adf
CD:\GreenBay\alternative_analysis\south\muv6_10cs\muv6_10cs\hdr.adf
CD:\GreenBay\alternative_analysis\south\muv6_10cs\muv6_10cs\log
CD:\GreenBay\alternative_analysis\south\muv6_10cs\muv6_10cs\sta.adf
CD:\GreenBay\alternative_analysis\south\muv6_10cs\muv6_10cs\w001001.adf
CD:\GreenBay\alternative_analysis\south\muv6_10cs\muv6_10cs\w001001x.adf

CD:\GreenBay\alternative_analysis\south\muv6_10cs\info\arc0000.dat
CD:\GreenBay\alternative_analysis\south\muv6_10cs\info\arc0000.nit
CD:\GreenBay\alternative_analysis\south\muv6_10cs\info\arc0001.dat
CD:\GreenBay\alternative_analysis\south\muv6_10cs\info\arc0001.nit
CD:\GreenBay\alternative_analysis\south\muv6_10cs\info\arc.dir

CD:\GreenBay\alternative_analysis\south\muv6_10s\muv6_10s\dblbnd.adf
CD:\GreenBay\alternative_analysis\south\muv6_10s\muv6_10s\hdr.adf
CD:\GreenBay\alternative_analysis\south\muv6_10s\muv6_10s\log
CD:\GreenBay\alternative_analysis\south\muv6_10s\muv6_10s\sta.adf
CD:\GreenBay\alternative_analysis\south\muv6_10s\muv6_10s\w001001.adf
CD:\GreenBay\alternative_analysis\south\muv6_10s\muv6_10s\w001001x.adf

CD:\GreenBay\alternative_analysis\south\muv6_10s\info\arc0000.dat
CD:\GreenBay\alternative_analysis\south\muv6_10s\info\arc0000.nit
CD:\GreenBay\alternative_analysis\south\muv6_10s\info\arc0001.dat
CD:\GreenBay\alternative_analysis\south\muv6_10s\info\arc0001.nit
CD:\GreenBay\alternative_analysis\south\muv6_10s\info\arc.dir

CD:\GreenBay\alternative_analysis\south\muvgt10cs\muvgt10cs\dblbnd.adf
CD:\GreenBay\alternative_analysis\south\muvgt10cs\muvgt10cs\hdr.adf
CD:\GreenBay\alternative_analysis\south\muvgt10cs\muvgt10cs\log
CD:\GreenBay\alternative_analysis\south\muvgt10cs\muvgt10cs\sta.adf
CD:\GreenBay\alternative_analysis\south\muvgt10cs\muvgt10cs\w001001.adf
CD:\GreenBay\alternative_analysis\south\muvgt10cs\muvgt10cs\w001001x.adf

CD:\GreenBay\alternative_analysis\south\muvgt10cs\info\arc0000.dat
CD:\GreenBay\alternative_analysis\south\muvgt10cs\info\arc0000.nit
CD:\GreenBay\alternative_analysis\south\muvgt10cs\info\arc0001.dat
CD:\GreenBay\alternative_analysis\south\muvgt10cs\info\arc0001.nit
CD:\GreenBay\alternative_analysis\south\muvgt10cs\info\arc.dir

CD:\GreenBay\alternative_analysis\south\muvgt10s\muvgt10s\dblbnd.adf
CD:\GreenBay\alternative_analysis\south\muvgt10s\muvgt10s\hdr.adf
CD:\GreenBay\alternative_analysis\south\muvgt10s\muvgt10s\log
CD:\GreenBay\alternative_analysis\south\muvgt10s\muvgt10s\sta.adf
CD:\GreenBay\alternative_analysis\south\muvgt10s\muvgt10s\w001001.adf
CD:\GreenBay\alternative_analysis\south\muvgt10s\muvgt10s\w001001x.adf

CD:\GreenBay\alternative_analysis\south\muvgt10s\info\arc0000.dat
CD:\GreenBay\alternative_analysis\south\muvgt10s\info\arc0000.nit
CD:\GreenBay\alternative_analysis\south\muvgt10s\info\arc0001.dat
CD:\GreenBay\alternative_analysis\south\muvgt10s\info\arc0001.nit
CD:\GreenBay\alternative_analysis\south\muvgt10s\info\arc.dir

CD:\GreenBay\methodtest\2ffootprint.dbf
CD:\GreenBay\methodtest\2ffootprint.shp
CD:\GreenBay\methodtest\2ffootprint.shx
CD:\GreenBay\methodtest\baysegments.dbf
CD:\GreenBay\methodtest\baysegments.sbn
CD:\GreenBay\methodtest\baysegments.sbx
CD:\GreenBay\methodtest\baysegments.shp
CD:\GreenBay\methodtest\baysegments.shx

CD:\GreenBay\methodtest\cellaroundpnt.ave
CD:\GreenBay\methodtest\cliptopoly.ave
CD:\GreenBay\methodtest\gbaybarr.dbf
CD:\GreenBay\methodtest\gbaybarr.sbn
CD:\GreenBay\methodtest\gbaybarr.sbx
CD:\GreenBay\methodtest\gbaybarr.shp
CD:\GreenBay\methodtest\gbaybarr.shx
CD:\GreenBay\methodtest\GBMB0_1.txt
CD:\GreenBay\methodtest\GBMB0_1.xls
CD:\GreenBay\methodtest\GBMB.xls
CD:\GreenBay\methodtest\gbmbcells.dbf
CD:\GreenBay\methodtest\gbmbcells.shp
CD:\GreenBay\methodtest\gbmbcells.shx
CD:\GreenBay\methodtest\gbmboutline.dbf
CD:\GreenBay\methodtest\gbmboutline.shp
CD:\GreenBay\methodtest\gbmboutline.shx
CD:\GreenBay\methodtest\methareacomp.xls
CD:\GreenBay\methodtest\Method_test.doc

CD:\GreenBay\methodtest\GBMBbulkdensity\gbmbbd\dblbnd.adf
CD:\GreenBay\methodtest\GBMBbulkdensity\gbmbbd\hdr.adf
CD:\GreenBay\methodtest\GBMBbulkdensity\gbmbbd\log
CD:\GreenBay\methodtest\GBMBbulkdensity\gbmbbd\sta.adf
CD:\GreenBay\methodtest\GBMBbulkdensity\gbmbbd\w001001.adf
CD:\GreenBay\methodtest\GBMBbulkdensity\gbmbbd\w001001x.adf

CD:\GreenBay\methodtest\GBMBbulkdensity\info\arc0000.dat
CD:\GreenBay\methodtest\GBMBbulkdensity\info\arc0000.nit
CD:\GreenBay\methodtest\GBMBbulkdensity\info\arc0001.dat
CD:\GreenBay\methodtest\GBMBbulkdensity\info\arc0001.nit
CD:\GreenBay\methodtest\GBMBbulkdensity\info\arc.dir

CD:\GreenBay\methodtest\GBMBpcb\gbmbpcb\dblbnd.adf
CD:\GreenBay\methodtest\GBMBpcb\gbmbpcb\hdr.adf
CD:\GreenBay\methodtest\GBMBpcb\gbmbpcb\log
CD:\GreenBay\methodtest\GBMBpcb\gbmbpcb\sta.adf
CD:\GreenBay\methodtest\GBMBpcb\gbmbpcb\w001001.adf
CD:\GreenBay\methodtest\GBMBpcb\gbmbpcb\w001001x.adf

CD:\GreenBay\methodtest\GBMBpcb\info\arc0000.dat
CD:\GreenBay\methodtest\GBMBpcb\info\arc0000.nit
CD:\GreenBay\methodtest\GBMBpcb\info\arc0001.dat
CD:\GreenBay\methodtest\GBMBpcb\info\arc0001.nit
CD:\GreenBay\methodtest\GBMBpcb\info\arc.dir

CD:\GreenBay\methodtest\PCBintxBDint\pcbintxbdint\dblbnd.adf
CD:\GreenBay\methodtest\PCBintxBDint\pcbintxbdint\hdr.adf
CD:\GreenBay\methodtest\PCBintxBDint\pcbintxbdint\log
CD:\GreenBay\methodtest\PCBintxBDint\pcbintxbdint\sta.adf
CD:\GreenBay\methodtest\PCBintxBDint\pcbintxbdint\w001001.adf
CD:\GreenBay\methodtest\PCBintxBDint\pcbintxbdint\w001001x.adf

CD:\GreenBay\methodtest\PCBintxBDint\info\arc0000.dat
CD:\GreenBay\methodtest\PCBintxBDint\info\arc0000.nit
CD:\GreenBay\methodtest\PCBintxBDint\info\arc0001.dat
CD:\GreenBay\methodtest\PCBintxBDint\info\arc0001.nit
CD:\GreenBay\methodtest\PCBintxBDint\info\arc.dir

CD:\GreenBay\methodtest\PCBxBDint\pcbxbdint\dblbnd.adf
CD:\GreenBay\methodtest\PCBxBDint\pcbxbdint\hdr.adf
CD:\GreenBay\methodtest\PCBxBDint\pcbxbdint\log
CD:\GreenBay\methodtest\PCBxBDint\pcbxbdint\sta.adf
CD:\GreenBay\methodtest\PCBxBDint\pcbxbdint\w001001.adf
CD:\GreenBay\methodtest\PCBxBDint\pcbxbdint\w001001x.adf

CD:\GreenBay\methodtest\PCBxBDint\info\arc0000.dat
CD:\GreenBay\methodtest\PCBxBDint\info\arc0000.nit
CD:\GreenBay\methodtest\PCBxBDint\info\arc0001.dat
CD:\GreenBay\methodtest\PCBxBDint\info\arc0001.nit
CD:\GreenBay\methodtest\PCBxBDint\info\arc.dir

White Paper No. 19 – Estimates of PCB Mass, Sediment Volume, and Surface Sediment Concentrations in Operable Unit 5, Green Bay Using an Alternative Approach

Response to Comments on the

Remedial Investigation for the Lower Fox River and Green Bay, Wisconsin, Feasibility Study for the Lower Fox River and Green Bay, Wisconsin, Proposed Remedial Action Plan for the Lower Fox River and Green Bay, and Record of Decision for Operable Unit 1 and Operable Unit 2

This Document has been Prepared by the

Wisconsin Department of Natural Resources

Madison, Wisconsin

June 2003

WHITE PAPER NO. 19 – ESTIMATES OF PCB MASS, SEDIMENT VOLUME, AND SURFACE SEDIMENT CONCENTRATIONS IN OPERABLE UNIT 5, GREEN BAY USING AN ALTERNATIVE APPROACH

ABSTRACT

The paper addresses concerns raised during the public comment period for the *Final Remedial Investigation for the Lower Fox River and Green Bay, Wisconsin* (RI) (RETEC, 2002a), the *Final Feasibility Study for the Lower Fox River and Green Bay, Wisconsin* (FS) (RETEC, 2002b), and the *Proposed Remedial Action Plan, Lower Fox River and Green Bay* (Proposed Plan) (WDNR and EPA, 2001), on the relative lack of polychlorinated biphenyl (PCB) sediment data in southern Green Bay. Specifically, concerns were raised regarding the overall mass and volume estimates in Green Bay as well as areas of the Bay where elevated surface concentrations may exist in historic open-water navigational dredge disposal sites in Green Bay. To address these concerns, the Wisconsin Department of Natural Resources (WDNR) and United States Environmental Protection Agency (EPA) collected additional data from areas identified as potential open-water disposal areas in July 2002. This white paper presents the results of that sampling effort, as well as incorporation of these additional sediment data, and data submitted during the public comment period into new bed maps for Green Bay following the methods outlined in *White Paper No. 18 – Evaluation of an Alternative Approach of Calculating Mass, Sediment Volume, and Surface Concentrations in Operable Unit 5, Green Bay* (WDNR, 2003). Revised PCB mass, contaminated sediment volumes, and surface-weighted average PCB concentrations are presented for Operable Unit (OU) 5, Green Bay.

1 INTRODUCTION AND BACKGROUND

The navigational channel of the Lower Fox River and Green Bay has been dredged for many years. Prior to operation and construction of the dredge material management facilities such as the Renard Island confined disposal facility (CDF) operated by the United States Army Corps of Engineers (USACE) and the Bayport facility operated and managed by Brown County, open-water disposal of navigational dredged materials occurred. Historically, several locations in Green Bay were used as disposal sites, and in particular southern Green Bay (Figure 1). The volume and exact location of sediment generated by navigational dredging disposed of in this manner is unknown. However, since open-water disposal was in practice at the same time PCBs were being discharged into the Lower Fox River, it is likely these dredged materials also carried PCBs.

The pattern and distribution of PCBs within Green Bay is significantly influenced by the disposition of the PCB-contaminated sediment load from the Lower Fox River. Wind and wave forces and the general counterclockwise circulation pattern in Green Bay are the principal dispersal mechanisms. Manchester-Neesvig et al. (1996) documented the results of these dispersal forces during the Green Bay Mass Balance Study (GBMBS) as PCB-contaminated sediment accumulation along the eastern shore of Green Bay.

During the public comment period following the release of the Proposed Plan (WDNR and EPA, 2001) concerns were raised about potential elevated levels of PCBs in Green Bay, particularly in the southern Bay. Previous PCB mapping did indicate several areas with elevated PCB levels (Manchester-Neesvig et al., 1996). Regrettably, there were few data points in the southern end of Green Bay and thus some of these areas of potentially elevated concentrations were mapped on the basis of only a single data point. In December 2001, the Fox River Group (FRG) collected a series of sediment samples in the southern end of Green Bay in an attempt to address this lack of data. This data was presented in the public comments (FRG, 2002) and has already been incorporated into the bed map as part of *White Paper No. 18 – Evaluation of an Alternative Approach of Calculating Mass, Sediment Volume, and Surface Concentrations in Operable Unit 5, Green Bay*. However, the open-water disposal sites were not adequately sampled to determine if elevated levels of PCBs were still associated with the historic open-water disposal sites. As a result of the paucity of data, WDNR and EPA decided to conduct additional sampling in southern Green Bay.

2 2002 GREEN BAY SAMPLING

WDNR and EPA contracted The RETEC Group, Inc. (RETEC) to conduct a limited sediment survey of Green Bay. There were two principal objectives for the additional Green Bay sediment analyses:

- To more thoroughly characterize areas of Green Bay associated with historic open-water dredge disposal areas and navigation channel side casts.
- To provide additional sediment characterization of the southern end of Green Bay.

Sample Collection and Analyses

Sediment cores were collected from Green Bay between July 22 and 24, 2002 (RETEC, 2002c). Sample locations and results are presented on Figure 2 and in Appendix A. A total of 99 samples were collected at 36 core locations. Samples were not obtained at only one station (GB02-35, Figure 1) due to shallow water depths. All samples were analyzed for PCBs (Aroclor), total organic carbon (TOC), and bulk density. PCB concentrations ranged from non-detectable to 30 milligrams per kilogram (mg/kg) (parts per million [ppm]; Station GB02-33). The high concentrations found at Station GB02-33 reconfirmed concentrations found at this location in 1995 and are associated with sediments adjacent to the navigation channel at the River mouth, not in Green Bay proper. Surface concentrations found in Green Bay samples (all stations except GB02-33) were less than 0.3 ppm (300 micrograms per kilogram [µg/kg], parts per billion [ppb]) with subsurface concentrations at a single location (GB02-34) only as high as 1.4 ppm (1,400 ppb).

3 PROCEDURES TO INCORPORATE THE GREEN BAY SEDIMENT SAMPLE RESULTS INTO THE BAY MASS, VOLUME, AND SURFACE CONCENTRATION ESTIMATES

Upon completion of the sampling and analyses, the data were incorporated into the Green Bay PCB bed maps. PCB isopach maps, the mass and volumes of PCB-contaminated sediments were generated and are reported. This was accomplished by incorporating the results of the Bay sampling in the database and then following the alternative methods developed by WDNR and presented in *White Paper No. 18 – Evaluation of an Alternative Approach of Calculating Mass, Sediment Volume, and Surface Concentrations in Operable Unit 5, Green Bay* with three necessary modifications:

1. Inclusion of the results from the July 2002 data collection.
2. Revised data projection.
3. Revised depth of analysis grid resulting from including the July 2002 data.

Included in Appendix B of this white paper is a data directory list and a CD containing the data.

3.1 2002 Data Collection

As referred to in Section 2, data from the 2002 Green Bay sampling effort was incorporated into the database used for this white paper. Figure 2 graphically presents PCB data.

3.2 Data Projection

PCB bed generation followed the methods described in *White Paper No. 18 – Evaluation of an Alternative Approach of Calculating Mass, Sediment Volume, and Surface Concentrations in Operable Unit 5, Green Bay*. The data used by WDNR for this white paper was obtained and combined with the data collected by RETEC in 2002. The WDNR data were geographically referenced using the customized Universal Transverse Mercator projection in 1927 North American Datum (commonly referred to as Wisconsin Transverse Mercator [WTM] 1927). The RETEC 2002 data were projected in Wisconsin State Plane Coordinates, 1983 North American Datum. All data were re-projected into the engineering standard set for the Lower Fox River using the 1983 custom Universal Transverse Mercator coordinate system (WTM 1983). Locational re-projections were done using *Project Wizard*®, a tool included with ArcGIS 8®.

While WDNR used WTM 1927 and ArcGIS 3.2®, re-projecting the data and creating the bed maps in WTM 1983 and ArcGIS 8® resulted in minor (less than 1 percent) differences in subsequent mass and volume estimations.

3.3 Depth of Analysis

As described in *White Paper No. 18 – Evaluation of an Alternative Approach of Calculating Mass, Sediment Volume, and Surface Concentrations in Operable Unit 5, Green Bay*, the depth of sediment included in the interpolations contributes significantly to the calculation of PCB mass and contaminated sediment volume. As presented in the alternate method included in *White Paper No. 18 – Evaluation of an Alternative Approach of Calculating Mass, Sediment Volume, and Surface Concentrations in Operable Unit 5, Green Bay*, the July 2002 data was included in the delineation of the depth of analysis GIS coverage. As a result of including the July 2002 data, the depth of analysis coverage increased slightly from the *White Paper No. 18 – Evaluation of an Alternative Approach of Calculating Mass, Sediment Volume, and Surface Concentrations in Operable Unit 5, Green Bay* depth of analysis coverage. The depth range of the coverage in *White Paper No. 18 – Evaluation of an Alternative Approach of Calculating Mass, Sediment Volume, and Surface Concentrations in Operable Unit 5, Green Bay* was 0.03 to 0.845 meter while after the addition of the July 2002 data the depth ranged from 0.03 to 0.863 meter.

4 INTERPOLATION RESULTS INCORPORATING THE 2002 GREEN BAY DATA

4.1 Estimates of PCB Mass and Contaminated Sediment Volume

PCB mass estimates are presented by Green Bay Zone (Table 1) and by sediment layer (Table 2) using the alternative method presented in *White Paper No. 18 – Evaluation of an Alternative Approach of Calculating Mass, Sediment Volume, and Surface Concentrations in Operable Unit 5, Green Bay* and including the July 2002 data. In total, the mass estimate decreased by less than 1 percent (39 kilograms [kg]) when compared to the estimates presented in *White Paper No. 18 – Evaluation of an Alternative Approach of Calculating Mass, Sediment Volume, and Surface Concentrations in Operable Unit 5, Green Bay*. This minimal total difference does not reflect the differences observed within each Green Bay Zone. Within Green Bay, PCB mass estimates are lower in Zone 2 by 433 kg, while mass estimates increased in zones 3A and 3B by 269 and 115 kg, respectively. These differences resulted from the combined effects of reduced spatial influence of historic data points near the River mouth and new concentrations at depth resulting in a slightly larger depth of analysis layer in the northern portions of Zone 2 which also influenced the southern end of zones 3A and 3B.

TABLE 1 GREEN BAY PCB MASS ESTIMATES BY GREEN BAY ZONE INCORPORATING THE JULY 2002 DATA

Source		PCB Mass (kg)
July 2002 Data Incorporated	Zone 2	3,898
	Zone 3A	3,696
	Zone 3B	5,811
	Zone 4	1,160
	TOTAL	**14,565**
White Paper No. 18 – Evaluation of an Alternative Approach of Calculating Mass, Sediment Volume, and Surface Concentrations in Operable Unit 5, Green Bay, Table 4 (WDNR alternative method)	Zone 2	4,331
	Zone 3A	3,427
	Zone 3B	5,696
	Zone 4	1,150
	TOTAL	**14,604**

TABLE 2 GREEN BAY PCB MASS ESTIMATES BY SEDIMENT LAYER AND GREEN BAY ZONE INCORPORATING THE JULY 2002 DATA

Depth	Zone 2	Zone 3A	Zone 3B	Zone 4	Total
0–2 cm	279	570	894	304	**2,047**
2–4 cm	278	670	1,210	258	**2,416**
4–6 cm	283	743	1,168	262	**2,456**
6–10 cm	562	1,064	1,670	308	**3,604**
>10 cm	2,496	649	869	28	**4,042**
Total	**3,898**	**3,696**	**5,811**	**1,160**	**14,565**

Table 3 summarizes PCB-contaminated sediment volume for each zone in Green Bay using the alternative method presented in *White Paper No. 18 – Evaluation of an Alternative Approach of Calculating Mass, Sediment Volume, and Surface Concentrations in Operable Unit 5, Green Bay* and including the July 2002 data. In total, the volume estimate increased by approximately 10 percent (24 million cubic meters) when compared to the estimates presented in *White Paper No. 18 – Evaluation of an Alternative Approach of Calculating Mass, Sediment Volume, and Surface Concentrations in Operable Unit 5, Green Bay*. This total difference reflects observed increases in Green Bay zones 2 and 3. Within Green Bay, contaminated sediment volume estimates are higher by approximately 5, 12, and 7 million cubic meters in zones 2, 3A, and 3B, respectively. This minimal percent total increase is the result of increased depth of analysis coverage in these zones.

TABLE 3 CONTAMINATED SEDIMENT VOLUME BY SEDIMENT LAYER AND GREEN BAY ZONE INCORPORATING THE JULY 2002 DATA

Source		Contaminated Sediment Volume (cubic meters)
July 2002 Data Incorporated	Zone 2 Zone 3A Zone 3B Zone 4 **All Zones Combined**	33,644,658 76,367,063 90,081,683 66,134,492 **266,227,896**
White Paper No. 18 – Evaluation of an Alternative Approach of Calculating Mass, Sediment Volume, and Surface Concentrations in Operable Unit 5, Green Bay, Table 6 (WDNR alternative method)	Zone 2 Zone 3A Zone 3B Zone 4 **All Zones Combined**	28,710,478 64,487,652 83,151,447 66,193,726 **242,543,303**

4.2 PCB Surface Concentration

Figure 3 is a map of Green Bay depicting the interpolated results of PCB concentrations in the top layer (0 to 2 centimeters [cm]) of sediment. Compared to the PCB concentration maps presented in *White Paper No. 18 – Evaluation of an Alternative Approach of Calculating Mass, Sediment Volume, and Surface Concentrations in Operable Unit 5, Green Bay*, Figure 8, the revised concentration distribution differs only slightly in Zone 2 where the additional 2002 data were included. In the northern portion of Green Bay (zones 3A, 3B, and 4), concentration patterns and magnitudes remain nearly identical to those presented in *White Paper No. 18 – Evaluation of an Alternative Approach of Calculating Mass, Sediment Volume, and Surface Concentrations in Operable Unit 5, Green Bay*. Table 4 is a summary of average PCB concentrations for each zone of Green Bay compared to the results presented in *White Paper No. 18 – Evaluation of an Alternative Approach of Calculating Mass, Sediment Volume, and Surface Concentrations in Operable Unit 5, Green Bay*.

TABLE 4 AVERAGE GREEN BAY PCB SURFACE CONCENTRATIONS (0 TO 2 CM) INCORPORATING THE JULY 2002 DATA

Source		Average PCB Surface Concentration (ppb)
July 2002 Data Incorporated	Zone 2	262
	Zone 3A	363
	Zone 3B	672
	Zone 4	82
	All Zones Combined	**246**
White Paper No. 18 – Evaluation of an Alternative Approach of Calculating Mass, Sediment Volume, and Surface Concentrations in Operable Unit 5, Green Bay, Table 8 (WDNR alternative method)	Zone 2	320
	Zone 3A	370
	Zone 3B	690
	Zone 4	80
	All Zones Combined	**353**

4.3 Bulk Density and TOC

The 2002 Green Bay data collection also generated bulk density and total organic carbon data for each of the samples collected. Appendix A contains a full listing of these results and Figures 4 and 5 incorporate the 2002 results into new bulk density and TOC bed maps, respectively.

5 CONCLUSIONS

- The results of the bay sampling did not reveal any excessively high concentrations of PCBs in areas sampled where the former open-water disposal activities took place. Furthermore, when the data was included in generating more current bed maps, no new areas of elevated surface concentrations were found.

- Bed maps generated using the method described in *White Paper No. 18 – Evaluation of an Alternative Approach of Calculating Mass, Sediment Volume, and Surface Concentrations in Operable Unit 5, Green Bay* reveal there is not a significant change in PCB mass or contaminated sediment volume with the July 2002 data included.

- Bed maps generated using the method described in *White Paper No. 18 – Evaluation of an Alternative Approach of Calculating Mass, Sediment Volume, and Surface Concentrations in Operable Unit 5, Green Bay* reveal there is not a significant change in PCB surface sediment concentrations with the July 2002 data included.

6 REFERENCES

FRG, 2002. *Exhibit 24: Lower Fox River and Green Bay Database Report Version 6.0. Comments of the Fox River Group on the Wisconsin Department of Natural Resources' Draft Remedial Investigation, Draft Feasibility Study, Baseline Human Health and Ecological Risk Assessment, and Proposed Remedial Action Plan*.

Manchester-Neesvig, Jon B., Anders W. Andren, and David N. Edgington, 1996. Patterns of mass sedimentation and deposition of sediment contaminated by PCBs in Green Bay. *Journal of Great Lakes Research*. 22(2):444–462.

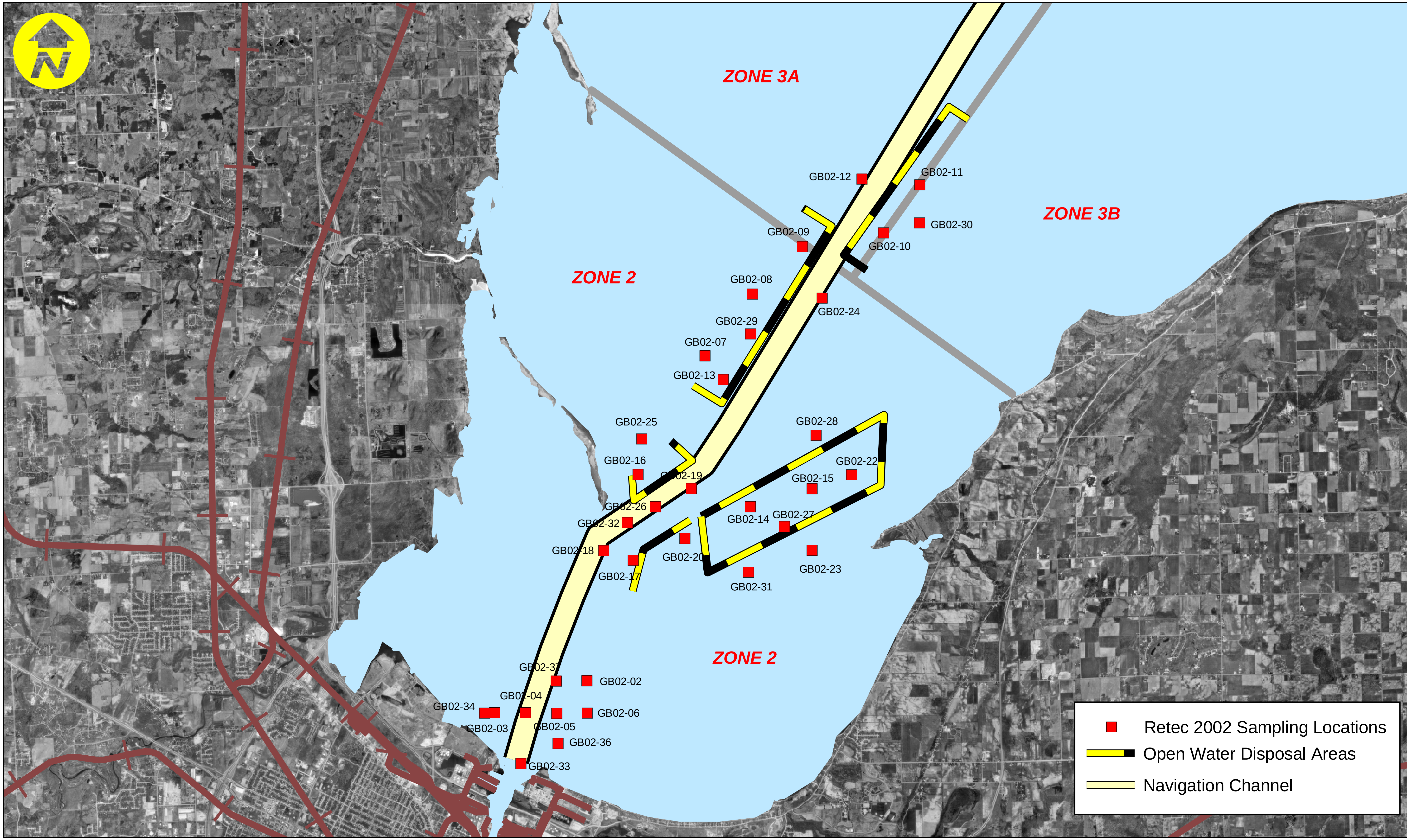
RETEC, 2002a. *Final Remedial Investigation for the Lower Fox River and Green Bay, Wisconsin*. Prepared for Wisconsin Department of Natural Resources by The RETEC Group, Inc., St. Paul, Minnesota. December.

RETEC, 2002b. *Final Feasibility Study for the Lower Fox River and Green Bay, Wisconsin*. Prepared for Wisconsin Department of Natural Resources by The RETEC Group, Inc., Seattle, Washington. December.

RETEC, 2002c. *Green Bay Sediment Results from July 2002 Survey, Green Bay, Wisconsin*. Prepared for Wisconsin Department of Natural Resources by The RETEC Group, Inc., Madison, Wisconsin. Available at Wisconsin Department of Natural Resources website: http://www.dnr.state.wi.us/org/water/wm/lowerfox/reports.html.

WDNR, 2003. *White Paper No. 18 – Evaluation of an Alternative Approach of Calculating Mass, Sediment Volume, and Surface Concentrations in Operable Unit 5, Green Bay*. Wisconsin Department of Natural Resources, Madison, Wisconsin. June.

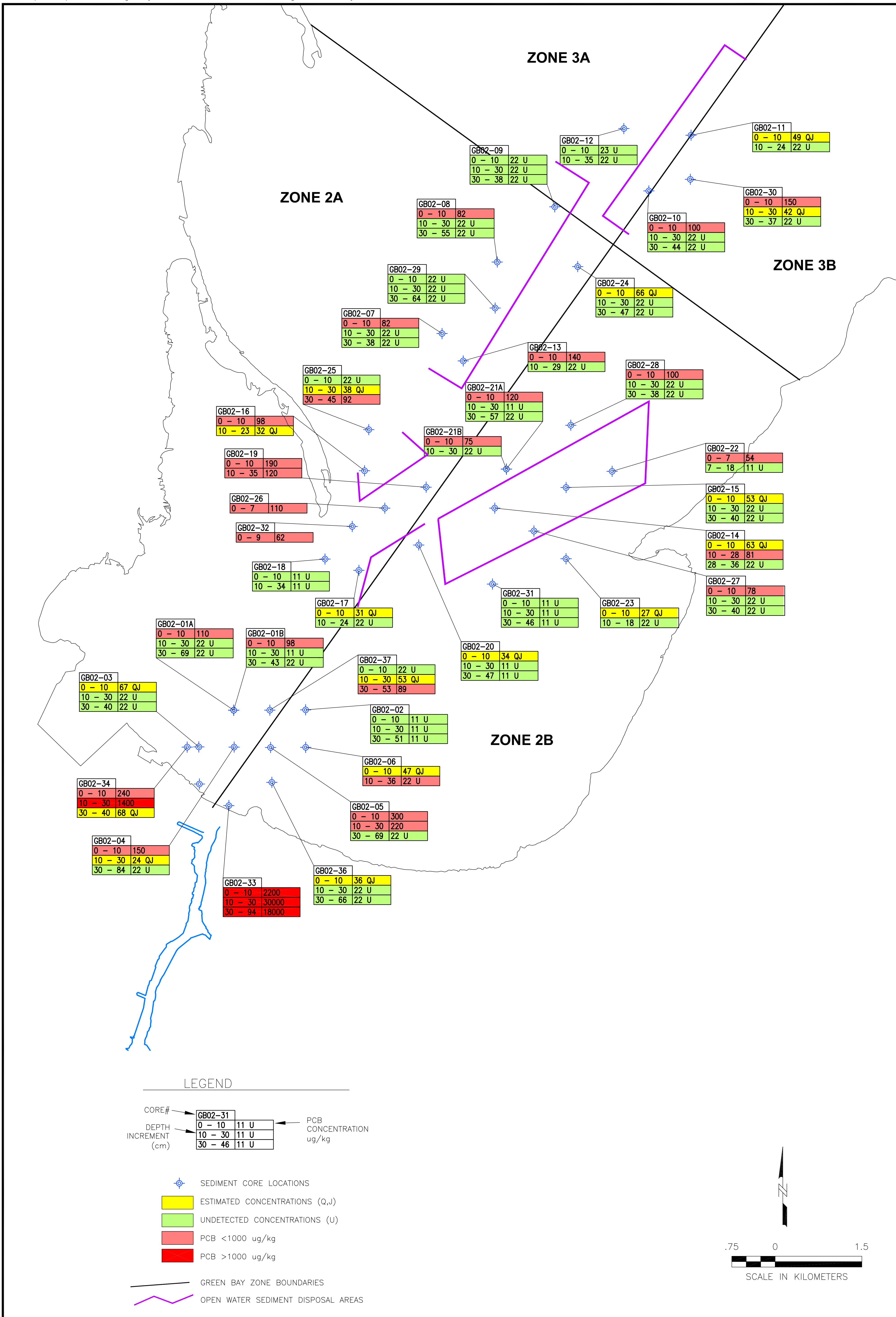
WDNR and EPA, 2001. *Proposed Remedial Action Plan, Lower Fox River and Green Bay*. Wisconsin Department of Natural Resources, Madison and Green Bay, Wisconsin and United States Environmental Protection Agency, Region 5, Chicago, Illinois. October.



RETEC

GREEN BAY Green Bay, WI (WISCN-16394-601)	SEDIMENT CORE SAMPLING LOCATIONS, JULY 2002
DATE: 05/27/03 · DRWN: SCJ · FILE: Map Document (*.mxd)	LAYOUT NAME: GB PCB Points · **FIGURE: 1**

File: H:\16040\16040S003.dwg Layout: ANSI_BVI-LJ User: astenberg Plotted: May 27, 2003 - 11:58am Xref's:



RETEC

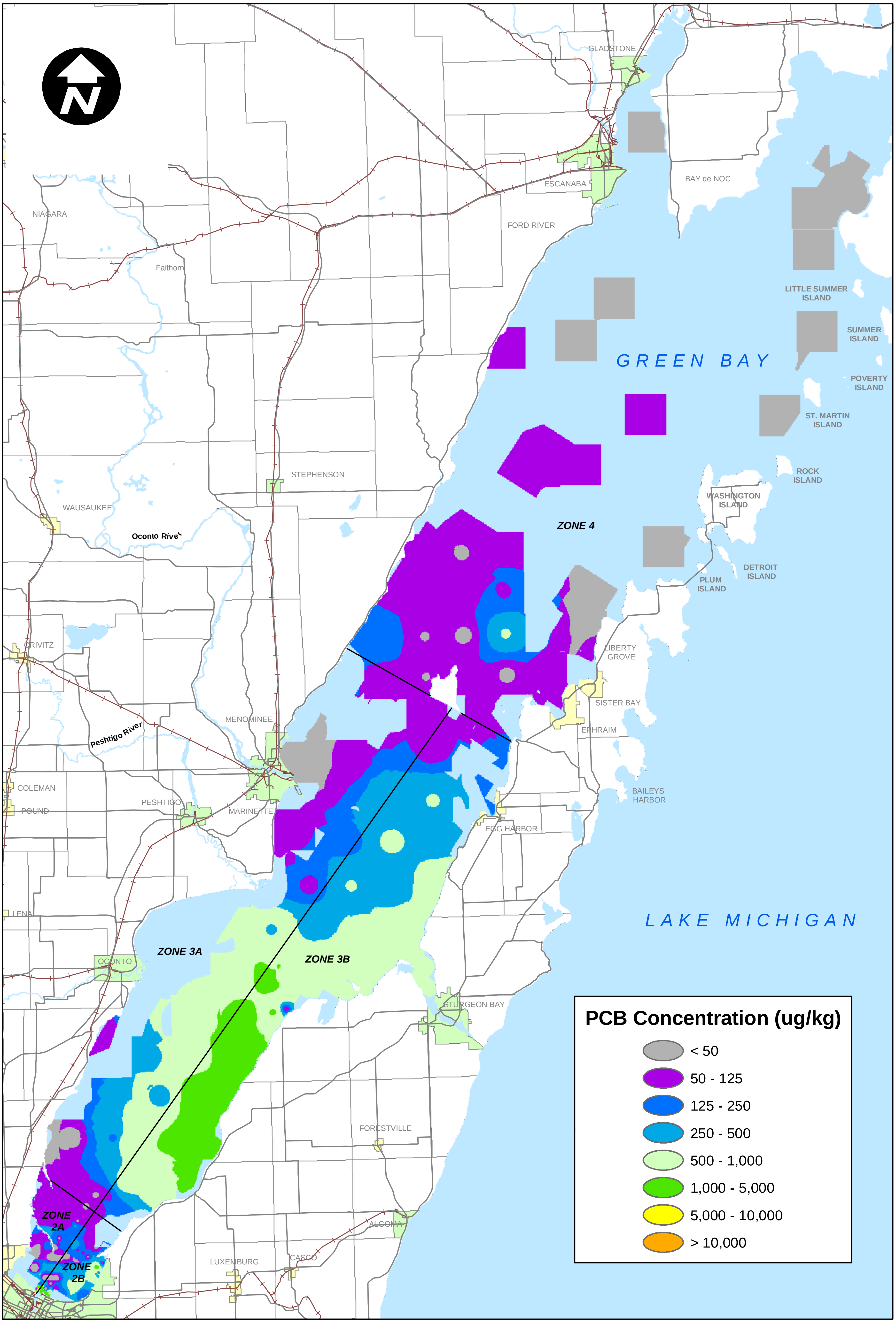
FOX RIVER

WISCN-16040-100

DATE: 03/31/03 | DRWN: A.S./SEA

GREEN BAY SEDIMENT CORE PCB CONCENTRATIONS

FIGURE 2



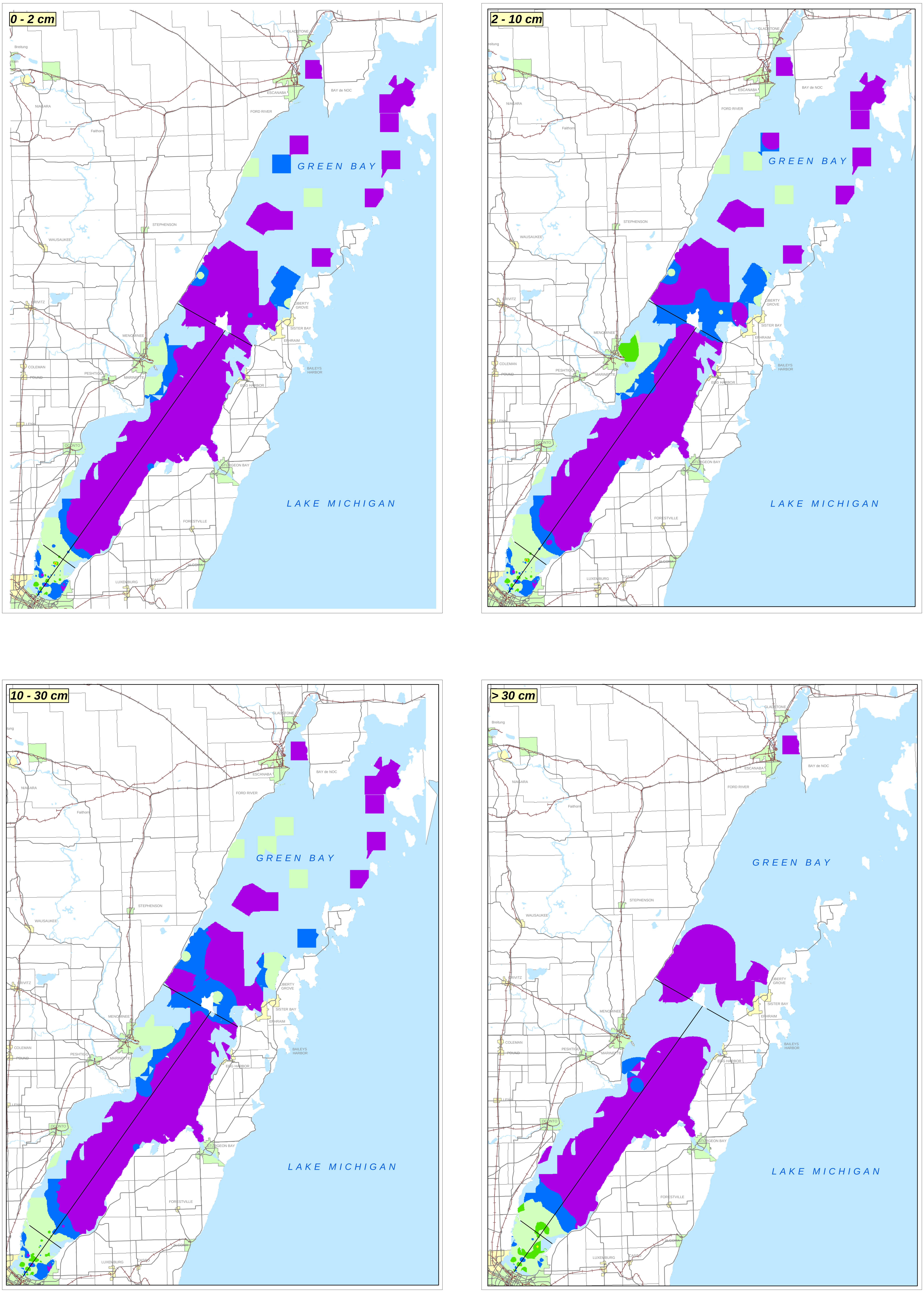
0 3.5 7 14

1" = 7 Miles

RETEC

GREEN BAY WISCN-16394-601	DISTRIBUTION OF INTERPOLATED PCB CONCENTRATIONS IN SURFACE SEDIMENTS (0-2 cm): GREEN BAY

DATE: 03/24/03 | DRWN: SCJ/SEA | FILE: GB PCB Lyr1.mxd | FIGURE: 3



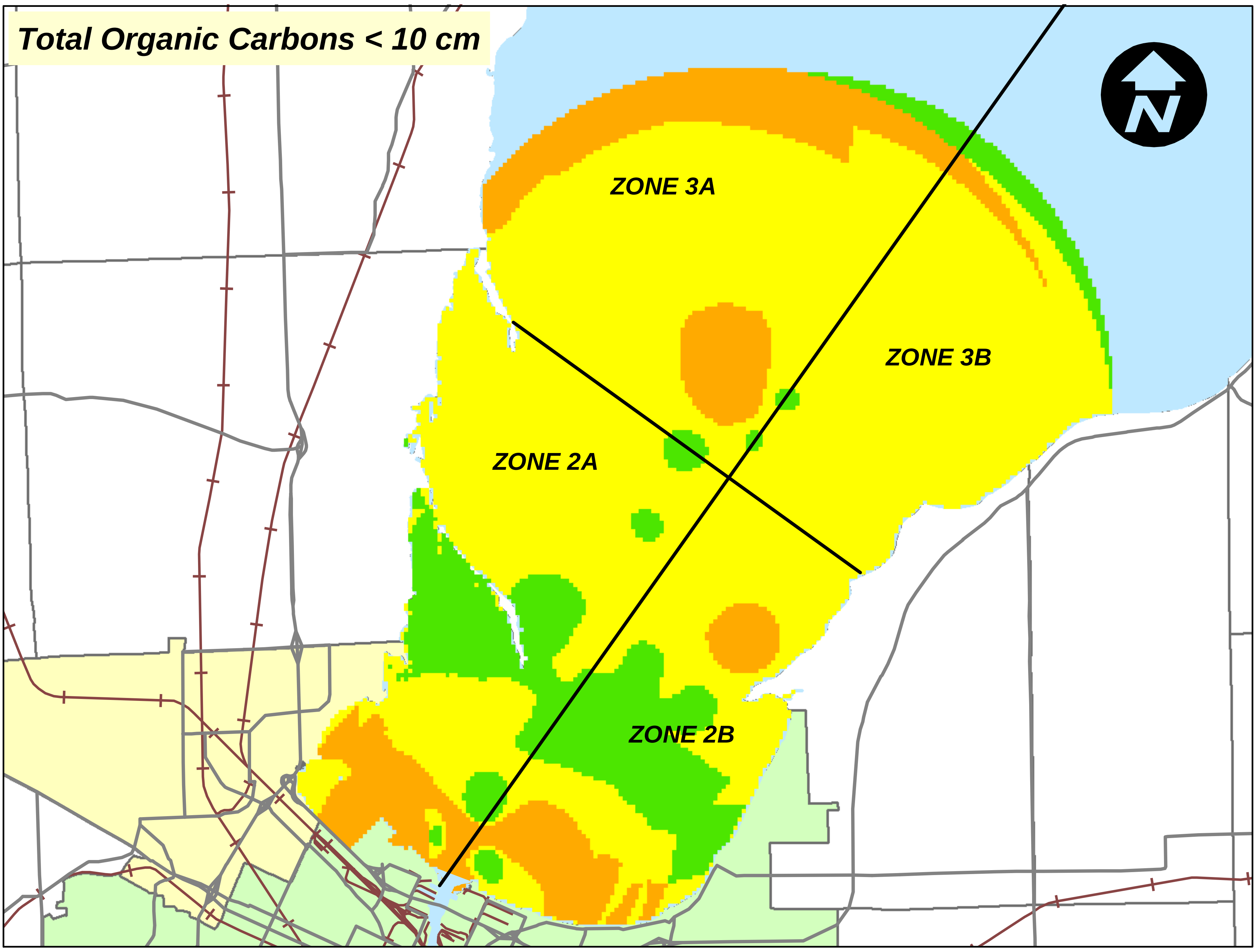
Bulk Density (g/cm^3)

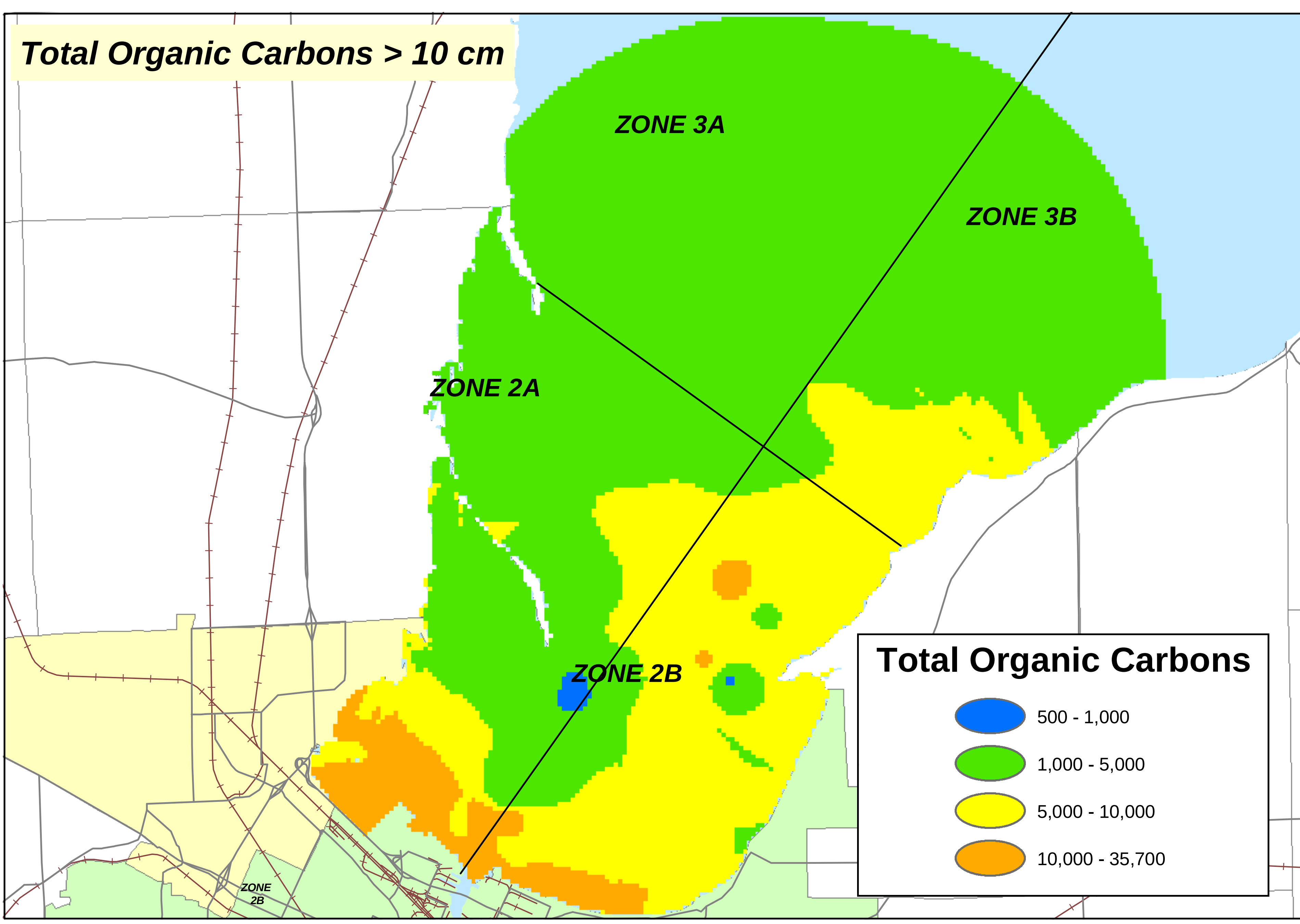
- < 0.5
- 0.5 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- 2.0 - 2.5
- 2.5 - 3.0
- > 3.0

0 5 10 20 30 40 Miles

RETEC

GREEN BAY WISCN-16394-601		BULK DENSITY IN SEDIMENTS: GREEN BAY
DATE: 05/27/03	FILE: Y:/16394/Maps/GB BD Layers.mxd	FIGURE: 4





0 5,000 10,000 20,000

1" = 10,000 Feet

RETEC

GREEN BAY WISCN-16394-601		TOTAL ORGANIC CARBONS IN SEDIMENTS: GREEN BAY	
DATE: 05/27/03	DRWN: SCJ/SEA	FILE: GB TOCs.mxd	FIGURE: 5

APPENDIX A

SEDIMENT DATA SUMMARY TABLES

Table 1 Green Bay Sediment Sampling Stations, July 2002

Station ID	Sample Date	Sample Time	Station Location (WTM NAD 83)				Water Depth (ft)
			Planned		Actual		
			Easting (ft)	Northing (ft)	Easting (ft)	Northing (ft)	
GB02-01	07/23/02	1030	2489528	269513	2489523	269512	6.5
GB02-02	07/24/02	1015	2493628	269514	2493606	269534	2.0
GB02-03	07/22/02	1115	2487530	267414	2487544	267433	3.4
GB02-04	07/22/02	1140	2489527	267414	2489548	267423	7.8
GB02-05	07/22/02	1630	2491630	267414	2491618	267399	10.4
GB02-06	07/23/02	0930	2493627	267414	2493610	267408	8.2
GB02-07	07/24/02	1530	2501347	290889	2501347	290880	18.5
GB02-08	07/24/02	1610	2504478	294935	2504478	294937	23.0
GB02-09	07/24/02	1650	2507739	298067	2507745	298068	21.0
GB02-10	07/24/02	1710	2513089	298980	2513083	298970	21.8
GB02-11	07/22/02	1410	2515437	302112	2515476	302129	22.0
GB02-12	07/22/02	1330	2511653	302503	2511665	302509	21.5
GB02-13	07/24/02	1515	2504739	289193	2502549	289325	20.0
GB02-14	07/24/02	1220	2504349	280973	2504341	280975	13.5
GB02-15	07/24/02	1305	2508394	282147	2508386	282145	16.5
GB02-16	07/22/02	1510	2496911	283060	2496950	283097	14.0
GB02-17	07/23/02	1225	2496651	277449	2496629	277446	8.4
GB02-18	07/23/02	1205	2494693	278101	2494704	278088	8.7
GB02-19	07/24/02	0925	2499651	282668	2500443	282165	19.1
GB02-20	07/24/02	0950	2500043	278884	2500025	278884	16.0
GB02-21	07/24/02	1235	2505001	283191	2504998	283191	15.8
GB02-22	07/24/02	1325	2511003	283061	2510999	283064	14.5
GB02-23	07/24/02	1150	2508394	278102	2508387	278105	4.0
GB02-24	07/24/02	1630	2509044	294674	2509047	294678	21.0
GB02-25	07/22/02	1445	2497172	285408	2497190	285427	13.0
GB02-26	07/24/02	0857	2498085	280972	2498097	280976	19.0
GB02-27	07/24/02	1205	2506567	279668	2506564	279676	12.5
GB02-28	07/24/02	1340	2508654	285671	2508654	285679	14.2
GB02-29	07/24/02	1550	2504397	292325	2504360	292327	18.5
GB02-30	07/24/02	1720	2515438	299633	2515438	299627	21.5
GB02-31	07/24/02	1130	2504219	276667	2504213	276668	7.5
GB02-32	07/24/02	0835	2496259	279928	2496250	279937	16.1
GB02-33	07/22/02	1015	2489257	264102	2489249	264101	9.2
GB02-34	07/22/02	1100	2486862	267413	2486885	267420	3.4
GB02-35	07/22/02	1040	2487582	265314	2487576	265327	2.0
GB02-36	07/22/02	1605	2491682	265413	2491688	265422	3.2
GB02-37	07/23/02	0955	2491577	269513	2491573	269516	3.2

Table 2 PCB, TOC, and Percent Solids Results for Green Bay Sediment, July 2002

Station ID	Start Depth (cm)	End Depth (cm)	Percent Solids	PCB Concentration (ug/kg)*								TOC (mg/kg)
				Aroclor 1016	Aroclor 1221	Aroclor 1232	Aroclor 1242	Aroclor 1248	Aroclor 1254	Aroclor 1260	Total	
GB02-01A-0010	0	10	73.5	22 U	22 U	22 U	110	22 U	22 U	22 U	110	8,000 J
GB02-01A-1030	10	30	59.4	22 U	22 U	22 U	22 U	22 U	22 U	22 U	22 U	14,000 J
GB02-01A-3069	30	69	50.4	22 U	22 U	22 U	22 U	22 U	22 U	22 U	22 U	17,000
GB02-01B-0010	0	10	71.4	22 U	22 U	22 U	98	22 U	22 U	22 U	98	7,900 J
GB02-01B-1030	10	30	59.3	11 U	11 U	11 U	11 U	11 U	11 U	11 U	11 U	12,000 J
GB02-01B-3043	30	43	58	22 U	22 U	22 U	22 U	22 U	22 U	22 U	22 U	19,000
GB02-02-0010	0	10	82.7	11 U	11 U	11 U	11 U	11 U	11 U	11 U	11 U	1,800 J
GB02-02-1030	10	30	80.7	11 U	11 U	11 U	11 U	11 U	11 U	11 U	11 U	2,100 J
GB02-02-3051	30	51	82.1	11 U	11 U	11 U	11 U	11 U	11 U	11 U	11 U	1,300
GB02-03-0010	0	10	83.2	22 U	22 U	22 U	67 QJ	22 U	22 U	22 U	67 QJ	1,300 J
GB02-03-1030	10	30	81.6	22 U	22 U	22 U	22 U	22 U	22 U	22 U	22 U	3,300 J
GB02-03-3040	30	40	69.2	22 U	22 U	22 U	22 U	22 U	22 U	22 U	22 U	20,000
GB02-04-0010	0	10	51.2	23 U	23 U	23 U	150	23 U	23 U	23 U	150	24,000
GB02-04-1030	10	30	47.4	23 U	23 U	23 U	24 QJ	23 U	23 U	23 U	24 QJ	20,000 J
GB02-04-3084	30	84	80.2	22 U	22 U	22 U	22 U	22 U	22 U	22 U	22 U	3,000 J
GB02-05-0010	0	10	58.7	22 U	22 U	22 U	260	22 U	36 QJ	22 U	300	14,000
GB02-05-1030	10	30	59.1	22 U	22 U	22 U	200	22 U	24 QJ	22 U	220	13,000
GB02-05-3069	30	69	71	22 U	22 U	22 U	22 U	22 U	22 U	22 U	22 U	12,000
GB02-06-0010	0	10	71.2	22 U	22 U	22 U	47 QJ	22 U	22 U	22 U	47 QJ	14,000
GB02-06-1036	10	36	74	22 U	22 U	22 U	22 U	22 U	22 U	22 U	22 U	9,100 J
GB02-07-0010	0	10	59.8	22 U	22 U	22 U	82	22 U	22 U	22 U	82	9,100 J
GB02-07-1030	10	30	76.3	22 U	22 U	22 U	22 U	22 U	22 U	22 U	22 U	4,900
GB02-07-3038	30	38	75.1	22 U	22 U	22 U	22 U	22 U	22 U	22 U	22 U	7,400 J
GB02-08-0010	0	10	62.5	22 U	22 U	22 U	82	22 U	22 U	22 U	82	7,100
GB02-08-1030	10	30	78.3	22 U	22 U	22 U	22 U	22 U	22 U	22 U	22 U	1,500 J
GB02-08-3055	30	55	82.2	22 U	22 U	22 U	22 U	22 U	22 U	22 U	22 U	760 J

Notes:
J and Q - Estimated concentrations.
U – Undetected at listed limit of detection.

Table 2 PCB, TOC, and Percent Solids Results for Green Bay Sediment, July 2002

Station ID	Start Depth (cm)	End Depth (cm)	Percent Solids	PCB Concentration (ug/kg)*								TOC (mg/kg)
				Aroclor 1016	Aroclor 1221	Aroclor 1232	Aroclor 1242	Aroclor 1248	Aroclor 1254	Aroclor 1260	Total	
GB02-09-0010	0	10	79.2	22 U	22 U	22 U	22 U	22 U	22 U	22 U	22 U	2,000
GB02-09-1030	10	30	77	22 U	22 U	22 U	22 U	22 U	22 U	22 U	22 U	2,900 J
GB02-09-3038	30	38	77.2	22 U	22 U	22 U	22 U	22 U	22 U	22 U	22 U	5,000
GB02-10-0010	0	10	70	22 U	22 U	22 U	100	22 U	22 U	22 U	100	4,000 J
GB02-10-1030	10	30	80.4	22 U	22 U	22 U	22 U	22 U	22 U	22 U	22 U	2,700 J
GB02-10-3044	30	44	79	22 U	22 U	22 U	22 U	22 U	22 U	22 U	22 U	4,900
GB02-11-0010	0	10	68.8	22 U	22 U	22 U	49 QJ	22 U	22 U	22 U	49 QJ	3,500
GB02-11-1024	10	24	77.6	22 U	22 U	22 U	22 U	22 U	22 U	22 U	22 U	3,200
GB02-12-0010	0	10	57.6	23 U	23 U	23 U	23 U	23 U	23 U	23 U	23 U	24,000 J
GB02-12-1035	10	35	82	22 U	22 U	22 U	22 U	22 U	22 U	22 U	22 U	4,700
GB02-13-0010	0	10	65.2	22 U	22 U	22 U	110	22 U	27 QJ	22 U	140	6,200
GB02-13-1029	10	29	79.2	22 U	22 U	22 U	22 U	22 U	22 U	22 U	22 U	6,300
GB02-14-0010	0	10	78.8	22 U	22 U	22 U	63 QJ	22 U	22 U	22 U	63 QJ	2,700
GB02-14-1028	10	28	79.1	22 U	22 U	22 U	81	22 U	22 U	22 U	81	3,800 J
GB02-14-2836	28	36	82.6	22 U	22 U	22 U	22 U	22 U	22 U	22 U	22 U	17,000
GB02-15-0010	0	10	75.6	22 U	22 U	22 U	53 QJ	22 U	22 U	22 U	53 QJ	6,100
GB02-15-1030	10	30	76.7	22 U	22 U	22 U	22 U	22 U	22 U	22 U	22 U	8,600 J
GB02-15-3040	30	40	79.2	22 U	22 U	22 U	22 U	22 U	22 U	22 U	22 U	10,000
GB02-16-0010	0	10	66.8	22 U	22 U	22 U	98	22 U	22 U	22 U	98	4,500
GB02-16-1023	10	23	81.3	22 U	22 U	22 U	32 QJ	22 U	22 U	22 U	32 QJ	2,600
GB02-17-0010	0	10	81.8	22 U	22 U	22 U	31 QJ	22 U	22 U	22 U	31 QJ	3,000
GB02-17-1024	10	24	83.7	22 U	22 U	22 U	22 U	22 U	22 U	22 U	22 U	870
GB02-18-0010	0	10	76.7	11 U	11 U	11 U	11 U	11 U	11 U	11 U	11 U	6,100 J
GB02-18-1034	10	34	82.2	11 U	11 U	11 U	11 U	11 U	11 U	11 U	11 U	1,100
GB02-19-0010	0	10	67.6	11 U	11 U	11 U	170	11 U	19 QJ	11 U	190	8,200 J
GB02-19-1035	10	35	73.9	11 U	11 U	11 U	110	11 U	14 QJ	11 U	120	6,200 J

Notes:
J and Q - Estimated concentrations.
U – Undetected at listed limit of detection.

Table 2 PCB, TOC, and Percent Solids Results for Green Bay Sediment, July 2002

Station ID	Start Depth (cm)	End Depth (cm)	Percent Solids	PCB Concentration (ug/kg)*								TOC (mg/kg)
				Aroclor 1016	Aroclor 1221	Aroclor 1232	Aroclor 1242	Aroclor 1248	Aroclor 1254	Aroclor 1260	Total	
GB02-20-0010	0	10	82	11 U	11 U	11 U	34 QJ	11 U	11 U	11 U	34 QJ	1,200 J
GB02-20-1030	10	30	82.1	11 U	11 U	11 U	11 U	11 U	11 U	11 U	11 U	3,100 J
GB02-20-3047	30	47	82.3	11 U	11 U	11 U	11 U	11 U	11 U	11 U	11 U	2,200
GB02-21A-0010	0	10	67.5	11 U	11 U	11 U	100	11 U	21 QJ	11 U	120	12,000
GB02-21A-1030	10	30	78.2	11 U	11 U	11 U	11 U	11 U	11 U	11 U	11 U	14,000
GB02-21A-3057	30	57	81.3	22 U	22 U	22 U	22 U	22 U	22 U	22 U	22 U	11,000 J
GB02-21B-0010	0	10	73.6	22 U	22 U	22 U	75	22 U	22 U	22 U	75	10,000
GB02-21B-1030	10	30	77.5	22 U	22 U	22 U	22 U	22 U	22 U	22 U	22 U	9,500 J
GB02-22-0007	0	7	72.4	11 U	11 U	11 U	54	11 U	11 U	11 U	54	22,000 J
GB02-22-0718	7	18	78.4	11 U	11 U	11 U	11 U	11 U	11 U	11 U	11 U	3,800 J
GB02-23-0010	0	10	85	22 U	22 U	22 U	27 QJ	22 U	22 U	22 U	27 QJ	2,900 J
GB02-23-1018	10	18	85.5	22 U	22 U	22 U	22 U	22 U	22 U	22 U	22 U	420 QJ
GB02-24-0010	0	10	69.9	22 U	22 U	22 U	66 QJ	22 U	22 U	22 U	66 QJ	8,600 J
GB02-24-1030	10	30	74.6	22 U	22 U	22 U	22 U	22 U	22 U	22 U	22 U	3,700
GB02-24-3047	30	47	82.3	22 U	22 U	22 U	22 U	22 U	22 U	22 U	22 U	6,700
GB02-25-0010	0	10	76.8	22 U	22 U	22 U	22 U	22 U	22 U	22 U	22 U	2,000
GB02-25-1030	10	30	78	22 U	22 U	22 U	38 QJ	22 U	22 U	22 U	38 QJ	1,800
GB02-25-3045	30	45	69.5	22 U	22 U	22 U	92	22 U	22 U	22 U	92	3,600
GB02-26-0007	0	7	64.1	11 U	11 U	11 U	96	11 U	12 QJ	11 U	110	5,800
GB02-27-0010	0	10	77.7	22 U	22 U	22 U	78	22 U	22 U	22 U	78	5,300
GB02-27-1030	10	30	76.4	22 U	22 U	22 U	22 U	22 U	22 U	22 U	22 U	11,000
GB02-27-3040	30	40	78.2	22 U	22 U	22 U	22 U	22 U	22 U	22 U	22 U	13,000
GB02-28-0010	0	10	67	22 U	22 U	22 U	100	22 U	22 U	22 U	100	5,000
GB02-28-1030	10	30	75.4	22 U	22 U	22 U	22 U	22 U	22 U	22 U	22 U	15,000 J
GB02-28-3038	30	38	75.8	22 U	22 U	22 U	22 U	22 U	22 U	22 U	22 U	8,900
GB02-29-0010	0	10	82	22 U	22 U	22 U	22 U	22 U	22 U	22 U	22 U	3,200 J
GB02-29-1030	10	30	79.9	22 U	22 U	22 U	22 U	22 U	22 U	22 U	22 U	7,100
GB02-29-3064	30	64	82.5	22 U	22 U	22 U	22 U	22 U	22 U	22 U	22 U	5,500

Notes:
J and Q - Estimated concentrations.
U – Undetected at listed limit of detection.

Table 2 PCB, TOC, and Percent Solids Results for Green Bay Sediment, July 2002

Station ID	Start Depth (cm)	End Depth (cm)	Percent Solids	PCB Concentration (ug/kg)*								TOC (mg/kg)
				Aroclor 1016	Aroclor 1221	Aroclor 1232	Aroclor 1242	Aroclor 1248	Aroclor 1254	Aroclor 1260	Total	
GB02-30-0010	0	10	59.5	22 U	22 U	22 U	120	22 U	27 QJ	22 U	150	7,500
GB02-30-1030	10	30	66.7	22 U	22 U	22 U	42 QJ	22 U	22 U	22 U	42 QJ	6,400
GB02-30-3037	30	37	75.2	22 U	22 U	22 U	22 U	22 U	22 U	22 U	22 U	10,000 J
GB02-31-0010	0	10	81.5	11 U	11 U	11 U	11 U	11 U	11 U	11 U	11 U	4,600 J
GB02-31-1030	10	30	81.4	11 U	11 U	11 U	11 U	11 U	11 U	11 U	11 U	9,000
GB02-31-3046	30	46	81.4	11 U	11 U	11 U	11 U	11 U	11 U	11 U	11 U	8,300 J
GB02-32-0009	0	9	77.3	11 U	11 U	11 U	62	11 U	11 U	11 U	62	2,800
GB02-33-0010	0	10	69.1	110 U	110 U	110 U	1,900	110 U	260 QJ	110 U	2,200	14,000
GB02-33-1030	10	30	40.3	2,300 U	2,300 U	2,300 U	30,000	2,300 U	2,300 U	2,300 U	30,000	30,000
GB02-33-3094	30	94	39.2	1,100 U	1,100 U	1,100 U	18,000	1,100 U	1,100 U	1,100 U	18,000	41,000
GB02-34-0010	0	10	57.4	22 U	22 U	22 U	210	22 U	29 QJ	22 U	240	16,000
GB02-34-1030	10	30	63.8	130 U	130 U	130 U	1,400	130 U	130 U	130 U	1,400	18,000
GB02-34-3040	30	40	71.8	22 U	22 U	22 U	68 QJ	22 U	22 U	22 U	68 QJ	7,100 J
GB02-36-0010	0	10	86.3	22 U	22 U	22 U	36 QJ	22 U	22 U	22 U	36 QJ	2,600 J
GB02-36-1030	10	30	84.4	22 U	22 U	22 U	22 U	22 U	22 U	22 U	22 U	2,500 J
GB02-36-3066	30	66	69	22 U	22 U	22 U	22 U	22 U	22 U	22 U	22 U	18,000
GB02-37-0010	0	10	83.1	22 U	22 U	22 U	22 U	22 U	22 U	22 U	22 U	1,100 J
GB02-37-1030	10	30	82.3	22 U	22 U	22 U	53 QJ	22 U	22 U	22 U	53 QJ	1,500
GB02-37-3053	30	53	81.8	22 U	22 U	22 U	89	22 U	22 U	22 U	89	1,300

Notes:
J and Q - Estimated concentrations.
U – Undetected at listed limit of detection.

Table 3 Bulk Density Results for Green Bay Sediment, July 2002

Station ID	Wet Density (lbs/cf)	Dry Weight Basis		Wet Weight Basis	
		% water	Dry Density (lbs/cf)	% water	Dry Density (lbs/cf)
GB02-01A-0010	97.3	37.2	70.9		
GB02-01A-1030	88.5	70	52		
GB02-01A-3069	90.3	142.8	37.2	58.8	56.9
GB02-01B-0010	113.8	39.9	81.4		
GB02-01B-1030	92.5	71.9	53.8		
GB02-01B-3043	100.7	70.5	59		
GB02-02-0010	98.4	23.7	79.6		
GB02-02-1030	131.4	24.1	106		
GB02-02-3051	133.9	21.9	109.8		
GB02-03-0010	114.2	22.4	93.4		
GB02-03-1030	128.6	30.3	98.7		
GB02-03-3040	131.5	42.8	92.1		
GB02-04-0010	67.7	95.3	34.7		
GB02-04-1030	76.8	120.1	34.9	54.6	49.7
GB02-04-3084	99.9	105.9	48.5	51.4	66
GB02-05-0010	72.2	81.1	39.9		
GB02-05-1030	101.8	71	59.5		
GB02-05-3069	118.1	43.9	82.1		
GB02-06-0010	98.7	41.2	69.9		
GB02-06-1036	103.9	38.2	75.2		
GB02-07-0010	93.4	53.6	60.8		
GB02-07-1030	108.1	35.1	80.1		
GB02-07-3038	104.8	32.4	79.2		
GB02-08-0010	97.7	48.9	65.6		
GB02-08-1030	128.5	25.9	102		
GB02-08-3055	115.5	24	93.2		
GB02-09-0010	125.9	25.4	100.4		
GB02-09-1030	116.2	28.2	90.7		
GB02-09-3038	126.4	30.1	97.2		
GB02-10-0010	116	36.9	84.7		
GB02-10-1030	120.6	23.8	97.5		
GB02-10-3044	104.5	25.8	83		
GB02-11-0010	76.7	36.4	56.3		
GB02-11-1024	50.8	29	39.4		
GB02-12-0010	110.9	36.6	81.2		
GB02-12-1035	126.3	21.8	103.7		
GB02-13-0010	105.7	48.2	71.3		
GB02-13-1029	132	26.2	104.6		
GB02-14-0010	105.6	27	83.1		
GB02-14-1028	98.9	25	79.1		
GB02-14-2836	137.1	25.4	109.3		
GB02-15-0010	126.7	32.8	95.4		
GB02-15-1030	137.2	29.1	106.2		
GB02-15-3040	118.5	26.2	93.9		
GB02-16-0010	113.3	41.2	80.2		
GB02-16-1023	133.3	24.3	107.4		
GB02-17-0010	145.1	22.9	118.1		
GB02-17-1024	116.1	22.9	95.1		
GB02-18-0010	95.9	24	77.3		
GB02-18-1034	112.9	18.9	94.6		
GB02-19-0010	90.1	48.9	60.5		
GB02-19-1035	112.6	36.9	82.2		

Table 3 Bulk Density Results for Green Bay Sediment, July 2002

Station ID	Wet Density (lbs/cf)	Dry Weight Basis		Wet Weight Basis	
		% water	Dry Density (lbs/cf)	% water	Dry Density (lbs/cf)
GB02-20-0010	107.8	22.4	88		
GB02-20-1030	129.6	22.5	105.8		
GB02-20-3047	142	22.4	116		
GB02-21A-0010	116.4	34	86.9		
GB02-21A-1030	110.4	30.7	84.4		
GB02-21A-3057	127	23.6	102.7		
GB02-21B-0010	117.4	39.1	84.4		
GB02-21B-1030	109.7	31.2	83.6		
GB02-22-0007	94	33.8	70.2		
GB02-22-0718	137	27.8	107.2		
GB02-23-0010	129.9	15.6	112.3		
GB02-23-1018	107.3	14.9	93.4		
GB02-24-0010	103.7	42.7	72.7		
GB02-24-1030	116.6	34.1	87		
GB02-24-3047	118.4	22.8	96.5		
GB02-25-0010	102.2	29.7	78.9		
GB02-25-1030	107.9	29.1	83.5		
GB02-25-3045	111	25.3	88.6		
GB02-26-0007	73.8	46.2	50.5		
GB02-27-0010	119.7	29.9	92.1		
GB02-27-1030	117.9	26.7	93		
GB02-27-3040	131	29.4	101.3		
GB02-28-0010	84.8	40.4	60.4		
GB02-28-1030	94	33.7	70.3		
GB02-28-3038	185.1	32.7	139.5		
GB02-29-0010	240.9	21	199.1		
GB02-29-1030	103.9	25.8	82.5		
GB02-29-3064	58.5	26.3	46.4		
GB02-30-0010	85.8	15	74.6		
GB02-30-1030	91.5	45.9	62.7		
GB02-30-3037	132.2	31.4	100.6		
GB02-31-0010	119.7	23.4	97		
GB02-31-1030	116.2	22.7	94.7		
GB02-31-3046	138.2	24.5	111		
GB02-32-0009	105	30.3	80.5		
GB02-33-0010	66.6	71.2	38.9		
GB02-33-1030	67.3	165.5	25.3	62.3	41.5
GB02-33-3094	78.8	150.9	31.4	60.1	49.2
GB02-34-0010	82.2	69.8	48.4		
GB02-34-1030	105.5	64.2	64.2		
GB02-34-3040	123.6	34.4	91.9		
GB02-36-0010	98.2	17.4	83.7		
GB02-36-1030	108.9	19.2	91.4		
GB02-36-3066	83.9	63.7	51.3		
GB02-37-0010	134.2	21.1	110.9		
GB02-37-1030	121.5	21.6	99.9		
GB02-37-3053	105.5	18.7	88.9		

APPENDIX B

CD DIRECTORY LIST AND DATA CD

CD DIRECTORY LIST

CD:\readme.txt

CD:\Shapefiles\greenbay.dbf
CD:\Shapefiles\greenbay.prj
CD:\Shapefiles\greenbay.sbn
CD:\Shapefiles\greenbay.sbx
CD:\Shapefiles\greenbay.shp
CD:\Shapefiles\greenbay.shp.xml
CD:\Shapefiles\greenbay.shx
CD:\Shapefiles\southbay.dbf
CD:\Shapefiles\southbay.prj
CD:\Shapefiles\southbay.shp
CD:\Shapefiles\southbay.shx
CD:\Shapefiles\zoneclip.dbf
CD:\Shapefiles\zoneclip.prj
CD:\Shapefiles\zoneclip.shp
CD:\Shapefiles\zoneclip.shx

CD:\Tables\2002 RETEC Green Bay Sediment Sampling Data.mdb
CD:\Tables\bd1.dbf
CD:\Tables\bd2.dbf
CD:\Tables\bd3.dbf
CD:\Tables\bd4.dbf
CD:\Tables\gbpcb1.dbf
CD:\Tables\gbpcb2.dbf
CD:\Tables\gbpcb3.dbf
CD:\Tables\gbpcb4.dbf
CD:\Tables\MUV1.dbf
CD:\Tables\MUV2.dbf
CD:\Tables\MUV3.dbf
CD:\Tables\MUV4.dbf
CD:\Tables\MUV5.dbf
CD:\Tables\toc_0_2cm.dbf
CD:\Tables\toc_2_4cm.dbf
CD:\Tables\toc_4_6cm.dbf
CD:\Tables\toc_6_10cm.dbf
CD:\Tables\toc_gr_10cm.dbf

White Paper No. 20 – Green Bay Modeling
Evaluation of the Effects of Sediment PCB Bed Map Revisions on GBTOXe Model Results

Response to Comments on the

Remedial Investigation for the Lower Fox River and Green Bay, Wisconsin, Feasibility Study for the Lower Fox River and Green Bay, Wisconsin, Proposed Remedial Action Plan for the Lower Fox River and Green Bay, and Record of Decision for Operable Unit 1 and Operable Unit 2

This Document has been Prepared by

HydroQual, Inc.

for the

Wisconsin Department of Natural Resources

Madison, Wisconsin

June 2003

WHITE PAPER NO. 20 – GREEN BAY MODELING EVALUATION OF THE EFFECTS OF SEDIMENT PCB BED MAP REVISIONS ON GBTOXE MODEL RESULTS

ABSTRACT

During the public comment period for the *Final Remedial Investigation for the Lower Fox River and Green Bay, Wisconsin* (RI) (RETEC, 2002a), the *Final Feasibility Study for the Lower Fox River and Green Bay, Wisconsin* (FS) (RETEC, 2002b) and the *Proposed Remedial Action Plan, Lower Fox River and Green Bay* (Proposed Plan) (WDNR and EPA, 2001), several commenters expressed concern about mass and volume estimates for total polychlorinated biphenyls (PCBs) in Operable Unit (OU) 5, Green Bay. The Agencies' original PCB mass estimates were based upon 100-year simulations using a model, GBTOXe (HydroQual, 2001). Since the original model evaluation, new data have been collected and original sediment bed maps revised. With these new data and bed map revisions, the GBTOXe 25-year model simulations were rerun, and results analyzed. These initial condition changes affected the simulations results as follows:

- Lowered the carbon-normalized PCB sediment mass estimates for all three layers (0 to 2, 2 to 4, and 4 to 10 centimeters [cm]) in zones 2, 3A, and 3B with the greatest difference occurring in Zone 2.
- Lowered the estimate for the 0- to 2-cm layer for Zone 4.
- Increased the carbon-normalized PCB sediment mass estimate for the 4- to 10-cm layer for Zone 4.
- Did not appreciably affect the predicted rate of change over time (both simulations show a decrease over time, slowly until year 10, with the rate slowing until year 20, and then with a level steady state).
- Lowered the water column dissolved PCB concentrations estimates appreciably in Zone 2, but less so in Zone 3A.
- While both water column concentration simulations showed a decrease over time, the rate of change differed overall.

Finally, recalibration of the GBTOXe model based on the alternative PCB mass estimates may reduce the differences between water column PCB concentrations computed in the two scenarios.

This white paper is submitted in response to comments as a component of the Responsiveness Summary for OUs 3, 4, and 5 and Responsiveness Summary for OUs 1 and 2 (released in January of 2003).

1 INTRODUCTION

In June 2001, HydroQual completed a series of 100-year simulations of PCB fate and transport in Green Bay as part of the Green Bay Remedial Investigation and Feasibility

Study (RI/FS) conducted by the Wisconsin Department of Natural Resources (WDNR). In that effort, bed maps of various sediment bed properties were developed as part of Task 2F (WDNR, 2000). Those bed maps were used to generate initial conditions for the GBTOXe model. Since the development of the Task 2F bed maps, decisions were made to exclude particular data previously included and additional sediment property data were obtained and incorporated by WDNR into revised bed maps yielding an alternative sediment PCB mass estimate. These alternative PCB bed maps are presented in *White Paper No. 19 – Estimates of PCB Mass, Sediment Volume, and Surface Sediment Concentrations in Operable Unit 5, Green Bay Using an Alternative Approach*. GBTOXe was used to assess the effect of this sediment PCB mass difference in Green Bay. A 25-year GBTOXe simulation has been performed with inputs derived from the revised bed maps, and the results of this simulation have been compared to the results of the original simulation, in which inputs were based on the previous bed maps. Discussions of the method of analysis and results follow.

2 METHODS

WDNR provided HydroQual with the revised bed maps for PCBs and dry bulk density (with concentrations expressed on a mass per volume basis). These bed maps were prepared for sediment depth intervals of 0 to 2, 2 to 4, 4 to 6, 6 to 10, and greater than 10 cm. The upper two (0 to 2, 2 to 4 cm) GBTOXe sediment layers correspond directly to bed map layers, however, GBTOXe sediment layer 3 (4 to 10 cm) encompasses the interval covered by two bed map layers. Therefore, ArcView spatial analyst was used to generate a 4- to 10-cm layer by taking the depth-weighted average of bed map layers 3 and 4 (4 to 6 cm and 6 to 10 cm, respectively). No modifications were performed on the dry bulk density bed maps because they were provided at depth-intervals corresponding to GBTOXe's sediment segment depths. Revised particulate detrital carbon (PDC) bed maps were generated as the product of the original total organic carbon (TOC) grids and revised dry bulk density grids. The sediment PCB mass inventory associated with the revised bed maps is 14,603 kilograms (kg) in contrast to 70,000 kg from the original bed maps.

To generate sediment concentrations for each GBTOXe sediment segment, the PCB, dry bulk density, and PDC bed maps were overlaid on the GBTOXe model grid. ArcView spatial analyst was then used to compute the spatial averages across the GBTOXe cell surface areas. The method for incorporating the alternative sediment PCB mass inventory into the GBTOXe modeling framework was the same as that performed for the RI/FS. The bottom sediment layer depth was adjusted such that the product of all sediment segment volumes and their corresponding PCB concentration (i.e., the initial condition concentrations extracted from the bed maps) summed to the total mass inventory of the bed maps. The bottom sediment layer depth that approximates the alternative mass inventory of 14,603 kg for the entire sediment bed was computed as 3 cm in contrast to 21 cm used for the original RI/FS. PCB loadings were based on the first 25 years of the no-action RI/FS projection run (i.e., no remedial action for either Green Bay or the Lower Fox River).

3 RESULTS

PCB results from both the original RI/FS and alternative mass 25-year scenarios were annually averaged and plotted for comparison. Figures 1 through 3 are comparisons of the annually averaged carbon-normalized PCB concentrations in sediment layers 0 to 2, 2 to 4, and 4 to 10 from both scenarios. These figures show that the carbon-normalized sediment PCB concentrations from the alternative mass scenario are lower in zones 2, 3A, and 3B in all three layers and the 0- to 2-cm layer of Zone 4. By contrast, the Zone 4 concentrations at 2 to 4 cm show no appreciable difference, and at the 4- to 10-cm depth interval, the alternative mass scenario concentrations are higher than concentrations from the original RI/FS scenario. With time, both scenarios show concentrations decreasing slowly until about year 10. After year 10, concentrations decrease more slowly than in the first 10 years and then tend to approach a level state.

Figure 4 presents a comparison of the annually averaged dissolved PCB concentrations from the original RI/FS and alternative mass scenarios for each GBFood zone. The dissolved PCB concentrations from both simulations tend to decrease slowly with time. The concentration profiles from the alternative mass scenario for zones 3A, 3B, and 4 are initially lower by 14 to 17 percent at year 1. With time, the differences increase to over 60 percent by the end of the simulation period, but at lower concentrations. The alternative mass scenario concentrations in Zone 2, however, are initially lower by 40 percent. In contrast to the other zones, the difference tends to remain relatively constant with time, increasing slowly to 60 percent by the end of the simulation period. As a consequence of the alternative sediment PCB mass estimate, concentrations in Zone 2 are more comparable to the concentrations in zones 3A, 3B, and 4 (from either scenario since the concentrations in these zones do not differ much), and yields a more homogeneous distribution of water column PCB concentrations throughout the Bay. The table below presents a summary of the percent reduction in water column dissolved PCB concentration by zone in response to the alternative mass estimate.

TABLE 1 PERCENT REDUCTION OF WATER COLUMN DISSOLVED PCB CONCENTRATIONS (VOLUME BASED) IN RESPONSE TO ALTERNATIVE SEDIMENT PCB MASS ESTIMATE

Zone	Year					
	1	5	10	15	20	25
Zone 2	44.2	56.8	62.3	68.6	68.4	68.9
Zone 3A	17.3	44.1	53.4	58.4	60.2	60.6
Zone 3B	13.4	43.0	53.7	58.9	60.9	61.2
Zone 4	13.7	29.0	33.7	35.2	35.5	33.8

4 DISCUSSION

While the sediment PCB concentrations of the alternative mass scenario tend to be lower in all zones, the greatest difference occurs in Zone 2. The differences in GBTOXe output for the two mass estimates show up to 60 percent for the sediment layers of Zone 2 and 20 to 30 percent for Zone 3A. By contrast, the initial differences shown for the sediment layers of zones 3B and 4 range from 1 to 8 percent, with the exception of layer 4 to 10 cm of Zone 4 where the alternative mass scenario concentrations are consistently higher by 40 percent. Given the large surface area of Zone 4, this difference reflects a substantial increase in buried PCBs in the northern region of the Bay compared to the sediment PCB distribution in the original RI/FS. The differences associated with Zone 4 remain virtually unchanged over time because most of Zone 4 sediments are characterized as hardpan where there is little or no mass transfer between the water column and surface sediments, or between sediment layers.

A general conclusion from this effort is that the alternative mass estimate derived from the revised bed maps introduces new initial conditions, which appear to be substantially lower in Zone 2 (and to a lesser extent, Zone 3A). The lower initial condition in Zone 2 results in reduced Zone 2 concentrations relative to the original RI/FS scenario that are more consistent with those computed for zones 3A, 3B, and 4 over the course of the simulation period. While there are substantial differences between the concentrations computed in these two scenarios, it is noted that these are due only to the differences in sediment initial conditions based on the alternative PCB mass estimates. As discussed in *White Paper No. 19 – Estimates of PCB Mass, Sediment Volume, and Surface Sediment Concentrations in Operable Unit 5, Green Bay Using an Alternative Approach*, the alternate bed maps are considered to be a lower-bound estimate for PCB mass in Green Bay. By consequence, then, the results presented in this white paper may be interpreted as being a lower-bound transport estimate of PCBs.

It should be noted that the analysis did not include an effort to recalibrate GBTOXe based on the alternative PCB mass estimates. It is reasonable to assume that a recalibration of GBTOXe would reduce the differences between water column PCB concentrations computed in the two scenarios.

5 References

HydroQual, 2001. *Enhancement and Application of a PCB Fate and Transport Model for Green Bay: Lower Fox River/Green Bay Remedial Investigation and Feasibility Study*. Prepared for Wisconsin Department of Natural Resources by HydroQual, Inc. June.

RETEC, 2002a. *Final Remedial Investigation for the Lower Fox River and Green Bay, Wisconsin*. Prepared for Wisconsin Department of Natural Resources by The RETEC Group, Inc., St. Paul, Minnesota. December.

RETEC, 2002b. *Final Feasibility Study for the Lower Fox River and Green Bay, Wisconsin*. Prepared for Wisconsin Department of Natural Resources by The RETEC Group, Inc., Seattle, Washington. December.

WDNR, 2000. *Technical Memorandum 2f: Estimation of Sediment Bed Properties for Green Bay*. Wisconsin Department of Natural Resources, Madison, Wisconsin. December 15.

WDNR and EPA, 2001. *Proposed Remedial Action Plan, Lower Fox River and Green Bay*. Wisconsin Department of Natural Resources, Madison and Green Bay, Wisconsin and United States Environmental Protection Agency, Region 5, Chicago, Illinois. October.

WDNR and RETEC, 2002. *Final Model Documentation Report for the Lower Fox River and Green Bay, Wisconsin*. Wisconsin Department of Natural Resources and The RETEC Group, Inc., Seattle, Washington. December.

FIGURE 1 RI/FS NO-ACTION SCENARIO RESPONSE TO ALTERNATIVE SEDIMENT PCB MASS ESTIMATE, ANNUAL AVERAGED SEDIMENT PCBS 0–2 CM

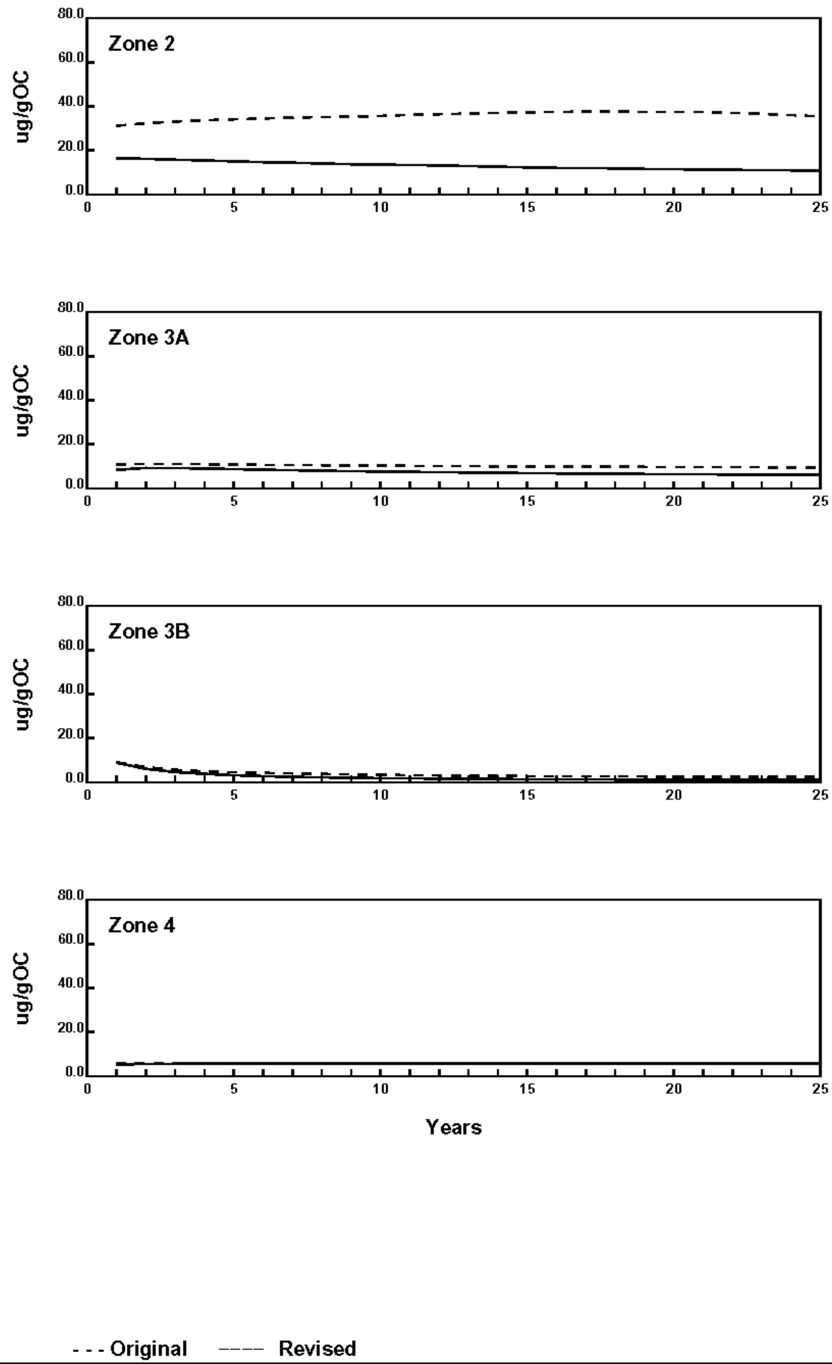


FIGURE 2 RI/FS NO-ACTION SCENARIO RESPONSE TO ALTERNATIVE SEDIMENT PCB MASS ESTIMATE, ANNUAL AVERAGED SEDIMENT PCBS 2–4 CM

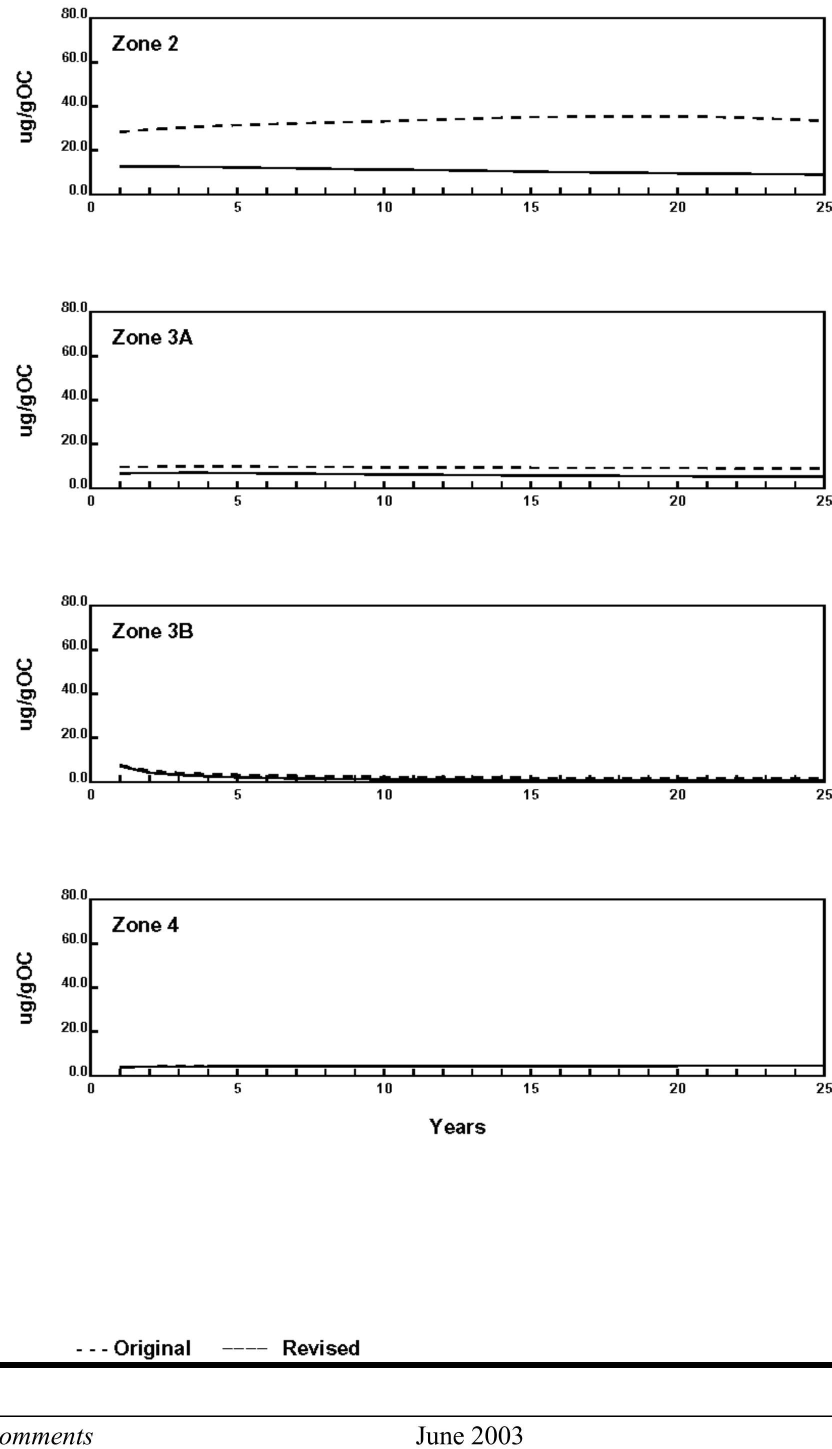


FIGURE 3 RI/FS NO-ACTION SCENARIO RESPONSE TO ALTERNATIVE SEDIMENT PCB MASS ESTIMATE, ANNUAL AVERAGED SEDIMENT PCBS 4–10 CM

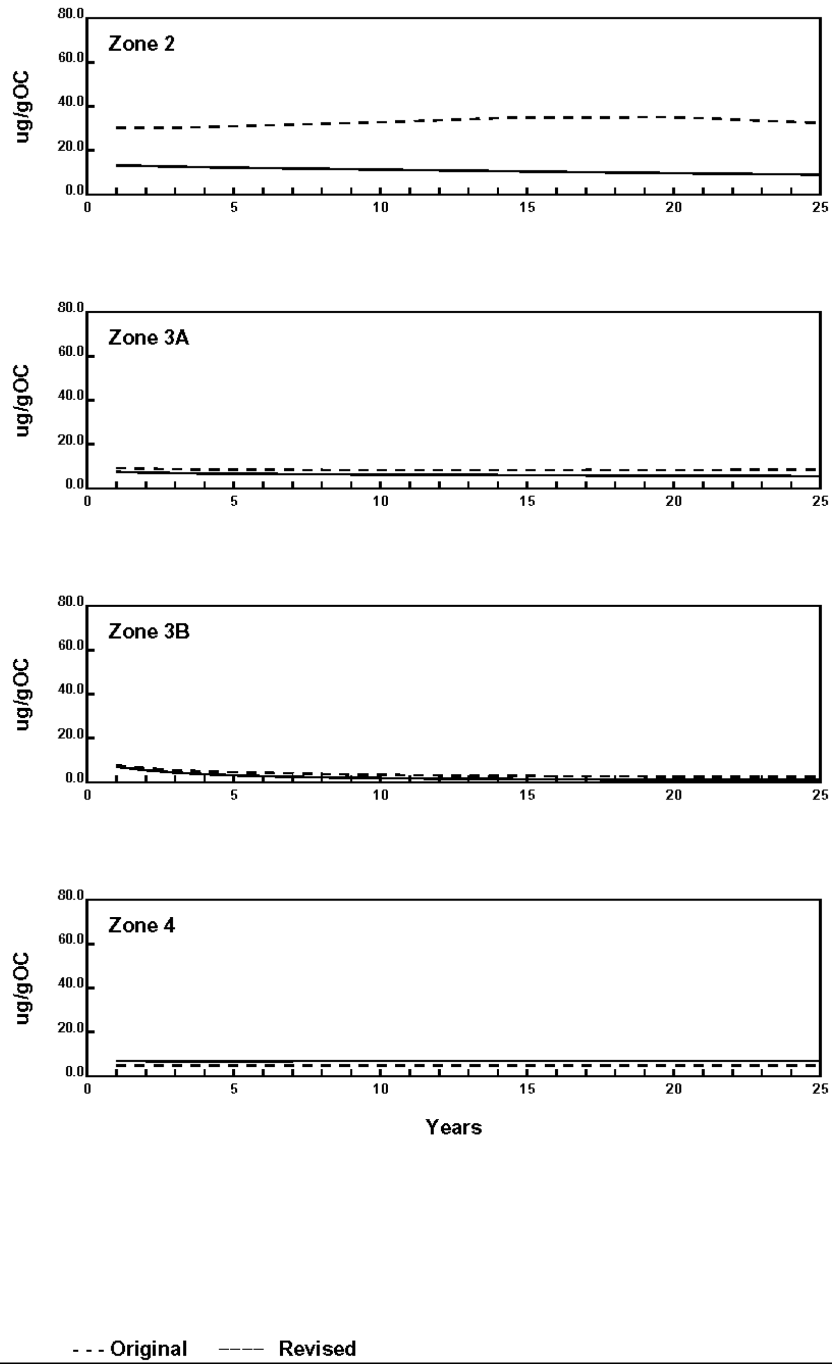
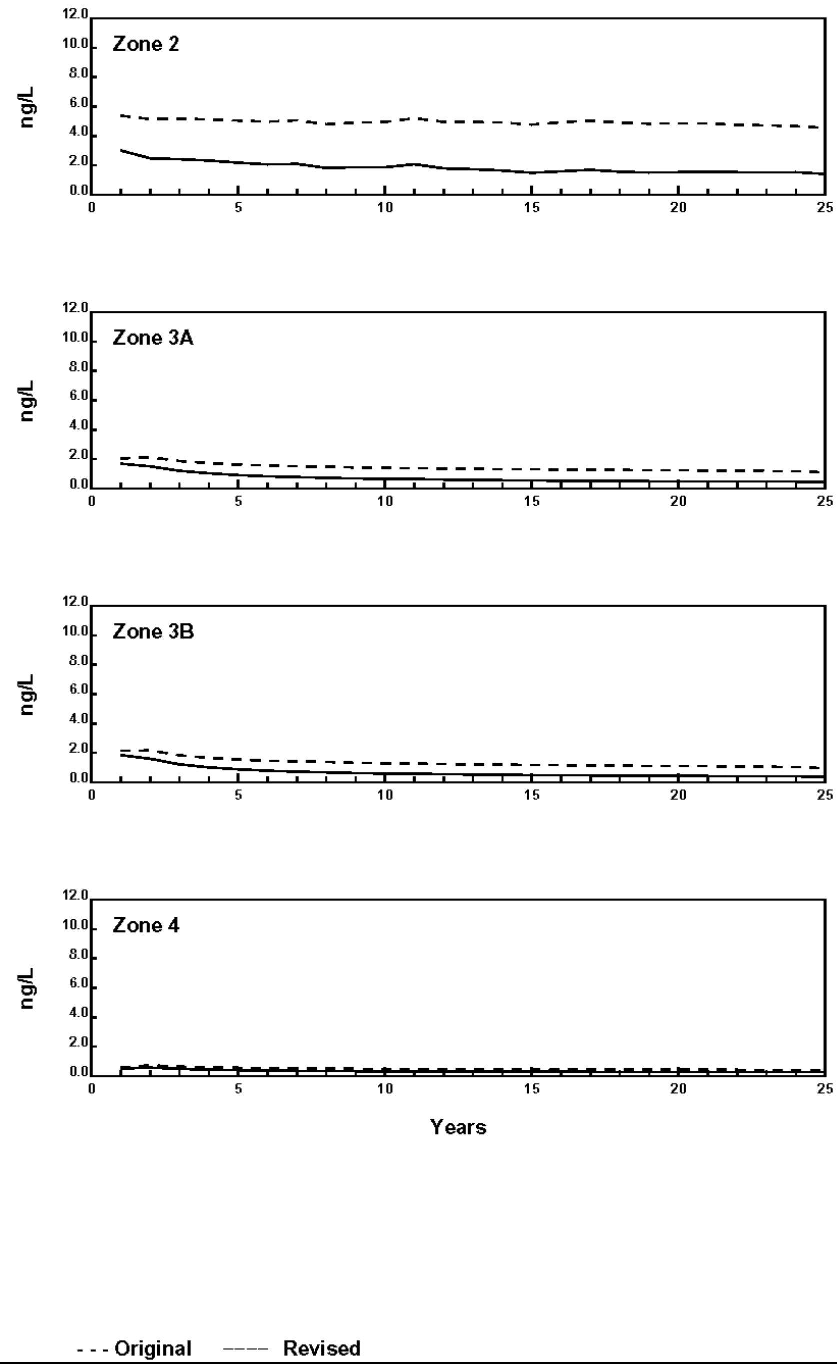


FIGURE 4 RI/FS NO-ACTION SCENARIO RESPONSE TO ALTERNATIVE SEDIMENT PCB MASS ESTIMATE, ANNUAL AVERAGED DISSOLVED PCBS IN WATER COLUMN



White Paper No. 21 – Green Bay Modeling
Evaluation of a Hypothetical Open-Water Disposal Site for Navigational Dredged Material in Southern Green Bay

Response to Comments on the

Remedial Investigation for the Lower Fox River and Green Bay, Wisconsin, Feasibility Study for the Lower Fox River and Green Bay, Wisconsin, Proposed Remedial Action Plan for the Lower Fox River and Green Bay, and Record of Decision for Operable Unit 1 and Operable Unit 2

This Document has been Prepared by
HydroQual, Inc.
for the
Wisconsin Department of Natural Resources
Madison, Wisconsin

June 2003

WHITE PAPER NO. 21 – GREEN BAY MODELING
EVALUATION OF A HYPOTHETICAL OPEN-WATER DISPOSAL SITE FOR NAVIGATIONAL DREDGED MATERIAL IN SOUTHERN GREEN BAY

ABSTRACT

This white paper was prepared in response to comments raised during the public comment period for the *Final Remedial Investigation for the Lower Fox River and Green Bay, Wisconsin* (RI) (RETEC, 2002a), the *Final Feasibility Study for the Lower Fox River and Green Bay, Wisconsin* (FS) (RETEC, 2002b) and the *Proposed Remedial Action Plan, Lower Fox River and Green Bay* (Proposed Plan) (WDNR and EPA, 2001). Commenters expressed concern that sediments dredged to maintain navigational channels in the past were disposed of either as side-cast to the navigation channels, or were placed in open-water disposal areas in southern Green Bay. Since those areas had not been previously sampled for polychlorinated biphenyls (PCBs), there was the potential to encounter high concentrations, and that those areas continued to serve as a PCB reservoir, contaminating other parts of the Bay.

To address this concern, hypothetical modeling scenarios were constructed that assumed that PCB concentrations within a dredged material disposal site area at both 10 parts per million (ppm) (micrograms per gram [µg/g] solid) and 1 ppm, respectively, with 1 ppm representing the post-remediation scenario. GBTOXe was run to determine how Bay-wide surface sediment concentrations might change over time with and without remedial action in the River for the hypothetical dredged material disposal site.

Using the GBTOXe fate and transport model, the results of this evaluation indicate that the sediment located at dredged material disposal sites redistribute to other zones. The results from analysis of long-term PCB mass transfer indicated that 71 percent of the PCB mass would be redistributed from the deposit site to other locations, and that the resultant sediment concentrations would not be significantly different after 10 years.

1 INTRODUCTION

In a post evaluation of the Remedial Investigation/Feasibility Study (RI/FS) modeling efforts of PCB fate and transport in Green Bay, interest was raised over the possibility that open-water disposal of sediments dredged to maintain navigational channels of southern Green Bay may cause elevated sediment PCB concentrations at the locations that receive the dredged material. To address this issue, the Green Bay PCB fate and transport model, GBTOXe, was used to evaluate the Bay-wide effects of a hypothetical dredged material disposal site in southern Green Bay. The model was used to compare a no remedial action scenario and post-action scenario. The Wisconsin Department of Natural Resources (WDNR) specified the no action and post-action PCB concentrations within the dredged material disposal site area to be 10 ppm (µg/g solid) and 1 ppm, respectively. The Lower Fox River loading was specified to correspond to the 1 ppm remedial action level scenario of the RI/FS. Two 100-year GBTOXe simulations were performed to show how Bay-wide surface sediment concentrations change over time with and without remedial action at the hypothetical dredged material disposal site.

2 METHODS

The site selected by WDNR for this hypothetical analysis is a dredged material disposal site located east of the navigational channel that extends to the shore of Green Bay by Point Au Sable as shown on Figure 1. In terms of the GBTOXe model grid, this location is approximated as the surface and subsurface sediment cells that underlie water column cell 48, which is within the Zone 2 region. The gray area of Figure 2 presents the location of this grid cell within model domain. The affected surface area is 12 square kilometers (3 percent of the total surface area of Zone 2), and represents the sediment area to which the no action and post-action initial condition concentrations were applied.

PCB load and initial conditions for both simulations were based on the RI/FS 100-year simulation with Green Bay and the Lower Fox River remedial action levels of no action and 1,000 parts per billion (ppb), respectively. The model grid cell numbers that represent the sediment layers underlying water column cell 48 are 1538, 1687, and 1836, and have depth intervals of 0 to 2, 2 to 4, and 4 to 10 centimeters (cm), respectively. The initial conditions for PCBs in these cells were modified in the GBTOXe input files based on a bulk density of 0.5 grams per cubic centimeter (g/cm^3) and a PCB concentration of 10 ppm (µg/g dry weight) for the no action case or 1 ppm for the post-action case, in accordance with specifications provided by WDNR. The PCB initial condition for the bottom sediment cell (1985, 10 to 31 cm) was not modified. Given a no action initial concentration of 10 ppm to a depth of 10 cm and a bulk density of 0.5 g/cm^3, the no action PCB mass in the dredged material disposal site sediment volume corresponds to 6,000 kilograms (kg). Assuming a 1 ppm remedial action level, the remaining PCB mass corresponds to 600 kg.

To evaluate the Bay-wide effects on sediment and water column PCBs in response to the no action and post-action scenarios, the complete 100-year time series of sediment and water column PCB model results from both simulations (spatially averaged across each GBFood zone and on an organic carbon-normalized basis) were compared.

3 RESULTS

Annual average PCB concentrations were computed from the results of the no action and post-action 100-year simulations. The top three panels of Figures 3 through 6 present comparisons of the time series of the annually averaged carbon-normalized PCB concentrations in sediment layers 0 to 2, 2 to 4, and 4 to 10 cm for each GBFood region. The bottom panels of Figures 3 through 6 represent the time series of concentrations vertically averaged over the upper 10 cm of sediment, weighted by interval depth. These figures show that the most substantial differences between the no action and post-action carbon-normalized sediment PCB concentrations occur in Zone 2 (Figure 3). Annual average PCB concentrations computed in Zone 2 in the first year of the post-action simulation are 43 percent lower than the results of the no action simulation. However, sediment PCB concentrations computed in the no action simulation decrease rapidly and tend to approach the post-action concentrations towards the end of the first 10 years at all depth intervals. After 10 years, the difference between the Zone 2 results computed in the two simulations continues to decrease, but at a slower rate than in the first 10 years. Differences between the results of the two simulations, averaged over the upper 10 cm (bottom panel of Figure 3) decrease from 15 percent at year 10 to 9.4 percent at year 100. Table 1 summarizes the comparison of the 0- to 10-cm sediment PCB concentrations at specific time intervals.

For the other GBFood regions (i.e., Zone 3A, Zone 3B, and Zone 4), a comparison of the no action and post-action sediment PCB concentrations shows that the 1 ppm remedial action level at the hypothetical dredged material disposal site has a relatively small effect. PCB concentrations computed in Zone 3A (Figure 4) and Zone 3B (Figure 5) in the remedial action simulation are only slightly different from the no action results throughout the simulation period. In Zone 4 (Figure 6), the results from the two simulations are very similar, with differences of near or less than 1 percent.

Figure 7 presents a comparison of the annually averaged water column dissolved PCB concentrations from the no action and post-action simulations for each GBFood zone. The Bay-wide impact on water column dissolved PCB concentrations computed in response to remedial action at the hypothetical dredged material disposal site is most clearly evident in Zone 2 during the first 10 years. This would be expected since the greatest redistribution of Zone 2 sediment PCBs occurs during this period. Post-action water column PCB concentrations in zones 3A, 3B, and 4 are only slightly lower than results from the no action simulation and tend to approach the no action concentrations after year 10. Zone 2 water column PCB concentrations computed in the first year of the post-action simulation are 27 percent lower than concentrations computed in the no action simulation. Zone 2 water column dissolved PCB concentrations computed in both simulations decrease from over 4 nanograms per liter (ng/L) at year 10 to less than 1 ng/L at year 100. During this time period, Zone 2 dissolved PCB concentrations computed in the post-action simulation are approximately 10 percent lower than concentrations computed in the no action simulation. Table 2 summarizes the comparison of concentrations in the water column at specific time intervals.

In general, GBTOXe model results indicate that Bay-wide reductions in sediment and water column PCB concentrations, in response to a 1 ppm remedial action level at the hypothetical dredged material disposal site, are greatest in Zone 2 but tend to become less appreciable after the first 10 years of the simulation period. By contrast, model results indicate that there is no appreciable impact to sediment and water column PCB concentrations for zones 3A, 3B, and 4. The relatively rapid decline of PCB concentrations within the first 10 cm of sediment, which is computed in the no action simulation, is due, in part, to the computed transfer of PCBs to the bottom sediment layer. This computed flux is affected by the large concentration gradient between the bottom and upper sediment layers specified in the initial conditions for the simulation. As the gradient is reduced, the computed burial flux between sediment layers becomes less of a factor. Over the long term, an analysis of the PCB mass transfer indicates that 71 percent of the PCB mass from the hypothetical dredged material disposal site sediments is eventually redistributed to other zones after 25 years.

4 REFERENCES

HydroQual, 2001. *Enhancement and Application of a PCB Fate and Transport Model for Green Bay: Lower Fox River/Green Bay Remedial Investigation and Feasibility Study*. Prepared for Wisconsin Department of Natural Resources by HydroQual, Inc. June.

RETEC, 2002a. *Final Remedial Investigation for the Lower Fox River and Green Bay, Wisconsin*. Prepared for Wisconsin Department of Natural Resources by The RETEC Group, Inc., St. Paul, Minnesota. December.

RETEC, 2002b. *Final Feasibility Study for the Lower Fox River and Green Bay, Wisconsin*. Prepared for Wisconsin Department of Natural Resources by The RETEC Group, Inc., Seattle, Washington. December.

WDNR, 2003. *White Paper No. 19 – Estimates of PCB Mass, Sediment Volume, and Surface Sediment Concentrations in Operable Unit 5, Green Bay Using an Alternative Approach*. Wisconsin Department of Natural Resources, Madison, Wisconsin. June.

WDNR and EPA, 2001. *Proposed Remedial Action Plan, Lower Fox River and Green Bay*. Wisconsin Department of Natural Resources, Madison and Green Bay, Wisconsin and United States Environmental Protection Agency, Region 5, Chicago, Illinois. October.

WDNR and RETEC, 2002. *Final Model Documentation Report for the Lower Fox River and Green Bay, Wisconsin*. Wisconsin Department of Natural Resources, Madison and Green Bay, Wisconsin and The RETEC Group, Inc., Seattle, Washington. December.

TABLE 1 NO ACTION AND POST-ACTION SEDIMENT PCB CONCENTRATIONS (µG/G OC) (AVERAGED OVER 0 TO 10 CM)

Year	Zone 2			Zone 3A			Zone 3B			Zone 4		
	No Action	Post-Action	% Diff.	No Action	Post-Action	% Diff.	No Action	Post-Action	% Diff.	No Action	Post-Action	% Diff.
1	55.1	31.6	42.7	9.68	9.63	0.5	8.00	7.95	0.6	4.88	4.88	0.0
10	38.5	32.8	14.7	9.46	8.90	5.9	3.34	3.14	6.0	5.06	5.03	0.6
25	35.5	31.5	11.4	9.03	8.51	5.8	2.32	2.18	6.0	5.13	5.09	0.8
50	23.7	21.1	11.1	8.15	7.68	5.8	1.56	1.46	6.4	5.13	5.07	1.2
75	15.9	14.3	10.5	7.01	6.61	5.7	1.01	0.94	6.9	5.03	4.98	1.0
100	10.9	9.9	9.4	5.96	5.64	5.4	0.67	0.63	6.0	4.92	4.88	0.8

TABLE 2 NO ACTION AND POST-ACTION DISSOLVED PCB CONCENTRATIONS IN WATER COLUMN

Year	Zone 2			Zone 3A			Zone 3B			Zone 4		
	No Action	Post-Action	% Diff.	No Action	Post-Action	% Diff.	No Action	Post-Action	% Diff.	No Action	Post-Action	% Diff.
1	6.98	5.07	27.4	2.37	2.04	14	2.42	2.13	12	0.61	0.59	3.3
10	4.76	4.28	10.1	1.49	1.34	10	1.38	1.24	10	0.51	0.48	5.9
25	4.13	3.81	7.75	1.17	1.07	8.6	1.04	0.95	8.7	0.52	0.40	4.8
50	2.39	2.18	8.79	0.78	0.71	9	0.68	0.62	8.8	0.34	0.33	3.0
75	1.33	1.20	9.77	0.53	0.49	7.6	0.45	0.41	8.9	0.29	0.28	3.5
100	0.87	0.80	8.1	0.39	0.36	7.7	0.32	0.30	6.3	0.25	0.25	0

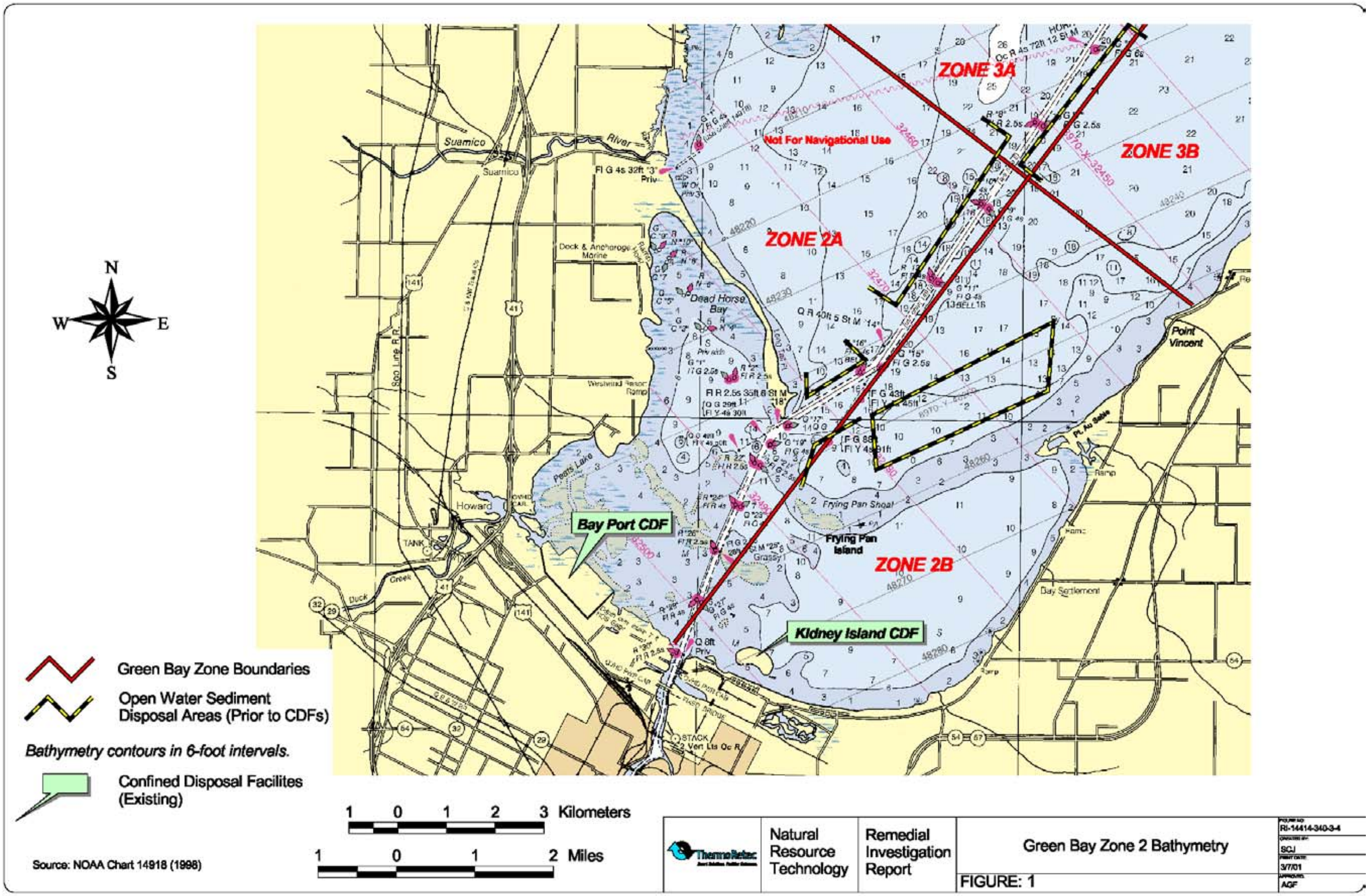

ZONE 3A
ZONE 3B
ZONE 2A
ZONE 2B
Not For Navigational Use
Bay Port CDF
Kidney Island CDF
Dead Horse Bay
Frying Pan Shoal
Frying Pan Island
Point Vincent
Suamico
Howard
N
E
S
W
Green Bay Zone Boundaries
Open Water Sediment Disposal Areas (Prior to CDFs)
Bathymetry contours in 6-foot intervals.
Confined Disposal Facilites (Existing)
1 0 1 2 3 Kilometers
1 0 1 2 Miles
Source: NOAA Chart 14918 (1998)
ThermoRetec
Natural Resource Technology
Remedial Investigation Report
Green Bay Zone 2 Bathymetry
FIGURE: 1
RI-14414-340-3-4
SCJ
3/7/01
AGF

FIGURE 2 GBTOXE SURFACE AREA CORRESPONDING TO DREDGE MATERIAL DISPOSAL SITE

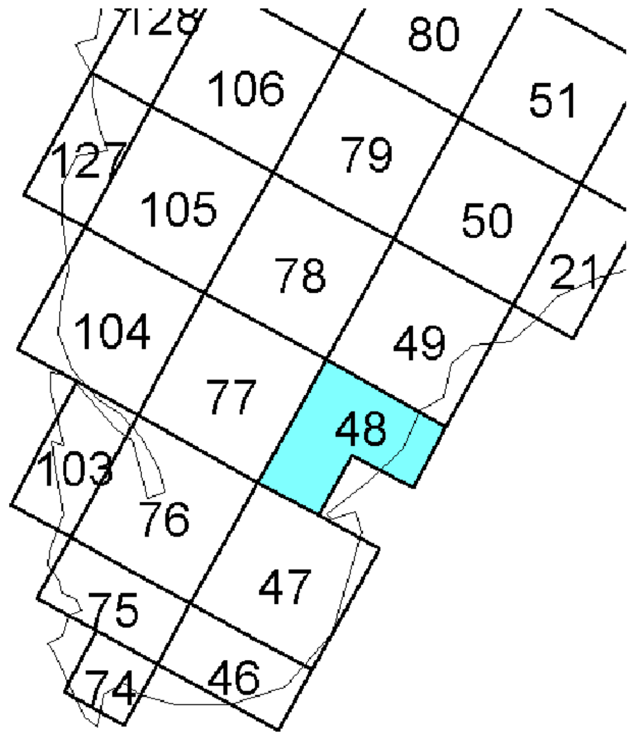


FIGURE 3 ZONE 2 PCB SEDIMENT RESPONSE TO NO-ACTION AND POST-ACTION AT DREDGE MATERIAL DISPOSAL SITE

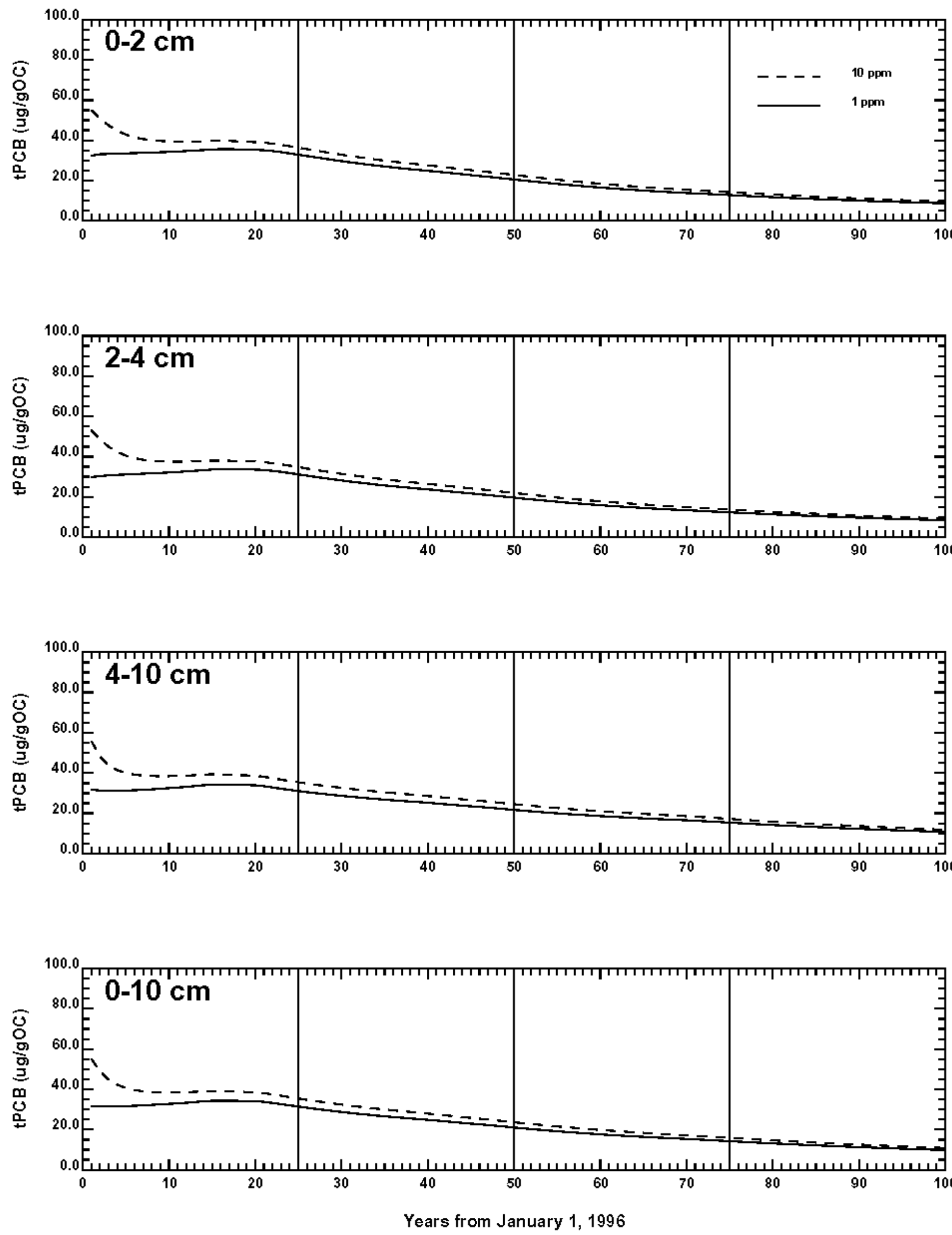


FIGURE 4 ZONE 3A PCB SEDIMENT RESPONSE TO NO-ACTION AND POST-ACTION AT DREDGE MATERIAL DISPOSAL SITE

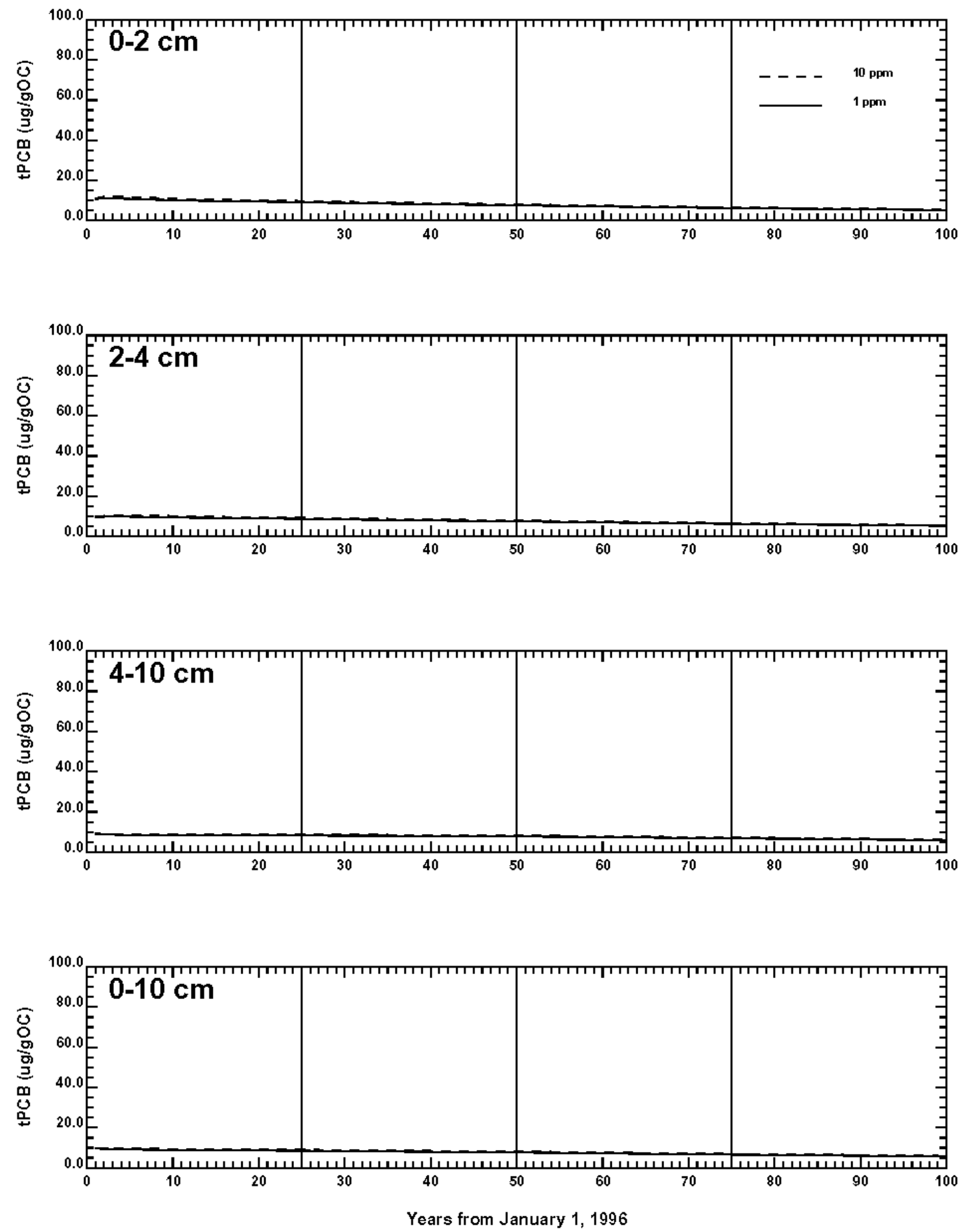


FIGURE 5 ZONE 3B PCB SEDIMENT RESPONSE TO NO-ACTION AND POST-ACTION AT DREDGE MATERIAL DISPOSAL SITE

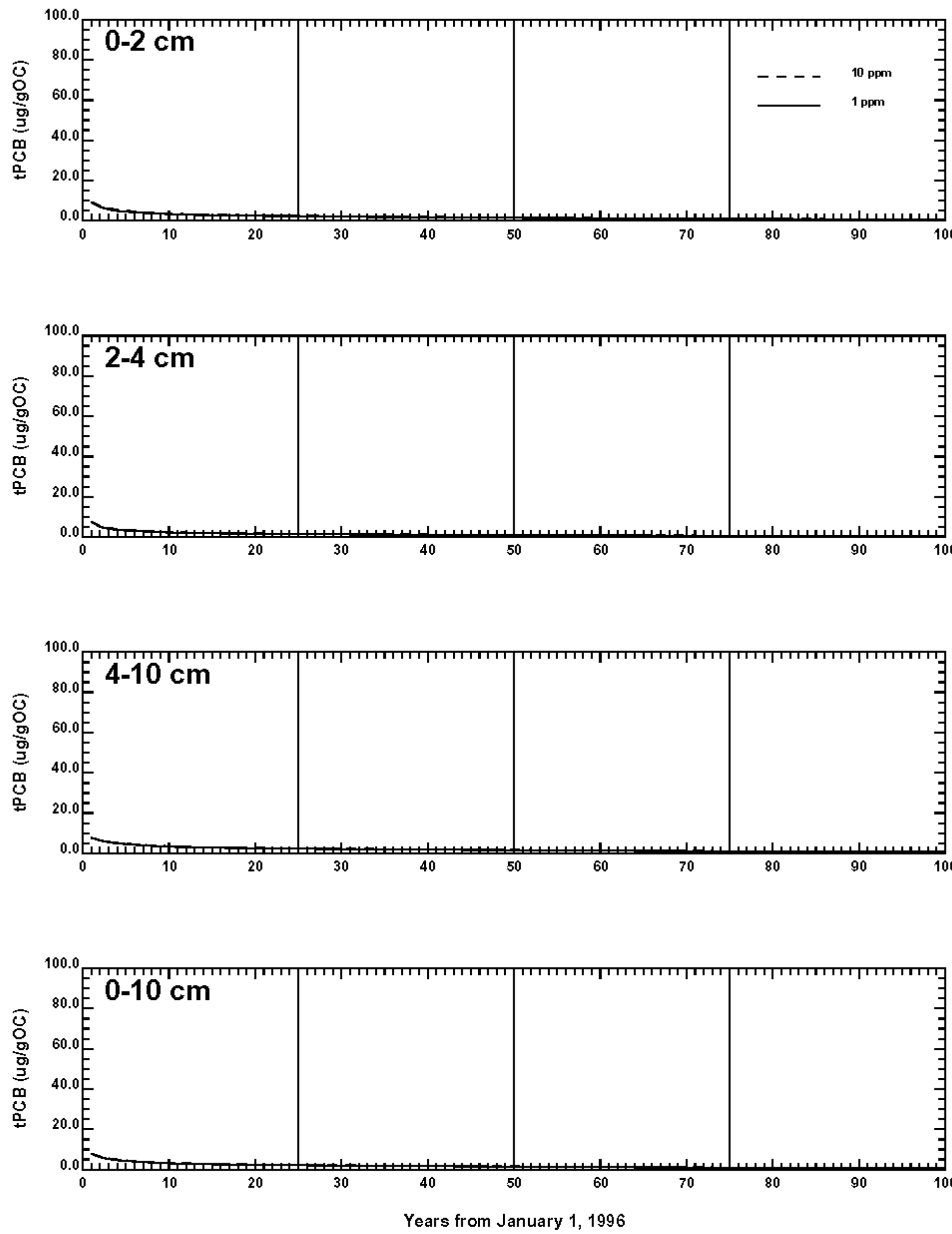


FIGURE 6 ZONE 4 PCB SEDIMENT RESPONSE TO NO-ACTION AND POST-ACTION AT DREDGE MATERIAL DISPOSAL SITE

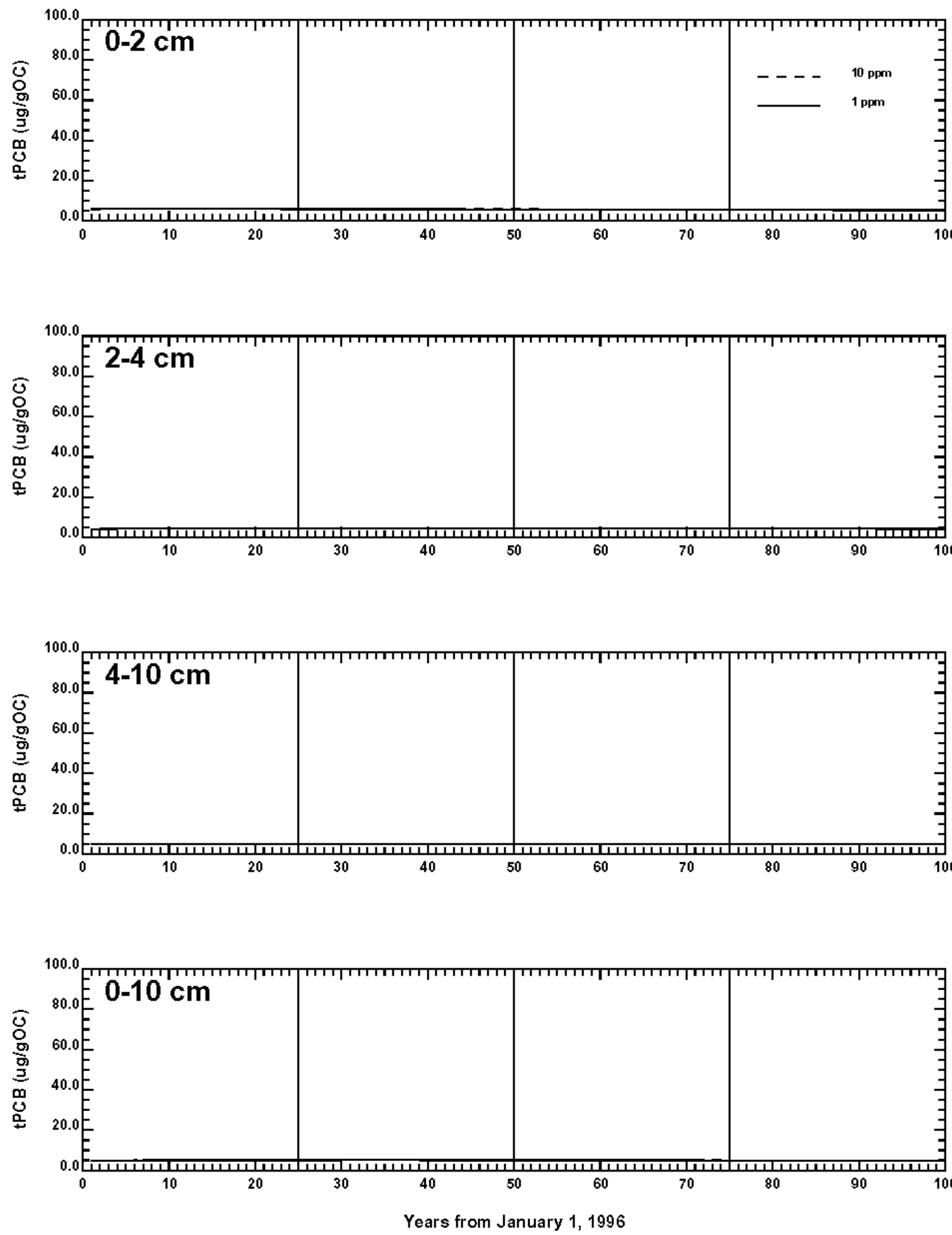
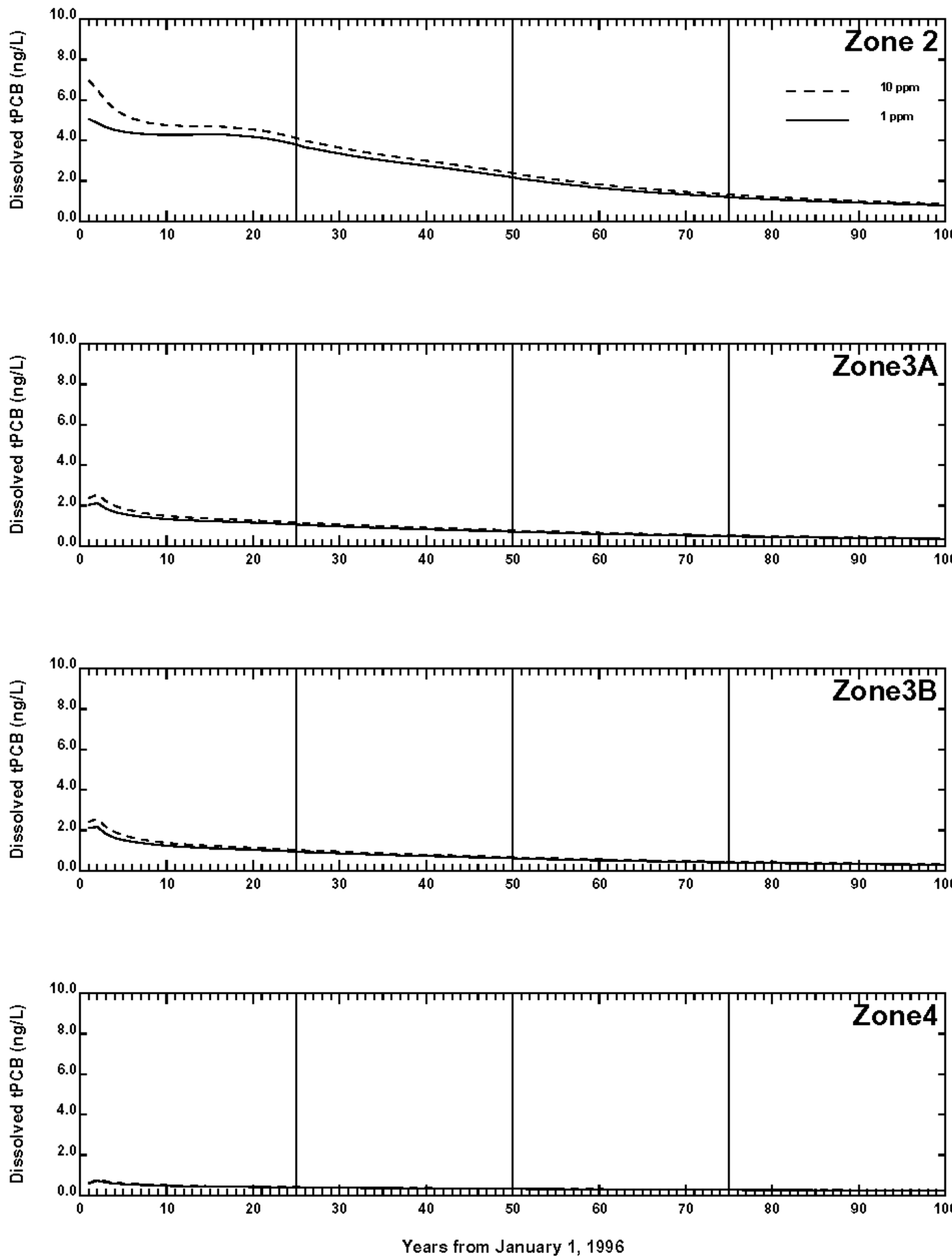


FIGURE 7 WATER COLUMN PCB RESPONSE TO NO-ACTION AND POST-ACTION AT DREDGE MATERIAL DISPOSAL SITE



White Paper No. 22 – Remedial Decision-Making for the Lower Fox River/Green Bay Remedial Investigation, Feasibility Study, Proposed Remedial Action Plan, and Record of Decision for Operable Units 3 through 5

Response to Comments on the

Remedial Investigation for the Lower Fox River and Green Bay, Wisconsin, Feasibility Study for the Lower Fox River and Green Bay, Wisconsin, Proposed Remedial Action Plan for the Lower Fox River and Green Bay, and Record of Decision for Operable Unit 1 and Operable Unit 2

This Document has been Prepared by the
Wisconsin Department of Natural Resources
Madison, Wisconsin

June 2003

TABLE OF CONTENTS

LIST OF TABLES

ABSTRACT

This white paper was prepared to document the remedial decision-making process for remedy selection for Operable Units (OUs) 3 through 5 of the Lower Fox River and Green Bay Site. A Record of Decision (ROD) for the Site's OUs 1 and 2 was released in January 2003. Development of the remedy selection for OUs 3 through 5 is consistent with the evaluation process under United States Environmental Protection Agency (EPA) guidelines for Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), National Research Council (NRC) guidance, and EPA guidance for the management of polychlorinated biphenyl (PCB)-contaminated sites. This white paper provides an overview of the supporting studies and tools used, the remedy evaluation process is described and discussed, and the remedy itself is briefly summarized. As shown in this white paper, these tools, together with the *Remedial Investigation for the Lower Fox River and Green Bay, Wisconsin* (RI) (RETEC, 2002a), *Feasibility Study for the Lower Fox River and Green Bay, Wisconsin* (FS) (RETEC, 2002b), and *Proposed Remedial Action Plan, Lower Fox River and Green Bay* (Proposed Plan) (WDNR and EPA, 2001) demonstrate the necessity to remediate, the availability of the remedial technology, and what may be reasonably expected from the remediation.

1 INTRODUCTION

In October 2001, the EPA and the Wisconsin Department of Natural Resources (WDNR) issued a Proposed Plan for addressing PCB contamination of the Lower Fox River and Green Bay. Development of the Proposed Plan and the selection of a remedy were the end result of an extensive evaluation process consistent with EPA guidelines for the CERCLA (or Superfund) projects in accordance with the federal National Contingency Plan (NCP). The remedy selection process was also consistent with NRC recommendations and other EPA guidance regarding the management of PCB-contaminated sediment sites. In addition to a site-specific Remedial Investigation and Feasibility Study (RI/FS), selection of the proposed remedy was based on consideration of information provided by numerous supporting studies, tools, and public comments. Each of these supporting efforts contributed to the remedy evaluation process by providing a wide spectrum of analyses that consider the full range of possible outcomes for each remediation alternative. When collectively considered with the RI/FS, these tools:

1. Clearly demonstrate the need to remediate Lower Fox River contaminated sediments.

2. Show that technology exists to implement the selected remedy.

3. Provide an understanding of what may be reasonably expected after the remedy is implemented.

An overview of the supporting studies contributing to the remedy evaluation process follows. After this overview, the remedy selection process is described and discussed. This white paper then concludes with a brief summary of the selected remedy to restore the environmental quality of the Lower Fox River and Green Bay. A ROD for OUs 1 and 2 for the Site was released in January of 2003. The selected remedy for OUs 3 through 5 is further described in the ROD for that portion of the Site. The ROD for OUs 3 through 5 is being released at this time.

2 OVERVIEW OF SUPPORTING STUDIES AND TOOLS

The types of supporting studies contributing to the development of the Proposed Plan for the Lower Fox River and Green Bay include:

1. Field studies delineating the extent and distribution of PCB in water, sediment, and fish
2. Human health and ecological risk assessments
3. Analyses of the spatial and temporal PCB concentration trends in sediment and fish
4. Contaminated sediment depth and sediment bed stability
5. Site-specific chemical transport and biota modeling
6. Sediment remediation evaluation and demonstration projects
7. Public input into the remedy selection process

An overview of each of these items and the lessons learned from them are discussed below. In the RI/FS, the River and Bay were described in terms of reaches, zones, and OUs as summarized in Table 1. The same terminology is also used in this white paper.

TABLE 1 LOWER FOX RIVER AND GREEN BAY REACH, ZONE, AND OPERABLE UNIT DESCRIPTIONS

Location	Description	Reach or Zone	Operable Unit
Lower Fox River	Little Lake Butte des Morts	Reach 1	1
	Appleton to Little Rapids	Reach 2	2
	Little Rapids to De Pere	Reach 3	3
	De Pere to Green Bay	Reach 4/Zone 1	4
Green Bay	Lower Fox River mouth to Little Tail Point	Zone 2	5
	Little Tail Point to Chambers Island (west)	Zone 3A	
	Little Tail Point to Chambers Island (east)	Zone 3B	
	Chambers Island to Lake Michigan interface	Zone 4	

2.1 FIELD STUDIES TO DELINEATE THE EXTENT AND DISTRIBUTION OF PCBS

PCB contamination of the Lower Fox River and Green Bay has been routinely monitored since the 1970s. Over the past 30 years, numerous field studies have been conducted to determine the extent and distribution of PCB contamination in the water, sediment, and fish of the Lower Fox River and Green Bay. In recent years, EPA, WDNR, the United States Geological Survey (USGS) and other groups have completed many field studies. A summary of these studies is presented in Table 2. Since the release of the RI/FS and supporting documents, additional field sampling efforts have been completed.

The Fox River Database (FRDB), a site-specific data management system, was developed to compile all field data for the Lower Fox River/Green Bay project area. As part of database development, efforts were also undertaken to review data quality of all data was compiled into the database. More than 580,000 individual data records from over 45 different field studies are compiled into the FRDB. These data provide critical, site-specific information that was used to construct the RI, FS, risk assessments, and other supporting studies. Further information regarding FRDB development is presented in the *Data Management Summary Report* found in Appendix A of the RI (RETEC, 2002a) and *Data Management Summary Report, Addendum 2* (EcoChem, 2003).

Beyond the data in the FRDB, the overall project database includes contaminant release data for each major industrial and municipal wastewater facility that discharges to the Lower Fox River. The contaminant release records were further augmented by discharge information each facility submitted to the U.S. Department of Justice as part of Natural Resource Damage Assessment (NRDA) efforts. These records provide discharge information for the entire period of PCB use and occurrence in the Lower Fox River (1954–present). Further information regarding the releases of solids and PCBs is presented in Technical Memorandum 2d (WDNR, 1999a).

The sufficiency of the project database was examined by an EPA-sponsored review panel prior to the first release of the draft RI/FS in February 1999. This peer review found that the underlying database for the RI/FS and supporting projects was sufficient to determine the distribution of contaminants, support identification, and selection of a remedy using technologies employed at other large-scale sites, and select a remedy.

TABLE 2 RECENT FIELD DATA COLLECTION EFFORTS FOR THE LOWER FOX RIVER AND GREEN BAY

Year	Study	Media Sampled		
		Water	Sediment	Fish
1989–1990	EPA Green Bay Mass Balance Study (GBMBS)	✓	✓	✓
1991–1994	Deposit A RI/FS (WDNR) USGS Follow-up to GBMBS WDNR Fish Sampling	✓ ✓ 	✓ 	 ✓
1994–1996	RI/FS for Select Deposits (WDNR/GAS) WDNR Detailed Sediment Characterizations WDNR Fish Sampling EPA Lake Michigan Mass Balance Study (LMMBS)	 ✓	✓ ✓ 	 ✓
1998–1999	Deposit N Demonstration Project (WDNR)	✓[1]	✓[2]	
1998	RI/FS Supplemental Sampling (WDNR/RETEC)	✓	✓	✓
1998–2001	Fox River Group (FRG):[3] Selected Portions of River and Bay Sediment Management Unit (SMU) 56/57 Demonstration Project	✓ ✓[1]	✓ ✓[2]	✓
2001	FRG Inner Green Bay Sediment Sampling		✓	
2001–2002	P.H. Glatfelter and WTMI Sediment Sampling – OU 1		✓	
2002	WDNR Green Bay Sediment Sampling Effort		✓	

2.2 HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENTS

Human health and ecological risk assessments specific to the Lower Fox River and Green Bay were completed as part of RI/FS development. These studies examine the risks posed by exposure to PCBs and other chemicals of concern (COCs). These studies consider the most significant means by which chemical exposures and risks occur. For PCBs in the Lower Fox River and Green Bay, the most significant risks to human health and wildlife occur though the consumption of contaminated fish. Human cancer risks were found to be 1,000 times greater than the 10^{-6} (one in one million) cancer risk management level and noncancer hazards were found to be 20 times greater than background risks. In addition to human health risk, ecological receptors such as fish-eating birds and mammals were also found to be at risk. The conclusion of these studies is that PCBs in the Lower Fox River and Green Bay present an unacceptable level of risk to human health and the ecosystem. The conclusion that PCBs are unacceptably high is also confirmed by the fact that fish consumption advisories have been in place for this region continuously since the risks were first evaluated in 1976. Further information regarding the risk assessments of PCBs is presented in the *Baseline Human Health and Ecological Risk Assessment for the Lower Fox River and Green Bay, Wisconsin* (BLRA) (RETEC, 2002c).

The risk assessment studies were examined by an FRG-sponsored peer review panel following the February 1999 release of the draft RI/FS. The peer review was conducted at the direction of the Association for the Environmental Health of Soils (AEHS). One significant peer review panel recommendation was the need to conduct a probabilistic risk assessment. In response to peer review panel recommendations, WDNR conducted a

1 Water samples also include contaminant analyses for wastewater effluent.
2 Sediment samples also include contaminant analyses for dewatered sediments.
3 The FRG is a group of paper companies considered to be the potentially responsible parties (PRPs) for cleanup actions at this Site.

probabilistic risk assessment for human heath issues for the October 2001 release of the final RI/FS (see Appendix B of the BLRA entitled "Additional Evaluation of Exposure to PCBs in Fish from the Lower Fox River and Green Bay"). This assessment addresses concerns related to prenatal and developmental effects and more clearly states the basis for risk assumptions.

2.3 ANALYSES OF SPATIAL AND TEMPORAL PCB CONCENTRATION TRENDS IN SEDIMENT AND FISH

Analyses of spatial and temporal PCB concentration trends in sediment and fish were completed as part of RI/FS development. Identification of spatial and temporal trends in sediments is inherently difficult because field observations were collected at different horizontal locations, at different vertical locations relative to a fixed datum, and at different times. Clear identification of fish tissue PCB concentration trends is also difficult because fish are mobile and the predominant source of contaminants have shifted from wastewater discharges to sediments over time.

Due to the factors that complicate identification of trends, two studies employing different assumptions were conducted to examine sediment PCB trends. The first study (TMWL, 2002) assumes that, in the absence of a reference elevation datum, changes in sediment bed elevation were negligible in order to estimate trends with depth in the sediment column. This study also assumed that none of the differences in observed PCB concentrations over time could be attributed to differences in laboratory procedures. The second study (see Appendix B of WDNR, 2001a) assumes that bed elevation changes are significant based on the results presented in Technical Memorandum 2g (WDNR, 1999b) and some of the differences in observed PCB concentrations over time are attributed to differences in laboratory procedures based on the results of independent inter-laboratory comparisons. Despite the differences in assumptions, these two studies both conclude that sediment PCB trends are highly variable (some decreasing, some constant, some increasing) and that trends cannot be assumed to be uniformly decreasing in future years.

To examine fish tissue PCB concentration trends, a study was conducted by The Mountain-Whisper-Light Statistical Consulting (TMWL) (2002). This study assumes that fish experience PCB exposures in the area proximate to their collection location and that none of the differences in observed PCB concentrations over time could be attributed to differences in laboratory procedures. The time trends analyses were conducted in such as way as to determine if apparent declines in fish PCB concentrations were correlated with changes to PCB loadings to the River. Termed "breakpoints," these changes in the rate of PCB declines in fish were found that range between the year when the last wastewater discharger to the River installed improved treatment facilities (P.H. Glatfelter Company in August 1979) to a year when residual PCB discharges were reduced to very small levels (the mid- to late 1980s). Years before the breakpoint represent a period when both point source discharges and sediments may have affected fish tissue PCB concentrations. Years after the breakpoint represent a period when only sediments are believed to have affected fish PCB burdens. This study concludes that in recent years, the rates at which fish tissue PCB levels have declined is significantly less than the historical period where ongoing PCB discharges occurred.

2.4 CONTAMINATED SEDIMENT DEPTH AND SEDIMENT BED STABILITY

Analyses of contaminated sediment depth and sediment bed stability were completed as part of RI/FS development. These studies examine the depths to which contaminants occur in the sediment column of the River and the stability of the sediment bed. These studies provide information needed to evaluate whether sediments contaminated with PCBs may be diluted by natural burial or contribute to risks in place (by mixing) or elsewhere (by transport). In response to comments on the PCB mass and contaminated sediment volume, two white papers were generated as part of the Responsiveness Summary for OUs 3 through 5. The papers, (*White Paper No. 18 – Evaluation of an Alternative Approach of Calculating Mass, Sediment Volume, and Surface Concentrations in Operable Unit 5, Green Bay* (WDNR, 2003a) and *White Paper No. 19 – Estimates of PCB Mass, Sediment Volume, and Surface Sediment Concentrations in Operable Unit 5, Green Bay Using an Alternative Approach* (WDNR, 2003b), were generated to compare methods of estimating Bay PCB mass and contaminated sediment volume in Green Bay, as well as to generate mass and volume estimates using the most recent data available. Additional studies were also completed by EPA (*White Paper No. 3 – Fox River Bathymetric Survey Analysis*, 2002), WDNR (*Green Bay Sediment Results from the July 2002 Survey* [RETEC, 2002d]), and for the FRG (LTI, 2002) as part of independent efforts.

In the Lower Fox River, PCBs have been observed more than 5 meters (16 feet) below the sediment-water interface at some locations.[4] Based on the observations compiled in the FRDB and additional information regarding the thickness of Lower Fox River sediments, the volumetric extent and distribution of PCBs in the sediment column of the river was estimated in Technical Memorandum 2e and follow-up efforts (WDNR, 1999c, 2000a). As described in the RI (RETEC, 2002a), in the River reaches between Lake Winnebago and De Pere (OUs 1 through 3), more than 97 percent of the PCB mass is located within the upper 100 centimeters (cm) (3.3 feet) of sediment; and for the River reach between De Pere and Green Bay (OU 4), more than 90 percent of the PCB mass is within the upper 200 cm (6.6 feet) of sediment. A similar study was also completed for Green Bay (WDNR, 2001b).

The elevations of the sediment bed within the bounds of the River navigation channel between the De Pere dam and Green Bay are routinely monitored by the United States Army Corps of Engineers (USACE). Additional surveys have been completed by EPA and the USGS. Based on these data sources, three separate studies examining sediment bed elevations changes in sections of the River that have not been dredged in more than 30 years have been completed. As summarized in Technical Memorandum 2g (WDNR, 1999b) and follow-up efforts (see Section 4.2.2.1 of WDNR, 2001a), these surveys demonstrate that the sediment bed of the Lower Fox River is a very dynamic environment and that bed elevations can increase or decrease by more than 200 cm (6.6 feet) even during periods when there are very small net increases in bed elevation. These studies also concluded that the net rate of sediment accumulation can be very small compared to gross changes in bed elevation. A study completed by the EPA FIELDS Group (2002) reaches similar conclusions for undredged portions of the river channel. A third study

[4] This condition was observed in the area around SMU 56/57 prior to the start of the pilot project for that site.

completed for the FRG (LTI, 2002) that considered radioisotope patterns in sediment also concluded that sediment bed elevations between the De Pere dam and the River mouth may be decreasing in response to declining water levels in the Bay. These changes in sediment bed elevations are believed to result in episodic sediment mixing and downstream transport.

As described by WDNR (1999b, 2001a), it should be noted that the majority of the bed elevation data used for these studies was collected by the USACE as part of Class I surveys. The accuracy of these surveys was confirmed by field tests of the actual combined errors (equipment and procedural) of measurements. Data collected at the SMU 56/57 demonstration site in August 1999 indicates that the combined vertical accuracy achieved by the USACE Kewaunee Office was approximately ±4 cm (WDNR, 1999d).

Several specific conclusions can be drawn from these studies. First, PCB contamination of Lower Fox River sediments is extensive. However, more than 97 percent of the PCB mass of OUs 1 through 3 resides in the upper 100 cm of the sediment column and more than 90 percent of the PCB mass in OU 4 resides in the upper 200 cm of sediment. Second, the sediment bed of the River can be a very dynamic environment. Large increases and decreases in sediment bed elevations were observed even for periods when there were very small net increases in bed elevation. Because natural rates of net sediment accumulation (burial) can be small, the potential to restore the River by natural burial (a passive PCB-contaminated sediment approach) may be limited. Third, the portions of the sediment column where most of the PCB mass in the sediment resides can be subject to episodic mixing and transport. Further, episodic mixing and transport of sediments between the De Pere dam and the River mouth (OU 4) may occur now and in the future in response to cyclical changes in water levels in Green Bay/Lake Michigan. When considered together, these studies indicate that the sediment bed of the Lower Fox River is not necessarily a stable environmental for *in-situ* management of PCB-contaminated sediments and that the stability of the sediment bed can change over time in response to changes in conditions such as declining water levels.

In response to comments on the PCB mass and contaminated sediment volume in Green Bay, WDNR compared the methods used in Technical Memorandum 2f (WDNR, 2000b) and by the University of Wisconsin (Manchester-Neesvig et al., 1996) to generate the values used in the Site's RI and FS. This evaluation was conducted as part of the series of white papers supporting the OUs 3 through 5 ROD and Responsiveness Summary and is entitled, *White Paper No. 18 – Evaluation of an Alternative Approach of Calculating Mass, Sediment Volume, and Surface Concentrations in Operable Unit 5, Green Bay*. *White Paper No. 18 – Evaluation of an Alternative Approach of Calculating Mass, Sediment Volume, and Surface Concentrations in Operable Unit 5, Green Bay* developed an alternative method to estimating Green Bay bed properties and concludes there is some uncertainty associated with any method of estimating existing PCB mass and contaminated sediment volume in the Bay. It is possible to develop multiple PCB mass estimates for Green Bay based solely on factors influencing PCB mass. The alternative method developed as part of the *White Paper No. 18 – Evaluation of an Alternative Approach of Calculating Mass, Sediment Volume, and Surface Concentrations in*

Operable Unit 5, Green Bay evaluation provides a sound estimate of PCB mass in Green Bay.

White Paper No. 19 – Estimates of PCB Mass, Sediment Volume, and Surface Sediment Concentrations in Operable Unit 5, Green Bay Using an Alternative Approach used the alternative method developed as part of the *White Paper No. 18 – Evaluation of an Alternative Approach of Calculating Mass, Sediment Volume, and Surface Concentrations in Operable Unit 5, Green Bay* evaluation with the more recent data collected in southern Green Bay to generate more recent estimates of Green Bay PCB mass and contaminated sediment volume.

Finally, it is worth noting that in terms of the dynamics of sediment bed elevation changes, the Lower Fox River is not unique. Similar ranges of bed elevation changes have been observed in the Sheboygan River (Wisconsin) (WDNR, 2000c). A recent study of bed mobility in the Sacramento River (California) also demonstrates that the bed of a river can be a very dynamic environment (Dinehart, 2002). In that study, the upper 30 cm of the sediment bed was typically found to be mobile (bedform transport) and moved downstream at rates that ranged from 0.43 to 2.01 meters per day (Dinehart, 2002).

2.5 SITE-SPECIFIC CHEMICAL TRANSPORT AND BIOTA MODELING

Site-specific PCB transport and food web bioaccumulation models were developed as part of the RI/FS. These models use mass balance and bioenergetics concepts to estimate the rates at which chemical concentrations in water, sediment, and biota (plankton, fish, etc.) change. For the RI/FS, four models were developed. A summary of these models is presented in Table 3. Brief descriptions of the models are presented in the sections that follow. Full descriptions of the models and all associated supporting studies are presented in the *Model Documentation Report for the Lower Fox River and Green Bay, Wisconsin* (MDR) (WDNR and RETEC, 2002) that accompanies the RI/FS.

These models have been calibrated to conditions in the Lower Fox River and Green Bay. The primary use of the calibrated suite of models was to help estimate, in a comparative sense, what time frame might be required to achieve acceptable fish tissue PCB concentrations for a series of different sediment action levels. Collectively, these modeling studies suggest: (1) that at present rates of change (the no action alternative) it may take many decades before PCB exposures and fish tissue PCB concentrations meet acceptable risk levels; (2) rates of PCB change (decline) may be improved by managing PCB levels in sediments; and (3) the degree to which rates of PCB decline may be improved is directly related to the extent of sediment PCB management efforts (more extensive management yields more rapid declines).

TABLE 3 SITE-SPECIFIC CHEMICAL TRANSPORT AND BIOTA MODELS DEVELOPED FOR THE RI/FS

Model	Sites	Use	MDR Location
wLFRM	Lower Fox River (OUs 1–4)	Water and Sediment Quality	Appendix B
GBTOXe	Green Bay (OU 5)	Water and Sediment Quality	Appendix C
FRFood	Lower Fox River (OUs 1–4)	Biota	Appendix D
GBFood	Lower Fox River (OU 4) Green Bay (OU 5)	Biota	Appendix E

The development history of these models and modeling approaches is well documented. Several generations of model development for the Lower Fox River and Green Bay system have been completed. The present generation of model applications presented in the MDR was based on information developed in conjunction with the FRG companies by a Model Evaluation Workgroup (MEW) under the terms of a January 1997 agreement. A series of Technical Memoranda (TM) was prepared by the MEW. Each TM provides detailed analyses of a key aspect of model development such as solids and PCB loads, sediment transport dynamics, and initial conditions. A more complete description of each TM is presented in the MDR (WDNR and RETEC, 2002). In addition to the TM, numerous publications, technical reports, and peer review documents describing aspects of the whole Lower Fox River Model (wLFRM), Enhanced Green Bay Toxics Model (GBTOXe), Fox River Food Web Model (FRFood), and Green Bay Food Web Model (GBFood) development and performance are available. These include other documents: AGI (2000), Bierman et al. (1992), Connolly and Thomann (1992), Connolly et al. (1992), DePinto et al. (1993), Gobas (1993), Gobas et al. (1995), HydroQual (1995), HydroQual (1996), Steuer et al. (1995), Velleux and Endicott (1994), Tetra Tech, Inc. (2000), Velleux et al. (1995), Velleux et al. (1996), Velleux et al. (2001), and WDNR (1997).

2.5.1 Whole Lower Fox River Model (wLFRM)

The wLFRM was developed to examine the transport and fate of PCBs in the Lower Fox River (WDNR, 2001a). The wLFRM is the result of numerous assessments of Lower Fox River water quality model performance and represents the fourth generation of model development. The wLFRM was designed to estimate PCB concentrations in the water column and sediment of the Lower Fox River. PCBs and three types of solids in the water column and sediments were simulated. The model spatial domain is the entirety of the Lower Fox River from Lake Winnebago to the River mouth at Green Bay. This region was represented as 40 water column and 165 sediment stacks. Each sediment stack has up to 10 vertical layers depending on the thickness of sediments at a given location. The sediment layers represent biologically active sediments and deeper biologically inactive sediments. Mechanisms affecting PCB transport include: advection, dispersion, volatilization, erosion and deposition of particulate phases, porewater exchange of dissolved phases, and sediment bed armoring.

The wLFRM was calibrated using data collected as part of the EPA 1989–1990 GBMBS, the 1994–1995 LMMBS, and other field studies over the period 1989–1995. Once calibrated, the primary use of the wLFRM in the RI/FS was to conduct long-term (100-

year) simulations of PCB transport and fate in the Lower Fox River for conditions ranging from no action to a series of sediment management action levels. Further information regarding the wLFRM is presented in the MDR (WDNR and RETEC, 2002).

It should be noted that development of the wLFRM for the RI/FS was based on information developed in conjunction with the FRG companies by the MEW and a peer review of model performance. The MEW prepared a series of TMs. Each TM provides detailed analyses of a key aspect of model development such as solids and PCB loads, sediment transport dynamics, and initial conditions. A more complete description of each TM is presented in the MDR (WDNR and RETEC, 2002). In addition to MEW efforts, an FRG-sponsored peer review panel presented additional assessments of model performance (AGI, 2000). To the greatest extent practical, peer review panel recommendations were integrated into wLFRM development efforts.

2.5.2 Enhanced Green Bay Toxics Model (GBTOXe)

The GBTOXe was developed to examine the transport and fate of PCBs in Green Bay (HydroQual, 2001). GBTOXe is an enhanced version of the GBTOX model originally developed as part of the EPA GBMBS (Bierman et al., 1992; DePinto et al., 1993). Enhancements include finer spatial resolution and linkages to a hydrodynamics model (GBHYDRO) and a sediment transport model (GBSED) for Green Bay. GBTOXe was designed to estimate PCB concentrations in the water column and sediment of Green Bay. PCBs and three types of carbon in the water column and sediments were simulated. The carbon types considered are dissolved, biotic, and particulate detritus. The biotic and particulate detritus carbon types represent the portion of the suspended solids in the Bay with which PCBs may associate. The model spatial domain is the entirety of Green Bay from the Lower Fox River mouth to the Lake Michigan interface. This region was represented as 1,490 water column and 596 sediment segments. The water column has 10 vertical layers, each with 149 horizontal segments. The sediment layers represent biologically active sediments and deeper biologically inactive sediments. Mechanisms affecting PCB transport include: advection, dispersion, volatilization, erosion and deposition of particulate phases, porewater exchange of dissolved phases, and sediment bed armoring.

GBTOXe was calibrated using data collected as part of the 1989–1990 EPA GBMBS. The GBMBS provides the only comprehensive data for Green Bay water and sediment sufficient for model development. Once calibrated, the primary use of GBTOXe in the RI/FS was to conduct long-term (100-year) simulations of PCB transport and fate in Green Bay for conditions ranging from no action to a series of sediment management action levels. Further information regarding GBTOXe is presented in the MDR (WDNR and RETEC, 2002).

2.5.3 Fox River Food Web Model (FRFood)

The FRFood bioaccumulation model provides a mathematical description of PCB transfer within the food web of all four reaches of the Lower Fox River (OUs 1 through 4) and inner Green Bay (Zone 2). This model was designed to estimate PCB concentrations in the aquatic food web of the Lower Fox River (i.e., benthic organisms, phytoplankton, zooplankton, and fish) based on PCB concentrations in water and sediment. In addition to the River, FRFood also includes a portion of the Bay food web. This overlap is necessary because fish can freely move between the last reach of the River (De Pere to Green Bay) and the Bay. FRFood is functionally similar to the food web model for Green Bay (GBFood) described in Section 2.5.4. FRFood was also designed to estimate the average sediment PCB concentration needed to meet a specified target fish tissue PCB level. Each reach has a specified food web. The food web is represented as the primary energy and chemical transfer pathways from exposure sources (sediment and water) to fish species of interest. These pathways include: chemical uptake across the gill surface, chemical uptake from food by species-specific and age class-specific predator-prey relationships, chemical loss by excretion, and dilution by growth.

FRFood was calibrated using exposure concentrations defined by field data collected as part of the 1989–1990 EPA GBMBS and subsequent sampling efforts over the period 1989–1995 (RETEC, 2002c). Once calibrated, the primary uses of FRFood in the RI/FS were to: (1) estimate potential risk-based remedial cleanup levels, called sediment quality thresholds (SQTs); and (2) conduct long-term (100-year) simulations to estimate fish tissue concentrations for conditions ranging from no action to a series of sediment management action levels. For FRFood long-term simulations, exposure conditions were defined by wLFRM long-term simulation results. Further information regarding FRFood is presented in the MDR (WDNR and RETEC, 2002).

2.5.4 Green Bay Food Web Model (GBFood)

The GBFood bioaccumulation model provides a mathematical description of PCB transfer within the food web of last reach of the Lower Fox River (De Pere to Green Bay) (OU 4) (Zone 1) and all of Green Bay (OU 5) (Zones 2 through 4). This model was designed to estimate PCB concentrations in the aquatic food web of Green Bay (i.e., benthic organisms, phytoplankton, zooplankton, and fish) based on PCB concentrations in water and sediment. In addition to the Bay, GBFood also includes a portion of the River food web. This overlap is necessary because fish can freely move between the last reach of the River (De Pere to Green Bay) and the Bay. Each zone has a specified food web. The food web is represented as the primary energy and chemical transfer pathways from the exposure sources (sediment and water) to the fish species of interest. These pathways include: chemical uptake across the gill surface, chemical uptake from food by species-specific and age class-specific predator-prey relationships, chemical loss by excretion, and dilution by growth.

GBFood was calibrated to conditions defined by field data collected as part of the 1989–1990 EPA GBMBS (QEA, 2001) using exposures estimated by wLFRM and GBTOXe. Once calibrated, the primary uses of GBFood in the RI/FS were to conduct long-term (100-year) simulations to estimate fish tissue concentrations for conditions ranging from no action to a series of sediment management action levels. For GBFood long-term simulations, exposure conditions were defined by wLFRM and GBTOXe long-term simulation results. Further information regarding GBFood is presented in the MDR (WDNR and RETEC, 2002).

2.6 SEDIMENT REMEDIATION EVALUATION AND DEMONSTRATION PROJECTS

A range of different PCB-contaminated sediment remediation approaches for the Lower Fox River was examined as part of the RI/FS. Passive and active methods for managing contaminated sediments were considered. Passive processes that can affect PCB risks include burial (dilution of PCB-contaminated sediment by the buildup of an overlying layer of cleaner sediments), dispersion (dilution of PCB-contaminated sediment through movement within the water column and the gradual settlement of this contaminated sediment), and dechlorination (detoxification by the removal of chlorine atoms from PCB molecules). Burial, dispersion, and dechlorination are processes that contribute to "natural recovery." The potential for burial of PCBs was examined as part of contaminated sediment depth and sediment bed stability studies. The potential for continued dispersion remains high as long as PCBs continue to remain at the sediment surface, which results in downstream contamination and movement of PCB mass into Green Bay. The potential for PCB dechlorination was examined as part of a dechlorination study described in Section 2.6.1. Active methods to manage PCBs include capping and dredging. Capping was examined as part of the FS (RETEC, 2002b). General aspects of dredging were examined as part of sediment technologies study described in Section 2.6.2.

In addition to the dechlorination and sediment technologies supporting studies, the results of two sediment remediation demonstration projects on the Lower Fox River were also considered in the RI/FS. Sediment removal demonstration projects were completed at two sites: Deposit N and SMU 56/57. These two projects provided information regarding insight on the technical and administrative feasibility of managing remediation projects for the Lower Fox River. In addition to providing information regarding the ability to complete environmental dredging projects on the Lower Fox River, the projects also were to: evaluate implementation issues (access agreements, insurance, site access, contracting, permits, and liability waivers and indemnification); conduct monitoring (operational, deposit mass balance, process mass balance, river transport, and air); and provide information on remediation prior to the initiation of full-scale work.

These demonstration projects showed communities in the Fox River Valley what dredging looked like and demonstrated that: (1) there were no community disruptions, (2) PCBs can be permanently removed from the River, (3) PCB-contaminated sediments can be disposed in a local landfill, and (4) there was compliance with all permits and permit requirements. In addition, at the SMU 56/57 project, additional monitoring showed there were no resuspension problems from dredging and there is no risk from air releases from dredging. These projects conclusively demonstrated that successful dredging projects can be conducted on the Lower Fox River.

2.6.1 Natural Dechlorination

A PCB dechlorination study was conducted as part of the RI/FS. Dechlorination is the only potential means by which PCB toxicity may be reduced under natural conditions (passive management). The *Review of Natural PCB Degradation Processes in Sediments* (Dechlorination Study) (see Appendix D of RETEC, 2002b) showed that dechlorination does not occur where PCB concentrations are less than 30 milligrams per kilogram (mg/kg). While certain locations in the River exceed this threshold, PCB concentrations at most locations are less than 30 mg/kg. As a result, the study concludes that passive management of PCBs by dechlorination is not a reliable or effective means to reduce PCB risks for Lower Fox River sediments.

2.6.2 Sediment Technologies Memorandum

To assess concerns about the short-term and long-term effectiveness of environmental dredging as a remedial alternative, WDNR commissioned an evaluation of 20 environmental dredging case studies in the a study entitled *Sediment Technologies Memorandum for the Lower Fox River and Green Bay, Wisconsin*, which can be found in Appendix B of the FS (RETEC, 2002b). The study found that dredging to achieve a specific target goal (e.g., an elevation or a concentration) can be accomplished and that dredging in soft sediments can effectively remove contamination with minimal re-suspension and downstream transport of contaminants. The study also found that environmental dredging has been effective in reducing the risk to human health in several projects. The study also identified several recommendations including the need to identify a clear target goal, having adequate site-specific knowledge, determining acceptable risks during implementation, and developing an appropriate long-term monitoring plan to verify project success.

2.6.3 Deposit N

In 1998 and 1999, WDNR and EPA sponsored a project to remove PCB-contaminated sediment from Deposit N in the Lower Fox River. The primary objective of this project was to demonstrate that dredging could be performed in an environmentally safe and cost-effective manner to manage PCB-contaminated sediments in the Lower Fox River. The Deposit N site was approximately 3 acres in size and contained about 11,000 cubic yards (cy) of contaminated sediment with PCB concentrations as high as 186 mg/kg. Sixty-five percent of the sediment volume of Deposit N was targeted for removal. Approximately 8,200 cy of sediment were removed from the site, generating 6,500 tons of dewatered sediment that contained 112 total pounds of PCBs. The total material also included approximately 1,000 cy of sediment that was removed from Deposit O, another contaminated sediment site adjacent to Deposit N.

Monitoring data from the project showed that the River was protected during the dredging and that wastewater discharged back to the River complied with all permit conditions. The project also met design specifications such as the volume of sediment removed, sediment tonnage, and allowed thickness of residual sediments. In addition to the removal of PCBs from the site, other benefits of the project included opportunities for public outreach and education on the subject of environmental dredging. In assessing project success, it should be noted that Deposit N project's goals were to test the ability of a management effort to meet design specifications that focused on PCB mass removal rather than a concentration-based cleanup. A cost analysis of this project indicated that a significant portion of the funds was expended in pioneering efforts associated with the first PCB cleanup project on the Lower Fox River and the added winter construction expenses that were incurred to meet an accelerated construction schedule. Such added costs are not typical and would not necessarily be incurred with future projects.

2.6.4 SMU 56/57

One of the projects conducted under the January 1997 agreement with the FRG companies was a sediment remediation project. The objective of this effort was to design, implement, and monitor a project in the Lower Fox River downstream of the De Pere dam. In conjunction with WDNR, the FRG selected SMUs 56 and 57 (SMU 56/57) as the project site. The specific goal of this project was to remove 80,000 cy of PCB-contaminated sediment from the site. In late 1999, contractors and consultants under the direction to the FRG designed and implemented the project. Dewatered sediment was moved by truck to a landfill owned and operated by Fort James Corporation (now Georgia Pacific) for disposal. Due cold weather, ice, and other factors, the FRG stopped dredging operations after approximately 31,350 cy of sediments were removed from the River. Following the end of FRG efforts, Fort James Corporation agreed to complete the SMU 56/57 project in Spring 2000 and entered into an Administrative Order By Consent (AOC) with EPA and the State of Wisconsin (Docket No. V-W-00-C-596). Under the terms of the AOC, Fort James Corporation funded and managed the project in 2000 with oversight from WDNR and EPA. Overall, the 1999 and 2000 efforts at SMU 56/57 resulted in the removal of approximately 2,070 pounds of PCBs from the River. In particular, the 2000 project efforts met all goals set forth in the AOC, and also met or exceeded project goals for sediment removal rates, dredge slurry solids, filter cake solids, and production rates that were set forth for the original effort managed by the FRG in 1999.

Like the Deposit N effort, monitoring data from the SMU 56/57 project showed that the River was protected during the dredging and that wastewater discharged back to the River complied with all permit conditions. In addition, the project data showed that air releases of PCBs during dredging and handling are so small (essentially zero) such that there is no real risk associated with possible air releases of PCBs. The SMU 56/57 project also demonstrated the ability to use a local landfill for sediment disposal.

2.7 Public Input into the Selection Process

Comments from the general public and all stakeholders such as municipalities and the FRG have been received throughout the development process for the RI/FS and Proposed Plan. At each stage of development, the RI/FS and Proposed Plan have been shaped by comments provided to EPA and WDNR. For example, WDNR and EPA received numerous comments regarding the draft RI/FS that was released in April 1999. In response to those comments, the scope of the RI/FS was expanded to include all of Green Bay and numerous supporting studies were completed to more fully consider remediation options for the Site. Following the release of the RI/FS in October 2001, WDNR and EPA again received numerous comments. It should be noted that a formal period for submission of comments was provided and that the time period for comments far exceeded the 30-day minimum time required by the NCP under CERCLA. For example, the comment period following the October 2001 release of the RI/FS and the Proposed Plan lasted more than 3 months. To finalize the RI/FS, WDNR and EPA have prepared a Responsiveness Summary to document responses to comments regarding the RI/FS that were received during the January 2002 formal comment period. Following the release of the Record of Decision for Operable Units 1 and 2, a public meeting was held in

Appleton, Wisconsin to inform the public of the decision made in the ROD and provide an opportunity to address public concerns. Following the release of the ROD for Operable Units 3 thought 5 a similar public meeting will be held.

In addition to formal comment periods, WDNR and EPA have participated in an ongoing process for community involvement that has included numerous public meetings since the summer of 1997. These meetings have focused on a variety of topics, including cleanup and restoration activities, the status of pilot projects, fish consumption advisories, and the draft RI/FS. Over this period, WDNR and EPA staff members have made presentations for various community groups. WDNR and EPA also publish a bimonthly newsletter, the *Fox River Current*, which is mailed to over 10,000 addresses. These communication efforts are consistent with National Academy of Science (NAS) recommendations that risk management of PCB-contaminated sediment sites include early, continuous, and frequent involvement of affected parties.

Beyond comment periods and communication efforts, it should be noted that long before formal RI/FS efforts were initiated, the public and the regulated community have been involved and contributed to the remedy selection process for the Lower Fox River. In 1993, a group of paper mills and municipalities approached WDNR to establish a cooperative process for resolving PCB-contaminated sediment issues. The outcome was the formation of the Fox River Coalition, a private-public partnership of businesses, state, and local officials, environmentalists, and others groups committed to improving the quality of the Lower Fox River. The Coalition focused on the technical, financial, and administrative issues that would need to be resolved to achieve a whole river cleanup. The Coalition helped conduct several projects including an RI/FS for several sediment deposits upstream of the De Pere dam, mapping of sediment contamination downstream of the De Pere dam, collection of sediment cores from 113 locations between De Pere and Green Bay, and funding for a portion of the Deposit N pilot project. The results of these Coalition efforts are fully integrated into the present RI/FS.

3 SELECTION OF THE PROPOSED REMEDY

The process used by WDNR and EPA to select the remedy for OUs 3 through 5 is well defined and consistent with EPA guidelines for projects conducted under CERCLA. The FS describes a series of alternatives to manage risks attributable to PCBs and other contaminants of concern for each management area of the Site. The Lower Fox River and Green Bay Site is divided into five OUs. These alternatives examined include an array of action levels that range from natural recovery (no action) to successively greater levels of management (lower target residual levels of PCBs) for each OU. A list of the OUs for the Site was presented in Table 1. Each remedial action level (RAL) was evaluated by well-established criteria within the context of a risk management goal. For the Lower Fox River and Green Bay Site, WDNR and EPA established the risk management goal as the elimination of fish consumption advisories for high-intake fish consumers within 10 years and recreational anglers within 30 years.

Consistent with CERCLA guidelines, nine criteria were used to evaluate alternatives. These nine criteria are summarized in Table 4. As part of this evaluation process, the tradeoffs between the degree to which a remedy could reach the risk management goal (Threshold Criteria), the scope and nature of the remedy (Balancing Criteria), and its acceptability (Regulatory Agency and Community Criteria) were considered. The proposed remedy selected by this process represents an optimized combination of the nine criteria in consideration of the overall management goal.

TABLE 4 CERCLA CRITERIA USED TO EVALUATE REMEDIATION ALTERNATIVES

Category	Criteria
Threshold Criteria	1. Overall protection of human health and the environment 2. Compliance with applicable or relevant and appropriate requirements (ARARs)
Balancing Criteria	3. Long-term effectiveness and permanence 4. Reduction of toxicity, mobility, and volume through treatment 5. Short-term effectiveness 6. Implementability 7. Cost
Regulatory Agency and Community Criteria	8. Agency acceptance 9. Community acceptance

A key feature of the remedy selection process for the Lower Fox River and Green Bay was the use of multiple lines of information to determine whether an alternative would comply with the criteria. Each of the supporting studies developed for the RI/FS contributed to remedy selection process. Supporting studies were developed using different assumptions in order to provide the widest possible perspective to inform the remedy selection process. The diversity of perspective that each study provides makes the RI/FS more complete and the Proposed Plan more sound because analyses were not restricted to approaches that favored any individual outcome (i.e., no action vs. action).

In contrast, approaches advocated by others appear to presuppose an alternative (e.g., no action).

Under CERCLA, the ROD is the document where a remedy for a site is selected. WDNR and EPA have issued an ROD for OU 1 (Little Lake Butte des Morts) and OU 2 (Appleton to Little Rapids). At this time, WDNR and EPA are issuing an ROD for the remainder of the Site which includes OU 3 (Little Rapids to De Pere), OU 4 (De Pere to Green Bay) and OU 5 (Green Bay). The discussion that follows focuses on how the selected remedy satisfies the nine criteria for OUs 3 though 5. It is important to note that the remedy selection process described is applicable to the entire Site.

3.1 Threshold Criteria

As part of remedy evaluation, the ability of each alternative to meet Threshold Criteria was considered. Protection of human health and the environment was evaluated by considering the risk associated with PCBs remaining in surface sediment for each alternative. For this evaluation, the following conditions were examined:

1. Surface-weighted average residual PCB concentrations in surface sediments
2. Average PCB concentrations in surface water
3. The estimated number of years needed to eliminate fish consumption advisories for PCBs
4. The estimated number of years required to reach surface sediment PCB concentration protective of fish and other biota
5. PCB loadings to downstream areas and total mass remediated

Compliance with ARARs was evaluated by considering whether an alternative can meet appropriate federal and state requirements, standards, criteria, and limitations as required by Section 121(d) of CERCLA and NCP § 300.430(f)(1)(ii)(B). Compliance with ARARs is required, unless waived under CERCLA Section 121(d)(4). ARARs are discussed in detail in Sections 4 and 9 of the FS (RETEC, 2002b) and are also presented in the ROD.

The primary risk to human health in the Site is through consumption of fish. The primary risk to the environment is the bioaccumulation of PCBs from the consumption of fish or, for invertebrates, the direct ingestion/consumption of sediment. The sediments of the River and Bay are PCB-contaminated and are the predominant source of PCBs in the system. On a Site-wide basis, human cancer risks were found to be 1,000 times greater than the 10^{-6} (one in one million) cancer risk management level and noncancer hazards were found to be 20 times greater than background risks. Wildlife such as fish-eating birds and mammals were also found to have unacceptably high risk levels. The conclusion that PCBs are unacceptably high is also confirmed by the fact that fish consumption advisories have been in place for this region continuously since the risks were first evaluated in 1976. Risks associated with existing conditions in the Lower Fox

River and Green Bay exceed acceptable limits described in risk assessment studies (RETEC, 2002c).

Protection of human health and the environment was evaluated by residual risk in surface sediment using five lines of evidence that include: residual PCB concentrations in surficial sediment using surface-weighted averaging after completion of a remedy; average PCB concentrations in surface water; the projected number of years required to reach safe consumption of fish; the projected number of years required to reach a surface sediment concentration protective of fish or other biota; and PCB loadings to downstream areas and total mass contained or removed.

As described in the FS, increasing levels of sediment management are expected to reduce residual surface sediment PCB concentrations, decrease average PCB concentrations in surface water, reduce the estimated number of years needed to eliminate fish consumption advisories, reduce the estimated number of achieve sediment conditions protective of fish and wildlife, and reduce PCB loadings to downstream areas.

The Threshold Criteria evaluation concludes that compliance with all ARARs can be achieved and that no waivers are necessary.

3.1.1 Operable Units 3 and 4

Based on consideration listed in Section 3.1, as well as further information specific to OUs 3 and 4 presented in the RI/FS and the BLRA, a level of remediation beyond no action or monitored natural recovery (MNR) is needed to meet Threshold Criteria for OUs 3 and 4.

Active remediation in OUs 3 and 4 is necessary to reduce PCB concentrations in surficial sediment and surface water, reduces the time needed to reach acceptable fish tissue concentrations for humans as well as fish and other wildlife, and will reduce downstream PCB loading into Green Bay to such an extent that active remediation will aid in the recovery of the Bay OU as well. This is further discussed in Section 11 of the ROD for OUs 3 and 4 as well as Sections 5 and 8 of the FS.

3.1.2 Operable Unit 5

Based on considerations listed in Section 3.1, above, as well as OU-specific information presented in the RI/FS and the BLRA, MNR is has been selected to meet Threshold Criteria for OU 5.

Concerning OU 5, it may take MNR over 100 years to reach safe fish consumption levels for recreational anglers as well as to achieve safe ecological levels for certain receptors. The estimated time to achieve protective standards for representative bird species vary by Bay zone and receptor. Furthermore, an active remediation would only provide a marginally more protective remedy than MNR in that risks would only be moderately reduced. It should be noted that because of limitations of modeling analysis, this relative comparison for receptors does not reflect how much longer than 100 years natural recovery would require because of limitations of the modeling analysis.

3.2 BALANCING CRITERIA

As part of remedy evaluation, the ability of each alternative to meet Balancing Criteria was considered. Balancing Criteria are important components that can define major trade-offs between alternatives and serve as important elements of project goals that require consideration for successful implementation and long-term success of a remediation project. These are discussed in Section 11 of the ROD and Section 9 of the FS.

3.2.1 Operable Units 3 and 4

Based on the reduction in residual risk and the adequacy and reliability of controls for the selected remedy, active remediation by dredging with off-site disposal of dewatered sediment is superior to a no action or MNR alternative due primarily to risk reduction, and also PCB mass removal from OUs 3 and 4. This remedy also reduces toxicity and mobility of PCB-contaminated sediments by eliminating the contaminants from the River thereby reducing the PCBs' ability to move in the environment and the amount of contamination present.

Dredging reduces concentrations of PCBs in the sediments' biologically active zone by permanently removing significant contaminated sediment volume and PCB mass from the food web. Furthermore, removal of PCBs will reduce the exposure pathway thus permanently reducing the toxicity associated with the sediments. Disposal of the dewatered sediment into a secure engineered licensed landfill eliminates PCB mobility.

The implementation time for the selected remedy is 6 years at an RAL of 1 part per million (ppm). This represents the estimated time required for mobilization, operation, and demobilization of the remedial work. While the construction of the remedy is underway, access to sediment processing facilities and areas would be restricted to authorized personnel. Work in the River will also be designed with provisions for control of air emissions, noise, and light. In summary, the active remediation would not pose significant risk to the nearby communities.

As successfully shown during the Lower Fox River demonstration dredging projects, environmental releases will be minimized during remediation by: (1) treating water prior to discharge; (2) controlling stormwater runon and runoff from staging and work areas; and (3) utilizing removal techniques that minimize losses; as well as through (4) the possible use of silt curtains where necessary to reduce the potential downstream transport of PCBs. The active remediation remedy is implementable as well as technically and administratively feasible. OUs 3 and 4 costs are estimated to be $284 million (WDNR, 2003c) at an action level of 1 ppm.

Based on these considerations, which are in large part from the RI/FS, active remediation is necessary to address Balancing Criteria for OUs 3 and 4.

3.2.2 Operable Unit 5

The MNR alternative does result in continuation of the current Bay circumstances of contaminated sediments and impacted surface water quality of OU 5, which may last for decades. Nevertheless, OU 5 will eventually recover as a result of slow natural decreases in concentrations. For MNR, fish consumption advisories and fishing restrictions will continue and can provide a measure of protection to humans until PCB concentrations in fish are reduced to the point where the fish consumption advisories and fishing restrictions can be relaxed or discontinued. A recent study by WDNR on commercial fishing of white perch in Green Bay (WDNR, 2003d) reached the following conclusions:

- Based on the most recent data, the *sport* fish consumption advisory will remain at six meals per year.

- The 2001–2002 data suggest that PCBs in white perch fillets reflects the location in which the fish were collected and also the season. To minimize the chance of harvesting an individual fish that exceeds 2 ppm, fish should be taken from the northern portion of Green Bay. In addition, the study suggests that fishing during the summer months may minimize the chance of harvesting an individual fish that exceeds 2 ppm. However, this seasonal pattern of 2001–2002 may not hold true in the future.

- The levels of PCBs and fat in white perch may vary with abundance of white perch, growth rates, and food availability and type, in addition to short-term and long-term changes in PCB exposure. Any of these factors may change in future years and future concentrations cannot be predicted from the 2001–2002 data. Future monitoring is needed.

More information is available from the WDNR's Fisheries Management website at: http://www.dnr.state.wi.us/org/water/fhp/fish/pubs/whiteperch.pdf.

Based on the above analysis of reduction in residual risk and adequacy and reliability of controls, active remediation is only marginally better than MNR. It may also be difficult to consistently achieve a remedial action level given the size of Green Bay.

Implementability addresses the technical and administrative feasibility of a remedy from design through construction and operation. Factors such as availability of services and materials, administrative feasibility, and coordination with other governmental entities are also considered. The MNR alternative is implementable as well as technically and administratively feasible as no active measures would be taken for the PCB-contaminated sediments. Certain institutional controls such as fish consumption advisories will be necessary.

The MNR remedy is implementable as well as technically and administratively feasible. Costs for OU 5 are estimated to be $39.6 million.

In addition, none of the alternatives appear to significantly reduce residual risk through removal or containment of this sediment based on modeling work conducted to date. Based on modeling estimates, there is no reduction in time required to reach acceptable fish tissue concentration ranges for any of the alternatives.

Based on these considerations, which are in large part from the RI/FS, MNR is the remedy selected to address Balancing Criteria for OU 5.

3.3 REGULATORY AGENCY AND COMMUNITY CRITERIA

Agency and community acceptance are modifying considerations that are usually taken into formal consideration once public comments have been received. These issues are the same for OUs 3 through 5 as they were for OUs 1 and 2. However, at the Lower Fox River and Green Bay Site, the State of Wisconsin has been actively involved in managing the resources of the Lower Fox River since before there was a federal Superfund law. These efforts have led to significant state knowledge and understanding of the River and Bay and of the contamination problems within those areas. As a result of this expertise, WDNR has served as the lead agency responsible for assessing risks and conducting the RI/FS, which forms the basis for the Proposed Plan and the ROD for OUs 3 through 5. As the lead agency, WDNR has worked closely with EPA to cooperatively develop this ROD. Both WDNR and EPA support the selected remedy identified in the ROD.

Community acceptance considers whether the local community agrees with EPA's analyses and preferred alternative. Comments received on the Proposed Plan are an important indicator of community acceptance. Community acceptance of the Proposed Plan was evaluated based on comments received at the public meetings and during the public comment period. There were more than 4,800 comments concerning the Proposed Plan. The ROD includes a Responsiveness Summary, Appendix B, which addresses public comments.

Based on the information listed in Sections 3.1 to 3.3, as well as further OU-specific information presented in the RI/FS and the BLRA, a level of remediation beyond no action or MNR is needed to meet CERCLA threshold, balancing, and acceptance criteria for OUs 3 and 4. However, based on the information in Sections 3.1 to 3.3, as well as OU-specific information presented in the RI/FS and the BLRA, MNR is adequate to meet CERCLA threshold, balancing, and acceptance criteria for OU 5.

3.4 OTHER FACTORS

In addition to consideration of the nine CERCLA criteria, discussion of additional factors in the evaluation of alternatives is worthwhile. These factors include:

- The potential for the direct release of PCBs during active dredging
- The potential of thin patinas (residual layers) following dredging
- Further evaluation of Green Bay bed mapping alternatives and data collection from the southern Bay

In particular, long-term simulations completed using the site-specific chemical transport and bioaccumulation models developed for the RI/FS do not include explicit representations of the potential for direct PCB releases during dredging operations and potential for thin patinas or residual layers to occur immediately following the end of dredging operations. These factors are believed to be of secondary importance.

Including or neglecting these factors is not believed to affect the selection of the remedy. Discussion of these two factors follows.

3.4.1 Direct Releases PCBs During Active Dredging Operations

Direct releases of PCBs can occur during active dredging operations. Such direct releases of PCBs were not explicitly included in the site-specific chemical transport and bioaccumulation models developed for the RI/FS. This model design factor was based on consideration of the scale of annual PCB mass transport through the River and the ability to control potential releases during dredging. As monitored during the Deposit N and SMU 56/57 demonstration projects, the mass of PCBs released by dredging was roughly two orders of magnitude smaller (less than 1 percent) than the present level of ongoing PCB transport through the Lower Fox River. Assuming full-scale dredging operations were initiated, direct releases of PCBs during dredging (a few kilograms per year) would always be far smaller than natural transport rates (several hundred kilograms per year). Further, as documented by the *Sediment Technologies Memorandum* (Appendix B of RETEC, 2002b) direct PCB releases during dredging can be minimized by the use of careful controls during dredging. Note that direct releases of PCBs as a result of propeller wash and bow thrusters by ships traversing the River may be a more significant loss (and uncontrollable) release mechanism. Based on these considerations, direct losses of PCBs during dredging were considered negligible.

3.4.2 Post-Dredge Patinas/Residual Layers

Immediately following the end of dredging operations, it is possible that patinas (thin residual layers) of more highly PCB-contaminated sediments may exist at the sediment-water interface. Such patinas were not explicitly included in the site-specific chemical transport and bioaccumulation models developed for the RI/FS. This model design factor was based on consideration of the ability of dredging technologies to achieve low residual PCB concentrations and the rapid rate at which conditions at the sediment-water interface are expected to change following dredging. As monitored following the first phase of the SMU 56/57 demonstration project in 1999, PCB concentrations in portions of the dredged area where post-dredging bed elevation met the target elevation were approximately equal to PCB concentrations initially present at that sediment depth (WDNR, 2000d). This indicates that low residual PCB levels can be achieved by careful control of dredging to ensure sediments are removed with minimum disturbance to a depth required to achieve a desired residual. In addition, dredging alters the sediment transport regime of the dredged area. As a result, conditions near the sediment-water interface can change rapidly following dredging. Post-dredging monitoring of the SMU 56/57 site showed that rapid changes in the sediment-water interface occurred and that conditions a few months following dredging did not resemble conditions immediately following dredging (WDNR, 2002). Based on these considerations, the effect of PCBs potentially present in post-dredge patina layers was considered negligible.

3.4.3 Green Bay Evaluation

In response to public concerns raised during the comment period, WDNR and EPA decided further evaluation of Green Bay was needed. These responsiveness activities included: evaluation of bed mapping techniques used to estimate PCB mass and volume in Green Bay, collection of data from southern Green Bay to determine if areas of elevated concentrations existed in the southern Bay, and further modeling to determine the effects of undiscovered areas of high PCB concentrations along with determining effects of changing the initial bed map conditions.

Bed Map Evaluation

White Paper No. 18 – Evaluation of an Alternative Approach of Calculating Mass, Sediment Volume, and Surface Concentrations in Operable Unit 5, Green Bay identifies the WDNR efforts at evaluating methods used by WDNR in Technical Memorandum 2f and the approach used by the University of Wisconsin to estimate PCB mass and contaminated sediment volume in Green Bay. *White Paper No. 18 – Evaluation of an Alternative Approach of Calculating Mass, Sediment Volume, and Surface Concentrations in Operable Unit 5, Green Bay* developed an alternative method to estimating Green Bay bed properties and concludes that given the expansiveness of the Bay, reliable sediment data is still sparse in many areas and there is some uncertainty associated with any method of estimating existing PCB mass and contaminated sediment volume in the Bay. As presented in both Technical Memorandum 2f and the University of Wisconsin method, it is possible to develop a variety of PCB mass estimates for Green Bay based solely on the magnitude of the factors influencing PCB mass. The alternative method developed as part of the *White Paper No. 18 – Evaluation of an Alternative Approach of Calculating Mass, Sediment Volume, and Surface Concentrations in Operable Unit 5, Green Bay* evaluation provides a sound estimate of PCB mass in Green Bay. *White Paper No. 19 – Estimates of PCB Mass, Sediment Volume, and Surface Sediment Concentrations in Operable Unit 5, Green Bay Using an Alternative Approach* uses this new approach with the most recent data to develop a set of bed maps which can be used as new initial conditions for future modeling in Green Bay.

Data Collection in Southern Green Bay

In July of 2002, additional samples were collected from the south end of Green Bay to address concerns raised about possible areas of elevated levels of PCBs. As additional data had been collected in December of 2001 by the FRG, this sample collection effort looked to historical areas where open-water disposal had occurred. This sampling effort did provide additional data that was used in further bed mapping activities in Green Bay, but it did not find any apparent former open-water disposal areas or areas of elevated PCB concentration.

Modeling

HydroQual, Inc., conducted two additional modeling activities for WDNR. The results of these modeling activities are found in *White Paper No. 20 – Green Bay Modeling Evaluation of the Effects of Sediment PCB Bed Map Revisions on GBTOXe Model Results* (HydroQual, 2003a) and *White Paper No. 21 – Green Bay Modeling Evaluation of a Hypothetical Open-Water Disposal Site for Navigational Dredged Material in Southern Green Bay* (HydroQual, 2003b).

White Paper No. 20 – Green Bay Modeling Evaluation of the Effects of Sediment PCB Bed Map Revisions on GBTOXe Model Results shows that in general, the alternative mass estimate derived from the revised bed maps introduces new initial conditions, which appear to be lower in Zone 2 (and to a lesser extent, Zone 3A). The lower initial condition in Zone 2 results in reduced Zone 2 concentrations relative to the original RI/FS scenario that are more consistent with those computed for zones 3A, 3B, and 4 over the course of the simulation period. While there are differences between the concentrations computed in these two scenarios, it is noted that these are due only to the differences in sediment initial conditions based on the alternative PCB mass estimates.

White Paper No. 21 – Green Bay Modeling Evaluation of a Hypothetical Open-Water Disposal Site for Navigational Dredged Material in Southern Green Bay results indicate that Bay-wide reductions in sediment and water column PCB concentrations, in response to a 1 ppm RAL at the hypothetical dredged material disposal site with an elevated concentration of 10 ppm, are greatest in Zone 2 but tend to become less appreciable after the first 10 years of the simulation period. By contrast, model results indicate that there is no appreciable impact to sediment and water column PCB concentrations for zones 3A, 3B, and 4. The relatively rapid decline of PCB concentrations within the first 10 cm of sediment, which is computed in the no action simulation, is due, in part, to the computed transfer of PCBs to the bottom sediment layer. This computed flux is affected by the large concentration gradient between the bottom and upper sediment layers specified in the initial conditions for the simulation. As the gradient is reduced, the computed burial flux between sediment layers becomes less of a factor. Over the long term, an analysis of the PCB mass transfer indicates that 71 percent of the PCB mass from the hypothetical dredged material disposal site sediments is eventually redistributed to other zones after 25 years.

As a result of this evaluation of Green Bay, WDNR and EPA are selecting MNR as the remedy for OU 5. At this time, the Agencies believe that current information is adequate for decision-making. However, as a result of public concerns and the results of the studies listed above, the Agencies will conduct further modeling with new information to evaluate impacts to the Bay and determine if there is any risk reduction benefit associated with remedial action in Green Bay. In the event a decision is made to undertake a remedial action in Green Bay, the public would be informed of the selection of this technology and the selection, implementation, and cost associated with it would be documented in an Explanation of Significant Differences (ESD).

4 SUMMARY OF THE SELECTED REMEDY

Taking into account the factors examined as part of the supporting studies, other information in the RI/FS, and public comments, WDNR and EPA recommend the cleanup actions listed in the Proposed Plan for the Lower Fox River and Green Bay. At this time, the Agencies are issuing the ROD for OUs 3 through 5. The selected remedy for OUs 3 through 5 is identified in Table 5 and is consistent with the Proposed Plan for these three OUs. Issuance of this ROD for OUs 3 through 5 completes the remedy selection process for this Site.

WDNR and EPA carefully considered more and less stringent cleanup levels (RALs) before selecting the 1 ppm level and believe the 1 ppm RAL is important to achieve the timely reduction of risks to an acceptable level. The selection of the cleanup level is the outcome of a complete and scientifically based risk evaluation. In selection of the 1 ppm RAL, WDNR and EPA considered Remedial Action Objectives (RAOs), model forecasts of the time necessary to achieve risk reduction, risk reduction, the post-remediation Surface-Weighted Average Concentration (SWAC), comparison of the residual SWAC concentration to SQTs for human and ecological receptors, sediment volume and PCB mass to be managed, and cost. The 1 ppm RAL achieves the Agencies' remedial action goals. WDNR and EPA believe this RAL selection is consistent with the 1999 Draft RI/FS. The 1999 Draft RI/FS called for an action level of 0.25 ppm or 0.25 ppm SWAC. The SWAC value resulting from the 1 ppm action level is 0.26 ppm in OU 3 and 0.16 ppm for OU 4.

TABLE 5 REMEDIATION PLAN FOR OUs 3 THROUGH 5 FOR THE LOWER FOX RIVER AND GREEN BAY SITE

Operable Unit	Selected Remedy	PCB Mass Removed (kg)	Contaminated Sediment Volume to Manage (cy)	Estimated Cost (million $)	Residual SWAC (ppm)
3	Dredge with off-site disposal to 1 ppm PCBs	1,111	586,800	27.5*	0.26
4	Dredge with off-site disposal to 1 ppm PCBs	26,433	5,879,500	257.5*	0.16
5	Monitored natural recovery	0	0	39.6	Zone 2: 1.159 Zone 3A: 0.320 Zone 3B: 0.561 Zone 4: 0.073

* From *White Paper No. 23 – Evaluation of Cost and Implementability of Alternative C2B for Operable Unit 3 and Operable Unit 4* (WDNR, 2003c).

5 CONCLUSIONS

Information from many different sources and supporting studies identified the need to implement an active remediation strategy for the Lower Fox River and Green Bay. While no single source of information or study findings in and of itself leads to selection of a remedy, the combination of these findings provides a clear weight of evidence supporting the selection of the remedy described in Sections 3 and 4 for OUs 1 and 2. An approach consistent with this will be followed for OUs 3 through 5. These findings can be categorized in a fashion consistent with the three groupings of the EPA NCP nine CERCLA criteria. The specific findings include:

- **Threshold Criteria**

  - Current risks to human health and the ecosystem are unacceptable. Natural recovery has not effectively reduced risks in the 30-plus years time frame since the manufacturing and recycling of PCB-contaminated carbonless copy paper has ceased. Furthermore, dechlorination in the Lower Fox River appears limited to concentrations that are greater than 30 mg/kg (ppm). This is far above the 1 ppm RAL.

  - WDNR and EPA objectives are to eliminate consumption advisories for recreational anglers within 10 years of completion of remediation and within 30 years for high-intake fish consumers.

  - Comparative modeling shows that active remediation will result in risk reduction more quickly than either the MNR or no action alternatives and will achieve WDNR and EPA risk reduction objectives for certain fish species.

  - Managing to a specific RAL will result in a specific risk-based, surface-weighted action level in any given OU.

  - This work can be completed while complying with ARARs of state and federal rules.

- **Balancing Criteria**

  - There is a large amount of PCBs and contaminated sediment in the Lower Fox River and Green Bay. Much of this sediment is found in the top 100 cm of the sediment bed for OU 3 and over 90 percent is in the top 200 cm in OU 4. This can be managed by active remediation such as dredging.

  - The sediment bed in the River is dynamic resulting in resuspension and downstream transport of PCBs in the water column.

  - Dredging technologies can achieve both short-term (e.g., remove to specific elevation or concentration, minimal resuspension of contaminated sediment) as well as long-term goals (e.g., achieving fish tissue concentrations acceptable to human receptors) for OUs 3 and 4.

- ► An effective post-remediation monitoring program is needed to ensure and measure the effectiveness of any remedial action.

- **Regulatory Agency/Community Criteria**
  - ► WDNR and EPA have worked together on the selection of this remedy and both are in agreement with the selection for OUs 3 through 5.
  - ► WDNR and EPA have taken many steps to inform the public of the work being conducted on the Lower Fox River and Green Bay and have used that input in preparing documents.
  - ► Comments submitted by the public have been considered in the selection of this remedy for OUs 3 through 5. The responses to comments received during the public comment period are included in the Responsiveness Summary that accompanies this ROD for OUs 3 through 5 as well as the ROD for OUs 1 and 2.

In addition, the Agencies will conduct further modeling related to Green Bay to further examine if there is any risk reduction benefit associated with remedial action in Green Bay. In the event a decision is made to undertake a remedial action in Green Bay, the public would be informed of the selection of this technology and the selection, implementation, and cost associated with it would be documented in an ESD.

6 REFERENCES

AGI, 2000. *Peer Review of Models Predicting the Fate and Export of PCBs in the Lower Fox River Below the De Pere Dam: A Report of the Lower Fox River Fate and Transport Peer Review Panel*. J. C. Tracy and C. M. Keane (eds). American Geological Institute, Alexandria, Virginia. 88 p.

Bierman, V. J., J. V. DePinto, T. C. Young, P. W. Rodgers, S. C. Martin, R. Raghunathan, and S. C. Hintz, 1992. *Development and Validation of an Integrated Exposure Model for Toxic Chemicals in Green Bay, Lake Michigan*. Prepared for United States Environmental Protection Agency, Large Lakes and Rivers Research Branch, Environmental Research Laboratory, Duluth, Michigan. September 1.

Connolly, J. P., T. F. Parkerton, J. D. Quadrini, S. T. Taylor and A. J. Thuman, 1992. *Development and Application of a Model of PCBs in the Green Bay, Lake Michigan Walleye and Brown Trout and Their Food Webs*. Report to the United States Environmental Protection Agency, Grosse Ile, Michigan. Cooperative Agreement CR-815396.

Connolly, J. P. and R. V. Thomann, 1992. Modeling the Accumulation of Organic Chemicals in Aquatic Food Chains. In: *Fate of Pesticides and Chemicals in the Environment*. J. L. Schnoor (ed). John Wiley & Sons, Inc. p. 385–406.

DePinto, J. V, V. J. Bierman, and T. C. Young, 1993. *Recalibration of GBTOX: An Integrated Exposure Model For Toxic Chemicals in Green Bay, Lake Michigan*. Prepared for United States Environmental Protection Agency, Large Lakes and Rivers Research Branch, Environmental Research Laboratory, Grosse Ile, Michigan. December 31.

Dinehart, R. L., 2002. Bedform movement recorded by sequential single-beam surveys in tidal rivers. *Journal of Hydrology*. 258(1–4):25–39.

EcoChem, 2003. *Data Management Summary Report, Addendum 2 – Fox River Remedial Investigation/Feasibility Study.* Prepared for Wisconsin Department of Natural Resources by EcoChem, Inc., Seattle, Washington. June.

EPA, 2002. *White Paper No. 3 – Fox River Bathymetric Survey Analysis*. United States Environmental Protection Agency, Region 5, Superfund Division, FIELDS Team. December.

Gobas, F. A. P. C., 1993. A model for predicting the bioaccumulation of hydrophobic organic chemicals in aquatic food-webs: Application to Lake Ontario. *Ecological Modeling*. 69:1–17. December 8.

Gobas, F. A. P. C., M. N. Z'Graggen, and X. Zhang, 1995. Time response of the Lake Ontario ecosystem to virtual elimination of PCBs. *Environmental Science & Technology*. 29(8):2038–2046.

HydroQual, Inc., 1995. *Addendum to Green Bay Final Report: Food Chain Model Projections*. Prepared for United States Environmental Protection Agency, Grosse Ile, Michigan.

HydroQual, Inc., 1996. *Green Bay Food Chain Model Documentation*. Prepared for United States Environmental Protection Agency, Grosse Ile, Michigan.

HydroQual, 2001. *Enhancement and Application of a PCB Fate and Transport Model for Green Bay – Lower Fox River/Green Bay Remedial Investigation and Feasibility Study*. Prepared for Wisconsin Department of Natural Resources by HydroQual, Inc. June.

HydroQual, 2003a. *White Paper No. 20 – Green Bay Modeling Evaluation of the Effects of Sediment PCB Bed Map Revisions on GBTOXe Model Results*. Prepared for Wisconsin Department of Natural Resources by HydroQual, Inc. June.

HydroQual, 2003b. *White Paper No. 21 – Green Bay Modeling Evaluation of a Hypothetical Open-Water Disposal Site for Navigational Dredged Martial in Southern Green Bay.* Prepared for Wisconsin Department of Natural Resources by HydroQual, Inc. June.

LTI, 2002. *Measurement of Burial Rates and Mixing Depths Using High Resolution Radioisotope Cores in the Lower Fox River*. Limno-Tech, Inc., Ann Arbor, Michigan. 95 p.

Manchester-Neesvig, Jon B., Anders W. Andren, and David N. Edgington, 1996. Patterns of mass sedimentation and deposition of sediment contaminated by PCBs in Green Bay. *Journal of Great Lakes Research*. 22(2):444–462.

QEA, 2001. *A Model of PCB Bioaccumulation in the Lower Fox River and Green Bay: GBFood*. Prepared for ThermoRetec Consulting Corporation by QEA, LLC, Montvale, New Jersey. June.

RETEC, 2002a. *Final Remedial Investigation for the Lower Fox River and Green Bay, Wisconsin*. Prepared for Wisconsin Department of Natural Resources by The RETEC Group, Inc., St. Paul, Minnesota. December.

RETEC, 2002b. *Final Feasibility Study for the Lower Fox River and Green Bay, Wisconsin*. Prepared for Wisconsin Department of Natural Resources by The RETEC Group, Inc., Seattle, Washington. December.

RETEC, 2002c. *Final Baseline Human Health and Ecological Risk Assessment for the Lower Fox River and Green Bay, Wisconsin*. Prepared for Wisconsin Department of Natural Resources by The RETEC Group, Inc., Seattle, Washington and Pittsburgh, Pennsylvania. December.

RETEC, 2002d. *Green Bay Sediment Results from the July 2002 Survey*. Prepared for Wisconsin Department of Natural Resources by The RETEC Group, Inc., Madison, Wisconsin. December.

Steuer, J., S. Jaeger, and D. Patterson, 1995. *A Deterministic PCB Transport Model for the Lower Fox River Between Lake Winnebago and De Pere, Wisconsin*. PUBL WR 389-95. Wisconsin Department of Natural Resources. May. 283 p.

Tetra Tech, Inc., 2000. *Overview of Sediment-Contaminant Transport and Fate Models for Use in Making Site-Specific Contaminated Sediment Remedial Action Decisions*. Prepared for United States Environmental Protection Agency OERR (5204G) by Tetra Tech, Inc., Fairfax, Virginia.

TMWL, 2002. *Time Trends in PCB Concentrations in Sediment and Fish: Lower Fox River and Green Bay, Wisconsin*. Prepared for Wisconsin Department of Natural Resources by The Mountain-Whisper-Light Statistical Consulting, Seattle, Washington and The RETEC Group, Inc., Seattle, Washington. December.

Velleux, M. and D. Endicott, 1994. Development of a mass balance model for estimating PCB export from the Lower Fox River to Green Bay. *Journal of Great Lakes Research*. 20(2):416–434.

Velleux, M., D. Endicott, J. Steuer, S. Jaeger, and D. Patterson, 1995. Long-term simulation of PCB export from the Fox River to Green Bay. *Journal of Great Lakes Research*. 21(3):359–372.

Velleux, M., J. Gailani, and D. Endicott, 1996. Screening-level approach for estimating contaminant export from tributaries. *ASCE Journal of Environmental Engineering*. 122(6):503–514.

Velleux, M., J. Killian, G. Statz, S. Jaeger, D. Damiani, and E. Garland, 2001. *Development and Application of a PCB Transport Model for the Lower Fox River – Lower Fox River/Green Bay Remedial Investigation and Feasibility Study*. Prepared by Wisconsin Department of Natural Resources. June 15.

WDNR, 1997. *Polychlorinated Biphenyl (PCB) Contaminated Sediment in the Lower Fox River: Modeling Analysis of Selective Sediment Remediation*. PUBL-WT-482-97. Wisconsin Department of Natural Resources, Bureau of Watershed Management, Madison, Wisconsin. February.

WDNR, 1999a. *Technical Memorandum 2d: Compilation and Estimation of Historical Discharges of Total Suspended Solids and PCB from Lower Fox River Point Sources*. Wisconsin Department of Natural Resources, Madison, Wisconsin. February 23.

WDNR, 1999b. *Technical Memorandum 2g: Quantification of Lower Fox River Sediment Bed Elevation Dynamics through Direct Observations*. Wisconsin Department of Natural Resources, Madison, Wisconsin. July 23.

WDNR, 1999c. *Technical Memorandum 2e: Estimation of Lower Fox River Sediment Bed Properties*. Wisconsin Department of Natural Resources, Madison, Wisconsin. March 31.

WDNR, 1999d. *Analysis of COE Sounding Data at 56/57*. Memorandum prepared by Jim Killian. Wisconsin Department of Natural Resources, Madison, Wisconsin. September 27.

WDNR, 2000a. *Addendum to Technical Memorandum 2e: Estimation of Sediment Bed Properties for the Lower Fox River (4 reach effort)*. Memorandum prepared by G. Fritz Statz. Wisconsin Department of Natural Resources, Madison, Wisconsin. October 26.

WDNR, 2000b. *Technical Memorandum 2f: Estimation of Sediment Bed Properties for Green Bay*. Wisconsin Department of Natural Resources, Madison, Wisconsin. December 15.

WDNR, 2000c. *Screening-Level Model of PCB Transport in the Sheboygan River*. Wisconsin Department of Natural Resources, Madison, Wisconsin. December 31.

WDNR, 2000d. *Post-Dredging Results for SMU 56/57*. Memorandum prepared by Bob Paulson. Wisconsin Department of Natural Resources, Madison, Wisconsin. February 21.

WDNR, 2001a. *Development and Application of a PCB Transport Model for the Lower Fox River*. Wisconsin Department of Natural Resources, Madison, Wisconsin. June 15.

WDNR, 2001b. *Estimation of Contemporary Net Burial Rates from the Depth of PCB Occurrence in the Lower Fox River Sediments*. Memorandum prepared by Mark Velleux. Wisconsin Department of Natural Resources, Madison, Wisconsin. March 23.

WDNR, 2002. *2002 Benthic and Sediment Sampling at Fox River Remediation Site Hotspot 56/57*. Memorandum prepared by Jim Killian. Wisconsin Department of Natural Resources, Madison, Wisconsin. November 26.

WDNR, 2003a. *White Paper No. 18 – Evaluation of an Alternative Approach of Calculating Mass, Sediment Volume, and Surface Concentrations in Operable Unit 5, Green Bay.* Wisconsin Department of Natural Resources, Madison, Wisconsin. June.

WDNR, 2003b. *White Paper No. 19 – Estimates of PCB Mass, Sediment Volume, and Surface Sediment Concentrations in Operable Unit 5, Green Bay Using an Alternative Approach*. Wisconsin Department of Natural Resources, Madison, Wisconsin. June.

WDNR, 2003c. *White Paper No. 23 – Evaluation of Cost and Implementability of Alternative C2B for Operable Unit 3 and Operable Unit 4.* Wisconsin Department of Natural Resources, Madison, Wisconsin. June.

WDNR, 2003d. *Green Bay's Other Perch*. Wisconsin Department of Natural Resources, Madison, Wisconsin. http://www.dnr.state.wi.us/org/water/fhp/fish/pubs/whiteperch.pdf.

WDNR and EPA, 2001. *Proposed Remedial Action Plan, Lower Fox River and Green Bay*. Wisconsin Department of Natural Resources, Madison and Green Bay, Wisconsin and United States Environmental Protection Agency, Region 5, Chicago, Illinois. October.

WDNR and RETEC, 2002. *Final Model Documentation Report for the Lower Fox River and Green Bay, Wisconsin*. Wisconsin Department of Natural Resources, Madison, Wisconsin and The RETEC Group, Inc., Seattle, Washington. December.

White Paper No. 23 – Evaluation of Cost and Implementability of Alternative C2B for Operable Unit 3 and Operable Unit 4

Response to Comments on the

Proposed Remedial Action Plan for the Lower Fox River and Green Bay

October 2001

This Document has been Prepared by the

Wisconsin Department of Natural Resources

Madison, Wisconsin

June 2003

White Paper No. 23 – Evaluation of Cost and Implementability of Alternative C2B for Operable Unit 3 and Operable Unit 4

Abstract

The paper addresses concerns raised during the public comment period for the *Final Remedial Investigation for the Lower Fox River and Green Bay, Wisconsin* (RI) (RETEC, 2002a), the *Final Feasibility Study for the Lower Fox River and Green Bay, Wisconsin* (FS) (RETEC, 2002b), and the *Proposed Remedial Action Plan, Lower Fox River and Green Bay* (Proposed Plan) (WDNR and EPA, 2001), on the implementability and cost of the Proposed Plan concerning Operable Units (OUs) 3 and 4. More specifically, concerns were raised concerning the possible use and cost of a pipeline to remove the dredge slurry from the River and the size and cost of the de-watering and disposal cells recommended in the Proposed Plan. To address these concerns, the Wisconsin Department of Natural Resources (WDNR) reviewed technical and cost issues associated with the Proposed Plan for these two Operable Units. This work is discussed in the following white paper.

1 Introduction

In the Proposed Plan for the Lower Fox River (WDNR and EPA, 2001), the proposed remedy for OU 3 and OU 4 is Alternative "C2." This alternative includes dredging, pipeline transport, passive dewatering, and disposal with the dewatering and disposal in separate but adjacent facilities. Comments received by WDNR and the United States Environmental Protection Agency (EPA) during the public comment period expressed concern over the implementability and cost associated with the length and placement of the dredge slurry pipeline as well as the sizing of the dewatering and disposal facilities. The purpose of this white paper is to evaluate implementability and cost concerns for this alternative to review these issues and provide a basis for responding to these concerns.

For purposes of the Proposed Plan and Record of Decision (ROD) for OUs 3 through 5, the alternative of separate but adjacent dewatering and disposal facilities managing the dredged material from both OUs 3 and 4 together was evaluated. In the Final FS released in 2002, alternatives were presented for both combined and separate dewatering and disposal facilities. These are listed as Alternatives C2A and C2B, respectively. Alternative C2B more clearly identifies separate dewatering and disposal facilities discussed in the Proposed Plan.

As described in the FS, Alternative C2B includes some features such as the addition of lime and solidification due to a short passive dewatering duration. This specific set of assumptions was one of many sets of assumptions that could have been used in the FS. Upon further evaluation, the Agencies decided that some features such as the lime addition and solids processing were not necessary for this alternative.

Consequently, the Agencies have reexamined the implementability and cost of Alternative C2B as part of the response to comments so a representative feasibility study-level alternative and cost estimate can be presented. To conduct this evaluation, conceptual design issues such as sizing of the dewatering and disposal cells along with operational constraints from Alternatives C2A and C2B from the FS were considered. The set of assumptions used in this evaluation are based on the trade-off between project duration, land availability, final dewatered sediment solids content, and cost. In addition, these dewatering choices impact the design and operations of the disposal facility.

The remedy in the OUs 3 through 5 ROD includes a longer duration of passive dewatering, additional passive dewatering cells, and a greater assumed solids content at the end of dewatering (35 percent). The remedy assumes that intermediate drainage layers can be incorporated into the landfill construction.

2 IMPLEMENTABILITY

Section 6 of the Final FS for the Lower Fox River and Green Bay (RETEC, 2002b) covers the screening of applicable remediation technologies, including the transfer, dewatering, and disposal of dredged material. Much of the information in this white paper evaluation was considered in the development of the Section 6 of the FS and as well as earlier drafts of that document.

2.1 Pipeline

Pipeline technology has been used to transfer sediment dredge slurry over long distances. This has been a common practice in mining facilities and at dredging operations. An example is White Rock Lake in Dallas, Texas (Hagler, 2001). In that case, a pipeline with a length of 20 miles was used to transport dredged sediments over land. At the USX portion of the Grand Calumet River Project, a 3-mile in-water pipeline with an 18-inch diameter is being used. In a Wisconsin case, hydraulically dredged sediments were transferred via pipeline from the Grubers Bay Grove sediment project, part of the U.S. Army Badger Army Ammunition Plant remediation, to the on-site disposal location, a distance of about 0.7 mile.

In FS Section 7, there is a discussion concerning the application of this pipeline technology to OU 3 (page 7-97) and to OU 4 (page 7-137) as part of a proposed remedy. This conceptual pipeline design includes the use of a 15-inch polyethylene pipe inside a 20-inch steel pipe that would travel to a disposal location with booster pumps located along the route. Additional assumptions include that the pipeline would be 18 miles in length and that there would be four booster pumps along the route. While no route has been selected yet, it is possible to place the pipeline adjacent to an existing recreational route, in the River, along public right of ways, or some combination thereof. Pipeline routing is a concern. The specific route and details concerning the design and construction of a pipeline along any specific route or combination of routes is a design consideration to be addressed in the future. The inability to route such a pipeline could result in increased cost for this approach, or, the use of a different, potentially more costly, dredge material transport method.

2.2 Passive Dewatering and Disposal

Passive dewatering technology was evaluated in Section 6.5.1 of the FS. Passive dewatering represents a feasible "low tech" approach for dewatering sediments. In this particular alternative, the application of this technology relies on gravity settlement of solids conducted in upland ponds. This approach is consistent with the approach used at the Bayport facility managed by Brown County for the management of navigational dredge materials in conjunction with mechanical dredging. Use of passive dewatering cells can result in the need for large land areas. Finding a location for such a facility could pose a difficulty due to the large land areas necessary for the dewatering cells.

Management of PCB-contaminated material in an upland disposal location is a proven technology. In the two Lower Fox River demonstration projects, this approach was successfully utilized for management of the dredge materials as it has been at numerous other sites. Upland disposal is also a protective risk reduction approach that does not allow for PCBs to be reintroduced into the food chain. The size of the disposal facility is dependent upon the solids content of the material and the compressive strength of the dewatered sediment. As a general rule of thumb, the lower the percent solids, the less the compressive strength, the less ability there is to place waste in lifts and the greater the area needed. The larger the area needed, the greater the area that needs to be lined for disposal, resulting in higher disposal cost. An important aspect of design is to optimize the dewatering step to get a high percent solids to reduce the size of the disposal cells.

From an implementability perspective, the design and operation of dewatering and disposal facilities must consider the following: size of the dewatering cell, the filling sequence of and hence the number of cells, the percent solids at which the dredge material enters the cells, how water will be withdrawn from the cell, the percent solids of the material that will exit the dewatering cells, how the material will be removed from the dewatering cells and placed into the disposal cells, what will be the lift height within a landfill cell, what is the compressive strength, will the material continue to dewater in the disposal cells, the need for an intermediate drainage layer between lifts, the depth of cut of the landfill cell, liner and cover design requirements for the disposal cells, and when closure is needed.

2.2.1 Dewatering. Combining the estimated size of the dewatering cells for Alternative C2B for both OU 3 and OU 4 result in a total area of 218 acres. To add a degree of conservatism to this approach, this area was multiplied by 1.5 for a total area of 327 acres. This area, if split among cells and allowing for berms could provide for construction of multiple cells. Depending upon operation needs, cells could be loaded every third or fourth year. This would allow for an operational approach that would provide for loading of a cell while supernatant was being decanted of off the cell, a year to dewater the cell, and a final year of dewatering prior to the material being removed at the end of the third year and then the cell being readied for more dredge slurry the following year. Dewatering would take place by decanting, bottom drainage, desiccation, vegetative growth, evapo-transpiration, and could be enhanced by disking or other methods. It is assumed that the material would be approximately 35 percent solids when it leaves the dewatering cell. An end loader filling multiple dump trucks could conduct transfer to the adjacent disposal facility. The relationship between volume and percent solids is included in the table below. This higher percent solids may make it worthwhile to place more emphasis on the additional dewatering cell(s) rather than construction of additional landfill capacity. The size, operation and the number of cells will be optimized during the design process.

Combined OU 3 and OU 4 Weight and Volume		
Percent Solids	**Weight (tons)**	**Volume (cubic yards)**
30%	7,739,200	7,580,000
35%	6,633,600	6,205,500
40%	5,804,400	5,234,000
45%	5,159,500	4,486,500
50%	4,643,500	3,928,500

2.2.2 Disposal. Combining the estimated size of the disposal areas for Alternative C2B for both OU 3 and OU 4 result in a total area of 121 acres. This area, if split among cells and allowing for berms could provide for construction of two cells of approximately 50 acres apiece with a fill height of approximately 20 feet. Each cell could be loaded every other year in lifts of 6 to 7 feet. Placement of the material in such a manner could allow for further dewatering as the material is placed and in subsequent years as the material consolidates due to gravity and further placement of material from subsequent lifts. Dewatering layers could be placed in between lifts to enhance dewatering and consolidation. Consolidation would not likely be enhanced through typical compaction techniques. As is pointed out in the dewatering discussion, consolidation and increased percent solids affects the size of the disposal facility in terms of both total land area and ability to fill using vertical airspace rather than expanding horizontally and adding to land needs. Leaving the cells open for a time period of 2 or so years will allow for further drying and consolidation of the material prior to final closure. Once closure takes place, further settlement may take place due to the cover weight and self-weight consolidation. Maintenance of the cover will be necessary to address further settlement.

Of particular concern in the siting of such facilities is the availability and acquisition of the large land areas necessary. This issue will need to be addressed as part of the post-ROD siting process as well as negotiations with local communities. It should be noted that the more difficult it is to site these facilities locally, the greater the cost will be.

3 COST

Costs at the feasibility study level are expected to be within a -30 to +50 percent range per Superfund guidance. While this is a broad range, it is meant to provide sufficient information on cost for decision-making without having to go into a detailed design of the alternative. Estimated costs included in the Proposed Plan for this alternative was $30.9 million for OU 3 and $169.6 million for OU 4. The total cost of this plan for both OUs was estimated at $200.5 million. Details of this cost estimate can be found in Appendix H of the Final FS for the Lower Fox River and Green Bay (RETEC, 2002b). Sources of the unit cost information included in Appendix H include the R.S. Means Heavy Construction Cost Estimating Data, 2000, past reports and studies, information from various consulting firms and contractors, and professional judgment.

To more clearly evaluate costs for this combined OU 3 and OU 4 alternative, the cost information included in Appendix H of the FS for Alternative C2B was reviewed to refine costs for Alternative C2B. Unit costs were considered along with the source of the unit cost estimate and the conceptual FS design. A decision was then made as to whether this was a reasonable cost for a "feasibility study" level of effort. Furthermore, the FS has done a complete cost estimate for each Operable Unit. This results in some duplication of costs such as the pipeline construction, certain landfill operation and monitoring costs, as well as wastewater treatment costs. In reviewing these cost estimates as part of this evaluation, these "shared" costs were identified and are only included once. This combined OU 3 and OU 4 cost summary is included as Attachment 1 to this white paper and is entitled *Basis for Preliminary Cost Estimates – Little Rapids to De Pere and De Pere to Green Bay*. This cost summary provides the same level of detail as does Appendix H of the Final FS.

3.1 Pipeline

The source of the unit costs for pipeline are listed in Appendix H of the FS as are the conceptual design assumptions for the pipeline. These assumptions for the pipeline construction and operation included in Appendix H are consistent with the text in the FS. Furthermore, since the cost estimates for the FS included two pipelines (one each for OU 3 and OU 4), only the OU 4 pipeline is carried forward. Applying the unit cost to the conceptual design result in a cost for pipeline construction were approximately $17,155,000 or about $180 per foot.

3.2 Passive Dewatering and Disposal Facilities

3.2.1 Dewatering. The cost from Attachment 1 for the combined OU 3 and OU 4 from Attachment 1 gives an estimated cost of $58,300,000 for the construction of approximately 327 acres of dewatering cells. These costs cover land purchase, berm and grade construction, and liner placement. On a per-acre basis, this leads to a cost of $178,300 per acre. This is a reasonable cost estimate for this type of facility when a liner is required.

3.2.2 Disposal. The cost from Attachment 1 for the combined OU 3 and OU 4 from Attachment 1 gives an estimated cost of $36,600,000 for the construction and closure of approximately 121 acres of disposal cells. These costs cover land purchase, berm and grade construction, liner placement, as well as cover construction. On a per-acre basis, this leads to a cost of $302,000 per acre for landfill construction and closure. This is a reasonable cost estimate for this type of disposal facility with a liner and cover requirement.

3.3 Unit Processing Fee

There is a cost associated with transferring, processing, and transporting material within and between the dewatering facility and the disposal facility. In the Final FS, this cost is roughly $38 per ton. This figure included the purchase and processing to add lime to the dewatered sediment to achieve a high percent solids and strength of the dredge material more quickly as well as the transfer of the material over public roads from the dewatering facility to the disposal facility.

Following the proposal for managing the dewatered material included in the implementation discussion above was a unit processing cost of roughly $3.5 to $4 per ton. Using a cost of $4 per ton for a total tonnage of 6.6 million tons (at 35 percent solids) equates to a cost of $26,400,000.

3.4 Combined OU 3 and OU 4 Costs

Costs covering dredging, water treatment, local siting, and institutional controls also need to be considered for the revised Alternative C2B need cost estimate. These costs along with the costs for pipeline, dewatering, and disposal are included in the table below which has the combined cost for the revised Alternative C2B cost estimate. Attachment 1 is a revised Alternative C2B cost table based on Appendix H of the FS. In that more detailed table, the various costs are readily identifiable.

Revised Estimated Alternative C2B Costs	
Sediment Removal	$112,500,000
Sediment Dewatering	$58,300,000
Disposal	$96,100,000
Water Treatment*	$7,300,000
Institutional Controls*	$9,000,000
Total OU 3 and 4 Cost =	**$283,200,000**

Costs come from Attachment 1 which is based on refined Appendix H costs from the Final FS; a combined OU 3 and OU 4 alternative.

3.5 Unit Cost

The estimated *in-situ* contaminated sediment volume to be dredged from OU 3 is 586,800 cubic yards (cy) and the estimated *in-situ* volume from OU 4 is 5,879,500 cy for a combined amount of 6,466,300 cy. At an estimated cost of $283,200,000, the unit cost is $43.80 per cy. Individual costs are based on the volume in each OU and are included in the following table.

Estimated Costs per Operable Unit	**Sediment Volume in OU**	**Cost per OU Based on Volume**
Operable Unit 3	586,800 cy	$25,700,000
Operable Unit 4	5,880,000 cy	$257,500,000
Total	**6,466,800 cy**	**$283,200,000**

The ROD for OUs 3 through 5 calls for the removal of Deposit DD from OU 2 as part of the OU 3 remedy. The estimated volume of contaminated sediment in Deposit DD at a concentration above 1 ppm is 9,000 cy (6,920 cubic meters from RI Table 5-13). At a unit cost of $43.80 per cy, the estimated cost is $0.4 million. Doubling this to account for any additional piping, staging costs, etc., brings the estimated cost to remove Deposit DD to $0.8 million. This cost is added to the cost to remediate OU 3. Furthermore, using the unit cost to assign costs to the different OUs leads to a cost estimate of $26.5 million for OU 3 (including Deposit DD) and a cost of $257.5 million for OU 4. Consequently, the combined cost estimate for OU 3 and OU 4 is $284 million.

4 CONCLUSIONS

Based on this evaluation, the following conclusions regarding cost and implementation can be reached.

4.1 Cost

- The cost for separate dewatering and disposal facilities are above what was included in the Proposed Plan, but are less than what is estimated in the Final Lower Fox River and Green Bay FS. The cost estimate has increased from $200.5 million to remediate these two units to $284 million, or an increase of about 42 percent. Some cost savings may be incurred in the design in areas such as the possible flexibility in the design of the liner of the disposal facility as well as in operational efficiencies.

- The basis for establishing unit costs for cost estimates are reasonable and include source such as the R.S. Means Heavy Construction Cost Estimating Guide, past reports and studies, information from various consulting firms and contractors, as well as professional judgment. Applying these sources generate cost estimates that are within the -30 to +50 percent feasibility study cost range set forth in EPA guidance.

- Cost savings are incurred by selecting the same alternative for both OU 3 and OU 4.

4.2 Implementability

- Overall, Alternative C2B is implementable and a technically feasible alternative. There are, however, many technical and operational issues that must be considered in the final design, construction, and operation of the alternative.

- Use of a pipeline to transfer dredge slurry is an implementable and a feasible technology. Final route placement, size of the pipe, number of pumps and pump stations, as well as the length of the pipeline will be part of the final design.

- Siting of the dewatering and disposal facilities are land intensive and could be difficult to site due to availability and acquisition of land. Siting of the disposal facility will need to follow the state siting laws.

- Addressing items such as siting, technical issues as well as operational, monitoring, and closure plans will be important considerations in the design phase of this project. As a final design is developed, cost estimates will be able to be more refined.

- Per-acre cost estimates developed as part of this evaluation fall within typical cost for disposal and closure of disposal facilities. Information to be collected as part of the pre-design sampling effort concerning physical and chemical properties of the dewatered sediment may allow for modification of liner specifications that may afford further savings.

5 References

Hagler, 2001. Personal communications between ThermoRetec and Bob Hagler of Hagler Systems in Augusta Georgia, regarding performance of the 20-mile slurry pipe run used at White Rock Lake, Texas. June 18.

R.S. Means Heavy Construction Cost Estimating Guide, 2000 and 2001.

RETEC, 2002a. *Final Remedial Investigation for the Lower Fox River and Green Bay, Wisconsin*. Prepared for Wisconsin Department of Natural Resources by The RETEC Group, Inc., St. Paul, Minnesota. December.

RETEC, 2002b. *Final Feasibility Study for the Lower Fox River and Green Bay, Wisconsin*. Prepared for Wisconsin Department of Natural Resources by The RETEC Group, Inc., Seattle, Washington. December.

WDNR and EPA, 2001. *Proposed Remedial Action Plan, Lower Fox River and Green Bay*. Wisconsin Department of Natural Resources, Madison and Green Bay, Wisconsin and United States Environmental Protection Agency, Region 5, Chicago, Illinois. October.

ATTACHMENT 1

BASIS FOR PRELIMINARY COST ESTIMATES – LITTLE RAPIDS TO DE PERE AND DE PERE TO GREEN BAY

White Paper No. 23 Attachment 1
Cost Comparison for OU 3 and OU 4
Alternative C2B - Lower Fox River

Activity	Final FS Costs			Proposed Plan		Basis for Cost Benefit
	OU 3	**OU 4**	**OU 3 and OU 4**	**Joint OU 3/OU 4**	**Cost Benefit**	
Sediment Removal	$24,700,000	$98,900,000	$123,600,000	$112,500,000	$11,100,000	Single mobilization and single pipeline constructed.
Sediment Dewatering	$22,100,000	$19,900,000	$42,000,000	$58,300,000	($16,300,000)	Assumed 35% solids at completion of dewatering rather than 30% due to longer dewatering duration – 2.5 years versus 6 months. Savings more than offset by increase in number of cells and associated acreage.
Water Treatment	$4,600,000	$6,900,000	$11,500,000	$7,300,000	$4,200,000	Single water treatment system and discharge piping to river.
Sediment Disposal	$44,000,000	$359,400,000	$403,400,000	$96,100,000	$307,300,000	Eliminated lime purchase and soldification from dewatering process due to increased dewatering time frame and associated increased solids content. Decreased haul time from 2 hours per load to 0.5 hour.
Institutional Controls	$4,500,000	$4,500,000	$9,000,000	$9,000,000	$0	
TOTAL	**$99,900,000**	**$489,600,000**	**$589,500,000**	**$283,200,000**	**$306,300,000**	

BASIS FOR PRELIMINARY COST ESTIMATES
SEDIMENT REMEDIATION
FOX RIVER, WISCONSIN
LITTLE RAPIDS TO DE PERE AND DE PERE TO GREEN BAY
Action Level - 1,000 ppb

ALTERNATIVE C2B: Dredge Sediment with Separate Dewatering and Disposal Facilities

SEDIMENT REMOVAL (2 12-INCH CUTTERHEADS)

Capital Items	Quantity	Units		Cost
Site Preparation	3	EA		$2,410,200
Mobilization - Equipment and Silt Curtain	1	LS		$1,170,000
Debris Sweep	1362	acre		$21,792,000
Dredging - 2 12 hour shifts/day	1121	Day	6.15934066	$31,836,400
Dredge Monitoring (Water Quality)	1121	Day		$6,726,000
Sediment Removal QA	1121	Day		$2,690,400
Piping	95,000	ft		$6,365,000
Road Crossings	12	ea		$600,000
Booster Pumps	4	ea		$11,210,000
Winter Over All Equipment	7	yr		$1,995,000
Site Restoration	3	EA		$1,800,000

Direct Capital:	$88,595,000
Engineering, Procurement & Construction Management:	10,631,400
Contractor Overhead/Profit:	13,289,250
Total Capital:	**$112,500,000**

SEDIMENT DEWATERING (GRAVITY - NR 213)

Capital Items	Quantity	Units	Cost
Land Lease or Purchase	13,189,454	sf	$23,741,016
Mobilization	1	LS	$20,000
Clear and Grub	13,189,454	sf	$605,576
Berm Construction	260,294	cy	$1,561,761
Rough Grading	13,189,454	sf	$3,297,363
Liner Placement	13,189,454	sf	$19,784,180
Demob/Disposal	1	LS	$10,000
Regrade	260,294	cy	$1,561,761
Seed/Sod	1,465,495	sy	$1,465,495

Direct Capital:	$52,047,153
Engineering, Procurement & Construction Management:	6,245,658
Total Capital:	**$58,300,000**

WATER TREATMENT

Capital Items	Quantity	Units	Cost
Unit Purchase	3,110	gpm	$2,586,470
Water Treatment (Including Operator)	5,238,315,325	gal	$2,095,326
Water Treatment QA	1,304	Day	$521,600
Piping	20,000	ft	$1,340,000

Direct Capital:	$6,543,396
Engineering, Procurement & Construction Management:	785,207
Total Capital:	**$7,300,000**

BASIS FOR PRELIMINARY COST ESTIMATES
SEDIMENT REMEDIATION
FOX RIVER, WISCONSIN
LITTLE RAPIDS TO DE PERE AND DE PERE TO GREEN BAY
Action Level - 1,000 ppb

SEDIMENT DISPOSAL (Dedicated NR 500 Monofill)

Capital Items	Quantity	Units		Cost
Sediment Loading	6,612,557	ton		$18,515,160
Sediment Hauling	6,612,557	ton		$7,749,090
Landfill Construction	1	LS		$24,467,146
Local Siting Fee	3,906,255	cy		$19,531,275
Closure	121	acres		$12,100,000
Direct Capital:				$82,362,671
Engineering, Procurement & Construction Management:				9,883,521
Total Capital:				**$92,200,000**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Operations		10	$500,000	$3,680,044
Post Closure Monitoring		40	$30,000	$252,053
Total Present Worth, Longer Term O&M Costs				$3,932,097
Total Project Capital and O&M Cost				**$96,100,000**

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units		Cost
Deed Restrictions	1	LS		$5,000
Direct Capital:				$5,000
Engineering, Procurement & Construction Management:				600
Total Capital:				**$5,600**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Long-term Monitoring (no action)		40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs				$4,513,889
Total Project Capital and O&M Cost				**$9,000,000**
Combined OU 3 and OU 4 COST				**$283,200,000**
Unit cost in $ / cubic yard				**$43.80**

In Situ Volumes

Depost DD	9,000	cy
OU 3	586,800	cy
OU 4	5,879,500	cy

Costs

OU 3 (including DD)	$26,500,000
OU 4	$257,500,000.00
Total Costs	**$284,000,000.00**

Data Management Summary Report, Addendum 2

Fox River Remedial Investigation/Feasibility Study

This Document has been Prepared by

EcoChem, Inc.

Seattle, Washington

for the

Wisconsin Department of Natural Resources

Madison, Wisconsin

June 2003

ADDENDUM 2 TO THE DATA MANAGEMENT SUMMARY REPORT

Note: As data are collected, reviewed (or validated), and appended to the Fox River Database (FRDB), the Data Management Summary Report will also be appended. A description of the data set, along with results of data review/validation and determination of usability will be discussed in consecutively numbered sections. Addendum 1 was included as part of the Final Lower Fox River and Green Bay Remedial Investigation Report issued in December of 2002.

As supporting tables (Table 3-1: Data Set Analysis and Table 3-2: QC Elements for Data Sets Supporting the Fox River Remedial Investigation [RI]/Feasibility Study [FS] and Risk Assessment [RA]) are appended, the tables will be resubmitted (with each Addendum) in their entirety. With the addition of these data sets, this brings the number of individual data records to 586,000 now in the FRDB.

3.2.35 2002 RETEC GREEN BAY SEDIMENT DATA

The RETEC Group, Inc. (RETEC) collected sediment samples in July 2002 for the Wisconsin Department of Natural Resources (WDNR). The samples were collected as part of the Green Bay Sediment Sampling event. En Chem, of Madison, Wisconsin, analyzed samples for polychlorinated biphenyl (PCB) Aroclors and total organic carbon (TOC).

EcoChem performed a review of the data validation conducted October 2002 by MAKuehl Company; the data set consisted of 99 samples. EcoChem evaluated the validation worksheets and reports for completeness and technical agreement. The samples were analyzed by United States Environmental Protection Agency (EPA) SW-846 methodology and other miscellaneous EPA methods. The validation report states that the data reviewer used both *National Functional Guidelines for Organic Data Review* (1999) and the EPA Region 5 *Standard Operating Procedure for Validation of CLP Organic Data* (1997). The sample result summary forms are initialed and dated.

MAKuehl Company estimated (J) 27 Aroclor values and four (4) TOC values between the limit of detection (LOD) and limit of quantitation (LOQ). Although EcoChem would not have estimated these values, the usability of the data is not affected either way. Forty (40) TOC sample results were estimated (J) because the relative standard deviation (RSD) for the 4 replicates was greater than 20 percent. Also, the TOC result for sample GB02-12-0010 was estimated (J) (biased low) due to poor spike recovery in the matrix spike/matrix spike duplicate (MS/MSD) samples, indicating a matrix interference.

Overall, the data are of acceptable quality. The samples appear to have been analyzed as per the cited methods, and the validation of MAKuehl Company follows the guidelines specified in EPA *National Functional Guidelines for Organic Data Review* (February 1999). As determined by this review, the data, as qualified, are usable for the intended purpose.

3.2.36 2002 Foth and Van Dyke Little Lake Butte des Morts Data

Foth and Van Dyke collected sediment samples (at Deposit A/B) in May and June 2002 for P.H. Glatfelter. En Chem, of Madison, Wisconsin, analyzed samples for PCB Aroclors and TOC.

EcoChem performed a review of the data validation conducted in February 2003 by MAKuehl Company. The data set consisted of 47 samples analyzed for PCBs and TOC. This number of samples differs from the number of sample records loaded into the FRDB because the PCB analyses occasionally used different sediment core intervals than the other physical analyses (e.g., there were 47 samples actually analyzed for PCBs and 28 physical samples, of which about 11 had different (or additional) sample intervals than the PCBs).

EcoChem evaluated the validation worksheets and reports for completeness and technical agreement. The samples were analyzed by EPA SW-846 methodologies. The validation report states that the evaluation was based on *National Functional Guidelines for Organic Data Review* (1999) and *National Functional Guidelines for Inorganic Data Review* (1994). The sample result summary forms are initialed and dated. No sample recalculations were reproduced during the EcoChem review.

MAKuehl Company estimated (J) 31 Aroclor sample values between the LOD and LOQ. Although EcoChem may not have estimated these values, the usability of the data is not affected either way. Three (3) samples were estimated (J) due to low recovery of PCB surrogates (DCB and TCX) on both columns. These samples are potentially biased low. Eighteen (18) TOC sample results were estimated (J) because the RSD for replicates was greater than the 20 percent criteria.

Overall the data are of acceptable quality. The samples appear to have been analyzed as per the cited methods, and the validation of MAKuehl Company follows the guidelines specified in EPA *National Functional Guidelines for Organic Data Review* (February 1999). As determined by this review, the data, as qualified, are usable for the intended purpose.

3.3 Data Usability

3.3.1 Fully Validated Data

The following data sets have been validated by an independent party and are considered useable, as qualified:

- 1994 GAS/SAIC Sediment Collection
- 1994 Woodward-Clyde Deposit A Sediment Collection
- 1995 WDNR Sediment Data Collection

- 1996 USFWS NRDA Fish Tissue Data Collection
- 1996 WDNR Fish Tissue Data Collection
- 1998 Demonstration Project Data – SMU 56/57
- 1998 RETEC RI/FS Supplemental Data Collection
- 1996 FRG/BBL Sediment/Tissue Data Collection
- 1997 Demonstration Project Data – Deposit N
- 1992/93 BBL Deposit A Sediment Data Collection
- 1998 FRG/Exponent Data Collection
- 1998 FRG/Blasland, Bouck, and Lee, Inc. Sediment/Tissue Data Collection
- 1998 Deposit N Pilot Remediation – Pre-Dredge, Post-Dredge, Operation Monitoring, and Environmental Monitoring Data
- 1999 Demonstration Project Data – SMU 56/57
- State of Michigan Fish Consumption Advisory Data
- Lake Michigan Tributary Monitoring Data
- 1999 Demonstration Project Data – SMU 56/57
- Minergy EPA SITE Program Data
- 2000/2001 FRG/CH2M HILL Sediment and Wood Chip Data
- 2000 FRG/BBL Supplemental Monitoring Program Data: Surface Water
- 2000/2001 FRG/BBL Supplemental Monitoring Program Data: Sediment Data
- 2001 FRG/BBL Green Bay Sediment Sampling Data
- 2001 FRG/BBL Water Column-High Flow Data
- 2002 RETEC Green Bay Sediment Data
- 2002 Foth and Van Dyke/Glatfelter Deposit A/B (Little Lake Butte des Morts) Sediment Data

Although the data sets (listed above) were found to be validated and usable, it must be stressed that there were individual data points that were rejected. These rejected data points have not been used in support of the RI/FS or RA.

3.3.2 SUPPORTING DATA

The following data sets have not been validated and, in general, should be used only as supporting data. The data have been collected within different programs and with different data quality objectives therefore, varying degrees of supporting documentation may be available.

- 1989/90 Fox River Mass Balance Study
- 1989/90 Green Bay Mass Balance Study (GLNPO)
- 1993 Triad Assessment
- 1993–1996 USFWS Tree Swallow Data Collection
- 1994–1995 Cormorant Data Collection
- 1997 USFWS NRDA Waterfowl Tissue Data Collection
- 1997 WDNR Caged Fish Bioaccumulation Study Data
- Fox River Fish Consumption Advisory Data
- Stromberg Eagle Data Collection
- USGS NAWQA Data
- WDNR Wildlife Tissue Data
- WPDES Permit Influent Data
- Lake Michigan Mass Balance Data
- Minergy Mineralogical Data
- Lower Fox River Background Metals Assessment
- FoxView Data

3.3.3 INDETERMINATE DATA

The following data sets have not been validated and have not been subjected to a data quality review. This is due to complete lack of supporting quality assurance/quality control documentation; or, EcoChem did not receive the hard copy data and documents by the date of this report. At this time the overall quality of these data sets is unknown and the data should be used with that fact in mind.

- Ankley and Call

Table 3-1 Data Set Analysis

Data Source	Number of Samples	Matrices [1]	Analyses Conducted [2]	Number of Records	Number of Files in Delivery	File Type	Report Section	Earliest Year of Collection	Latest Year of Collection	Event of Incorporation into FRDB [3]
1989–1990 Fox River Mass Balance Study	1,967	S, W	PCB-A, PCB-C, W	25,457	6	Spreadsheet	3.2.01	1989	1990	1
1989–1990 Green Bay Mass Balance Study (GLNPO)	2,069	S, T, W	B, PCB-C, W	201,701	92	Database	3.2.01	1987	1990	1
1992–1993 BBL Deposit A Sediment Data	117	S, W	M, P/H, PCB-A, SVOA, V, W	1,094	1	Spreadsheet	3.2.02	1992	1993	1
1993 Triad Assessment	27	S	B, M, P/H, PCB-A, SVOA, W	631	11	Spreadsheet	3.2.03	1992	1993	1
1994 GAS/SAIC Sediment Collection	253	S	DXN, M, P/H, PCB-A, SVOA, V, W	5,654	6	Spreadsheet	3.2.04	1994	1994	1
1995 WDNR Sediment Data	488	S	M, PCB-A, W	6,433	8	Spreadsheet	3.2.05	1995	1995	1
1996 FRG/BBL Sediment/Tissue Data	25	S, T	B, PCB-C, W	2,771	6	Spreadsheet	3.2.06	1996	1996	1
1995–1996 WDNR Tissue Data	200	T	B, PCB-A, W	1,673	1	Spreadsheet	3.2.07	1995	1996	1
1996–USFWS NRDA Tissue Data	376	T	DXN, P/H, PCB-A, PCB-C, W	16,017	5	Spreadsheet	3.2.08	1996	1999	1
1993–1996 Tree Swallow Data	200	T	B, DXN, P/H, V, W	5,429	2	Database	3.2.09	1993	1993	1
1994–1995 Cormorant Data	193	T	B, DXN, P/H, PCB-C, W	6,178	2	Database	3.2.09	1994	1995	1
1997 USFWS NRDA Waterfowl Tissue	70	T	B, P/H, PCB, V, W	1,680	2	Database	3.2.09	1997	1997	1
Fox River Fish Consumption Advisory Data: 1998 WDNR Fish Consumption Data	130	T	B,M, PCB-A, W	777	1	ASCII	3.2.10	1998	1998	2
Fox River Fish Consumption Advisory Data	1,766	S, T	B, DXN, M, P/H, PCB-A, PCB-C, SVOA, V, W	11,620	2	ASCII	3.2.10	1971	1996	1
WDNR Wildlife Tissue Data	417	T	B, M, P/H, PCB-A	2,532	3	Database	3.2.11	1984	1996	1
Lake Michigan Tributary Monitoring Data	88	W	M, P/H, PCB-C, V	5,722	5	Spreadsheet	3.2.12	1994	1995	1
Stromberg Eagle Data	31	T	B, DXN, P/H, PCB-A, PCB-C, SVOA, V, W	954	1	ASCII	3.2.13	1991	1996	1
USGS NAWQA Data	441	S, T, W	B, M, P/H, PCB, SVOA, V, W	11,879	21	Spreadsheet	3.2.14	1992	1997	1
1994 Woodward-Clyde Deposit A Sediment Data	66	S	PCB-A, W	585	12	Spreadsheet	3.2.15	1994	1994	1
WPDES Permit Influent Data	8	W	B, DXN, M, P/H, PCB-A, RAD, SVOA, V, W	847	1	Spreadsheet	3.2.16	1993	1997	1
Lower Fox River Background Metals Assessment Data	14	W	M	78	1	Spreadsheet	3.2.17	1991	1993	1
1997 WDNR Caged Fish Bioaccumulation Study Data	25	S, T	B, PCB-C, W	1,672	2	Spreadsheet	3.2.18	1997	1997	1
1997 Demonstration Project Data – Deposit N	10	S	M, PCB, W	83	1	Spreadsheet	3.2.19	1997	1997	1
1997 Demonstration Project Data – SMU 56/57	295	S, W	DXN, M, P/H, PCB-A, SVOA, V, W	3,114	12	Spreadsheet	3.2.20	1997	1998	1
1998 RETEC RI/FS Supplemental Data	252	S, T	B, DXN, M, P/H, PCB-A, PCB-C, SVOA, V, W	10,781	1	ASCII	3.2.21	1998	1998	1
Lake Michigan Mass Balance Data	6,987	A, S, T, W	M, P/H, PCB-C, V, W	91,621	211	Database	3.2.22	1993	1996	2
Minergy Mineralogical Data	15	S	W	219	1	Spreadsheet	3.2.23	1995	1999	2
1998 FRG/Exponent Data	225	T	B, M, P/H, PCB-A, PCB-C, W	17,708	3	Database	3.2.24	1998	1998	2
1998 FRG/BBL Sediment/Tissue Data	1,315	S, T, W	B, M, P/H, PCB-A, PCB-C, RAD, SVOA, W	18,824	1	Database	3.2.25	1998	1998	2
1998–1999 Deposit N Data: Post-Dredge	43	S	PCB-A, PCB-C, W	690	8	Spreadsheet	3.2.26	1999	1999	2
1998 Deposit N Data: Pre-Dredge	53	S	PCB-A, PCB-C, W	1,437	6	Spreadsheet	3.2.26	1998	1998	2

Table 3-1 Data Set Analysis

Data Source	Number of Samples	Matrices [1]	Analyses Conducted [2]	Number of Records	Number of Files in Delivery	File Type	Report Section	Earliest Year of Collection	Latest Year of Collection	Event of Incorporation into FRDB [3]
1998/1999 Deposit N Data: Remediation	197	T, W	PCB-C, W	10,264	1	Spreadsheet	3.2.26	1998	1999	2
1998–1999 Deposit N Data: Operational Monitoring	12	S	M, PCB-A, W	123	1	Spreadsheet	3.2.26	1998	1998	2
Ankley and Call Data	62	PW, S, T, W	DXN, M, P/H, PCB, SVOA, W	1,607	0	Hardcopy	3.2.27	1989	1989	2
State of Michigan Fish Consumption Advisory Data	434	T	B, DXN, M, P/H, PCB-A, W	6,979	1	Database	3.2.28	1983	1999	2
1999 FRG Demonstration Project Data – Deposit N and SMU 56/57	2,408	A, O, S, W	PCB-A, PCB-C, M, W, V, SVOA, P/H, DXN	46,389	28	Database/ Spreadsheet	3.2.29	1999	1999	3
2000–2001 FRG/CH2M HILL Sediment/Woodchip Data	428 [a]	S, WC	PCB-A, GRO, DRO, M, V, SVOA, CN	6,428	1	Database	3.2.30	2000	2001	3
2000 FRG/BBL Supplemental Monitoring Program Data: Surface Water [b]	219	W, XAD	PCB-A, PCB-C, W, P/H	10,511	1	Database	3.2.31	2000	2000	4
2000–2001 FRG/BBL Supplemental Monitoring Program Data: Sediment [b]	145	S	PCB-A, W	2,445	1	Database	3.2.32	2000	2001	4
2001 FRG/BBL Green Bay Sediment Sampling Data [b]	30	S	PCB-A, W	507	1	Database	3.2.33	2001	2001	4
2001 FRG/BBL Water Quality High Flow Data [b]	444	W, XAD	PCB-A, PCB-C, W, P/H	24,138	1	Database	3.2.34	2001	2001	4
Minergy EPA SITE Data	90	A, O, S, W	PCB-C, M, W, V, SVOA, DXN	8,053	5	Spreadsheet	na	2001	2001	3
2002 Green Bay Sediment Data – RETEC Group, Inc.	99	S	PCB-A, W	1,792	1	Database	3.2.35	2002	2002	4
May 2002 Little Lake Butte des Morts Sampling - Foth & Van Dyke	68	S	PCB-A, W	676	2	Excel, Word	3.2.36	2002	2002	4
2000 – SMU 56/57 During/Post-Dredge Sampling	198	S, W	PCB-A, W, M	1,148	1	Database	na	2000	2000	4
2000 – SMU 56/57 Post-Dredge Sampling	90	S, W	PCB, W, M	225	1	Database	na	2000	2000	4
2000–2001 Radio-Isotopes for BDP/LW to DP	903	S	W, R	5,838	1	Database	na	2000	2001	4
Total: 46 Data Sets	**23,565**			**582,984**	**482**					

[1] **Matrices**
A – Ambient Air
O – Other Solid Matrix
PW – Sediment Pore Water
S – Sediment
T – Tissue
W – Water
WC – Wood Chip
XAD – Filters

[2] **Analyses**
B – Biological
CN – Cyanide
DRO – Diesel-range Organics
DXN – Dioxins
GRO – Gas-range Organics
M – Metals
PCB – Total PCB Only
PCB-A – PCB Aroclor
PCB_C – PCB Congener
P/H – Pesticides/Herbicides
SVOA – Semivolatiles
V – Volatiles
W – Wet Chemistry (including all physical and conventional data)

[3] **Event of Incorporation into FRDB**
1 – February 1999 RI/FS
2 – 1999–2001 RI/FS
3 – December 2002 Addendum 1
4 – June 2003 Addendum 2

[a] There is a discrepancy between the data assessed during the data validation review and that included in the FRDB. Only a portion of the data provided by Wisconsin Tissue electronically for inclusion into the FRDB was actually provided via hardcopy for review. Whereas 428 samples were reviewed, 801 samples were added to the FRDB. The number of records identified (6,428) also is indicative of the number of records added to the FRDB.

[b] These four data sets are currently not included in the FRDB. They have been reviewed and were identified in Technical Memorandum 14 as potentially important data with the recommendation to include these data sets in future updates to the FRDB.

Table 3-2 QC Elements for Data Sets Supporting the Fox River RI/FS and RA

	Study Name:	**1989–1990 Fox River and Green Bay Mass Balance Study DMR Section 3.2.01**	**1992/1993 BBL Deposit A Sediment Data DMR Section 3.2.02**				
	Parameter & Matrix:	**PCBs** **Sediments**	**VOA** **Soil**	**SVOCs** **Soil**	**PCBs** **Soil**	**Pesticides** **Soil**	**Metals/CN** **Soil**
QA Elements	**SDG #'s:**	University of Minnesota - Data groups; IN0042, IN0047, IN0052, IN0057, IN0061, IN0070, IN0076, IN0078, IN0037, and IN0041	Hazleton 104116 203257	Hazleton 104116 203242	Hazleton SDG-1, SDG-2, SDG-3, SDG-4, SDG-5	Hazleton 104135 203256	Hazleton BASD34 SD01 BASD08
Data Review	1) Third-Party Validation Performed	Verification Only Deborah Swackhamer, Ph.D.	EcoChem	EcoChem	EcoChem	EcoChem	EcoChem
Deliverables	1) Electronic Deliverables	Yes	Yes	Yes	Yes	Yes	Yes
	2) Hard Copy	Some – Not sure if this is a complete set	Yes	Yes	Yes	Yes	Yes
Data Review Details	1) Package Completeness	Not determined	Yes	Yes	Yes	Yes	Yes
	2) Chain of Custody Procedures	Not determined	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable
	3) Holding Times	Not summarized on the QA/QC Summary Report Sheet	Yes	Yes	Yes	Yes	Yes
	4) Initial Calibration	Not summarized on the QA/QC Summary Report Sheet	Yes	Yes	Yes	Yes	Yes
	4) Curve – Number of standards	Not summarized on the QA/QC Summary Report Sheet	Yes – As required by method	Yes – As required by method	Yes – As required by method	Yes – As required by method	Yes – As required by method
	5) Calibration Verification	Not summarized on the QA/QC Summary Report Sheet	20%	20%	20%	20%	10%
	5) Secondary Column	Not summarized on the QA/QC Summary Report Sheet	NA	NA	Yes	Yes	NA
	6) Laboratory Blanks	Not clear	Yes – Tics rejected due to contamination	Yes – Tics rejected due to contamination	Yes	Yes	Yes
	7) Surrogate Recoveries, Number Required	Yes – 50%-120%	Yes	Yes	Yes	Yes	Yes
	8) Matrix Spike, Number Required	Yes – 50%-120%	Yes – No MS/MSD for SDG 203257 J/UJ	Yes – No MS/MSD for SDG 203242 J/UJ	Yes	Yes	Yes
	9) Lab Duplicate or Replicate	Yes – Not clear what limits are	Yes – No MS/MSD for SDG 203257 J/UJ	Yes – No MS/MSD for SDG 203242 J/UJ	Yes	Yes	Yes
	9) Lab Control Sample (SRM Results?)	None – QAPP says that a series of blindly coded QA samples will be analyzed	Yes – No LCS for SDG 203257 J/UJ	Yes – No LCS for SDG 203242 J/UJ	Yes	Yes	Yes
	10) Gel Permeation/Florisil Cleanup	Not provided	NA	NA	NA	NA	NA
	11) Detection Limit	Not provided	NA	NA	NA	NA	NA
	12) Calc and Transposition Verification Qualitative Verification?	Not able to determine if this was done	Yes	Yes	Yes	Yes	Yes
	13) Field QC Results	Not apparent	None identified	None identified	Yes	Yes	None identified
	14) Usability Usable/Supporting	Yes	Usable – Tics rejected due to contamination	Usable – Tics rejected due to contamination	Usable	Usable	Usable
	14) Qualifiers	Qualifiers mentioned but not defined.	Yes – Blank contamination U, Ical RSD, CCAL%D, no LCS MS/MSD TICs rejected due to blank contamination	Yes – Blank contamination, CCAL %D, Internal std %R, NO LCS MS/MSD, TICs rejected due to blank contamination	Yes – Surrogate %R, LCS %R, Field Dup RPD 1242	Yes – RPD between main and confirmation columns NJ	Yes – Blank contamination, ICV %R CN, MS %R, GFAA post spike %R
SAP		No – Study Plan					
QAPP		Yes					
Lab QAM		Answer Pending/U of M SOPs?					

Table 3-2 QC Elements for Data Sets Supporting the Fox River RI/FS and RA

	Study Name:	1993 Triad Assessment DMR Section 3.2.03	1994 SAIC/GAS RI/FS Data Sets DMR Section 3.2.04				
	Parameter & Matrix:	Multiple Parameters Multiple Matrices	PCBs Sediments	PCBs Sediments	PCBs Sediments	PCBs Sediments	PCBs Sediments
QA Elements	SDG #'s:	SLOH Multiple SDGs	ARI M172	ARI M174	ARI M176	ARI M177	ARI M365
Data Review	1) Third-Party Validation Performed	None	SAIC	SAIC	SAIC	SAIC	SAIC
Deliverables	1) Electronic Deliverables	Yes	Yes	Yes	Yes	Yes	Yes
	2) Hard Copy	Not Available	Yes but not easily accessed	Yes but not easily accessed	Yes but not easily accessed	Yes but not easily accessed	Yes but not easily accessed
Data Review Details	1) Package Completeness	Not Available	Yes	Yes	Yes	Yes	Yes
	2) Chain of Custody Procedures	Not determined	Not determined	Not determined	Not determined	Not determined	Not determined
	3) Holding Times	Not determined	Yes (Frozen)	Yes – Some exceedances	Yes	Yes	Yes – Exceedances, several samples qualifed J for gross exceedances (M365)
	4) Initial Calibration	Not Available	Yes	Yes	Yes	Yes	Yes
	4) Curve – Number of standards	Not Available	3-5 pt	3-5 pt	5 pt	5 pt	5 pt
	5) Calibration Verification	Not Available	15% D but Ave was higher; results flagged (J/UJ)	15% D but Ave was higher; results flagged (J/UJ)	15% D but Ave was higher; results flagged (J/UJ)	15% D but Ave was higher; results flagged (J/UJ)	15% D but Ave was higher; results flagged (J/UJ)
	5) Secondary Column	Not Available	Not indicated	Not indicated	Not indicated	Not indicated	Not indicated
	6) Laboratory Blanks	Not Available	Yes	Yes	Yes	Yes	Yes
	7) Surrogate Recoveries, Number Required	Not Available	TCMX 55%-115%/DCB 70%-125%	TCMX 55%-115%/DCB 70%-125%	TCMX 55%-115%/DCB 70%-125%	TCMX 55%-115%/DCB 70%-125%	TCMX 55%-115%/DCB 70%-125%
	8) Matrix Spike, Number Required	Not Available	35% min–130% max	35% min–130% max	35% min–130% max	35% min–130% max	35% min–130% max
	9) Lab Duplicate or Replicate	Not Available	No	Not mentioned	Not mentioned	Not mentioned	Not mentioned
	9) Lab Control Sample (SRM Results?)	Not Available	Yes	Yes	Yes	Yes	Yes
	10) Gel Permeation/Florisil Cleanup	Not Available	Yes – If necess.	Yes – If necess.	Not sure	Not sure	Not sure
	11) Detection Limit	Not Available	50 ppb wet wt	NA	NA	NA	NA
	12) Calc and Transposition Verification Qualitative Verification?	Not Available	Yes, 10%?	No, No chros	ID and Quants could not be verified. Raw data not provided	ID and Quants could not be verified. Raw data not provided	Data verified
	13) Field QC Results	Not Available	None	None	None	Not identified	Not identified
	14) Usability Usable/Supporting	Yes – Supporting	Usable	Usable	Usable	Usable	Usable
	14) Qualifiers	Not Available	Yes – Minor quals assigned due to CCV (J/UJ)	Yes – Minor quals assigned due to CCV (J/UJ)	Yes – Minor quals assigned due to CCV, surrogate recoveries J/UJ	Yes – Minor quals assigned due to CCV, surrogate recoveries J/UJ	Yes – Minor quals assigned due to CCV, surrogate recoveries J/UJ
SAP		NA	Yes				
QAPP		NA	Yes				
Lab QAM		NA					

Table 3-2 QC Elements for Data Sets Supporting the Fox River RI/FS and RA

	Study Name:	**1994 SAIC/GAS RI/FS Data Sets (continued) DMR Section 3.2.04**				
	Parameter & Matrix:	**PCBs** **Sediments**	**PCBs** **Sediments**	**Dioxins** **Sediments**	**CLP Pesticides/PCBs** **Sediments**	**CLP SVOCs** **Sediments**
QA Elements	**SDG #'s:**	ARI M367/M368	ARI M370	Triangle Lab SDG # 35589	Swanson/SDG 948521	Swanson/SDG 948521
Data Review	1) Third-Party Validation Performed	SAIC	SAIC	SAIC	SAIC	SAIC
Deliverables	1) Electronic Deliverables	Yes	Yes	Yes	Yes	Yes
	2) Hard Copy	Yes but not easily accessed	Yes but not easily accessed	Yes but not easily accessed	Yes but not easily accessed	Yes but not easily accessed
Data Review Details	1) Package Completeness	Yes	Yes	Yes	Yes	No – Form 1s not supplied by lab
	2) Chain of Custody Procedures	Not determined	Not determined	Not determined	Not determined	Not determined
	3) Holding Times	Yes – Minor violations	Yes – Minor violations	Yes – Minor violations	No – Samples sent to TL 10 days after collection	No – All samples exceeded HT and are qualified as estimated (J, UJ)
	4) Initial Calibration	Yes	Yes	Yes	Yes – Not consistent with CLP protocol	Yes – Not consistent with CLP protocol
	4) Curve – Number of standards	5 pt	5 pt	5 pt	5 pt	5 pt
	5) Calibration Verification	15% D but Ave was higher; results flagged (J/UJ)	15%	20% RSD	No – Correct concentration not used; certain analytes outside RT window	15% D – Some exceedances qualified samples as estimated J/UJ
	5) Secondary Column	Not indicated	Not indicated	NA	Not indicated	Not indicated
	6) Laboratory Blanks	Yes	Yes	Yes	Yes	Yes
	7) Surrogate Recoveries, Number Required	TCMX 55%-115%/DCB 70%-125%	TCMX 55%-115%/DCB 70%-125%	TCFD 25%-150%/TCDD 25%-150%	TCMX 55%-115%/DCB 70%-125%	8 Required/18% min–137% max
	8) Matrix Spike, Number Required	35% min–130% max	35% min–130% max	TCDD/TCDF 54–162	18/9 Required 29 min–152 max	11 Required/11% min–142% max
	9) Lab Duplicate or Replicate	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Not mentioned
	9) Lab Control Sample (SRM Results?)	Yes	Yes	Yes	Yes	Yes – Acenapthene fell outside at 53%
	10) Gel Permeation/Florisil Cleanup	Not sure	Not sure	Not sure	Not sure	Not sure
	11) Detection Limit	NA	NA	Elevated in some samples due to blank cont. and noise	Elevated in some samples due to blank cont. and noise	NA
	12) Calc and Transposition Verification Qualitative Verification?	No	Not verified	Yes, Sample Identifications. Sample Quant not reviewed.	Not Verifiable	Yes
	13) Field QC Results	Not identified	Not identified	Not identified	Not identified	Not identified
	14) Usability Usable/Supporting	Usable	Usable	Usable	Third party validation considers it unusable.	Usable
	14) Qualifiers	Yes – Minor quals assigned due to CCV, surrogate recoveries J/UJ	Yes – Minor quals assigned due to surrogate recoveries J/UJ	Yes – Due to blank cont, and elevated matrix spike recovery sample results may be biased positive (J+)	Yes – Major issues about overall quality of data. Associated with RT drift, quality of work poor.	Yes – Minor qualifications due to HT exceedances and low surr and spike recoveries (J/UJ)
SAP						
QAPP						
Lab QAM						

Table 3-2 QC Elements for Data Sets Supporting the Fox River RI/FS and RA

	Study Name:	**1994 SAIC/GAS RI/FS Data Sets (continued) DMR Section 3.2.04**					
	Parameter & Matrix:	**CLP Metals Sediments**	**TCLP Metals Sediments**	**Mercury Sediments**	**Mercury Sediments**	**Mercury Sediments**	**Mercury Sediments**
QA Elements	**SDG #'s:**	Swanson/SDGs 12718, 12724, 12745, 12806, 12816, 12941	Swanson/SDGs 12718, 12724,12730, 12827, 12718, 12802, 12833, 12844	Swanson WL12941	Swanson WL12745	Swanson WL12806	Swanson WL12812/12724/12718
Data Review	1) Third-Party Validation Performed	SAIC	SAIC	SAIC	SAIC	SAIC	SAIC
Deliverables	1) Electronic Deliverables	Yes	Yes	Yes	Yes	Yes	Yes
	2) Hard Copy	Yes but not easily accessed	Yes but not easily accessed	Yes but not easily accessed	Yes but not easily accessed	Yes but not easily accessed	Yes but not easily accessed
Data Review Details	1) Package Completeness	Yes	Yes	No – Form 1s not supplied by lab	Yes	Yes	Yes
	2) Chain of Custody Procedures	Not determined	Not determined	Not determined	Not determined	Not determined	Not determined
	3) Holding Times	Yes – Hg results are flagged for exceeding HT by 27 to 42 days (J/UJ)	Yes	No – All samples exceeded HT and are qualified as estimated (J, UJ)	Yes	Yes	Yes
	4) Initial Calibration	Yes (Validator recalc HG results)	Yes	Yes – Exceedance	Yes – Exceedance	Yes – Exceedance	Yes (Validator recalc results)
	4) Curve – Number of standards	Lin Reg	Lin Reg	5 pt	5 pt	5 pt	5 pt
	5) Calibration Verification	10% D	10% D	Yes – 15%	Yes – 15%	Yes – 15%	Yes – 15%
	5) Secondary Column	NA	NA	NA	NA	NA	NA
	6) Laboratory Blanks	Yes	Yes	Yes	Yes	Yes	Yes
	7) Surrogate Recoveries, Number Required	NA	NA	NA	NA	NA	NA
	8) Matrix Spike, Number Required	75%–125%	75%–125%	75%–125%	75%–125%	75%–125%	75%–125%
	9) Lab Duplicate or Replicate	Yes (20%) – Some exceedances qualified J/UJ	Yes	Yes	Yes	Yes	Used MS/MSD
	9) Lab Control Sample (SRM Results?)	Yes	Yes	Yes	Yes	Yes	Yes (not always performed) CLs were 75%–125%
	10) Gel Permeation/Florisil Cleanup	NA	NA	NA	NA	NA	NA
	11) Detection Limit	NA	NA	NA	NA	NA	NA
	12) Calc and Transposition Verification Qualitative Verification?	Yes, Some calc errors.	Yes	No	No	No	Yes
	13) Field QC Results	None	No	Yes – Field Duplicate >	No	No	Yes – OK on rinsate/FD (12812) failed No Action
	14) Usability Usable/Supporting	Usable – 1 data point rejected for Zn	Usable	Usable	Usable	Usable	Usable
	14) Qualifiers	Yes – Minor and Major qualifications due poor spike recoveries (J/UJ) and (R) on Zinc	No Qualifications	Yes – Minor J Flags	Yes – Minor UJ/J Flags	Yes – Minor UJ/J Flags	Yes – Minor qualifications due to incorrect ICB calc.
SAP							
QAPP							
Lab QAM							

Table 3-2 QC Elements for Data Sets Supporting the Fox River RI/FS and RA

		1994 SAIC/GAS RI/FS Data Sets (continued) DMR Section 3.2.04			1995 WDNR Sediment Data (Below De Pere) DMR Section 3.2.05		
	Study Name:						
	Parameter & Matrix:	**Mercury** **Sediments**	**Mercury** **Sediments**	**Mercury** **Sediments**	**PCBs** **Sediments**	**TOC** **Sediments**	**Metals** **Sediments**
QA Elements	**SDG #'s:**	Swanson WL12816/12882/12929/ 12922/12853/12852/ 12851	Swanson WL12688/12725/12783/ 12777	Swanson WL12693	Hazleton SDG #'s TBD2,10, 1 and 20	Hazleton SDG #'s TBD2,10, 1 and 20	Hazleton SDG #'s TBD2, and 20
Data Review	1) Third-Party Validation Performed	SAIC	SAIC	SAIC	MAKuehl	MAKuehl	MAKuehl
Deliverables	1) Electronic Deliverables	Yes	Yes	Yes	Yes	Yes	Yes
	2) Hard Copy	Yes but not easily accessed	Yes but not easily accessed	Yes but not easily accessed	Some	Some	Some
Data Review Details	1) Package Completeness	Yes	Yes	Yes	Yes	Yes	Yes
	2) Chain of Custody Procedures	Not determined	Not determined	Not determined	Not determined	Not determined	Not determined
	3) Holding Times	No – Qualifiers J/UJ	Yes	Yes	Yes	Yes	Yes
	4) Initial Calibration	Yes (Validator recalc results)	Yes (Validator recalc results)	Yes (Validator recalc results)	25%	Yes	Yes
	4) Curve – Number of standards	5 pt	5 pt	5 pt	5 pt	Daily 1 pt	1 pt/6 pt for Hg
	5) Calibration Verification	Yes – 15%	Yes – 15%	Yes – 15%	15%	20%	10% for metals and 20% for Hg
	5) Secondary Column	NA	NA	NA	25% D for CC on 2nd column	NA	NA
	6) Laboratory Blanks	Yes	Yes	Yes	Yes	Yes	Yes
	7) Surrogate Recoveries, Number Required	NA	NA	NA	60%-150%	NA	NA
	8) Matrix Spike, Number Required	75%–125%	75%–125%	75%–125%	65%–125%	75%–125%	75%–125%
	9) Lab Duplicate or Replicate	Yes – Occ. Used MS/MSD SDG 12922 >35%	Yes – Used MS/MSD	Yes	26%	20%	20%
	9) Lab Control Sample (SRM Results?)	Used MS/MSD (75%–125%)	Used MS/MSD (80%–120%)	Yes	NA	NA	Yes – EPA
	10) Gel Permeation/Florisil Cleanup	NA	NA	NA	Yes	NA	NA
	11) Detection Limit	NA	NA	NA	50 ppb	NA	CRDL
	12) Calc and Transposition Verification Qualitative Verification?	Yes, Recalc	Yes, Recalc	Yes, Recalc	Yes, Recalc performed >10% frequency	NA	10%
	13) Field QC Results	Yes – OK on rinsate/<35% on FD	Yes – OK on rinsate/<20?% on FD	Yes – OK on rinsate/OK on FD	None	None	None
	14) Usability Usable/Supporting	Usable	Usable	Usable	Usable	Usable	Usable
	14) Qualifiers	Yes – Minor J/UJ Flags due to HT exceedances/SDG 12853 also qualifed on poor FD values.	No Qualifications	Not apparent if no or some minor qualifications	Yes – Minor J Flags due to low surrogate recovery or below PQL and above MDL.	Yes – Minor J Flags due to poor lab RPD	None
SAP					Yes		
QAPP					Yes		
Lab QAM					Yes – Hazleton SOPs		

Table 3-2 QC Elements for Data Sets Supporting the Fox River RI/FS and RA

		1995–1996 WDNR Tissue DMR Section 3.2.07	1996 USFWS NRDA Tissue Data (Hagler Bailly) DMR Section 3.2.08	1992–1995 USGS NAWQA Data DMR Section 3.2.14	1994 Woodward-Clyde Deposit A Data DMR Section 3.2.15	
	Study Name:	**1995–1996 WDNR Tissue DMR Section 3.2.07**	**1996 USFWS NRDA Tissue Data (Hagler Bailly) DMR Section 3.2.08**	**1992–1995 USGS NAWQA Data DMR Section 3.2.14**	**1994 Woodward-Clyde Deposit A Data DMR Section 3.2.15**	
	Parameter & Matrix:	**PCBs** Fish Tissue	**PCBs** Fish Tissue	**Multiple Parameters** Multiple Matrices	**PCBs** Sediments	**TOC** Sediments
QA Elements	**SDG #'s:**	SLOH Fish SDG-1	Battelle Laboratory Multiple SDGs	USGS NWQL Multiple SDGs	Hazleton Laboratory Multiple SDGs	Hazleton Laboratory Multiple SDGs
Data Review	1) Third-Party Validation Performed	MAKuehl	EcoChem	NAWQA Program	Limited by EcoChem	Limited by EcoChem
Deliverables	1) Electronic Deliverables	Yes	Yes	Yes	Yes	Yes
	2) Hard Copy	Yes	Yes	Not Available	No – Summary Data Only	No – Summary Data Only
Data Review Details	1) Package Completeness	Yes	Yes	Summary review of QC sample results	No – Chain of Custody not provided	No – Chain of Custody not provided
	2) Chain of Custody Procedures	Not determined	Yes – Minor issues	Not determined	Not determined	Not determined
	3) Holding Times	Yes	Yes	Not determined	Unable to document	Unable to document
	4) Initial Calibration	Yes (25%)	Yes (35%)	Not Available	NA – Data not provided	NA – Data not provided
	4) Curve – Number of standards	5 pt	5 pt	Not Available	QAPP/SOP indicates 3 pt	QAPP/SOP indicates daily 1 pt
	5) Calibration Verification	15% D	Varies between GC/ECD and GC/MS; <25% for 75% analytes	Not Available	QAPP/SOP indicates 15% RSD	20%
	5) Secondary Column	25% D	Yes, data not used	Not Available	QAPP/SOP indicatesOptional/15%	NA
	6) Laboratory Blanks	Yes	Yes	Not Available	Yes	Yes
	7) Surrogate Recoveries, Number Required	Yes – 70%-120%	Yes – 50%-125%	Not Available	62%-125%	NA
	8) Matrix Spike, Number Required	Yes – 65%–125%	Yes – 50%–125% tri and deca 30%–125% for mono and dichloro	Not Available	46%–145%	75%–125%
	9) Lab Duplicate or Replicate	Yes (26% Limit)	Yes (50%)	Not Available	Yes – Not clear if field or lab dups were performed	20%
	9) Lab Control Sample (SRM Results?)	No	SRM NRC %D Carp-1 <35%	Not Available	No	NA
	10) Gel Permeation/Florisil Cleanup	Yes	Not mentioned	Not Available	Not Documented	NA
	11) Detection Limit	50 µg/kg	Results reported to zero	Not Available	50 µg/kg	NA
	12) Calc and Transposition Verification Qualitative Verification?	Yes, Recalc	Yes, Recalc and Verification	Not discussed	Not performed	NA
	13) Field QC Results	NA	None	Yes – 15% on all matrices. Evaluated in summary and table format.	Yes	None
	14) Usability Usable/Supporting	Usable	Usable	Supporting	Yes – As qualified	Yes – As qualified
	14) Qualifiers	Yes – Minor J Quals due to detections below PQL.	Yes – Qualifiers due to CCV %D outliers, BS results, surrogate outliers, lab dups, SRM results and inteferences	Data not qualified but summaries infer low and high bias in QC Results Summary.	Yes – Minor J Quals due to spike outliers	No – No qualifiers based on review
SAP			No	NA	Yes	Yes
QAPP			Yes – Tech Memo	NA	Yes	Yes
Lab QAM		Yes	Yes – Tech Memo	NA	Yes – SOPs only	Yes – Hazleton SOPs

Table 3-2 QC Elements for Data Sets Supporting the Fox River RI/FS and RA

		1997 Demonstration Project Data – Deposit N DMR Section 3.2.19			1997–1998 Demonstration Project Data – SMU 56/57 DMR Section 3.2.20	
	Study Name:	**1997 Demonstration Project Data – Deposit N DMR Section 3.2.19**			**1997–1998 Demonstration Project Data – SMU 56/57 DMR Section 3.2.20**	
	Parameter & Matrix:	**PCBs** Sediments/Water	**Mercury** Sediments/Water	**TOC** Sediments	**PCBs** Sediments	**Mercury** Sediments
QA Elements	**SDG #'s:**	En Chem Laboratory Multiple SDGs	En Chem Laboratory Multiple SDGs	En Chem Laboratory Multiple SDGs	En Chem Laboratory Multiple SDGs	En Chem Laboratory Multiple SDGs
Data Review	1) Third-Party Validation Performed	MAKuehl	MAKuehl	MAKuehl	Montgomery Watson	Montgomery Watson
Deliverables	1) Electronic Deliverables	Yes	Yes	Yes	Yes	Yes
	2) Hard Copy	Not Available	Not Available	Not Available	No – Summary Data Only	No – Summary Data Only
Data Review Details	1) Package Completeness	No – Chain of Custody not provided	No – Chain of Custody not provided	No – Chain of Custody not provided	No – Chain of Custody not provided	No – Chain of Custody not provided
	2) Chain of Custody Procedures	Acceptable	Acceptable	Acceptable	Not determined	Not determined
	3) Holding Times	Yes – One qualifer applied due to holding time exceedance	Yes	Yes	Yes – Some qualifers applied due to reextractions	Yes – Only 1 of 282 exceeded HT
	4) Initial Calibration	Yes	Yes	Yes	Yes	Yes
	4) Curve – Number of standards	5 pt	3 pt	3 replicates	5 pt	6 pt
	5) Calibration Verification	15% D	Yes – 90-110	Yes – 90-110	15% RSD	Yes
	5) Secondary Column	Yes – 25%	NA	NA	Yes	NA
	6) Laboratory Blanks	Yes	Yes	Yes	Yes	Yes
	7) Surrogate Recoveries, Number Required	60%-150%	NA	NA	60%-150%	NA
	8) Matrix Spike, Number Required	65%–125%. One exceedance. No action due to high conc.	60%–135%	75%–125%. All w/in 20% RPD	65%–125%	75%–125%. One exceedance
	9) Lab Duplicate or Replicate	20%	Yes (35%)	Yes (20%)	Yes (20%)	Yes (20%) – Several exceedances
	9) Lab Control Sample (SRM Results?)	No	No	No	No	Yes (80–120)
	10) Gel Permeation/Florisil Cleanup	No	NA	NA	Not noted	NA
	11) Detection Limit	50 µg/kg Aroclor 1242 for sediment and 0.05 µg/L Aroclor 1242 for water	0.40 mg/kg or 0.25 µg/L	110 µg/kg	20 µg/kg dw	0.04 mg/kg dry wt per QAPP
	12) Calc and Transposition Verification Qualitative Verification?	Yes, 10%	Yes, 10%	Not discussed	Yes	Yes
	13) Field QC Results	Yes – <20% QAPP for sediment. Not enough volume for H_2O	Yes – Field blank OK; field water and sediment duplicates acceptable	Yes – Field duplicate	Not specified in DV report	Not specified in DV report
	14) Usability Usable/Supporting	Yes – As qualified	Yes – As qualified	Yes – As qualified	Yes – As qualified	Yes – As qualified
	14) Qualifiers	Yes – Minor qualifiers	No – No qualifiers based on review	No – No qualifiers based on review	Yes – Minor qualifers assinged due to holding time exceedances	Yes – Qualifiers due to ht exceedances, lab dups, and spike recoveries.
SAP		Yes	Yes	Yes	Yes	Yes
QAPP		Yes	Yes	Yes	No – QAPP tables only	No – QAPP tables only
Lab QAM		No	No	No	No	No

Table 3-2 QC Elements for Data Sets Supporting the Fox River RI/FS and RA

		1998 RETEC RI/FS Supplemental Data DMR Section 3.2.21		Lake Michigan Mass Balance Data DMR Section 3.2.22	1998 FRG/Exponent Data (NRDA) DMR Section 3.2.24		
	Study Name:	**1998 RETEC RI/FS Supplemental Data DMR Section 3.2.21**		**Lake Michigan Mass Balance Data DMR Section 3.2.22**	**1998 FRG/Exponent Data (NRDA) DMR Section 3.2.24**		
	Parameter & Matrix:	**PCBs** Sediments	**Metals** Sediments	**Asst. Conventionals, Pesticides/PCBs, Hg, Atrazine, DEA, DIA Water (Open Lake, Tributary), Air, Sediments, Phytoplankton**	**PCBs** Fish Tissue	**PCB Congeners** Fish Tissue	**PCB Congeners** Fish Tissue
QA Elements	**SDG #'s:**	ARI Multiple SDGs	ARI Multiple SDGs	BALN, GPLN, GRAN, GRLN, IUAA, IUAP, LHTL, LHTM, LHTN, LHTP, MDLH, MIAH, MNPH, RUAP, RULA, RUTA, SSSP, USTN, WSAA, WWTH, WWTN	En Chem Multiple SDGs	Michigan State University	Quanterra
Data Review	1) Third-Party Validation Performed	Yes	Yes	No – data reviewed by QC Coordinators	Exponent	Exponent	Exponent
Deliverables	1) Electronic Deliverables	Yes	Yes	Yes	Yes	Yes	Yes
	2) Hard Copy	Yes	Yes	Unknown	Yes	Yes	Yes
Data Review Details	1) Package Completeness	Yes – Minor qualifiers applied	Yes	Not addressed	Yes	Yes	Yes
	2) Chain of Custody Procedures	Yes – Minor issues	Acceptable	Not addressed	Acceptable	Acceptable	Acceptable
	3) Holding Times	Yes – Minor qualifiers	Yes	No DV reports provided	Yes	Some exceedances samples J/UJ	Yes
	4) Initial Calibration	Yes – Minor qualifiers	Yes	No DV reports provided	Yes	Yes	Yes
	4) Curve – Number of standards	5 pt	Blank plus 5 pt	No DV reports provided	Yes	Yes	Yes
	5) Calibration Verification	Yes <20%	90-110 every 10 samples	No DV reports provided	20%	20%	20%
	5) Secondary Column	Yes – Qualifers applied	NA	No DV reports provided	Yes	Yes	Yes
	6) Laboratory Blanks	Yes	Yes	No DV reports provided	Yes	Yes – U based on blank contamination	Yes
	7) Surrogate Recoveries, Number Required	Yes – 65%-125%	NA	No DV reports provided	Yes	Yes	Yes
	8) Matrix Spike, Number Required	Yes – 65%–125%	70%–130%	No DV reports provided	Yes – No quals for %R outliers	Yes – No quals for %R outliers	Yes – No quals for %R outliers
	9) Lab Duplicate or Replicate	Yes – RPD <30%	NA	No DV reports provided	Yes – MS/MSD	Yes – MS/MSD	Yes – MS/MSD
	9) Lab Control Sample (SRM Results?)	w/in 35% of certified value	Yes – w/in 35% of certified value	No DV reports provided	Yes	Yes	Yes
	10) Gel Permeation/Florisil Cleanup	Not determined	NA	No DV reports provided	Not mentioned	Not mentioned	Not mentioned
	11) Detection Limit	1.0–2.0 µg/kg	0.1–50 mg/kg	No DV reports provided	NA	NA	NA
	12) Calc and Transposition Verification Qualitative Verification?	Yes, 10%	Yes, 10%	No recalculations were provided unable to determine if transcription checks were done	No recalculations were provided unable to determine if transcription checks were done	No recalculations were provided unable to determine if transcription checks were done	No recalculations were provided unable to determine if transcription checks were done
	13) Field QC Results	Yes – Some exceedances. No action taken on this basis.	Yes – Some exceedances of 50%. No action taken.	Not addressed	None identified	None identified	None identified
	14) Usability Usable/Supporting	Yes – As qualified	Yes – As qualified	Supporting	Usable	Usable – Some results rejected for low surrogate %R	Usable
	14) Qualifiers	Yes – Data qualified due to ht exceedance, calibration, surrogate, internal standard outliers etc.	Yes – Minor qualifiers assigned due to lab RPD exceedances.	Yes – Specific LLMB 3 character Qual codes	Yes – Holdtimes, surrogate %R, LCS %R	Yes – Surr %R, blank contamination – U, coplanars – J/UJ diff between GC and HRGCMS, interference, coelutions	Yes – Coelutions, greater than calibration range
SAP		NA	NA				
QAPP		Yes	Yes				
Lab QAM		Yes	Yes				

Table 3-2 QC Elements for Data Sets Supporting the Fox River RI/FS and RA

	Study Name:	1998 FRG/BBL NRDA Data DMR Section 3.2.25					
	Parameter & Matrix:	**Pesticides** **Fish Tissue**	**Mercury** **Fish Tissue**	**PCBs** **Surface Water**	**Conventionals** **Surface Water**	**PCBs** **Sediments**	**PCB Congeners** **Sediments**
QA Elements	**SDG #'s:**	En Chem Multiple SDGs	En Chem Multiple SDGs	En Chem Multiple SDGs	En Chem Multiple SDGs	En Chem Multiple SDGs	En Chem Multiple SDGs
Data Review	1) Third-Party Validation Performed	Exponent	Exponent	BBL	BBL	BBL	BBL
Deliverables	1) Electronic Deliverables	Yes	Yes	Yes	Yes	Yes	Yes
	2) Hard Copy	Yes	Yes	Yes	Yes	Yes	Yes
Data Review Details	1) Package Completeness	Yes	Yes	Yes	Yes	Yes	Yes
	2) Chain of Custody Procedures	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable
	3) Holding Times	Some exceedances samples J/UJ	Yes	Yes	Yes – TSS samples J flagged	Yes – Dilutions done out of hold, diluted Aroclors J	Yes
	4) Initial Calibration	Yes	Yes	Yes	Yes	Yes	Yes
	4) Curve – Number of standards	Yes	Yes				NA
	5) Calibration Verification	20%	10%	20%	10%	20%	30% Target analytes 40% Internal stds
	5) Secondary Column	Yes	NA	20% qualitative only	NA	20% qualitative only	NA
	6) Laboratory Blanks	Yes	Yes	Yes	Yes	Yes	Yes
	7) Surrogate Recoveries, Number Required	Yes	Yes	Yes – Control limits not provided	Yes – Control limits not provided	Yes – Control limits not provided	Yes – Control limits not provided
	8) Matrix Spike, Number Required	Yes	Yes	Yes – Control limits not provided	Yes – Control limits not provided	Yes – Control limits not provided	Yes – Control limits not provided
	9) Lab Duplicate or Replicate	Yes – MS/MSD	Yes	Yes – MS/MSD control limits not provided	Yes – Control limits not provided	Yes – MS/MSD control limits not provided	Yes – MS/MSD control limits not provided
	9) Lab Control Sample (SRM Results?)	Yes	Yes	Yes	Yes	Yes – Not addressed	Yes
	10) Gel Permeation/Florisil Cleanup	Not mentioned	NA	Not mentioned	NA	Not mentioned	Not mentioned
	11) Detection Limit	NA	NA	NA	NA	NA	NA
	12) Calc and Transposition Verification Qualitative Verification?	No recalculations were provided unable to determine if transcription checks were done	No recalculations were provided unable to determine if transcription checks were done	No recalculations were provided; unable to determine if transcription checks were done	No recalculations were provided; unable to determine if transcription checks were done	No recalculations were provided; unable to determine if transcription checks were done	No recalculations were provided; unable to determine if transcription checks were done
	13) Field QC Results	None identified	None identified	Field Duplicates OK. Rinsates had contamination	Field Duplicates OK. Rinsates had contamination	Field Duplicates OK	None identified
	14) Usability Usable/Supporting	Usable	Usable	Usable	Usable – Except some TOC/DOC rejected	Usable	Usable
	14) Qualifiers	Yes – Holdtimes, MS/MSD %R, Surr %R, PCB interference – all + J	Yes – Duplicate RPD	Yes – Aroclor 1242 ND based on rinsate cont./ UJ extraction errors/ J/UJ low surrogate %R	Yes – TOC/DOC R DOC > TOC, All parameters U rinsate, TSS J hold time	Yes – Aroclor 1242 and 1254 J spectral overlap/ J dilutions out of hold time/ minor CCAL %D	Yes – 1 compound J/UJ CCAL D, MS/MSD/LCS low %R, poor peak resolution
SAP							
QAPP							
Lab QAM							

Table 3-2 QC Elements for Data Sets Supporting the Fox River RI/FS and RA

		Pesticides	SVOCs	Metals	TOC/Ammonia	PCBs
	Study Name:	**1998 FRG/BBL NRDA Data (continued) DMR Section 3.2.25**				
	Parameter & Matrix:	**Pesticides Sediments**	**SVOCs Sediments**	**Metals Sediments**	**TOC/Ammonia Sediments**	**PCBs Fish Tissue**
QA Elements	**SDG #'s:**	Quanterra Multiple SDGs	En Chem Multiple SDGs	En Chem Multiple SDGs	En Chem Multiple SDGs	En Chem Multiple SDGs
Data Review	1) Third-Party Validation Performed	BBL	BBL	BBL	BBL	BBL
Deliverables	1) Electronic Deliverables	Yes	Yes	Yes	Yes	Yes
	2) Hard Copy	Yes	Yes	Yes	Yes	Yes
Data Review Details	1) Package Completeness	Yes	Yes	Yes	Yes	Yes
	2) Chain of Custody Procedures	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable
	3) Holding Times	Yes	Yes – 1 missed hold time sample J/UJ	Yes	Yes – Some TOC and ammonia samples J	Yes
	4) Initial Calibration	Yes	Yes	Yes	Yes	Yes
	Curve – Number of standards	NA	NA	NA	NA	NA
	5) Calibration Verification	20%	20%	10%	10%	20%
	Secondary Column	20% qualitative only	NA	NA	NA	20% qualitative only
	6) Laboratory Blanks	Yes	Yes	Yes	Yes	Yes
	7) Surrogate Recoveries, Number Required	Yes – Control limits not provided	Yes – Control limits not provided	Yes – Control limits not provided	Yes – Control limits not provided	Yes – Control limits not provided
	8) Matrix Spike, Number Required	Yes – Control limits not provided	Yes – Control limits not provided	Yes – Control limits not provided	Yes – Control limits not provided	Yes – Control limits not provided
	9) Lab Duplicate or Replicate	Yes – MS/MSD control limits not provided	Yes – MS/MSD control limits not provided	Yes – Control limits not provided	Yes – Control limits not provided	Yes – MS/MSD control limits not provided
	Lab Control Sample (SRM Results?)	Yes	Yes	Yes	Yes	Yes
	10) Gel Permeation/Florisil Cleanup	Not mentioned	Not mentioned	NA	NA	Not mentioned
	11) Detection Limit	NA	NA	NA	NA	NA
	12) Calc and Transposition Verification Qualitative Verification?	No recalculations were provided; unable to determine if transcription checks were done	No recalculations were provided; unable to determine if transcription checks were done	No recalculations were provided; unable to determine if transcription checks were done	No recalculations were provided; unable to determine if transcription checks were done	No recalculations were provided; unable to determine if transcription checks were done
	13) Field QC Results	Field Duplicates OK	Field Duplicates OK	Field Duplicates OK	Field Duplicates OK	None identified
	14) Usability Usable/Supporting	Usable	Usable – Except hexachlorocyclopentadiene rejected	Usable	Usable	Usable
	Qualifiers	No	Yes – HCCP R 0% MS/MSD, minor CCAL %D, low surr %R, and missed hold time	Yes – Blank contamination, low MS %R, RPD	Yes – Holdtimes	Yes – Aroclor 1242 and 1254 J spectral overlap, J/UJ due to extraction error
SAP						
QAPP						
Lab QAM						

Table 3-2 QC Elements for Data Sets Supporting the Fox River RI/FS and RA

		PCBs	PCB Congeners	TOC/DOC/TSS	PCBs	PCB Congeners	TOC
	Study Name:	**1998 Deposit N Demonstration Pilot Remediation Data DMR Section 3.2.26**					
	Parameter & Matrix:	**PCBs** Slurry, Soil, Liquid	**PCB Congeners** Slurry, Soil, Liquid	**TOC/DOC/TSS** Slurry, Soil, Liquid	**PCBs** Sludge	**PCB Congeners** Sludge	**TOC** Sludge
QA Elements	**SDG #'s:**	Severn Trent VT. Fox9, Fox10, Fox11, Fox12, Fox13, Fox14, Fox16	Severn Trent VT. Fox9, Fox10, Fox11, Fox12, Fox13, Fox14, Fox16	WSLH	Severn Trent VT. Fox17 and Fox18	Severn Trent VT. Fox17 and Fox18	Severn Trent VT. Fox17 and Fox18
Data Review	1) Third-Party Validation Performed	MAKuehl	MAKuehl	MAKuehl	MAKuehl	MAKuehl	MAKuehl
Deliverables	1) Electronic Deliverables	Yes	Yes	Yes	Yes	Yes	Yes
	2) Hard Copy	Yes	Yes	Yes	Yes	Yes	Yes
Data Review Details	1) Package Completeness	Yes	Yes	Yes	Yes	Yes	Yes
	2) Chain of Custody Procedures	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable
	3) Holding Times	Yes – Some exceedances	Yes – Some results J/UJ, some results rejected (greater than 14 days)	Yes – Some exceedances	Yes	Yes	Yes
	4) Initial Calibration	Yes	Yes	Yes	Yes	Yes	Yes
	4) Curve – Number of standards	NA	NA	NA	NA	NA	Yes
	5) Calibration Verification	15%	Yes	Yes	Yes	Yes	Yes
	5) Secondary Column	Yes – Some %D exceedances	Yes	NA	Yes – %D outliers	Yes	NA
	6) Laboratory Blanks	Yes	Yes – Some results U based on MB cont.	Yes	Yes	Yes	Yes
	7) Surrogate Recoveries, Number Required	Yes	Yes	Yes	Yes	Yes	Yes
	8) Matrix Spike, Number Required	Yes	Yes	Yes	Yes	Yes – Some %R and RPD outliers	Yes
	9) Lab Duplicate or Replicate	Yes	Yes	Yes	Yes	Yes	Yes – Some RPD outliers
	9) Lab Control Sample (SRM Results?)	Yes – Some %R outliers	Yes – Some %R outliers	Yes	Yes – Some %R outliers	Yes	Yes – One outlier
	10) Gel Permeation/Florisil Cleanup	Not addressed	Not Addressed	NA	Not Addressed	Not addressed	NA
	11) Detection Limit	NA	NA	NA	NA	NA	NA
	12) Calc and Transposition Verification Qualitative Verification?	Yes	Yes	Yes	Yes	Yes	Yes
	13) Field QC Results	Yes	Yes – Some outliers, no quals assigned	Yes – DOC RPD outlier	Yes	Yes – Some outliers, no quals assigned	Yes – Some RPD outliers
	14) Usability Usable/Supporting	Usable – Some results rejected due to possible cross contamination	Usable – Some results rejected due to exceeded holding times	Usable	Usable	Usable	Usable
	14) Qualifiers	Yes – Cooler temps, CCAL %D, holding time, LCS %R, Dual Column %D	Yes – Hold times, cooler temps, CCAl %D, method blank contamination, LCS %R, over cal	Yes – Holding times, cooler temps, Field Dup RPD, DOC>TOC	Yes – Dual column %D outliers	Yes – CCAL %D outliers, MS/MSD %R and RPD outliers, LCS %R, over cal	Yes – LCS %R, Dup RPD, Field Dup RPD
SAP							
QAPP							
Lab QAM							

Table 3-2 QC Elements for Data Sets Supporting the Fox River RI/FS and RA

	Study Name:	1998 Deposit N Demonstration Pilot Remediation Data (continued) DMR Section 3.2.26			1999 FRG Demonstration Project, Deposit N and SMU 56/57 DMR Section 3.2.29	2000/2001 FRG/CH2M HILL (Little Lake Butte des Morts) DMR Section 3.2.30	
	Parameter & Matrix:	PCB Congeners Surface Water	PCBs Fish	PCB Congeners Minnow	PCB-A, PCB-C, Conventionals Chemistry Sediments, Surface Water, PUF, Slurry and Influent/Effluent	VOCs Woodchips	Cyanide Sediments
QA Elements	SDG #'s:	WSLH	Severn Trent VT. Fox7	WSLH	En Chem and WSLH (Northern Lakes and Triangle)	En Chem 913915	En Chem 913915
Data Review	1) Third-Party Validation Performed	MAKuehl	MAKuehl	MAKuehl	MAKuehl	CH2M HILL	CH2M HILL
Deliverables	1) Electronic Deliverables	Yes	Yes	Yes	Yes	Yes	Yes
	2) Hard Copy	Yes	Yes	Yes	Yes – but only validation reports with Form 1s reviewed by EcoChem	Yes – but only Form 1s reviewed by EcoChem	Yes – but only Form 1s reviewed by EcoChem
Data Review Details	1) Package Completeness	Yes	Yes	Yes	Yes	Yes	Yes
	2) Chain of Custody Procedures	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable
	3) Holding Times	Yes	Yes	Yes	Several Hg, DOC, TOC and PCB-A results were estimated due to inadequate preservation and/or holding time exceedance	Yes	Yes
	4) Initial Calibration	Yes	Yes	Yes	Yes	Yes	Yes
	4) Curve – Number of standards	Yes	Yes	Yes	Yes, as per method One set of PCB-A estimated due to lack of initial cal.	5 pt	Yes – Criteria met
	5) Calibration Verification	Yes	Yes	Yes	Yes	unknown	Yes
	5) Secondary Column	Yes	Yes	Yes	Yes, when required by method	NA	NA
	6) Laboratory Blanks	Yes – Some results U because of MB cont.	Yes	Yes	Yes – Some contaminants	Yes	Yes
	7) Surrogate Recoveries, Number Required	Yes	Yes	Yes	Yes – Some exceedance	Yes – Low recoveries	NA
	8) Matrix Spike, Number Required	No – Not enough sample	No	Yes	Yes	No	Yes – Lab limits
	9) Lab Duplicate or Replicate	Yes	Yes	Yes	Yes	No	Yes – Criteria met
	9) Lab Control Sample (SRM Results?)	Yes	Yes	Yes	Not Addressed	Yes – Some low recoveries	Yes – Criteria met
	10) Gel Permeation/Florisil Cleanup	Not addressed	Not Adressed	Not Addressed	Not Addressed	NA	NA
	11) Detection Limit	NA	NA	NA	Varies by method and compound	ppb – Varies by sample and compound	ppm – Varies by sample
	12) Calc and Transposition Verification Qualitative Verification?	Yes	Yes	Yes	Yes, at 10% frequency	No recalculations were provided; unable to determine if transcription checks were done	No recalculations were provided; unable to determine if transcription checks were done
	13) Field QC Results	Yes – Some outliers, no quals assigned	Yes	Yes	Yes	Field Dups and Trip Blanks OK	Field Duplicates OK
	14) Usability Usable/Supporting	Usable	Usable	Usable	Usable, except acrolein.	Usable	Usable
	14) Qualifiers	Yes – Blank contamination, results < LOQ,	No	Yes – Reported results < LOQ	Yes – Various data were estimated due to blank contamination, preservation, holding time, precision and accuracy outliers. Also, some data estimated that were between the LOD and LOQ. Acrolein data rejected due to extremely low matrix spike recovery.	Yes – All results U/UJ for low surrogate %R	No
SAP					Yes – But not provided	Not provided	Not provided
QAPP					Yes – But not provided	Not provided	Not provided
Lab QAM					Yes – But not provided	Not provided	Not provided

Table 3-2 QC Elements for Data Sets Supporting the Fox River RI/FS and RA

	Study Name:	2000/2001 FRG/CH2M HILL (Little Lake Butte des Morts) DMR Section 3.2.30			
	Parameter & Matrix:	PCB Aroclors Sediments	Metals Sediments	SVOCs Sediments	Fuels (GRO/DRO) Sediments
QA Elements	SDG #'s:	En Chem Multiple SDGs	En Chem 913426/913915	En Chem 913426/913904	En Chem 913426/913904
Data Review	1) Third-Party Validation Performed	CH2M HILL	CH2M HILL	CH2M HILL	CH2M HILL
Deliverables	1) Electronic Deliverables	Yes	Yes	Yes	Yes
	2) Hard Copy	Yes – but only Form 1s reviewed by EcoChem	Yes – but only Form 1s reviewed by EcoChem	Yes – but only Form 1s reviewed by EcoChem	Yes – but only Form 1s reviewed by EcoChem
Data Review Details	1) Package Completeness	Yes	Yes	Yes	Yes
	2) Chain of Custody Procedures	Acceptable	Acceptable	Acceptable	Acceptable
	3) Holding Times	Yes	Yes	Yes	Yes
	4) Initial Calibration	Yes	Yes	Yes	Yes
	Curve – Number of standards	Yes – Criteria met	Lin Reg	5 pt	Lin Reg
	5) Calibration Verification	Yes	Yes	Yes	Yes
	Secondary Column	Qualitative only	NA	NA	NA
	6) Laboratory Blanks	Yes	Yes	Yes	Yes
	7) Surrogate Recoveries, Number Required	Yes	NA	Yes – 2 samples J/UJ for low %R	Yes
	8) Matrix Spike, Number Required	Yes – MS/MSD	Yes	Yes – MS/MSD – 1 sample J for high %R	No
	9) Lab Duplicate or Replicate	No	Yes	No	No
	Lab Control Sample (SRM Results?)	Yes – Acceptable	Yes – Acceptable	Yes – Acceptable	Yes – Acceptable
	10) Gel Permeation/Florisil Cleanup	Not mentioned	NA	Not mentioned	Not mentioned
	11) Detection Limit	ppb – Varies by sample	ppm – Varies by sample and analyte	ppb – Varies by sample and compound	ppm – Varies by sample
	12) Calc and Transposition Verification Qualitative Verification?	No recalculations were provided; unable to determine if transcription checks were done	No recalculations were provided; unable to determine if transcription checks were done	No recalculations were provided; unable to determine if transcription checks were done	No recalculations were provided; unable to determine if transcription checks were done
	13) Field QC Results	Field Duplicates some high RPD with no qualifiers	Field Dup for Hg only	Field Duplicates OK	Field Duplicates – All DRO results J due to high RPD
	14) Usability Usable/Supporting	Usable	Usable	Usable	Usable
	Qualifiers	Yes – Many Aroclor 1254 and some 1260 qualified J due to spectral overlap	No	Yes – Due to surrogate and MS %R outliers	Yes – All DRO results J due to high RPD
SAP		Not provided	Not provided	Not provided	Not provided
QAPP		Not provided	Not provided	Not provided	Not provided
Lab QAM		Not provided	Not provided	Not provided	Not provided

Table 3-2 QC Elements for Data Sets Supporting the Fox River RI/FS and RA

	Study Name:	**2000 FRG/BBL Supplemental Monitoring Program Data – Surface Water DMR Section 3.2.31**			**2000/2001 FRG/BBL Supplemental Monitoring Program Data – Sediments DMR Section 3.2.32**		
	Parameter & Matrix:	**Conventionals** **Water and XAD Resins**	**PCB Aroclors** **Water and XAD Resins**	**PCB Congeners** **Water and XAD Resins**	**Conventionals** **Sediments**	**PCB Aroclors** **Sediments**	**PCB Congeners** **Sediments**
QA Elements	**SDG #'s:**	En Chem Multiple SDGs	En Chem Multiple SDGs	En Chem & STL Multiple SDGs	En Chem & CQM Multiple SDGs	En Chem Multiple SDGs	STL GOL020161
Data Review	1) Third-Party Validation Performed	BBL	BBL	BBL	BBL	BBL	BBL
Deliverables	1) Electronic Deliverables	Yes	Yes	Yes	Yes	Yes	Yes
	2) Hard Copy	Yes – but only Form 1s reviewed by EcoChem	Yes – but only Form 1s reviewed by EcoChem	Yes – but only Form 1s reviewed by EcoChem	Yes – but only Form 1s reviewed by EcoChem	Yes – but only Form 1s reviewed by EcoChem	Yes – but only Form 1s reviewed by EcoChem
Data Review Details	1) Package Completeness	Yes	Yes	Yes	Yes	Yes	Yes
	2) Chain of Custody Procedures	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable
	3) Holding Times	Yes	Yes	Yes	Yes	Yes	Yes
	4) Initial Calibration	Yes	Yes	Yes	Yes	Yes	Yes
	4) Curve – Number of standards	Per method	Lin Reg	5 pt	Per method	Lin Reg	5 pt
	5) Calibration Verification	Yes	Yes	Yes – All samples in 3 SDG qualified 1+ congeners J/UJ	Per method	Yes	Yes
	5) Secondary Column	NA	Qualitative only	NA	NA	Qualitative only	NA
	6) Laboratory Blanks	Yes	Yes	Yes – Several congeners in several samples qualified U	Yes – TOC only	Yes	Yes
	7) Surrogate Recoveries, Number Required	NA	Yes	Yes	NA	Yes	Yes
	8) Matrix Spike, Number Required	Yes – TOC only	Yes – MS/MSD	No	Yes – TOC only; 20 samples J for high %R	Yes – MS/MSD	No
	9) Lab Duplicate or Replicate	Yes – Criteria met	No	No	No duplicates for grain size and % moisture	No	No
	9) Lab Control Sample (SRM Results?)	Yes – Criteria met	Yes – Acceptable	Yes – Acceptable	Yes – TOC only	Yes – Acceptable	No
	10) Gel Permeation/Florisil Cleanup	NA	Not mentioned	NA	NA	Not mentioned	NA
	11) Detection Limit	ppm – Varies by sample	ppb – Varies by sample	ppb – Varies by sample and congener	TOC – ppm – Varies by sample	ppb – Varies by sample	ppt – Varies by sample and congener
	12) Calc and Transposition Verification Qualitative Verification?	No recalculations were provided; unable to determine if transcription checks were done	No recalculations were provided; unable to determine if transcription checks were done	No recalculations were provided; unable to determine if transcription checks were done	No recalculations were provided; unable to determine if transcription checks were done	No recalculations were provided; unable to determine if transcription checks were done	No recalculations were provided; unable to determine if transcription checks were done
	13) Field QC Results	Field Duplicates OK	Field Duplicates – Some high RPD with no qualifiers	Field Dup for Hg only	Field Duplicates TOC only	Field Duplicates acceptable	No
	14) Usability Usable/Supporting	Usable	Usable	Usable	Usable	Usable	Usable
	14) Qualifiers	No	No	Yes – Due to blank cont., ccal, IS %R, and linear range exceed.	Yes – TOC 20 samples J for high %R	No	No
SAP		Not provided	Not provided	Not provided	Not provided	Not provided	Not provided
QAPP		Not provided	Not provided	Not provided	Not provided	Not provided	Not provided
Lab QAM		Not provided	Not provided	Not provided	Not provided	Not provided	Not provided

Table 3-2 QC Elements for Data Sets Supporting the Fox River RI/FS and RA

		2001 FRG/BBL Green Bay Sediment Data DMR Section 3.2.33		2001 FRG/BBL Water Quality High-Flow Data DMR Section 3.2.34		
	Study Name:					
	Parameter & Matrix:	**Conventionals** Sediments	**PCB Aroclors** Sediments	**Conventionals** Water and XAD Resins	**PCB Aroclors** Water and XAD Resins	**PCB Congeners** Water and XAD Resins
QA Elements	**SDG #'s:**	En Chem & CQM 914351, 914390	En Chem 914351, 914390	En Chem Multiple SDGs	En Chem Multiple SDGs	En Chem & STL Multiple SDGs
Data Review	1) Third-Party Validation Performed	EcoChem & BBL	EcoChem & BBL	BBL	BBL	BBL
Deliverables	1) Electronic Deliverables	Yes	Yes	Yes	Yes	Yes
	2) Hard Copy	Yes	Yes	Yes – but only Form 1s reviewed by EcoChem	Yes – but only Form 1s reviewed by EcoChem	Yes – but only Form 1s reviewed by EcoChem
Data Review Details	1) Package Completeness	Yes	Yes	Yes	Yes	Yes
	2) Chain of Custody Procedures	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable
	3) Holding Times	Yes	Yes	Yes – Several TVS samples J/UJ	Yes	Yes
	4) Initial Calibration	Yes	Yes	Yes	Yes	Yes
	4) Curve – Number of standards	Per method	Lin Reg	Per method	Lin Reg	5 pt
	5) Calibration Verification	Per method	Yes	Per method	Yes	Yes – All samples in 1 SDG qualified 1+ congeners J/UJ
	5) Secondary Column	NA	Qualitative only	NA	Qualitative only	NA
	6) Laboratory Blanks	Yes – TOC only	Yes	Yes – TOC only	Yes	Yes – 10 SDG had mult. congeners qualified U
	7) Surrogate Recoveries, Number Required	NA	Yes – 1 sample J due to high %R	NA	Yes – 1 sample J/UJ & 1 sample J/R due to low %R	Yes – Several results R due to low %R; several SDG J/UJ due to low %R
	8) Matrix Spike, Number Required	Yes – TOC only MS/MSD	Yes – MS/MSD	Yes – TOC only; 20 samples J for high %R	Yes – MS/MSD	No
	9) Lab Duplicate or Replicate	No duplicates for grain size and % moisture	No	No duplicates for grain size and % moisture	No	No
	9) Lab Control Sample (SRM Results?)	Yes – TOC only	Yes – Acceptable	Yes – TOC only	Yes – Acceptable	Yes – Results in 16 samples J/UJ due to low %R
	10) Gel Permeation/Florisil Cleanup	NA	Not mentioned	NA	Not mentioned	NA
	11) Detection Limit	TOC – ppm – Varies by sample	ppb – Varies by sample	TOC – ppm – Varies by sample	ppb – Varies by sample	ppt – Varies by sample and congener
	12) Calc and Transposition Verification Qualitative Verification?	EcoChem performed recalcs and transcription checks	EcoChem performed recalcs and transcription checks	No recalculations were provided; unable to determine if transcription checks were done	No recalculations were provided; unable to determine if transcription checks were done	No recalculations were provided; unable to determine if transcription checks were done
	13) Field QC Results	No	No	Field Duplicates acceptable; Rinse blank (TOC only) contamination	Field Duplicates acceptable	Yes – High RPD, no action taken
	14) Usability Usable/Supporting	Usable	Usable	Usable	Usable	Rejected (R) data not usable; all other data usable
	14) Qualifiers	Yes – TOC data estimated due to high RSD between injections	No	Yes – Several TOC samples U due to rinse blank contamination. Several TVS samples J/UJ due to HT exceedance.	Yes – 1 sample J/UJ and 1 sample J/R due to low %R	Yes – Several results R due to low %R. Results J/UJ due to surrogate, LCS, CCAL, coelution and ion ratio outliers. Results U due to blank contamination.
SAP		Not provided	Not provided	Not provided	Not provided	Not provided
QAPP		Not provided	Not provided	Not provided	Not provided	Not provided
Lab QAM		Not provided	Not provided	Not provided	Not provided	Not provided

Table 3-2 QC Elements for Data Sets Supporting the Fox River RI/FS and RA

		2002 RETEC Green Bay Sediment Data DMR Section 3.2.35		2002 Foth and Van Dyke Little Lake Butte des Morts Sediment Data DMR Section 3.2.36	
	Study Name:				
	Parameter & Matrix:	**TOC/Conventionals** Sediments	**PCB Aroclors** Sediments	**TOC/Conventionals** Sediments	**PCB Aroclors** Sediments
QA Elements	**SDG #'s:**	En Chem 922546A	En Chem 922546A	En Chem 921796A, B, C	En Chem 921796A, B, C
Data Review	1) Third-Party Validation Performed	MAKuehl	MAKuehl	MAKuehl	MAKuehl
Deliverables	1) Electronic Deliverables	Yes	Yes	Yes	Yes
	2) Hard Copy	Yes	Yes	Yes	Yes
Data Review Details	1) Package Completeness	Yes	Yes	Yes	Yes
	2) Chain of Custody Procedures	Acceptable	Acceptable	Acceptable	Acceptable
	3) Holding Times	Yes	Yes	Yes	Yes
	4) Initial Calibration	Yes	Yes	Yes	Yes
	4) Curve – Number of standards	Per method	Lin Reg	Per method	Lin Reg
	5) Calibration Verification	Per method	Yes	Per method	Yes
	5) Secondary Column	NA	Qualitative only	NA	Qualitative only
	6) Laboratory Blanks	Yes – TOC only	Yes	Yes – TOC only	Yes
	7) Surrogate Recoveries, Number Required	NA	Yes – 1 sample J/UJ & 1 sample J/R due to low %R	NA	Yes – 3 samples qualified J due to low %R
	8) Matrix Spike, Number Required	TOC – One sample estimated for low recovery	Yes – MS/MSD	Yes – TOC only	Yes – MS/MSD
	9) Lab Duplicate or Replicate	TOC – Replicate RSD >20% and 40 samples qualified J	No	TOC – Replicate RSD >20% and several samples qualified J	No
	9) Lab Control Sample (SRM Results?)	Yes – Acceptable	Yes – Acceptable	Yes – Acceptable	Yes – Acceptable
	10) Gel Permeation/Florisil Cleanup	NA	Hg used for sulphur removal	NA	Hg used for sulphur removal
	11) Detection Limit	TOC – ppm – Varies by sample. Note that MAKuehl estimates values (J) between the LOD and LOQ.	ppb – Varies by sample. Note that MAKuehl estimates values (J) between the LOD and LOQ.	TOC – ppm – Varies by sample. Note that MAKuehl estimates values (J) between the LOD and LOQ.	ppb – Varies by sample. Note that MAKuehl estimates values (J) between the LOD and LOQ.
	12) Calc and Transposition Verification Qualitative Verification?	No recalculations were provided; unable to determine if transcription checks were done	No recalculations were provided; peak matching was reviewed by MAKuehl	No recalculations were provided; unable to determine if transcription checks were done	No recalculations were provided; peak matching was reviewed by MAKuehl
	13) Field QC Results	Field Duplicates acceptable	Field Duplicates acceptable	Field Duplicates acceptable	Field Duplicates acceptable
	14) Usability Usable/Supporting	Usable	Usable	Usable	Usable
	14) Qualifiers	Yes – 40 TOC samples J due to RSD >20%; one TOC sample J due to low spike recovery.	No	Yes – 18 TOC samples J due to RSD >20%	Yes – 3 samples qualified J due to low surrogate %R
SAP		Not provided	Not provided	Not provided	Not provided
QAPP		Not provided	Not provided	Not provided	Not provided
Lab QAM		Not provided	Not provided	Not provided	Not provided

ERRATA

Corrections to

DOCUMENTS FOR THE LOWER FOX RIVER AND GREEN BAY SITE, WISCONSIN

This Document has been Prepared by the
The RETEC Group, Inc.
Seattle, Washington
and
Wisconsin Department of Natural Resources
Madison, Wisconsin
and
United States Environmental Protection Agency
Region 5
Chicago, Illinois

June 2003

ERRATA

This document summarizes errors identified to date and provides corrections to the *Feasibility Study for the Lower Fox River and Green Bay, Wisconsin* (Feasibility Study); *Record of Decision for Operable Unit 1 and Operable Unit 2, Lower Fox River and Green Bay, Wisconsin*; *Responsiveness Summary – Lower Fox River and Green Bay, Wisconsin Site, Record of Decision, Operable Units 1 and 2*; and white papers. This errata document is provided to address changes in the December 2002 printed version of the above-mentioned documents. This errata document and any subsequent errata documents will be posted on the Wisconsin Department of Natural Resources (WDNR) website at http://www.dnr.state.wi.us/org/water/wm/lowerfox/rifs/index.html.

FEASIBILITY STUDY

1. Table 5-5 of the FS, the surface-weighted average concentration (SWAC) table for Green Bay, contained errors on the SWAC for Zones 2 and 4 and omitted a no action SWAC. Based on the Technical Memorandum 2f, which was used to generate the original table, this table has been corrected and is attached.

2. Tables 7-2, 7-3, and 7-4 contained errors and omissions concerning mass and volumes for the Lower Fox River and Green Bay. Based on the Technical Memorandum 2f, which was used to generate the original tables, these tables have been corrected and are attached.

RECORD OF DECISION FOR OPERABLE UNITS 1 AND 2

3. Page 24, Section 8.2.4, Toxicity, Sources of Toxicity Information. In the third sentence, change "Appendix D of the BLRA" to "Appendix B of the BLRA."

RESPONSIVENESS SUMMARY FOR OPERABLE UNITS 1 AND 2

4. Page 4-5, Master Comment 4.7, Response. Beginning with the fourth sentence, replace the text with the following:

   "Sediment-to-water ratios were developed for all four reaches of the River and for Green Bay. The general term used to estimate SQTs was not from OU 4, as the commenter implies, but rather a value of 10^{-6} was determined to be a good estimation of the range of values observed. As documented in Section 7 of the BLRA, sediment-to-water ratios average between 10^{-4} and 10^{-7} for all Operable Units, with averages of 10^{-5} in OUs 3 and 4 to 10^{-6} in OUs 1 and 2 and Zone 2 of Green Bay. See Section 9.6 of the Proposed Plan and *White Paper No. 11 – Comparison of SQTs, RALs, RAOs, and SWACs for the Lower Fox River*."

5. Page 8-10, Master Comment 8.15, Response. In the fourth paragraph, replace the fourth sentence with the following: "The FS describes two 12-inch cutterhead dredges operating simultaneously 12 hours per day, 7 days per week, 26 weeks per year, and a dredge rate of 120 cy/hr per dredge (240 cy/hr for two dredges)."

6. Page 8-10, Master Comment 8.15, Response. In the fifth paragraph, replace the third sentence with the following: "The FS describes two 12-inch cutterhead dredges operating simultaneously 12 hours per day, 7 days per week, 26 weeks per year, and a dredge rate of 120 cy/hr per dredge (240 cy/hr for two dredges)."

7. *White Paper No. 2 – Evaluation of New Little Lake Butte des Morts PCB Sediment Samples* did not include Tables 1 and 2. Those data tables are attached to this document and have been added to the version available on the WDNR website (http://www.dnr.state.wi.us/org/water/wm/lowerfox/rifs/index.html).

8. *White Paper No. 9 – Remedial Decision-Making for the Lower Fox River/Green Bay Remedial Investigation, Feasibility Study, Proposed Remedial Action Plan, and Record of Decision* omitted some references cited in the paper from the reference section. The references have been added and a revised reference section is attached to this document. A revised version of the white paper is available on the WDNR website (http://www.dnr.state.wi.us/org/water/wm/lowerfox/rifs/index.html).

9. *White Paper No. 14 – Review of the FoxView Database* was incorrectly titled. The correct title is *Review of the FoxView Database*. A corrected title page has been added to the online version of the white paper available on the WDNR website (http://www.dnr.state.wi.us/org/water/wm/lowerfox/rifs/index.html).

ITEM 1

TABLE 5-5

Table 5-5 PCB Mass, Volume and SWAC—Green Bay

Bay Zone	Volume Based on Action Levels (cy)					PCB Mass Based on Action Levels (kg)					SWAC Based on Action Levels (ppb)					
	125 ppb	250 ppb	500 ppb	1,000 ppb	5,000 ppb	125 ppb	250 ppb	500 ppb	1,000 ppb	5,000 ppb	No Action	125 ppb	250 ppb	500 ppb	1,000 ppb	5,000 ppb
Zone 2A	15,075,443	11,965,659	10,811,785	10,528,221	3,337,891	13,560	13,171	12,971	12,883	4,803	—	105	172	267	408	1,006
Zone 2B	22,197,236	20,494,284	18,889,690	18,748,170	725,913	17,427	17,215	16,925	16,885	1,310	—	117	216	425	730	1,357
Zone 2	37,272,680	32,459,943	29,701,474	29,276,390	4,063,804	30,986	30,386	29,895	29,768	6,113	1,159	111	190	325	476	1,025
Zone 3A	206,264,396	39,014,609	16,302,563	14,387	0	16,495	5,472	2,156	2	0	320	84	113	182	274	274
Zone 3B	252,101,800	102,248,023	43,556,861	0	0	16,130	10,814	4,818	0	0	561	103	133	268	551	551
Zone 4	6,612,215	506,177	0	0	0	194	22	0	0	0	73	55	60	63	63	63

Notes:

[1] Estimated mass or volume of sediment to be removed or isolated at a specific action level.

[2] Estimated residual SWAC concentration in surface sediments after removal.

ITEM 2

TABLES 7-2, 7-3, AND 7-4

Table 7-2 Volume Allocation Table

Reach/Zone[2, 3]	Action Level (ppb)	Impacted Volume (cy)[6]	TSCA Volume (cy)[6]	Dredge Area (acres)	Alternative C: Dredge and Off-site Disposal (cy)	Alternative D/G: Dredge, CDF/CAD, and Off-site Disposal[1] (cy)		Alternative E: Dredge and Thermal Treatment[4] (cy)	Alternative F: Cap in Place, then Dredge to CDF and Off-site Disposal[5] (cy)		
						CDF/CAD	Off-site	Thermal Treatment	Cap	CDF	Off-site
Little Lake Butte des Morts	125	1,689,173	16,165	761	1,689,173	1,673,008	16,165	1,689,173	435,300	1,237,708	16,165
	250	1,322,818	16,165	697	1,322,818	1,306,653	16,165	1,322,818	323,701	982,952	16,165
	500	1,023,621	16,165	625	1,023,621	1,007,456	16,165	1,023,621	252,057	755,398	16,165
	1,000	784,192	16,165	526	784,192	768,027	16,165	784,192	148,646	619,381	16,165
	5,000	281,689	16,165	174	281,689	265,524	16,165	281,689	59,055	206,469	16,165
Appleton to Little Rapids	125	182,450	0	119	182,450	0	0	182,450	0	0	0
	250	80,611	0	73	80,611	0	0	80,611	0	0	0
	500	56,998	0	48	56,998	0	0	56,998	0	0	0
	1,000	46,178	0	34	46,178	0	0	46,178	0	0	0
	5,000	20,148	0	13	20,148	0	0	20,148	0	0	0
Little Rapids to De Pere	125	1,483,156	0	739	1,483,156	1,483,156	0	1,483,156	898,136	0	585,020
	250	1,171,585	0	665	1,171,585	1,171,585	0	1,171,585	760,521	0	411,065
	500	776,791	0	498	776,791	776,791	0	776,791	492,979	0	283,812
	1,000	586,788	0	328	586,788	586,788	0	586,788	416,370	0	170,418
	5,000	186,348	0	173	186,348	186,348	0	186,348	136,188	0	50,160
De Pere to Green Bay	125	6,868,500	240,778	1,130	6,868,500	2,136,771	4,731,729	6,868,500	2,187,936	2,136,771	2,543,793
	250	6,449,065	240,778	1,103	6,449,065	2,136,771	4,312,293	6,449,065	2,015,618	2,136,771	2,296,675
	500	6,169,458	240,778	1,083	6,169,458	2,136,771	4,032,687	6,169,458	1,926,748	2,136,771	2,105,939
	1,000	5,879,529	240,778	1,034	5,879,529	2,136,771	3,742,758	5,879,529	1,833,253	2,136,771	1,909,504
	5,000	4,517,391	240,778	715	4,517,391	2,136,771	2,380,620	4,517,391	1,415,350	2,136,771	965,269
Green Bay Zone 2	500	29,748,004	0	—	0	29,748,004	0	0	0	0	0
	1,000	29,322,254	0	—	0	29,322,254	0	0	0	0	0
	5,000	4,070,170	0	—	4,070,170	4,070,170	0	0	0	0	0
Green Bay Zone 3A	500	16,328,102	0	—	0	16,328,102	0	0	0	0	0
	1,000	14,410	0	—	14,410	14,410	0	0	0	0	0
Green Bay Zone 3B	500	43,625,096	0	—	0	43,625,096	0	0	0	0	0
Green Bay Zone 4	500	0	0	—	0	0	0	0	0	0	0

Notes:

[1] Alternative G applies to Green Bay zones only.
[2] Volume of *in-situ* material removed (cy) is represented in rows.
[3] Alternatives A and B are not shown on this table, but volume allocations for No Action, MNR, and Institutional Controls are the same as the Impacted Volume (cy) quantities.
[4] Assume no off-site disposal costs for treated sediments.
[5] Cap to maximum extent possible, then dredge to CDF. Take TSCA material off site.
[6] These values include any overburden material located above the impacted sediments of interest, therefore, these values may differ slightly from the values presented in Sections 2 and 5.

Table 7-3 PCB Mass Allocation Table

Reach/Zone [2]	Action Level (ppb)	Density (tons/cy) *In Situ* [3]	PCB Mass (kg) [6]	Alternative C: Dredge and Off-site Disposal (kg)	Alternative D/G: Dredge, CDF/CAD, and Off-site Disposal[1] (kg)		Alternative E: Dredge and Thermal Treatment[4] (kg)	Alternative F: Cap in Place, then Dredge to CDF and Off-site Disposal [5] (kg)		
					CDF/CAD	Off-site	Thermal Treatment	Cap	CDF	Off-site
Little Lake Butte des Morts	125	0.99	1,838	1,838	1,820	18	1,838	474	1,347	18
	250		1,814	1,814	1,792	22	1,814	444	1,348	22
	500		1,782	1,782	1,754	28	1,782	439	1,315	28
	1,000		1,715	1,715	1,680	35	1,715	325	1,355	35
	5,000		1,329	1,329	1,253	76	1,329	279	974	76
Appleton to Little Rapids	125	0.98	106	106	0	0	106	0	0	0
	250		99	99	0	0	99	0	0	0
	500		95	95	0	0	95	0	0	0
	1,000		92	92	0	0	92	0	0	0
	5,000		67	67	0	0	67	0	0	0
Little Rapids to De Pere	125	1.08	1,210	1,210	1,210	0	1,210	733	0	477
	250		1,192	1,192	1,192	0	1,192	774	0	418
	500		1,157	1,157	1,157	0	1,157	734	0	423
	1,000		1,111	1,111	1,111	0	1,111	788	0	323
	5,000		798	798	798	0	798	583	0	215
De Pere to Green Bay	125	1.05	26,620	26,620	8,281	18,339	26,620	8,480	8,281	9,859
	250		26,581	26,581	8,807	17,774	26,581	8,308	8,807	9,466
	500		26,528	26,528	9,188	17,340	26,528	8,285	9,188	9,055
	1,000		26,433	26,433	9,606	16,827	26,433	8,242	9,606	8,585
	5,000		24,950	24,950	11,802	13,148	24,950	7,817	11,802	5,331
Green Bay Zone 2	500	1.18	29,896	0	29,896	0	0	0	0	0
	1,000		29,768	0	29,768	0	0	0	0	0
	5,000		6,113	6,113	6,113	0	0	0	0	0
Green Bay Zone 3A	500	1.01	2,156	0	2,156	0	0	0	0	0
	1,000		2	2	2	0	0	0	0	0
Green Bay Zone 3B	500	1.01	4,818	0	4,818	0	0	0	0	0
Green Bay Zone 4	500	1.01	0	0	0	0	0	0	0	0

Notes:

1 Alternative G applies to Green Bay zones only.
2 If multiple disposal/treatment options were available in an alternative, PCB mass was assumed to be distributed proportional to total sediment mass.
3 Density values obtained from appendix of RI Report (2000).
4 Assume no off-site disposal costs for treated sediments.
5 Cap to maximum extent possible, then dredge to CDF. Take TSCA material off site.
6 These values include any overburden material located above the impacted sediments of interest, therefore, these values may differ slightly from the values presented in Sections 2 and 5

Table 7-4 Physical, Capacity, and Process Limitations

Reach [3]	PCB Action Level (ppb)	CDF Volume (m^3)	Cap Volume (m^3) [2]	Thermal Treatment Volume (tons) [4]
Little Lake Butte des Morts	125	1,337,963 [1]	332,290	2,145,500
	250	1,337,963 [1]	247,100	2,145,500
	500	1,337,963 [1]	192,410	2,145,500
	1,000	1,337,963 [1]	113,440	2,145,500
	5,000	1,337,963 [1]	45,080	2,145,500
Appleton to Little Rapids	125	0	0	2,145,500
	250	0	0	2,145,500
	500	0	0	2,145,500
	1,000	0	0	2,145,500
	5,000	0	0	2,145,500
Little Rapids to De Pere	125	0	685,600	6,440,000
	250	0	580,550	6,440,000
	500	0	376,320	6,440,000
	1,000	0	317,840	6,440,000
	5,000	0	103,960	6,440,000
De Pere to Green Bay	125	974,801	2,655,030	6,440,000
	250	974,801	2,455,710	6,440,000
	500	974,801	2,350,350	6,440,000
	1,000	974,801	2,245,330	6,440,000
	5,000	974,801	1,765,670	6,440,000

Notes:

1. The CDF dredge volume capacity in the Little Lake Butte des Morts Reach includes the Arrowhead Park CDF (750,000 cy) and the Menasha CDF (1 million cy).
2. The required cap volume decreases with higher action levels as the surface area footprint for each subsequent action level decreases.
3. No limitations for the Green Bay zones.
4. The thermal treatment volume capacity is based on vitrification unit information provided by Minergy (2002a, 2002b). The capacities assume one-250 glass tons per day integrated storage vitrification unit for Little Lake Butte des Morts and Appleton to Little Rapids reaches and two-375 glass tons per day standalone storage vitrification units for Little Rapids to De Pere and De Pere to Green Bay reaches.

ITEM 7

WHITE PAPER NO. 2
TABLES 1 AND 2

Table 1 PCB Data Retained for 2002 Interpolation

Station ID	Total PCB (µg/kg)	Start Depth (cm)	End Depth (cm)	Easting	Northing	Source
11001	2,955	0	10	623043.25902	397867.66114	2000–01 CH2M HILL
11002	2,732	0	10	623139.73195	397836.13803	2000–01 CH2M HILL
11003	2,135	0	10	623045.13412	397767.69608	2000–01 CH2M HILL
11004	406	0	10	622954.98250	397888.22813	2000–01 CH2M HILL
11005	2,890	0	10	623205.09085	397759.58726	2000–01 CH2M HILL
11006	3,150	0	10	623154.03831	397925.29576	2000–01 CH2M HILL
11007	2,598	0	10	623266.90297	397871.86000	2000–01 CH2M HILL
11008	4,342	0	10	623200.70989	397992.83908	2000–01 CH2M HILL
11009	236	0	10	623024.99292	397989.54105	2000–01 CH2M HILL
11010	2,248	0	10	622893.37341	397764.85120	2000–01 CH2M HILL
11011	1,905	0	10	622958.93820	397677.19080	2000–01 CH2M HILL
11012	2,698	0	10	623118.68847	397680.18706	2000–01 CH2M HILL
11013	295	0	10	622661.96857	396038.30048	2000–01 CH2M HILL
11014	2,900	0	10	622899.98973	396131.64189	2000–01 CH2M HILL
11015	3,523	0	10	622901.65364	396042.78429	2000–01 CH2M HILL
11016	226	0	10	622951.46324	395943.71732	2000–01 CH2M HILL
11017	10,080	0	10	622929.15855	395854.41080	2000–01 CH2M HILL
11018	605	0	10	622931.44675	395732.23166	2000–01 CH2M HILL
11019	5,180	0	10	622867.52771	395731.03489	2000–01 CH2M HILL
11020	8,880	0	10	622669.44123	395638.44145	2000–01 CH2M HILL
11021	365	0	10	622909.76482	395609.60367	2000–01 CH2M HILL
11022	385,000	0	10	622711.67514	395517.00904	2000–01 CH2M HILL
11023	142	0	10	622678.57039	396005.27753	2000–01 CH2M HILL
11024	142	0	10	622676.90953	396094.13512	2000–01 CH2M HILL
11025	525	0	10	622947.92610	396132.53970	2000–01 CH2M HILL
11026	2,192	0	10	623059.77762	396134.63597	2000–01 CH2M HILL
11027	375	0	10	622973.55916	396044.13115	2000–01 CH2M HILL
11028	1,280	0	10	623061.44369	396045.77837	2000–01 CH2M HILL
11029	614	0	10	622975.43212	395944.16636	2000–01 CH2M HILL
11030	1,338	0	10	623119.03701	395957.96963	2000–01 CH2M HILL
11031	263	0	10	622993.70079	395822.28661	2000–01 CH2M HILL
11032	1,333	0	10	623128.27678	395891.47632	2000–01 CH2M HILL
11034	1,673	0	10	622865.86443	395819.89244	2000–01 CH2M HILL
11035	38,980	0	10	622869.81467	395608.85577	2000–01 CH2M HILL
11036	2,105	0	10	622887.04232	395542.51175	2000–01 CH2M HILL
11037	10,615	0	10	622912.05249	395487.42457	2000–01 CH2M HILL
11038	655	0	10	623047.26094	395523.29085	2000–01 CH2M HILL
11039	22,780	0	10	622672.96982	395449.61921	2000–01 CH2M HILL
11040	78,000	0	10	622784.20963	395485.03213	2000–01 CH2M HILL
11041	16,700	0	10	622712.29803	395483.68747	2000–01 CH2M HILL
11042	42,800	0	10	622783.58638	395518.35370	2000–01 CH2M HILL
11043	70,300	0	10	622678.88428	395560.84043	2000–01 CH2M HILL
11044	12,180	0	10	622622.12375	395604.22417	2000–01 CH2M HILL
11045	57,850	0	10	622782.54761	395573.88965	2000–01 CH2M HILL
11046	5,980	0	10	622733.98417	395606.31470	2000–01 CH2M HILL
11047	2,408	0	10	622621.08632	395659.76012	2000–01 CH2M HILL
11048	33,000	0	10	622708.97591	395661.40253	2000–01 CH2M HILL
11049	4,160	0	10	622643.81104	395726.85109	2000–01 CH2M HILL
11050	2,888	0	10	622755.66937	395728.94204	2000–01 CH2M HILL
11051	4,070	0	10	622114.89419	395372.54797	2000–01 CH2M HILL
11052	8,680	0	10	621942.40859	395191.56545	2000–01 CH2M HILL
11053	8,640	0	10	621943.02751	395158.24390	2000–01 CH2M HILL
11054	5,450	0	10	622030.92363	395159.87709	2000–01 CH2M HILL
11055	14,000	0	10	622028.03321	395315.37767	2000–01 CH2M HILL
11056	1,575	0	10	622160.97574	395473.40462	2000–01 CH2M HILL
11058	367	0	10	622228.41278	395285.77229	2000–01 CH2M HILL
11059	5,150	0	10	622141.55154	395228.60050	2000–01 CH2M HILL
11060	323	0	10	622229.44677	395230.23636	2000–01 CH2M HILL
11061	217	0	10	622230.68754	395163.59326	2000–01 CH2M HILL
11062	3,280	0	10	622144.03128	395095.31430	2000–01 CH2M HILL
11063	4,760	0	10	622056.13427	395093.67961	2000–01 CH2M HILL
11064	9,660	0	10	622105.79545	394572.38516	2000–01 CH2M HILL
11065	9,540	0	10	622106.82816	394516.84929	2000–01 CH2M HILL
11066	4,680	0	10	622105.17581	394605.70668	2000–01 CH2M HILL
11067	2,882	0	10	622127.49681	394695.00992	2000–01 CH2M HILL
11068	774	0	10	622201.07061	394607.49060	2000–01 CH2M HILL
11069	2,870	0	10	622177.71691	394573.72297	2000–01 CH2M HILL
11070	4,570	0	10	622186.74157	394518.33580	2000–01 CH2M HILL

Table 1 PCB Data Retained for 2002 Interpolation

Station ID	Total PCB (µg/kg)	Start Depth (cm)	End Depth (cm)	Easting	Northing	Source
11071	2,060	0	10	622269.55033	394364.32288	2000–01 CH2M HILL
11072	11,150	0	10	622182.88344	394296.04369	2000–01 CH2M HILL
11073	844	0	10	622294.76600	394298.12630	2000–01 CH2M HILL
11074	251	0	10	622223.87511	394241.25142	2000–01 CH2M HILL
11075	932	0	10	622311.78358	394242.88812	2000–01 CH2M HILL
11076	502	0	10	622249.09072	394175.05467	2000–01 CH2M HILL
11077	674	0	8	622337.00008	394176.69170	2000–01 CH2M HILL
11078	2,520	0	10	622250.12452	394119.51884	2000–01 CH2M HILL
11079	1,578	0	10	622251.36506	394052.87584	2000–01 CH2M HILL
11080	2,500	0	10	622387.22752	394055.40629	2000–01 CH2M HILL
12000	1,675	0	10	623376.42687	397996.14183	2000–01 CH2M HILL
12001	2,530	0	10	623121.60689	397524.68591	2000–01 CH2M HILL
12002	1,435	0	10	622961.85283	397521.68966	2000–01 CH2M HILL
12003	3,340	0	10	622762.16025	397517.94981	2000–01 CH2M HILL
12004	192	0	10	622498.56606	397513.02252	2000–01 CH2M HILL
12005	2,440	0	10	622583.52506	397670.16491	2000–01 CH2M HILL
12006	3,220	0	10	622759.25036	397673.45095	2000–01 CH2M HILL
12007	1,158	0	10	622645.76385	397760.21710	2000–01 CH2M HILL
12090	852	0	10	622974.10122	395588.58645	2000–01 CH2M HILL
12092	1,550	0	10	622848.33892	395475.12085	2000–01 CH2M HILL
12093	70,650	0	10	622665.80979	395405.04115	2000–01 CH2M HILL
12094	8,625	0	10	622777.67361	395407.13236	2000–01 CH2M HILL
12095	1,133	0	10	622905.31003	395420.63184	2000–01 CH2M HILL
12097	1,138	0	10	622858.19995	395375.30569	2000–01 CH2M HILL
12098	1,778	0	10	622691.23370	395327.73880	2000–01 CH2M HILL
12099	1,578	0	10	622787.53361	395307.31712	2000–01 CH2M HILL
12100	1,090	0	10	622899.19120	395320.51756	2000–01 CH2M HILL
12101	8,740	0	10	622844.29773	395263.93476	2000–01 CH2M HILL
12102	23,475	0	10	622746.54324	395362.10593	2000–01 CH2M HILL
12103	326	0	10	622966.23486	395155.10677	2000–01 CH2M HILL
12104	455	0	10	623150.85170	395114.12287	2000–01 CH2M HILL
12105	329	0	10	623345.33974	394973.32959	2000–01 CH2M HILL
12106	322	0	10	623571.59108	394844.25061	2000–01 CH2M HILL
12107	193	0	10	623738.56431	394891.83973	2000–01 CH2M HILL
12108	201	0	10	623725.51262	394736.03803	2000–01 CH2M HILL
12109	162	0	10	622895.15126	395109.33146	2000–01 CH2M HILL
12111	639	0	10	623024.66651	395022.86845	2000–01 CH2M HILL
12112	77	0	10	623830.65391	394671.35330	2000–01 CH2M HILL
12117	216	0	10	622146.09769	394984.24249	2000–01 CH2M HILL
12118	226	0	10	622132.38886	394861.76621	2000–01 CH2M HILL
12119	560	0	10	622118.05965	394772.61153	2000–01 CH2M HILL
12120	770	0	10	621896.67662	393779.61929	2000–01 CH2M HILL
12121	1,468	0	10	621894.45575	393468.47056	2000–01 CH2M HILL
12122	1,250	0	10	621912.09010	393379.90999	2000–01 CH2M HILL
12123	824	0	10	621946.74146	393236.11044	2000–01 CH2M HILL
12124	413	0	10	621902.70006	393024.18452	2000–01 CH2M HILL
12125	1,278	0	10	621800.84830	392911.18575	2000–01 CH2M HILL
12132	745	0	10	622983.75601	395499.87861	2000–01 CH2M HILL
12133	850	0	10	622993.41099	395411.17079	2000–01 CH2M HILL
12134	873	0	10	622803.51440	395307.61604	2000–01 CH2M HILL
12135	16,400	0	10	622844.92124	395230.61320	2000–01 CH2M HILL
12136	18,700	0	10	622715.41243	395317.07965	2000–01 CH2M HILL
DA01S-01	2,075	0	10	622087.54119	394694.26689	2001 Blasland, Bouck, and Lee
DA01S-02	1,050	0	10	622112.34081	394650.28398	2001 Blasland, Bouck, and Lee
DA01S-03	406	0	10	622224.01056	394663.47268	2001 Blasland, Bouck, and Lee
DA01S-04	178	0	9	622367.43754	394688.36608	2001 Blasland, Bouck, and Lee
DA01S-05	3,870	0	10	622066.04556	394560.53509	2001 Blasland, Bouck, and Lee
DA01S-06	542	0	10	622290.21530	394542.48406	2001 Blasland, Bouck, and Lee
DA01S-07	4,560	0	10	622059.49950	394482.63634	2001 Blasland, Bouck, and Lee
DA01S-08	418	0	10	622022.43205	394326.39335	2001 Blasland, Bouck, and Lee
DA01S-09	1,663	0	10	622203.75777	394463.09736	2001 Blasland, Bouck, and Lee
DA01S-10	264	0	10	622044.96176	394404.58907	2001 Blasland, Bouck, and Lee
DA01S-11	314	0	10	622308.68047	394409.49567	2001 Blasland, Bouck, and Lee
DA01S-12	152	0	10	622388.38822	394422.09178	2001 Blasland, Bouck, and Lee
DA01S-13	2,630	0	10	622125.28965	394383.86046	2001 Blasland, Bouck, and Lee
DA01S-14	1,554	0	10	622197.41987	394374.09128	2001 Blasland, Bouck, and Lee
DA01S-15	3,310	0	10	621991.08477	394292.47794	2001 Blasland, Bouck, and Lee
DA01S-16	17,950	0	10	621928.59544	394213.54043	2001 Blasland, Bouck, and Lee

Table 1 PCB Data Retained for 2002 Interpolation

Station ID	Total PCB (µg/kg)	Start Depth (cm)	End Depth (cm)	Easting	Northing	Source
DA01S-17	2,490	0	10	622152.15660	394228.80600	2001 Blasland, Bouck, and Lee
DA01S-18	99	0	10	622383.91569	394233.12095	2001 Blasland, Bouck, and Lee
DA01S-19	110,700	0	10	621945.40384	394169.40854	2001 Blasland, Bouck, and Lee
DA01S-20	5,800	0	10	622145.81759	394139.80002	2001 Blasland, Bouck, and Lee
DA01S-21	25,550	0	10	622027.59162	394048.71418	2001 Blasland, Bouck, and Lee
DA01S-22	77,000	0	10	622171.65260	394040.28149	2001 Blasland, Bouck, and Lee
DA01S-23	137	0	10	622307.92898	394020.59596	2001 Blasland, Bouck, and Lee
DA01S-24	305	0	10	622371.86458	394021.78695	2001 Blasland, Bouck, and Lee
DE01S-01	89	0	10	623127.37558	396791.45964	2001 Blasland, Bouck, and Lee
DE01S-02	1,200	0	10	622958.57438	396843.84995	2001 Blasland, Bouck, and Lee
DE01S-03	2,600	0	10	622790.39959	396862.92293	2001 Blasland, Bouck, and Lee
DE01S-03	2,700	0	10	622790.39959	396862.92293	2001 Blasland, Bouck, and Lee
DE01S-04	760	0	10	622606.24898	396881.70164	2001 Blasland, Bouck, and Lee
DE01S-05	1,800	0	10	622811.66245	397007.76522	2001 Blasland, Bouck, and Lee
DE01S-06	960	0	10	623035.54384	397000.84838	2001 Blasland, Bouck, and Lee
DE01S-06	1,100	0	10	623035.54384	397000.84838	2001 Blasland, Bouck, and Lee
DE01S-07	2,400	0	10	622635.50410	397026.69256	2001 Blasland, Bouck, and Lee
DE01S-08	83	0	10	622466.09130	397112.41700	2001 Blasland, Bouck, and Lee
DE01S-08	0	0	10	622466.09130	397112.41700	2001 Blasland, Bouck, and Lee
DE01S-09	810	0	10	622889.46536	397120.33307	2001 Blasland, Bouck, and Lee
DE01S-10	2,050	0	10	622752.21147	397195.54149	2001 Blasland, Bouck, and Lee
DE01S-10	2,360	0	10	622752.21147	397195.54149	2001 Blasland, Bouck, and Lee
DE01S-11	870	0	10	622966.64100	397266.22356	2001 Blasland, Bouck, and Lee
DE01S-12	1,450	0	10	622749.92555	397317.72090	2001 Blasland, Bouck, and Lee
DE01S-12	890	0	10	622749.92555	397317.72090	2001 Blasland, Bouck, and Lee
DE01S-13	2,340	0	10	622581.34856	397359.01342	2001 Blasland, Bouck, and Lee
DE01S-14	1,690	0	10	623060.83044	397356.87861	2001 Blasland, Bouck, and Lee
DE01S-15	660	0	10	623220.17134	397382.09164	2001 Blasland, Bouck, and Lee
DE01S-15	630	0	10	623220.17134	397382.09164	2001 Blasland, Bouck, and Lee
DE01S-16	95	0	10	622618.79681	397493.04644	2001 Blasland, Bouck, and Lee
DE01S-16	2,570	0	10	622618.79681	397493.04644	2001 Blasland, Bouck, and Lee
DE01S-17	83	0	10	623336.23078	397584.27316	2001 Blasland, Bouck, and Lee
DE01S-18	1,000	0	10	623199.81519	397615.04330	2001 Blasland, Bouck, and Lee
DE01S-19	1,060	0	10	623333.51604	397728.66710	2001 Blasland, Bouck, and Lee
DE01S-19	910	0	10	623333.51604	397728.66710	2001 Blasland, Bouck, and Lee
DE01S-20	180	0	10	623460.89732	397753.28557	2001 Blasland, Bouck, and Lee
DE01S-20	260	0	10	623460.89732	397753.28557	2001 Blasland, Bouck, and Lee
DE01S-21	640	0	10	623378.93386	397862.85506	2001 Blasland, Bouck, and Lee
DE01S-21	790	0	10	623378.93386	397862.85506	2001 Blasland, Bouck, and Lee
DE01S-22	330	0	10	623577.98855	397899.93558	2001 Blasland, Bouck, and Lee
DE01S-23	640	0	10	623481.51419	397931.45227	2001 Blasland, Bouck, and Lee
DE01S-23	780	0	10	623481.51419	397931.45227	2001 Blasland, Bouck, and Lee
DE01S-24	440	0	10	623607.21656	398044.93157	2001 Blasland, Bouck, and Lee
DE01S-25	2,100	0	10	623271.75914	398038.61856	2001 Blasland, Bouck, and Lee
DE01S-25	2,400	0	10	623271.75914	398038.61856	2001 Blasland, Bouck, and Lee
DE01S-26	1,100	0	10	623487.41033	398042.67496	2001 Blasland, Bouck, and Lee
DE01S-27	1,300	0	10	623151.11875	398080.79701	2001 Blasland, Bouck, and Lee
DE01S-28	2,000	0	10	622908.85214	397365.14078	2001 Blasland, Bouck, and Lee
DE01S-28	1,900	0	10	622908.85214	397365.14078	2001 Blasland, Bouck, and Lee
DE01S-29	2,200	0	10	623349.33225	398162.29968	2001 Blasland, Bouck, and Lee
DE01S-29	3,200	0	10	623349.33225	398162.29968	2001 Blasland, Bouck, and Lee
DE01S-30	670	0	10	623661.03204	398157.05775	2001 Blasland, Bouck, and Lee
DE01S-30	730	0	10	623661.03204	398157.05775	2001 Blasland, Bouck, and Lee
DE01S-31	1,500	0	10	623516.84867	398176.56332	2001 Blasland, Bouck, and Lee
DE01S-31	1,300	0	10	623516.84867	398176.56332	2001 Blasland, Bouck, and Lee
DE01S-32	210	0	10	623188.96777	398192.61927	2001 Blasland, Bouck, and Lee
DE01S-33	86	0	10	623290.29185	398327.85703	2001 Blasland, Bouck, and Lee
DE01S-33	96	0	10	623290.29185	398327.85703	2001 Blasland, Bouck, and Lee
DE01S-34	1,400	0	10	623802.28119	398293.05665	2001 Blasland, Bouck, and Lee
DE01S-34	130	0	10	623802.28119	398293.05665	2001 Blasland, Bouck, and Lee
DE01S-35	2,100	0	10	623482.60072	398298.14136	2001 Blasland, Bouck, and Lee
DE01S-36	1,700	0	10	623609.55170	398344.97746	2001 Blasland, Bouck, and Lee
DE01S-36	1,400	0	10	623609.55170	398344.97746	2001 Blasland, Bouck, and Lee
DE01S-37	63	0	10	623400.85215	398396.60331	2001 Blasland, Bouck, and Lee
DE01S-38	1,000	0	10	623751.63594	398436.54638	2001 Blasland, Bouck, and Lee
DE01S-38	960	0	10	623751.63594	398436.54638	2001 Blasland, Bouck, and Lee
DE01S-39	1,300	0	10	623519.81512	398443.28743	2001 Blasland, Bouck, and Lee

Table 1 PCB Data Retained for 2002 Interpolation

Station ID	Total PCB (µg/kg)	Start Depth (cm)	End Depth (cm)	Easting	Northing	Source
PD-A/B-01	4,400	0	10	622144.76241	394512.45038	2002 Foth and Van Dyke
PD-A/B-02	600	0	10	622248.37222	394512.47836	2002 Foth and Van Dyke
PD-A/B-03	13,000	0	10	622061.01005	394327.15623	2002 Foth and Van Dyke
PD-A/B-05	25,000	0	10	621934.27041	394214.98410	2002 Foth and Van Dyke
PD-A/B-06	1,000	0	10	622221.94007	394215.06145	2002 Foth and Van Dyke
PD-A/B-07	15,000	0	10	621973.87922	394125.98514	2002 Foth and Van Dyke
PD-A/B-08	12,000	0	10	622057.71257	394122.99089	2002 Foth and Van Dyke
PD-A/B-09	340	0	10	622235.37304	394123.03864	2002 Foth and Van Dyke
PD-A/B-11	280,000	0	10	622137.27207	394034.33780	2002 Foth and Van Dyke
PD-A/B-12B	800	0	10	622325.90308	394034.38848	2002 Foth and Van Dyke
PD-A/B-13	22,000	0	10	621996.50590	393954.15784	2002 Foth and Van Dyke
PD-A/B-14	23,000	0	10	622136.68399	393954.19542	2002 Foth and Van Dyke
PD-A/B-15	90	0	10	622421.91611	393954.27201	2002 Foth and Van Dyke
SD060005	820	0	5	643505.69688	418370.60463	
SD050005	960	0	5	643136.57673	418030.32679	
SD030005	3,775	0	5	642008.92762	415509.24629	
SD010005	4,770	0	5	642142.48342	414345.06166	
324	14,750	0	10	621988.75000	393929.71880	Little Lake Butte des Morts RI/FS Deposit A - 1992, 1993 BBL
325	7,500	0	10	621979.37500	393951.40630	Little Lake Butte des Morts RI/FS Deposit A - 1992, 1993 BBL
326	7,200	0	10	621982.25000	393994.71880	Little Lake Butte des Morts RI/FS Deposit A - 1992, 1993 BBL
327	4,950	0	10	621965.81250	394024.93750	Little Lake Butte des Morts RI/FS Deposit A - 1992, 1993 BBL
332	6,500	0	10	622220.43750	393985.56250	Little Lake Butte des Morts RI/FS Deposit A - 1992, 1993 BBL
342	31,000	0	10	621952.93750	394070.03130	Little Lake Butte des Morts RI/FS Deposit A - 1992, 1993 BBL
346	15,000	0	10	622047.37500	393913.28130	Little Lake Butte des Morts RI/FS Deposit A - 1992, 1993 BBL
356	4,500	0	10	622176.31250	393933.12500	Little Lake Butte des Morts RI/FS Deposit A - 1992, 1993 BBL
357	1,300	0	10	622027.37500	394232.53130	Woodward Clyde Deposit A Sediment Samples - 1994
358	290	0	10	622020.06250	394240.15630	Woodward Clyde Deposit A Sediment Samples - 1994
359	960	0	10	622019.43750	394225.21880	Woodward Clyde Deposit A Sediment Samples - 1994
360	1,900	0	10	622012.12500	394232.21880	Woodward Clyde Deposit A Sediment Samples - 1994
381	240	0	10	622101.68750	394328.84380	Woodward Clyde Deposit A Sediment Samples - 1994
382	245	0	10	622093.75000	394336.15630	Woodward Clyde Deposit A Sediment Samples - 1994
383	93	0	10	622094.68750	394321.53130	Woodward Clyde Deposit A Sediment Samples - 1994
384	2,800	0	10	622087.06250	394328.84380	Woodward Clyde Deposit A Sediment Samples - 1994
409	1,300	0	10	622091.31250	394338.90630	Woodward Clyde Deposit A Sediment Samples - 1994
410	2,400	0	10	622084.00000	394346.50000	Woodward Clyde Deposit A Sediment Samples - 1994
411	2,200	0	10	622084.31250	394330.96880	Woodward Clyde Deposit A Sediment Samples - 1994
412	6,600	0	10	622076.37500	394338.28130	Woodward Clyde Deposit A Sediment Samples - 1994
413	1,778	0	10	622533.75000	396665.46880	1994 Sediment Data - SAIC and GAS
414	448	0	10	622443.43750	396220.06250	1994 Sediment Data - SAIC and GAS
415	1,021	0	10	622512.93750	396216.37500	1994 Sediment Data - SAIC and GAS
416	2,017	0	10	622469.50000	396172.09380	1994 Sediment Data - SAIC and GAS
418	2,840	0	10	622475.93750	396122.68750	1994 Sediment Data - SAIC and GAS
423	1,863	0	10	622644.12500	396683.34380	1994 Sediment Data - SAIC and GAS
431	9,133	0	10	622479.43750	396362.87500	1994 Sediment Data - SAIC and GAS
432	3,195	0	10	622540.43750	396307.12500	1994 Sediment Data - SAIC and GAS
433	234	0	10	653519.06250	421727.43750	1994 Sediment Data - SAIC and GAS
436	19,710	0	10	653652.43750	422206.06250	1994 Sediment Data - SAIC and GAS
437	3,800	0	10	653703.62500	422175.90630	1994 Sediment Data - SAIC and GAS
438	1,925	0	10	653764.06250	422182.59380	1994 Sediment Data - SAIC and GAS
439	8,860	0	10	653746.37500	422275.87500	1994 Sediment Data - SAIC and GAS
440	1,352	0	10	653826.06250	422268.81250	1994 Sediment Data - SAIC and GAS
441	37,870	0	10	653800.50000	422372.25000	1994 Sediment Data - SAIC and GAS
442	4,665	0	10	653828.31250	422345.96880	1994 Sediment Data - SAIC and GAS
443	429	0	10	653913.06250	422297.90630	1994 Sediment Data - SAIC and GAS
444	5,860	0	10	653600.75000	421697.28130	1994 Sediment Data - SAIC and GAS
445	3,140	0	10	653875.43750	422429.81250	1994 Sediment Data - SAIC and GAS
446	40,430	0	10	653919.62500	422413.50000	1994 Sediment Data - SAIC and GAS
447	37	0	10	653978.75000	422382.21880	1994 Sediment Data - SAIC and GAS
448	11,510	0	10	653939.87500	422510.18750	1994 Sediment Data - SAIC and GAS
449	9,875	0	10	653970.68750	422493.37500	1994 Sediment Data - SAIC and GAS
450	58	0	10	653942.25000	422635.06250	1994 Sediment Data - SAIC and GAS
451	7,873	0	10	654000.25000	422586.93750	1994 Sediment Data - SAIC and GAS
455	6,825	0	10	653542.25000	421812.31250	1994 Sediment Data - SAIC and GAS
456	15,990	0	10	653596.62500	421814.71880	1994 Sediment Data - SAIC and GAS
462	1,510	0	10	622666.93750	396735.40630	1994 Sediment Data - SAIC and GAS
463	990	0	10	622812.12500	396379.34380	1994 Sediment Data - SAIC and GAS
464	55	0	10	622942.93750	396367.15630	1994 Sediment Data - SAIC and GAS
465	506	0	10	622835.87500	396317.25000	1994 Sediment Data - SAIC and GAS

Table 1 PCB Data Retained for 2002 Interpolation

Station ID	Total PCB (µg/kg)	Start Depth (cm)	End Depth (cm)	Easting	Northing	Source
466	356	0	10	622772.12500	396226.84380	1994 Sediment Data - SAIC and GAS
467	59	0	10	622875.93750	396228.84380	1994 Sediment Data - SAIC and GAS
468	440	0	10	622813.06250	396127.46880	1994 Sediment Data - SAIC and GAS
469	12,430	0	10	622907.25000	396135.18750	1994 Sediment Data - SAIC and GAS
470	45,850	0	10	622921.06250	396038.59380	1994 Sediment Data - SAIC and GAS
471	635	0	10	622805.06250	396755.15630	1994 Sediment Data - SAIC and GAS
472	157	0	10	622968.00000	396735.37500	1994 Sediment Data - SAIC and GAS
473	1,828	0	10	623064.81250	396755.93750	1994 Sediment Data - SAIC and GAS
474	116	0	10	622937.75000	396643.18750	1994 Sediment Data - SAIC and GAS
475	228	0	10	623002.43750	396647.15630	1994 Sediment Data - SAIC and GAS
476	145	0	10	622940.31250	396544.90630	1994 Sediment Data - SAIC and GAS
477	1,389	0	10	622876.06250	396451.18750	1994 Sediment Data - SAIC and GAS
478	113	0	10	622933.31250	396453.87500	1994 Sediment Data - SAIC and GAS
514	755	0	10	622813.62500	396041.31250	1994 Sediment Data - SAIC and GAS
517	311	0	10	623221.87500	395724.96880	1994 Sediment Data - SAIC and GAS
519	663	0	10	623153.56250	395628.65630	1994 Sediment Data - SAIC and GAS
521	4,630	0	10	623285.87500	395611.59380	1994 Sediment Data - SAIC and GAS
524	970	0	10	622555.43750	395432.46880	1994 Sediment Data - SAIC and GAS
525	1,030	0	10	622746.12500	395948.40630	1994 Sediment Data - SAIC and GAS
527	1,269	0	10	623153.43750	395445.87500	1994 Sediment Data - SAIC and GAS
529	7,472	0	10	622846.87500	395946.25000	1994 Sediment Data - SAIC and GAS
530	11,760	0	10	622950.81250	395944.84380	1994 Sediment Data - SAIC and GAS
532	154	0	10	622786.06250	395852.12500	1994 Sediment Data - SAIC and GAS
533	24,750	0	10	622945.87500	395855.34380	1994 Sediment Data - SAIC and GAS
536	5,600	0	10	653705.31250	423639.87500	1995 Sediment Data Collection - WDNR
540	220	0	10	653663.62500	423780.59380	1995 Sediment Data Collection - WDNR
543	78	0	10	653833.06250	424005.56250	1995 Sediment Data Collection - WDNR
547	2,300	0	10	654063.12500	424156.59380	1995 Sediment Data Collection - WDNR
550	790	0	10	654004.37500	424246.71880	1995 Sediment Data Collection - WDNR
552	9,150	0	10	653972.25000	424475.84380	1995 Sediment Data Collection - WDNR
553	860	0	10	654145.00000	424419.53130	1995 Sediment Data Collection - WDNR
554	1,600	0	10	654277.06250	424629.37500	1995 Sediment Data Collection - WDNR
555	160	0	10	654467.75000	424517.37500	1995 Sediment Data Collection - WDNR
556	93	0	10	654492.75000	424620.21880	1995 Sediment Data Collection - WDNR
557	170	0	10	654538.68750	424798.21880	1995 Sediment Data Collection - WDNR
558	4,500	0	10	654631.62500	425017.53130	1995 Sediment Data Collection - WDNR
559	2,900	0	10	654526.62500	425099.12500	1995 Sediment Data Collection - WDNR
560	5,650	0	10	654723.87500	425150.68750	1995 Sediment Data Collection - WDNR
561	165	0	10	654867.43750	425149.62500	1995 Sediment Data Collection - WDNR
562	8,750	0	10	654705.56250	425301.37500	1995 Sediment Data Collection - WDNR
563	4,400	0	10	654820.87500	425528.25000	1995 Sediment Data Collection - WDNR
564	2,300	0	10	654910.00000	425828.62500	1995 Sediment Data Collection - WDNR
565	5,900	0	10	655026.75000	425772.50000	1995 Sediment Data Collection - WDNR
566	51	0	10	655060.31250	425667.34380	1995 Sediment Data Collection - WDNR
568	4,100	0	10	655101.93750	425929.50000	1995 Sediment Data Collection - WDNR
569	2,500	0	10	654996.93750	426161.87500	1995 Sediment Data Collection - WDNR
570	2,500	0	10	655185.25000	426011.34380	1995 Sediment Data Collection - WDNR
574	3,050	0	10	655364.87500	426354.96880	1995 Sediment Data Collection - WDNR
575	1,800	0	10	655334.37500	426528.18750	1995 Sediment Data Collection - WDNR
576	3,100	0	10	655515.37500	426323.93750	1995 Sediment Data Collection - WDNR
577	1,200	0	10	655695.56250	426175.59380	1995 Sediment Data Collection - WDNR
579	1,400	0	10	655613.43750	426594.68750	1995 Sediment Data Collection - WDNR
580	10,850	0	10	655807.75000	426431.68750	1995 Sediment Data Collection - WDNR
582	2,050	0	10	655686.87500	426956.34380	1995 Sediment Data Collection - WDNR
585	2,200	0	10	655760.37500	427135.75000	1995 Sediment Data Collection - WDNR
586	2,450	0	10	655964.31250	426984.09380	1995 Sediment Data Collection - WDNR
589	2,400	0	10	656130.81250	427158.34380	1995 Sediment Data Collection - WDNR
592	1,700	0	10	656092.68750	427193.15630	1995 Sediment Data Collection - WDNR
594	630	0	10	656137.87500	427520.28130	1995 Sediment Data Collection - WDNR
595	3,300	0	10	656290.31250	427451.12500	1995 Sediment Data Collection - WDNR
596	3,900	0	10	656360.12500	427730.84380	1995 Sediment Data Collection - WDNR
597	1,871	0	10	656481.62500	427602.62500	1995 Sediment Data Collection - WDNR
598	4,600	0	10	656602.18750	427850.21880	1995 Sediment Data Collection - WDNR
600	1,600	0	10	656765.18750	427876.37500	1995 Sediment Data Collection - WDNR
605	1,900	0	10	657066.75000	428150.59380	1995 Sediment Data Collection - WDNR
607	2,600	0	10	657019.37500	428391.93750	1995 Sediment Data Collection - WDNR
608	1,300	0	10	656973.62500	428716.46880	1995 Sediment Data Collection - WDNR
610	2,000	0	10	657105.56250	428891.75000	1995 Sediment Data Collection - WDNR

Table 1 PCB Data Retained for 2002 Interpolation

Station ID	Total PCB (µg/kg)	Start Depth (cm)	End Depth (cm)	Easting	Northing	Source
611	2,600	0	10	657050.68750	429205.31250	1995 Sediment Data Collection - WDNR
613	2,750	0	10	657053.18750	429346.90630	1995 Sediment Data Collection - WDNR
614	7,400	0	10	657203.12500	429271.43750	1995 Sediment Data Collection - WDNR
615	3,750	0	10	657206.87500	429466.59380	1995 Sediment Data Collection - WDNR
616	3,500	0	10	657183.25000	429741.84380	1995 Sediment Data Collection - WDNR
617	2,300	0	10	657303.62500	429884.21880	1995 Sediment Data Collection - WDNR
618	5,850	0	10	657328.68750	430151.96880	1995 Sediment Data Collection - WDNR
619	2,200	0	10	657332.87500	430377.87500	1995 Sediment Data Collection - WDNR
620	6,650	0	10	657394.12500	430360.81250	1995 Sediment Data Collection - WDNR
621	3,800	0	10	657403.62500	430527.78130	1995 Sediment Data Collection - WDNR
622	2,100	0	10	657537.18750	430705.68750	1995 Sediment Data Collection - WDNR
624	270	0	10	657738.56250	431041.96880	1995 Sediment Data Collection - WDNR
625	51	0	10	657665.31250	431175.40630	1995 Sediment Data Collection - WDNR
626	2,100	0	10	658105.87500	431388.78130	1995 Sediment Data Collection - WDNR
628	990	0	10	658030.06250	431791.68750	1995 Sediment Data Collection - WDNR
629	150	0	10	658201.00000	431967.37500	1995 Sediment Data Collection - WDNR
630	530	0	10	658144.56250	432242.37500	1995 Sediment Data Collection - WDNR
631	1,200	0	10	658291.06250	432310.96880	1995 Sediment Data Collection - WDNR
632	99	0	10	658168.56250	432683.84380	1995 Sediment Data Collection - WDNR
633	1,100	0	10	658239.12500	432929.15630	1995 Sediment Data Collection - WDNR
634	220	0	10	658320.25000	432710.87500	1995 Sediment Data Collection - WDNR
635	2,100	0	10	658388.68750	433082.12500	1995 Sediment Data Collection - WDNR
636	310	0	10	658455.00000	432945.71880	1995 Sediment Data Collection - WDNR
637	1,800	0	10	658376.62500	433240.37500	1995 Sediment Data Collection - WDNR
638	1,800	0	10	658518.06250	433351.09380	1995 Sediment Data Collection - WDNR
639	1,700	0	10	658537.18750	433660.37500	1995 Sediment Data Collection - WDNR
640	340	0	10	658854.75000	433589.40630	1995 Sediment Data Collection - WDNR
641	2,400	0	10	655229.06250	426088.56250	1995 Sediment Data Collection - WDNR
642	2,300	0	10	655260.81250	426124.46880	1995 Sediment Data Collection - WDNR
643	96	0	10	655274.56250	426064.46880	1995 Sediment Data Collection - WDNR
644	2,000	0	10	655195.81250	426051.37500	1995 Sediment Data Collection - WDNR
646	2,900	0	10	656127.12500	427343.31250	1995 Sediment Data Collection - WDNR
648	2,900	0	10	657051.18750	428668.09380	1995 Sediment Data Collection - WDNR
653	3,200	0	10	653419.81250	424164.15630	1995 Sediment Data Collection - WDNR
658	1,200	0	10	658761.31250	433671.21880	1995 Sediment Data Collection - WDNR
661	10,000	0	10	658684.75000	433661.37500	1995 Sediment Data Collection - WDNR
662	1,800	0	10	658035.06250	431313.31250	1995 Sediment Data Collection - WDNR
663	4,000	0	10	656973.62500	428716.46880	1995 Sediment Data Collection - WDNR
664	4,861	0	10	654237.68750	422757.34380	1996 BBL Sediment Data Collected for FRG
665	35,640	0	10	654270.62500	422822.18750	1996 BBL Sediment Data Collected for FRG
668	852	0	10	622991.12500	395584.34380	1996 BBL Sediment Data Collected for FRG
669	1,319	0	10	622996.12500	395455.75000	1996 BBL Sediment Data Collected for FRG
676	7,300	0	10	656627.31250	428118.56250	1997 Segment 56/57 Demonstration Project
677	2,000	0	10	656664.25000	428154.96880	1997 Segment 56/57 Demonstration Project
678	99,000	0	10	656678.06250	428176.59380	1997 Segment 56/57 Demonstration Project
679	3,000	0	10	656711.43750	428223.71880	1997 Segment 56/57 Demonstration Project
680	3,100	0	10	656736.87500	428249.96880	1997 Segment 56/57 Demonstration Project
681	3,300	0	10	656759.00000	428302.96880	1997 Segment 56/57 Demonstration Project
682	2,500	0	10	656788.87500	428310.50000	1997 Segment 56/57 Demonstration Project
683	2,700	0	10	656792.56250	428332.81250	1997 Segment 56/57 Demonstration Project
684	2,600	0	10	656626.06250	428070.06250	1997 Segment 56/57 Demonstration Project
685	2,000	0	10	656674.62500	428128.06250	1997 Segment 56/57 Demonstration Project
686	2,100	0	10	656707.25000	428157.84380	1997 Segment 56/57 Demonstration Project
687	1,900	0	10	656714.87500	428182.12500	1997 Segment 56/57 Demonstration Project
688	2,100	0	10	656740.43750	428221.93750	1997 Segment 56/57 Demonstration Project
689	2,400	0	10	656767.68750	428264.59380	1997 Segment 56/57 Demonstration Project
690	2,000	0	10	656818.87500	428285.90630	1997 Segment 56/57 Demonstration Project
691	2,000	0	10	656833.18750	428314.34380	1997 Segment 56/57 Demonstration Project
692	2,900	0	10	656681.93750	428100.12500	1997 Segment 56/57 Demonstration Project
693	1,600	0	10	656735.81250	428118.40630	1997 Segment 56/57 Demonstration Project
694	1,600	0	10	656756.75000	428157.81250	1997 Segment 56/57 Demonstration Project
695	1,800	0	10	656775.12500	428174.93750	1997 Segment 56/57 Demonstration Project
696	1,500	0	10	656788.25000	428198.71880	1997 Segment 56/57 Demonstration Project
697	1,600	0	10	656813.31250	428232.03130	1997 Segment 56/57 Demonstration Project
698	1,200	0	10	656842.50000	428267.93750	1997 Segment 56/57 Demonstration Project
699	1,700	0	10	656851.43750	428310.75000	1997 Segment 56/57 Demonstration Project
700	6,200	0	10	656714.56250	428085.18750	1997 Segment 56/57 Demonstration Project
701	1,600	0	10	656732.37500	428106.90630	1997 Segment 56/57 Demonstration Project

Table 1 PCB Data Retained for 2002 Interpolation

Station ID	Total PCB (µg/kg)	Start Depth (cm)	End Depth (cm)	Easting	Northing	Source
702	970	0	10	656754.75000	428131.84380	1997 Segment 56/57 Demonstration Project
703	1,500	0	10	656775.43750	428162.28130	1997 Segment 56/57 Demonstration Project
704	1,500	0	10	656795.81250	428187.15630	1997 Segment 56/57 Demonstration Project
705	1,300	0	10	656824.06250	428216.87500	1997 Segment 56/57 Demonstration Project
706	1,400	0	10	656854.00000	428249.06250	1997 Segment 56/57 Demonstration Project
707	1,700	0	10	656881.06250	428292.03130	1997 Segment 56/57 Demonstration Project
708	1,607	0	10	653287.87500	424012.18750	1998 BBL Sediment/Tissue Data Collected for FRG
709	843	0	10	655727.00000	427333.50000	1998 BBL Sediment/Tissue Data Collected for FRG
710	1,070	0	10	653636.81250	424326.40630	1998 BBL Sediment/Tissue Data Collected for FRG
711	673	0	10	654055.81250	423913.68750	1998 BBL Sediment/Tissue Data Collected for FRG
712	562	0	10	651848.68750	419516.90630	1998 BBL Sediment/Tissue Data Collected for FRG
713	1,157	0	10	654052.62500	422999.68750	1998 BBL Sediment/Tissue Data Collected for FRG
714	1,303	0	10	656178.00000	426925.40630	1998 BBL Sediment/Tissue Data Collected for FRG
715	157	0	10	691202.12500	479466.50000	1998 BBL Sediment/Tissue Data Collected for FRG
716	1,020	0	10	683303.68750	473073.40630	1998 BBL Sediment/Tissue Data Collected for FRG
717	254	0	10	678371.18750	468225.31250	1998 BBL Sediment/Tissue Data Collected for FRG
718	29,500	0	10	622109.62500	394078.59380	1998 BBL Sediment/Tissue Data Collected for FRG
720	6,800	0	10	653450.81250	423753.18750	1998 BBL Sediment/Tissue Data Collected for FRG
721	29,000	0	10	653282.62500	423944.00000	1998 BBL Sediment/Tissue Data Collected for FRG
722	1,700	0	10	653937.00000	423816.18750	1998 BBL Sediment/Tissue Data Collected for FRG
723	220	0	10	654291.50000	424276.31250	1998 BBL Sediment/Tissue Data Collected for FRG
724	11,000	0	10	653563.12500	424263.68750	1998 BBL Sediment/Tissue Data Collected for FRG
725	25,000	0	10	653822.50000	424430.90630	1998 BBL Sediment/Tissue Data Collected for FRG
726	85	0	10	655573.50000	426059.59380	1998 BBL Sediment/Tissue Data Collected for FRG
727	1,450	0	10	654878.50000	426037.50000	1998 BBL Sediment/Tissue Data Collected for FRG
729	12,000	0	10	655871.00000	426691.09380	1998 BBL Sediment/Tissue Data Collected for FRG
730	1,100	0	10	655372.68750	426736.90630	1998 BBL Sediment/Tissue Data Collected for FRG
731	4,200	0	10	655771.50000	427396.68750	1998 BBL Sediment/Tissue Data Collected for FRG
732	2,000	0	10	656936.31250	428585.09380	1998 BBL Sediment/Tissue Data Collected for FRG
733	15,000	0	10	656171.87500	426950.68750	1998 BBL Sediment/Tissue Data Collected for FRG
734	90	0	10	657293.31250	429150.09380	1998 BBL Sediment/Tissue Data Collected for FRG
735	3,340	0	10	657518.50000	430923.00000	1998 BBL Sediment/Tissue Data Collected for FRG
736	10,300	0	10	654042.62500	423071.59380	1998 BBL Sediment/Tissue Data Collected for FRG
737	1,520	0	10	654263.68750	423040.18750	1998 BBL Sediment/Tissue Data Collected for FRG
738	1,860	0	10	654232.00000	423224.00000	1998 BBL Sediment/Tissue Data Collected for FRG
739	27,800	0	10	654247.62500	422770.50000	1998 BBL Sediment/Tissue Data Collected for FRG
740	17,900	0	10	654056.00000	422935.68750	1998 BBL Sediment/Tissue Data Collected for FRG
741	15,700	0	10	654025.50000	422804.31250	1998 BBL Sediment/Tissue Data Collected for FRG
742	710	0	10	653564.50000	421987.00000	1998 BBL Sediment/Tissue Data Collected for FRG
743	17,200	0	10	622103.81250	394050.18750	1998 BBL Sediment/Tissue Data Collected for FRG
744	720	0	10	622059.81250	395134.50000	1998 BBL Sediment/Tissue Data Collected for FRG
745	220	0	10	622826.87500	395345.18750	1998 BBL Sediment/Tissue Data Collected for FRG
746	75	0	10	622860.18750	395651.40630	1998 BBL Sediment/Tissue Data Collected for FRG
747	76	0	10	622331.18750	395892.59380	1998 BBL Sediment/Tissue Data Collected for FRG
748	2,150	0	10	622299.87500	396072.40630	1998 BBL Sediment/Tissue Data Collected for FRG
749	180	0	10	622803.12500	397972.81250	1998 BBL Sediment/Tissue Data Collected for FRG
750	140	0	10	623638.62500	397925.68750	1998 BBL Sediment/Tissue Data Collected for FRG
751	410	0	10	622465.31250	397264.68750	1998 BBL Sediment/Tissue Data Collected for FRG
752	650	0	10	651860.87500	419514.09380	1998 BBL Sediment/Tissue Data Collected for FRG
753	100	0	10	650629.37500	417122.31250	1998 BBL Sediment/Tissue Data Collected for FRG
754	69	0	10	651752.50000	418575.81250	1998 BBL Sediment/Tissue Data Collected for FRG
755	130	0	10	640397.00000	405514.18750	1998 BBL Sediment/Tissue Data Collected for FRG
756	155	0	10	640887.62500	405296.81250	1998 BBL Sediment/Tissue Data Collected for FRG
757	169	0	10	640868.50000	406010.59380	1998 BBL Sediment/Tissue Data Collected for FRG
758	54	0	10	641273.50000	405973.59380	1998 BBL Sediment/Tissue Data Collected for FRG
759	1,420	0	10	633379.62500	404149.00000	1998 BBL Sediment/Tissue Data Collected for FRG
762	810	0	10	654272.62500	422809.40630	1998 BBL Sediment/Tissue Data Collected for FRG
763	1,000	0	10	654114.81250	423062.81250	1998 BBL Sediment/Tissue Data Collected for FRG
764	4,400	0	10	621933.81250	395110.09380	1998 BBL Sediment/Tissue Data Collected for FRG
765	140	0	10	640276.50000	405309.50000	1998 BBL Sediment/Tissue Data Collected for FRG
766	1,800	0	10	641317.12500	406135.40630	1998 BBL Sediment/Tissue Data Collected for FRG
768	370	0	10	633360.12500	404146.31250	1998 BBL Sediment/Tissue Data Collected for FRG
769	1,100	0	10	633491.18750	404241.68750	1998 BBL Sediment/Tissue Data Collected for FRG
770	15,000	0	10	622101.87500	394094.87500	1998 BBL Sediment/Tissue Data Collected for FRG
771	1,300	0	10	653455.68750	423819.00000	1998 BBL Sediment/Tissue Data Collected for FRG
772	780	0	10	654005.31250	423955.50000	1998 BBL Sediment/Tissue Data Collected for FRG
773	350	0	10	654219.62500	424238.31250	1998 BBL Sediment/Tissue Data Collected for FRG
774	1,650	0	10	653664.31250	424348.68750	1998 BBL Sediment/Tissue Data Collected for FRG

Table 1 PCB Data Retained for 2002 Interpolation

Station ID	Total PCB (µg/kg)	Start Depth (cm)	End Depth (cm)	Easting	Northing	Source
775	280	0	10	654840.68750	426012.81250	1998 BBL Sediment/Tissue Data Collected for FRG
776	730	0	10	655166.31250	426267.59380	1998 BBL Sediment/Tissue Data Collected for FRG
777	480	0	10	655374.62500	426797.18750	1998 BBL Sediment/Tissue Data Collected for FRG
778	200	0	10	655479.31250	426120.59380	1998 BBL Sediment/Tissue Data Collected for FRG
779	220	0	10	656313.37500	427282.90630	1998 BBL Sediment/Tissue Data Collected for FRG
780	930	0	10	657285.68750	429127.81250	1998 BBL Sediment/Tissue Data Collected for FRG
781	450	0	10	650561.12500	416976.31250	1998 BBL Sediment/Tissue Data Collected for FRG
782	230	0	10	623289.87500	395954.40630	1998 BBL Sediment/Tissue Data Collected for FRG
783	280	0	10	651726.87500	418464.06250	1998 BBL Sediment/Tissue Data Collected for FRG
784	60,000	0	10	622721.18750	395540.50000	1998 BBL Sediment/Tissue Data Collected for FRG
785	740	0	10	622332.12500	395978.18750	1998 BBL Sediment/Tissue Data Collected for FRG
786	1,000	0	10	622495.87500	396500.81250	1998 BBL Sediment/Tissue Data Collected for FRG
787	980	0	10	622530.81250	397284.81250	1998 BBL Sediment/Tissue Data Collected for FRG
788	1,100	0	10	622880.81250	398127.59380	1998 BBL Sediment/Tissue Data Collected for FRG
789	290	0	10	623569.37500	398121.09380	1998 BBL Sediment/Tissue Data Collected for FRG
790	57	0	10	657470.81250	434731.40630	1998 BBL Sediment/Tissue Data Collected for FRG
791	72	0	10	657863.50000	439243.18750	1998 BBL Sediment/Tissue Data Collected for FRG
792	68	0	10	657866.50000	439288.59380	1998 BBL Sediment/Tissue Data Collected for FRG
793	780	0	10	654026.37500	422804.78130	1998 BBL Sediment/Tissue Data Collected for FRG
794	6,400	0	10	654292.25000	422840.71880	1998 BBL Sediment/Tissue Data Collected for FRG
795	1,100	0	10	653568.43750	422012.31250	1998 BBL Sediment/Tissue Data Collected for FRG
796	7,300	0	10	653627.31250	422020.15630	1998 BBL Sediment/Tissue Data Collected for FRG
797	390	0	10	666327.62500	437414.59380	1998 BBL Sediment/Tissue Data Collected for FRG
798	170	0	10	663724.12500	433483.68750	1998 BBL Sediment/Tissue Data Collected for FRG
799	340	0	10	666327.62500	437414.59380	1998 BBL Sediment/Tissue Data Collected for FRG
800	460	0	10	665850.37500	435991.40630	1998 BBL Sediment/Tissue Data Collected for FRG
801	50	0	10	688583.00000	467964.40630	1998 BBL Sediment/Tissue Data Collected for FRG
802	69	0	10	666531.81250	464232.31250	1998 BBL Sediment/Tissue Data Collected for FRG
803	70	0	10	689649.12500	489673.31250	1998 BBL Sediment/Tissue Data Collected for FRG
804	64	0	10	715173.81250	548174.37500	1998 BBL Sediment/Tissue Data Collected for FRG
805	73	0	10	702302.37500	519141.40630	1998 BBL Sediment/Tissue Data Collected for FRG
806	72	0	10	725700.31250	512397.00000	1998 BBL Sediment/Tissue Data Collected for FRG
807	200	0	10	713696.68750	494831.40630	1998 BBL Sediment/Tissue Data Collected for FRG
808	1,100	0	10	622495.87500	396500.81250	1998 BBL Sediment/Tissue Data Collected for FRG
809	630	0	10	655564.81250	427033.68750	1998 BBL Sediment/Tissue Data Collected for FRG
810	680	0	10	655827.62500	427457.31250	1998 BBL Sediment/Tissue Data Collected for FRG
811	670	0	10	656934.50000	428581.68750	1998 BBL Sediment/Tissue Data Collected for FRG
812	330	0	10	697634.18750	485207.59380	1998 BBL Sediment/Tissue Data Collected for FRG
813	67	0	10	732202.18750	540068.50000	1998 BBL Sediment/Tissue Data Collected for FRG
814	26	0	10	666331.81250	437195.40630	1998 BBL Sediment/Tissue Data Collected for FRG
815	180	0	10	661383.93750	433402.56250	1998 BBL Sediment/Tissue Data Collected for FRG
816	160	0	10	659912.00000	439127.81250	1998 BBL Sediment/Tissue Data Collected for FRG
818	660	0	10	655890.18750	426618.18750	1998 BBL Sediment/Tissue Data Collected for FRG
819	48	0	10	658021.81250	443616.18750	1998 BBL Sediment/Tissue Data Collected for FRG
820	22,400	0	10	632672.68750	403918.34380	1998 Deposit N Post-Dredge Sediment Data
821	63,400	0	10	632677.56250	403932.65630	1998 Deposit N Post-Dredge Sediment Data
822	2,560	0	10	632704.37500	403923.90630	1998 Deposit N Post-Dredge Sediment Data
823	7,260	0	10	632713.50000	403955.18750	1998 Deposit N Post-Dredge Sediment Data
824	21,600	0	10	632722.93750	403941.18750	1998 Deposit N Post-Dredge Sediment Data
825	18,800	0	10	632740.00000	403932.34380	1998 Deposit N Post-Dredge Sediment Data
826	10,400	0	10	632739.43750	403958.25000	1998 Deposit N Post-Dredge Sediment Data
827	6,040	0	10	632750.68750	403948.78130	1998 Deposit N Post-Dredge Sediment Data
828	7,640	0	10	632765.62500	403941.46880	1998 Deposit N Post-Dredge Sediment Data
829	4,180	0	10	632589.43750	403899.46880	1998 Deposit N Post-Dredge Sediment Data
830	305	0	10	632787.25000	403930.50000	1998 Deposit N Post-Dredge Sediment Data
831	675	0	10	632835.43750	403952.43750	1998 Deposit N Post-Dredge Sediment Data
832	1,500	0	10	632871.68750	403964.90630	1998 Deposit N Post-Dredge Sediment Data
833	4,260	0	10	632874.43750	403946.62500	1998 Deposit N Post-Dredge Sediment Data
834	3,100	0	10	632904.87500	403934.12500	1998 Deposit N Post-Dredge Sediment Data
835	4,500	0	10	632932.93750	403929.53130	1998 Deposit N Post-Dredge Sediment Data
836	3,140	0	10	632917.06250	403956.06250	1998 Deposit N Post-Dredge Sediment Data
837	3,040	0	10	632927.43750	403970.68750	1998 Deposit N Post-Dredge Sediment Data
838	784	0	10	632946.62500	403961.84380	1998 Deposit N Post-Dredge Sediment Data
839	3,500	0	10	632597.06250	403928.40630	1998 Deposit N Post-Dredge Sediment Data
840	48,600	0	10	632608.93750	403907.96880	1998 Deposit N Post-Dredge Sediment Data
841	450	0	10	632892.12500	403974.06250	1998 Deposit N Post-Dredge Sediment Data
842	5,500	0	10	632853.68750	403973.75000	1998 Deposit N Post-Dredge Sediment Data
843	37,600	0	10	632608.93750	403907.96880	1998 Deposit N Post-Dredge Sediment Data

Table 1 PCB Data Retained for 2002 Interpolation

Station ID	Total PCB (µg/kg)	Start Depth (cm)	End Depth (cm)	Easting	Northing	Source
844	44,000	0	10	632626.93750	403909.18750	1998 Deposit N Post-Dredge Sediment Data
845	38,500	0	10	632621.75000	403929.90630	1998 Deposit N Post-Dredge Sediment Data
847	61,100	0	10	632637.00000	403918.93750	1998 Deposit N Post-Dredge Sediment Data
848	10,380	0	10	632650.12500	403911.03130	1998 Deposit N Post-Dredge Sediment Data
849	52,200	0	10	632654.37500	403937.53130	1998 Deposit N Post-Dredge Sediment Data
850	48,300	0	10	632658.62500	403928.68750	1998 Deposit N Post-Dredge Sediment Data
851	4,008	0	10	622127.31250	395068.90630	1998 RI/FS Supplemental Data Collection
853	1,284	0	10	622110.00000	395190.78130	1998 RI/FS Supplemental Data Collection
854	3,535	0	10	621982.50000	395296.87500	1998 RI/FS Supplemental Data Collection
855	12,550	0	10	622113.50000	395231.84380	1998 RI/FS Supplemental Data Collection
856	4,549	0	10	653465.68750	423588.46880	1998 RI/FS Supplemental Data Collection
857	1,910	0	10	653358.43750	424039.21880	1998 RI/FS Supplemental Data Collection
858	1,221	0	10	655692.25000	427483.71880	1998 RI/FS Supplemental Data Collection
859	134	0	10	658197.31250	431636.81250	1998 RI/FS Supplemental Data Collection
860	956	0	10	658734.75000	433524.00000	1998 RI/FS Supplemental Data Collection
861	620	0	10	623005.31250	397186.93750	1998 RI/FS Supplemental Data Collection
862	3,330	0	10	622644.68750	397239.03130	1998 RI/FS Supplemental Data Collection
863	146	0	10	623721.75000	398105.93750	1998 RI/FS Supplemental Data Collection
864	1,355	0	10	623351.18750	398284.12500	1998 RI/FS Supplemental Data Collection
865	21	0	10	623876.87500	399049.90630	1998 RI/FS Supplemental Data Collection
866	303	0	10	623924.18750	399587.90630	1998 RI/FS Supplemental Data Collection
867	68	0	10	649720.31250	416636.75000	1998 RI/FS Supplemental Data Collection
868	426	0	10	649864.06250	416456.50000	1998 RI/FS Supplemental Data Collection
869	17,240	0	10	650293.12500	416683.15630	1998 RI/FS Supplemental Data Collection
870	382	0	10	649892.43750	416886.34380	1998 RI/FS Supplemental Data Collection
871	171	0	10	650610.00000	417130.28130	1998 RI/FS Supplemental Data Collection
872	176	0	10	650366.75000	417157.37500	1998 RI/FS Supplemental Data Collection
873	497	0	10	650156.75000	417239.78130	1998 RI/FS Supplemental Data Collection
874	2,460	0	10	651096.93750	417622.09380	1998 RI/FS Supplemental Data Collection
875	762	0	10	650733.93750	417808.84380	1998 RI/FS Supplemental Data Collection
876	698	0	10	651505.56250	418121.87500	1998 RI/FS Supplemental Data Collection
877	243	0	10	651688.93750	418257.59380	1998 RI/FS Supplemental Data Collection
878	252	0	10	651634.81250	418439.81250	1998 RI/FS Supplemental Data Collection
879	320	0	10	651278.50000	418455.06250	1998 RI/FS Supplemental Data Collection
880	139	0	10	651999.43750	419029.00000	1998 RI/FS Supplemental Data Collection
881	122	0	10	651771.75000	419175.81250	1998 RI/FS Supplemental Data Collection
882	161	0	10	652076.18750	419679.59380	1998 RI/FS Supplemental Data Collection
883	1,646	0	10	651953.50000	419721.81250	1998 RI/FS Supplemental Data Collection
884	60	0	10	652772.93750	420221.37500	1998 RI/FS Supplemental Data Collection
885	245	0	10	652612.31250	420311.09380	1998 RI/FS Supplemental Data Collection
886	259	0	10	653094.06250	420517.87500	1998 RI/FS Supplemental Data Collection
887	5,900	0	10	653125.87500	420883.62500	1998 RI/FS Supplemental Data Collection
888	13,000	0	10	653127.37500	421087.81250	1998 RI/FS Supplemental Data Collection
889	104	0	10	653597.93750	421520.28130	1998 RI/FS Supplemental Data Collection
890	2,582	0	10	653475.12500	421563.81250	1998 RI/FS Supplemental Data Collection
891	1,024	0	10	654031.87500	422843.09380	1998 RI/FS Supplemental Data Collection
892	320	0	10	654150.37500	422650.37500	1998 RI/FS Supplemental Data Collection
893	18	0	10	627202.68750	395557.75000	1998 RI/FS Supplemental Data Collection
894	21	0	10	627410.43750	393400.09380	1998 RI/FS Supplemental Data Collection
895	33	0	10	626466.18750	391715.25000	1998 RI/FS Supplemental Data Collection
896	208	0	10	640568.62500	404835.65630	1998 RI/FS Supplemental Data Collection
897	238	0	10	640686.68750	405013.25000	1998 RI/FS Supplemental Data Collection
898	406	0	10	640600.75000	405178.09380	1998 RI/FS Supplemental Data Collection
899	295	0	10	641133.12500	405822.43750	1998 RI/FS Supplemental Data Collection
900	36	0	10	641283.06250	406148.87500	1998 RI/FS Supplemental Data Collection
901	150	0	10	640253.37500	405296.18750	1998 RI/FS Supplemental Data Collection
902	274	0	10	640476.00000	405456.65630	1998 RI/FS Supplemental Data Collection
903	216	0	10	640616.81250	405570.37500	1998 RI/FS Supplemental Data Collection
904	222	0	10	640796.93750	405799.15630	1998 RI/FS Supplemental Data Collection
905	21	0	10	640975.18750	406138.87500	1998 RI/FS Supplemental Data Collection
11001	5,030	10	30	623043.25902	397867.66114	2000–01 CH2M HILL
11002	15,675	10	30	623139.73195	397836.13803	2000–01 CH2M HILL
11003	2,815	10	30	623045.13412	397767.69608	2000–01 CH2M HILL
11004	138	10	20	622954.98250	397888.22813	2000–01 CH2M HILL
11005	3,075	10	30	623205.09085	397759.58726	2000–01 CH2M HILL
11006	4,245	10	30	623154.03831	397925.29576	2000–01 CH2M HILL
11007	4,600	10	30	623266.90297	397871.86000	2000–01 CH2M HILL
11008	10,920	10	30	623200.70989	397992.83908	2000–01 CH2M HILL

Table 1 PCB Data Retained for 2002 Interpolation

Station ID	Total PCB (µg/kg)	Start Depth (cm)	End Depth (cm)	Easting	Northing	Source
11010	456	10	30	622893.37341	397764.85120	2000–01 CH2M HILL
11011	2,760	10	30	622958.93820	397677.19080	2000–01 CH2M HILL
11012	2,778	10	30	623118.68847	397680.18706	2000–01 CH2M HILL
11013	77	10	30	622661.96857	396038.30048	2000–01 CH2M HILL
11014	14,300	10	30	622899.98973	396131.64189	2000–01 CH2M HILL
11015	27,750	10	30	622901.65364	396042.78429	2000–01 CH2M HILL
11017	43,100	10	30	622929.15855	395854.41080	2000–01 CH2M HILL
11018	22,550	10	30	622931.44675	395732.23166	2000–01 CH2M HILL
11019	98	10	30	622867.52771	395731.03489	2000–01 CH2M HILL
11020	361	10	30	622669.44123	395638.44145	2000–01 CH2M HILL
11021	122	10	30	622909.76482	395609.60367	2000–01 CH2M HILL
11022	17,340	10	30	622711.67514	395517.00904	2000–01 CH2M HILL
11023	77	10	30	622678.57039	396005.27753	2000–01 CH2M HILL
11024	77	10	30	622676.90953	396094.13512	2000–01 CH2M HILL
11025	110	10	30	622947.92610	396132.53970	2000–01 CH2M HILL
11026	430	10	30	623059.77762	396134.63597	2000–01 CH2M HILL
11027	123	10	17	622973.55916	396044.13115	2000–01 CH2M HILL
11028	338	10	20	623061.44369	396045.77837	2000–01 CH2M HILL
11029	109	10	20	622975.43212	395944.16636	2000–01 CH2M HILL
11030	376	10	30	623119.03701	395957.96963	2000–01 CH2M HILL
11031	77	10	26	622993.70079	395822.28661	2000–01 CH2M HILL
11032	605	10	30	623128.27678	395891.47632	2000–01 CH2M HILL
11033	1,024	10	30	622995.36580	395733.42905	2000–01 CH2M HILL
11034	1,185	10	17	622865.86443	395819.89244	2000–01 CH2M HILL
11035	284	10	30	622869.81467	395608.85577	2000–01 CH2M HILL
11036	110	10	30	622887.04232	395542.51175	2000–01 CH2M HILL
11037	2,318	10	30	622912.05249	395487.42457	2000–01 CH2M HILL
11038	338	10	30	623047.26094	395523.29085	2000–01 CH2M HILL
11039	9,860	10	30	622672.96982	395449.61921	2000–01 CH2M HILL
11040	395	10	21	622784.20963	395485.03213	2000–01 CH2M HILL
11041	10,025	10	30	622712.29803	395483.68747	2000–01 CH2M HILL
11042	9,400	10	27	622783.58638	395518.35370	2000–01 CH2M HILL
11043	14,620	10	30	622678.88428	395560.84043	2000–01 CH2M HILL
11044	375	10	30	622622.12375	395604.22417	2000–01 CH2M HILL
11045	1,445	10	23	622782.54761	395573.88965	2000–01 CH2M HILL
11046	811	10	30	622733.98417	395606.31470	2000–01 CH2M HILL
11047	139	10	20	622621.08632	395659.76012	2000–01 CH2M HILL
11048	381	10	30	622708.97591	395661.40253	2000–01 CH2M HILL
11049	77	10	20	622643.81104	395726.85109	2000–01 CH2M HILL
11050	251	10	30	622755.66937	395728.94204	2000–01 CH2M HILL
11051	1,356	10	30	622114.89419	395372.54797	2000–01 CH2M HILL
11052	9,330	10	30	621942.40859	395191.56545	2000–01 CH2M HILL
11053	19,300	10	30	621943.02751	395158.24390	2000–01 CH2M HILL
11054	1,238	10	30	622030.92363	395159.87709	2000–01 CH2M HILL
11055	39,700	10	30	622028.03321	395315.37767	2000–01 CH2M HILL
11056	196	10	30	622160.97574	395473.40462	2000–01 CH2M HILL
11058	331	10	30	622228.41278	395285.77229	2000–01 CH2M HILL
11059	168	10	30	622141.55154	395228.60050	2000–01 CH2M HILL
11060	2,060	10	30	622229.44677	395230.23636	2000–01 CH2M HILL
11061	149	10	30	622230.68754	395163.59326	2000–01 CH2M HILL
11062	321	10	30	622144.03128	395095.31430	2000–01 CH2M HILL
11063	1,865	10	30	622056.13427	395093.67961	2000–01 CH2M HILL
11064	335	10	30	622105.79545	394572.38516	2000–01 CH2M HILL
11065	6,810	10	30	622106.82816	394516.84929	2000–01 CH2M HILL
11066	235	10	25	622105.17581	394605.70668	2000–01 CH2M HILL
11067	146	10	16	622127.49681	394695.00992	2000–01 CH2M HILL
11069	156	10	30	622177.71691	394573.72297	2000–01 CH2M HILL
11070	77	10	30	622186.74157	394518.33580	2000–01 CH2M HILL
11071	123	10	15	622269.55033	394364.32288	2000–01 CH2M HILL
11072	77	10	23	622182.88344	394296.04369	2000–01 CH2M HILL
11073	173	10	16	622294.76600	394298.12630	2000–01 CH2M HILL
11074	77	10	20	622223.87511	394241.25142	2000–01 CH2M HILL
11075	152	10	18	622311.78358	394242.88812	2000–01 CH2M HILL
11076	77	10	30	622249.09072	394175.05467	2000–01 CH2M HILL
11078	197	10	30	622250.12452	394119.51884	2000–01 CH2M HILL
11079	106	10	30	622251.36506	394052.87584	2000–01 CH2M HILL
11080	144	10	30	622387.22752	394055.40629	2000–01 CH2M HILL
12000	1,430	10	30	623376.42687	397996.14183	2000–01 CH2M HILL

Table 1 PCB Data Retained for 2002 Interpolation

Station ID	Total PCB (µg/kg)	Start Depth (cm)	End Depth (cm)	Easting	Northing	Source
12001	2,940	10	30	623121.60689	397524.68591	2000–01 CH2M HILL
12002	1,744	10	30	622961.85283	397521.68966	2000–01 CH2M HILL
12003	3,230	10	30	622762.16025	397517.94981	2000–01 CH2M HILL
12005	918	10	30	622583.52506	397670.16491	2000–01 CH2M HILL
12006	1,625	10	30	622759.25036	397673.45095	2000–01 CH2M HILL
12007	97	10	30	622645.76385	397760.21710	2000–01 CH2M HILL
12090	1,290	10	30	622974.10122	395588.58645	2000–01 CH2M HILL
12092	127	10	28	622848.33892	395475.12085	2000–01 CH2M HILL
12093	1,675	10	30	622665.80979	395405.04115	2000–01 CH2M HILL
12095	164	10	30	622905.31003	395420.63184	2000–01 CH2M HILL
12097	856	10	30	622858.19995	395375.30569	2000–01 CH2M HILL
12098	135	10	20	622691.23370	395327.73880	2000–01 CH2M HILL
12099	21,550	10	28	622787.53361	395307.31712	2000–01 CH2M HILL
12101	8,560	10	30	622844.29773	395263.93476	2000–01 CH2M HILL
12102	26,900	10	30	622746.54324	395362.10593	2000–01 CH2M HILL
12103	369	10	30	622966.23486	395155.10677	2000–01 CH2M HILL
12104	289	10	30	623150.85170	395114.12287	2000–01 CH2M HILL
12105	326	10	30	623345.33974	394973.32959	2000–01 CH2M HILL
12106	77	10	30	623571.59108	394844.25061	2000–01 CH2M HILL
12107	144	10	30	623738.56431	394891.83973	2000–01 CH2M HILL
12109	329	10	17	622895.15126	395109.33146	2000–01 CH2M HILL
12111	509	10	24	623024.66651	395022.86845	2000–01 CH2M HILL
12119	77	10	30	622118.05965	394772.61153	2000–01 CH2M HILL
12120	307	10	30	621896.67662	393779.61929	2000–01 CH2M HILL
12121	232	10	30	621894.45575	393468.47056	2000–01 CH2M HILL
12122	1,332	10	30	621912.09010	393379.90999	2000–01 CH2M HILL
12123	2,270	10	30	621946.74146	393236.11044	2000–01 CH2M HILL
12124	726	10	30	621902.70006	393024.18452	2000–01 CH2M HILL
12125	704	10	30	621800.84830	392911.18575	2000–01 CH2M HILL
12132	906	10	30	622983.75601	395499.87861	2000–01 CH2M HILL
12133	521	10	30	622993.41099	395411.17079	2000–01 CH2M HILL
12134	3,075	10	30	622803.51440	395307.61604	2000–01 CH2M HILL
12136	42,100	10	21	622715.41243	395317.07965	2000–01 CH2M HILL
DA01S-01	49,400	10	30	622087.54119	394694.26689	2001 Blasland, Bouck, and Lee
DA01S-02	77	10	30	622112.34081	394650.28398	2001 Blasland, Bouck, and Lee
DA01S-03	154	10	30	622224.01056	394663.47268	2001 Blasland, Bouck, and Lee
DA01S-05	742	10	30	622066.04556	394560.53509	2001 Blasland, Bouck, and Lee
DA01S-06	124	10	30	622290.21530	394542.48406	2001 Blasland, Bouck, and Lee
DA01S-07	392	10	30	622059.49950	394482.63634	2001 Blasland, Bouck, and Lee
DA01S-08	81	10	30	622022.43205	394326.39335	2001 Blasland, Bouck, and Lee
DA01S-09	290	10	30	622203.75777	394463.09736	2001 Blasland, Bouck, and Lee
DA01S-10	6,690	10	30	622044.96176	394404.58907	2001 Blasland, Bouck, and Lee
DA01S-11	77	10	30	622308.68047	394409.49567	2001 Blasland, Bouck, and Lee
DA01S-12	154	10	30	622388.38822	394422.09178	2001 Blasland, Bouck, and Lee
DA01S-13	244	10	30	622125.28965	394383.86046	2001 Blasland, Bouck, and Lee
DA01S-14	130	10	30	622197.41987	394374.09128	2001 Blasland, Bouck, and Lee
DA01S-15	21,750	10	30	621991.08477	394292.47794	2001 Blasland, Bouck, and Lee
DA01S-16	40,750	10	30	621928.59544	394213.54043	2001 Blasland, Bouck, and Lee
DA01S-17	92	10	30	622152.15660	394228.80600	2001 Blasland, Bouck, and Lee
DA01S-18	154	10	30	622383.91569	394233.12095	2001 Blasland, Bouck, and Lee
DA01S-19	13,375	10	30	621945.40384	394169.40854	2001 Blasland, Bouck, and Lee
DA01S-20	380	10	30	622145.81759	394139.80002	2001 Blasland, Bouck, and Lee
DA01S-21	3,080	10	30	622027.59162	394048.71418	2001 Blasland, Bouck, and Lee
DA01S-22	10,775	10	30	622171.65260	394040.28149	2001 Blasland, Bouck, and Lee
DA01S-24	318	10	30	622371.86458	394021.78695	2001 Blasland, Bouck, and Lee
DE01S-01	0	10	20	623127.37558	396791.45964	2001 Blasland, Bouck, and Lee
DE01S-02	570	10	30	622958.57438	396843.84995	2001 Blasland, Bouck, and Lee
DE01S-03	2,100	10	30	622790.39959	396862.92293	2001 Blasland, Bouck, and Lee
DE01S-04	41	10	30	622606.24898	396881.70164	2001 Blasland, Bouck, and Lee
DE01S-05	2,800	10	30	622811.66245	397007.76522	2001 Blasland, Bouck, and Lee
DE01S-06	1,400	10	30	623035.54384	397000.84838	2001 Blasland, Bouck, and Lee
DE01S-07	760	10	30	622635.50410	397026.69256	2001 Blasland, Bouck, and Lee
DE01S-09	960	10	30	622889.46536	397120.33307	2001 Blasland, Bouck, and Lee
DE01S-10	1,190	10	30	622752.21147	397195.54149	2001 Blasland, Bouck, and Lee
DE01S-11	1,320	10	30	622966.64100	397266.22356	2001 Blasland, Bouck, and Lee
DE01S-12	1,530	10	30	622749.92555	397317.72090	2001 Blasland, Bouck, and Lee
DE01S-13	1,800	10	30	622581.34856	397359.01342	2001 Blasland, Bouck, and Lee
DE01S-14	2,740	10	30	623060.83044	397356.87861	2001 Blasland, Bouck, and Lee

Table 1 PCB Data Retained for 2002 Interpolation

Station ID	Total PCB (µg/kg)	Start Depth (cm)	End Depth (cm)	Easting	Northing	Source
DE01S-15	151	10	30	623220.17134	397382.09164	2001 Blasland, Bouck, and Lee
DE01S-16	700	10	30	622618.79681	397493.04644	2001 Blasland, Bouck, and Lee
DE01S-17	0	10	30	623336.23078	397584.27316	2001 Blasland, Bouck, and Lee
DE01S-18	940	10	30	623199.81519	397615.04330	2001 Blasland, Bouck, and Lee
DE01S-19	378	10	30	623333.51604	397728.66710	2001 Blasland, Bouck, and Lee
DE01S-20	27	10	30	623460.89732	397753.28557	2001 Blasland, Bouck, and Lee
DE01S-21	870	10	30	623378.93386	397862.85506	2001 Blasland, Bouck, and Lee
DE01S-22	47	10	30	623577.98855	397899.93558	2001 Blasland, Bouck, and Lee
DE01S-23	920	10	30	623481.51419	397931.45227	2001 Blasland, Bouck, and Lee
DE01S-24	140	10	30	623607.21656	398044.93157	2001 Blasland, Bouck, and Lee
DE01S-25	3,000	10	30	623271.75914	398038.61856	2001 Blasland, Bouck, and Lee
DE01S-26	510	10	30	623487.41033	398042.67496	2001 Blasland, Bouck, and Lee
DE01S-27	600	10	30	623151.11875	398080.79701	2001 Blasland, Bouck, and Lee
DE01S-28	1,900	10	30	622908.85214	397365.14078	2001 Blasland, Bouck, and Lee
DE01S-29	4,900	10	30	623349.33225	398162.29968	2001 Blasland, Bouck, and Lee
DE01S-30	220	10	30	623661.03204	398157.05775	2001 Blasland, Bouck, and Lee
DE01S-31	3,100	10	30	623516.84867	398176.56332	2001 Blasland, Bouck, and Lee
DE01S-32	0	10	23	623188.96777	398192.61927	2001 Blasland, Bouck, and Lee
DE01S-33	0	10	30	623290.29185	398327.85703	2001 Blasland, Bouck, and Lee
DE01S-34	0	10	27	623802.28119	398293.05665	2001 Blasland, Bouck, and Lee
DE01S-35	2,400	10	30	623482.60072	398298.14136	2001 Blasland, Bouck, and Lee
DE01S-36	2,000	10	30	623609.55170	398344.97746	2001 Blasland, Bouck, and Lee
DE01S-37	0	10	17	623400.85215	398396.60331	2001 Blasland, Bouck, and Lee
DE01S-38	1,100	10	30	623751.63594	398436.54638	2001 Blasland, Bouck, and Lee
DE01S-39	1,500	10	30	623519.81512	398443.28743	2001 Blasland, Bouck, and Lee
PD-A/B-01	44	10	30	622144.76241	394512.45038	2002 Foth and Van Dyke
PD-A/B-03	2,200	10	30	622061.01005	394327.15623	2002 Foth and Van Dyke
PD-A/B-05	72,000	10	30	621934.27041	394214.98410	2002 Foth and Van Dyke
PD-A/B-07	1,700	10	30	621973.87922	394125.98514	2002 Foth and Van Dyke
PD-A/B-08	2,000	10	30	622057.71257	394122.99089	2002 Foth and Van Dyke
PD-A/B-09	40	10	18	622235.37304	394123.03864	2002 Foth and Van Dyke
PD-A/B-09	22	18	23	622235.37304	394123.03864	2002 Foth and Van Dyke
PD-A/B-11	330,000	10	30	622137.27207	394034.33780	2002 Foth and Van Dyke
PD-A/B-12B	25	10	30	622325.90308	394034.38848	2002 Foth and Van Dyke
PD-A/B-13	2,400	10	30	621996.50590	393954.15784	2002 Foth and Van Dyke
PD-A/B-14	6,500	10	30	622136.68399	393954.19542	2002 Foth and Van Dyke
324	15,130	10	30	621988.75000	393929.71880	Little Lake Butte des Morts RI/FS Deposit A - 1992, 1993 BBL
325	2,070	10	30	621979.37500	393951.40630	Little Lake Butte des Morts RI/FS Deposit A - 1992, 1993 BBL
326	2,280	10	30	621982.25000	393994.71880	Little Lake Butte des Morts RI/FS Deposit A - 1992, 1993 BBL
327	4,613	10	30	621965.81250	394024.93750	Little Lake Butte des Morts RI/FS Deposit A - 1992, 1993 BBL
332	1,723	10	30	622220.43750	393985.56250	Little Lake Butte des Morts RI/FS Deposit A - 1992, 1993 BBL
342	24,250	10	30	621952.93750	394070.03130	Little Lake Butte des Morts RI/FS Deposit A - 1992, 1993 BBL
346	3,975	10	30	622047.37500	393913.28130	Little Lake Butte des Morts RI/FS Deposit A - 1992, 1993 BBL
356	1,187	10	30	622176.31250	393933.12500	Little Lake Butte des Morts RI/FS Deposit A - 1992, 1993 BBL
357	1,300	10	30	622027.37500	394232.53130	Woodward Clyde Deposit A Sediment Samples - 1994
358	290	10	30	622020.06250	394240.15630	Woodward Clyde Deposit A Sediment Samples - 1994
359	960	10	30	622019.43750	394225.21880	Woodward Clyde Deposit A Sediment Samples - 1994
360	1,900	10	30	622012.12500	394232.21880	Woodward Clyde Deposit A Sediment Samples - 1994
381	240	10	30	622101.68750	394328.84380	Woodward Clyde Deposit A Sediment Samples - 1994
382	245	10	30	622093.75000	394336.15630	Woodward Clyde Deposit A Sediment Samples - 1994
383	93	10	30	622094.68750	394321.53130	Woodward Clyde Deposit A Sediment Samples - 1994
384	2,800	10	30	622087.06250	394328.84380	Woodward Clyde Deposit A Sediment Samples - 1994
409	1,300	10	30	622091.31250	394338.90630	Woodward Clyde Deposit A Sediment Samples - 1994
410	2,400	10	30	622084.00000	394346.50000	Woodward Clyde Deposit A Sediment Samples - 1994
411	2,200	10	30	622084.31250	394330.96880	Woodward Clyde Deposit A Sediment Samples - 1994
412	6,600	10	30	622076.37500	394338.28130	Woodward Clyde Deposit A Sediment Samples - 1994
413	1,778	10	30	622533.75000	396665.46880	1994 Sediment Data - SAIC and GAS
414	448	10	30	622443.43750	396220.06250	1994 Sediment Data - SAIC and GAS
415	1,021	10	30	622512.93750	396216.37500	1994 Sediment Data - SAIC and GAS
416	2,017	10	30	622469.50000	396172.09380	1994 Sediment Data - SAIC and GAS
418	2,840	10	30	622475.93750	396122.68750	1994 Sediment Data - SAIC and GAS
423	1,863	10	30	622644.12500	396683.34380	1994 Sediment Data - SAIC and GAS
431	9,133	10	30	622479.43750	396362.87500	1994 Sediment Data - SAIC and GAS
432	3,195	10	30	622540.43750	396307.12500	1994 Sediment Data - SAIC and GAS
433	234	10	30	653519.06250	421727.43750	1994 Sediment Data - SAIC and GAS
436	19,710	10	30	653652.43750	422206.06250	1994 Sediment Data - SAIC and GAS
437	3,800	10	30	653703.62500	422175.90630	1994 Sediment Data - SAIC and GAS
438	1,925	10	30	653764.06250	422182.59380	1994 Sediment Data - SAIC and GAS

Table 1 PCB Data Retained for 2002 Interpolation

Station ID	Total PCB (µg/kg)	Start Depth (cm)	End Depth (cm)	Easting	Northing	Source
439	8,860	10	30	653746.37500	422275.87500	1994 Sediment Data - SAIC and GAS
440	1,352	10	30	653826.06250	422268.81250	1994 Sediment Data - SAIC and GAS
441	37,870	10	30	653800.50000	422372.25000	1994 Sediment Data - SAIC and GAS
442	4,665	10	30	653828.31250	422345.96880	1994 Sediment Data - SAIC and GAS
443	429	10	30	653913.06250	422297.90630	1994 Sediment Data - SAIC and GAS
444	5,860	10	30	653600.75000	421697.28130	1994 Sediment Data - SAIC and GAS
445	3,140	10	30	653875.43750	422429.81250	1994 Sediment Data - SAIC and GAS
446	40,430	10	30	653919.62500	422413.50000	1994 Sediment Data - SAIC and GAS
447	37	10	30	653978.75000	422382.21880	1994 Sediment Data - SAIC and GAS
448	11,510	10	30	653939.87500	422510.18750	1994 Sediment Data - SAIC and GAS
449	9,875	10	30	653970.68750	422493.37500	1994 Sediment Data - SAIC and GAS
450	58	10	30	653942.25000	422635.06250	1994 Sediment Data - SAIC and GAS
451	7,873	10	30	654000.25000	422586.93750	1994 Sediment Data - SAIC and GAS
455	6,825	10	30	653542.25000	421812.31250	1994 Sediment Data - SAIC and GAS
456	15,990	10	30	653596.62500	421814.71880	1994 Sediment Data - SAIC and GAS
462	1,510	10	30	622666.93750	396735.40630	1994 Sediment Data - SAIC and GAS
463	990	10	30	622812.12500	396379.34380	1994 Sediment Data - SAIC and GAS
464	55	10	30	622942.93750	396367.15630	1994 Sediment Data - SAIC and GAS
465	506	10	30	622835.87500	396317.25000	1994 Sediment Data - SAIC and GAS
466	356	10	30	622772.12500	396226.84380	1994 Sediment Data - SAIC and GAS
467	59	10	30	622875.93750	396228.84380	1994 Sediment Data - SAIC and GAS
468	440	10	30	622813.06250	396127.46880	1994 Sediment Data - SAIC and GAS
469	12,430	10	30	622907.25000	396135.18750	1994 Sediment Data - SAIC and GAS
470	45,850	10	30	622921.06250	396038.59380	1994 Sediment Data - SAIC and GAS
471	635	10	30	622805.06250	396755.15630	1994 Sediment Data - SAIC and GAS
472	157	10	30	622968.00000	396735.37500	1994 Sediment Data - SAIC and GAS
473	1,828	10	30	623064.81250	396755.93750	1994 Sediment Data - SAIC and GAS
474	116	10	30	622937.75000	396643.18750	1994 Sediment Data - SAIC and GAS
475	228	10	30	623002.43750	396647.15630	1994 Sediment Data - SAIC and GAS
476	145	10	30	622940.31250	396544.90630	1994 Sediment Data - SAIC and GAS
477	1,389	10	30	622876.06250	396451.18750	1994 Sediment Data - SAIC and GAS
478	113	10	30	622933.31250	396453.87500	1994 Sediment Data - SAIC and GAS
514	755	10	30	622813.62500	396041.31250	1994 Sediment Data - SAIC and GAS
517	311	10	30	623221.87500	395724.96880	1994 Sediment Data - SAIC and GAS
519	663	10	30	623153.56250	395628.65630	1994 Sediment Data - SAIC and GAS
521	4,630	10	30	623285.87500	395611.59380	1994 Sediment Data - SAIC and GAS
524	970	10	30	622555.43750	395432.46880	1994 Sediment Data - SAIC and GAS
525	1,030	10	30	622746.12500	395948.40630	1994 Sediment Data - SAIC and GAS
527	1,269	10	30	623153.43750	395445.87500	1994 Sediment Data - SAIC and GAS
529	7,472	10	30	622846.87500	395946.25000	1994 Sediment Data - SAIC and GAS
530	11,760	10	30	622950.81250	395944.84380	1994 Sediment Data - SAIC and GAS
532	154	10	30	622786.06250	395852.12500	1994 Sediment Data - SAIC and GAS
533	24,750	10	30	622945.87500	395855.34380	1994 Sediment Data - SAIC and GAS
536	43,000	10	30	653705.31250	423639.87500	1995 Sediment Data Collection - WDNR
540	50	10	30	653663.62500	423780.59380	1995 Sediment Data Collection - WDNR
543	50	10	30	653833.06250	424005.56250	1995 Sediment Data Collection - WDNR
547	2,050	10	30	654063.12500	424156.59380	1995 Sediment Data Collection - WDNR
550	190	10	30	654004.37500	424246.71880	1995 Sediment Data Collection - WDNR
552	15,000	10	30	653972.25000	424475.84380	1995 Sediment Data Collection - WDNR
553	91	10	30	654145.00000	424419.53130	1995 Sediment Data Collection - WDNR
554	1,370	10	30	654277.06250	424629.37500	1995 Sediment Data Collection - WDNR
555	50	10	30	654467.75000	424517.37500	1995 Sediment Data Collection - WDNR
556	50	10	30	654492.75000	424620.21880	1995 Sediment Data Collection - WDNR
557	50	10	30	654538.68750	424798.21880	1995 Sediment Data Collection - WDNR
558	16,450	10	30	654631.62500	425017.53130	1995 Sediment Data Collection - WDNR
559	3,800	10	30	654526.62500	425099.12500	1995 Sediment Data Collection - WDNR
560	16,500	10	30	654723.87500	425150.68750	1995 Sediment Data Collection - WDNR
561	51	10	30	654867.43750	425149.62500	1995 Sediment Data Collection - WDNR
562	19,000	10	30	654705.56250	425301.37500	1995 Sediment Data Collection - WDNR
563	13,000	10	30	654820.87500	425528.25000	1995 Sediment Data Collection - WDNR
564	2,200	10	30	654910.00000	425828.62500	1995 Sediment Data Collection - WDNR
565	12,200	10	30	655026.75000	425772.50000	1995 Sediment Data Collection - WDNR
566	51	10	30	655060.31250	425667.34380	1995 Sediment Data Collection - WDNR
568	12,000	10	30	655101.93750	425929.50000	1995 Sediment Data Collection - WDNR
569	12,000	10	30	654996.93750	426161.87500	1995 Sediment Data Collection - WDNR
570	12,050	10	30	655185.25000	426011.34380	1995 Sediment Data Collection - WDNR
574	4,450	10	30	655364.87500	426354.96880	1995 Sediment Data Collection - WDNR
575	2,900	10	30	655334.37500	426528.18750	1995 Sediment Data Collection - WDNR

Table 1 PCB Data Retained for 2002 Interpolation

Station ID	Total PCB (µg/kg)	Start Depth (cm)	End Depth (cm)	Easting	Northing	Source
576	330	10	30	655515.37500	426323.93750	1995 Sediment Data Collection - WDNR
577	53	10	30	655695.56250	426175.59380	1995 Sediment Data Collection - WDNR
579	220	10	30	655613.43750	426594.68750	1995 Sediment Data Collection - WDNR
580	18,000	10	30	655807.75000	426431.68750	1995 Sediment Data Collection - WDNR
582	6,950	10	30	655686.87500	426956.34380	1995 Sediment Data Collection - WDNR
585	3,400	10	30	655760.37500	427135.75000	1995 Sediment Data Collection - WDNR
586	12,100	10	30	655964.31250	426984.09380	1995 Sediment Data Collection - WDNR
589	9,600	10	30	656130.81250	427158.34380	1995 Sediment Data Collection - WDNR
592	17,000	10	30	656092.68750	427193.15630	1995 Sediment Data Collection - WDNR
594	130	10	30	656137.87500	427520.28130	1995 Sediment Data Collection - WDNR
595	3,100	10	30	656290.31250	427451.12500	1995 Sediment Data Collection - WDNR
596	50	10	30	656360.12500	427730.84380	1995 Sediment Data Collection - WDNR
597	2,013	10	30	656481.62500	427602.62500	1995 Sediment Data Collection - WDNR
598	10,000	10	30	656602.18750	427850.21880	1995 Sediment Data Collection - WDNR
600	3,000	10	30	656765.18750	427876.37500	1995 Sediment Data Collection - WDNR
605	1,700	10	30	657066.75000	428150.59380	1995 Sediment Data Collection - WDNR
607	3,300	10	30	657019.37500	428391.93750	1995 Sediment Data Collection - WDNR
608	3,100	10	30	656973.62500	428716.46880	1995 Sediment Data Collection - WDNR
610	2,500	10	30	657105.56250	428891.75000	1995 Sediment Data Collection - WDNR
611	3,300	10	30	657050.68750	429205.31250	1995 Sediment Data Collection - WDNR
613	2,850	10	30	657053.18750	429346.90630	1995 Sediment Data Collection - WDNR
614	11,850	10	30	657203.12500	429271.43750	1995 Sediment Data Collection - WDNR
615	16,150	10	30	657206.87500	429466.59380	1995 Sediment Data Collection - WDNR
616	14,000	10	30	657183.25000	429741.84380	1995 Sediment Data Collection - WDNR
617	2,300	10	30	657303.62500	429884.21880	1995 Sediment Data Collection - WDNR
618	10,600	10	30	657328.68750	430151.96880	1995 Sediment Data Collection - WDNR
619	3,100	10	30	657332.87500	430377.87500	1995 Sediment Data Collection - WDNR
620	6,050	10	30	657394.12500	430360.81250	1995 Sediment Data Collection - WDNR
621	280	10	30	657403.62500	430527.78130	1995 Sediment Data Collection - WDNR
622	2,000	10	30	657537.18750	430705.68750	1995 Sediment Data Collection - WDNR
624	50	10	30	657738.56250	431041.96880	1995 Sediment Data Collection - WDNR
625	50	10	30	657665.31250	431175.40630	1995 Sediment Data Collection - WDNR
626	2,600	10	30	658105.87500	431388.78130	1995 Sediment Data Collection - WDNR
628	1,600	10	30	658030.06250	431791.68750	1995 Sediment Data Collection - WDNR
630	54	10	30	658144.56250	432242.37500	1995 Sediment Data Collection - WDNR
632	190	10	30	658168.56250	432683.84380	1995 Sediment Data Collection - WDNR
633	50	10	30	658239.12500	432929.15630	1995 Sediment Data Collection - WDNR
634	760	10	30	658320.25000	432710.87500	1995 Sediment Data Collection - WDNR
635	620	10	30	658388.68750	433082.12500	1995 Sediment Data Collection - WDNR
636	64	10	30	658455.00000	432945.71880	1995 Sediment Data Collection - WDNR
637	2,300	10	30	658376.62500	433240.37500	1995 Sediment Data Collection - WDNR
638	1,200	10	30	658518.06250	433351.09380	1995 Sediment Data Collection - WDNR
639	1,500	10	30	658537.18750	433660.37500	1995 Sediment Data Collection - WDNR
640	1,400	10	30	658854.75000	433589.40630	1995 Sediment Data Collection - WDNR
646	2,600	10	30	656127.12500	427343.31250	1995 Sediment Data Collection - WDNR
662	8,800	10	30	658035.06250	431313.31250	1995 Sediment Data Collection - WDNR
663	4,000	10	30	656973.62500	428716.46880	1995 Sediment Data Collection - WDNR
676	86,000	10	30	656627.31250	428118.56250	1997 Segment 56/57 Demonstration Project
677	2,200	10	30	656664.25000	428154.96880	1997 Segment 56/57 Demonstration Project
678	150,000	10	30	656678.06250	428176.59380	1997 Segment 56/57 Demonstration Project
679	9,900	10	30	656711.43750	428223.71880	1997 Segment 56/57 Demonstration Project
680	3,600	10	30	656736.87500	428249.96880	1997 Segment 56/57 Demonstration Project
681	2,500	10	30	656759.00000	428302.96880	1997 Segment 56/57 Demonstration Project
682	12,000	10	30	656788.87500	428310.50000	1997 Segment 56/57 Demonstration Project
683	36,000	10	30	656792.56250	428332.81250	1997 Segment 56/57 Demonstration Project
684	39,000	10	30	656626.06250	428070.06250	1997 Segment 56/57 Demonstration Project
685	4,500	10	30	656674.62500	428128.06250	1997 Segment 56/57 Demonstration Project
686	3,100	10	30	656707.25000	428157.84380	1997 Segment 56/57 Demonstration Project
687	4,300	10	30	656714.87500	428182.12500	1997 Segment 56/57 Demonstration Project
688	4,500	10	30	656740.43750	428221.93750	1997 Segment 56/57 Demonstration Project
689	4,900	10	30	656767.68750	428264.59380	1997 Segment 56/57 Demonstration Project
690	3,700	10	30	656818.87500	428285.90630	1997 Segment 56/57 Demonstration Project
691	2,900	10	30	656833.18750	428314.34380	1997 Segment 56/57 Demonstration Project
692	33,000	10	30	656681.93750	428100.12500	1997 Segment 56/57 Demonstration Project
693	4,200	10	30	656735.81250	428118.40630	1997 Segment 56/57 Demonstration Project
694	4,100	10	30	656756.75000	428157.81250	1997 Segment 56/57 Demonstration Project
695	11,000	10	30	656775.12500	428174.93750	1997 Segment 56/57 Demonstration Project
696	12,000	10	30	656788.25000	428198.71880	1997 Segment 56/57 Demonstration Project

Table 1 PCB Data Retained for 2002 Interpolation

Station ID	Total PCB (µg/kg)	Start Depth (cm)	End Depth (cm)	Easting	Northing	Source
697	4,800	10	30	656813.31250	428232.03130	1997 Segment 56/57 Demonstration Project
698	5,900	10	30	656842.50000	428267.93750	1997 Segment 56/57 Demonstration Project
699	5,200	10	30	656851.43750	428310.75000	1997 Segment 56/57 Demonstration Project
700	40,000	10	30	656714.56250	428085.18750	1997 Segment 56/57 Demonstration Project
701	5,300	10	30	656732.37500	428106.90630	1997 Segment 56/57 Demonstration Project
702	5,000	10	30	656754.75000	428131.84380	1997 Segment 56/57 Demonstration Project
703	5,100	10	30	656775.43750	428162.28130	1997 Segment 56/57 Demonstration Project
704	22,000	10	30	656795.81250	428187.15630	1997 Segment 56/57 Demonstration Project
705	1,900	10	30	656824.06250	428216.87500	1997 Segment 56/57 Demonstration Project
706	2,800	10	30	656854.00000	428249.06250	1997 Segment 56/57 Demonstration Project
707	1,600	10	30	656881.06250	428292.03130	1997 Segment 56/57 Demonstration Project
708	2,225	10	30	653287.87500	424012.18750	1998 BBL Sediment/Tissue Data Collected for FRG
709	1,105	10	30	655727.00000	427333.50000	1998 BBL Sediment/Tissue Data Collected for FRG
710	7,458	10	30	653636.81250	424326.40630	1998 BBL Sediment/Tissue Data Collected for FRG
711	842	10	30	654055.81250	423913.68750	1998 BBL Sediment/Tissue Data Collected for FRG
712	507	10	30	651848.68750	419516.90630	1998 BBL Sediment/Tissue Data Collected for FRG
713	12,200	10	30	654052.62500	422999.68750	1998 BBL Sediment/Tissue Data Collected for FRG
714	5,695	10	30	656178.00000	426925.40630	1998 BBL Sediment/Tissue Data Collected for FRG
715	195	10	30	691202.12500	479466.50000	1998 BBL Sediment/Tissue Data Collected for FRG
716	164	10	30	683303.68750	473073.40630	1998 BBL Sediment/Tissue Data Collected for FRG
717	184	10	30	678371.18750	468225.31250	1998 BBL Sediment/Tissue Data Collected for FRG
718	39,940	10	30	622109.62500	394078.59380	1998 BBL Sediment/Tissue Data Collected for FRG
720	6,800	10	30	653450.81250	423753.18750	1998 BBL Sediment/Tissue Data Collected for FRG
721	29,000	10	30	653282.62500	423944.00000	1998 BBL Sediment/Tissue Data Collected for FRG
722	1,700	10	30	653937.00000	423816.18750	1998 BBL Sediment/Tissue Data Collected for FRG
723	220	10	30	654291.50000	424276.31250	1998 BBL Sediment/Tissue Data Collected for FRG
724	11,000	10	30	653563.12500	424263.68750	1998 BBL Sediment/Tissue Data Collected for FRG
725	25,000	10	30	653822.50000	424430.90630	1998 BBL Sediment/Tissue Data Collected for FRG
726	85	10	30	655573.50000	426059.59380	1998 BBL Sediment/Tissue Data Collected for FRG
727	1,450	10	30	654878.50000	426037.50000	1998 BBL Sediment/Tissue Data Collected for FRG
729	12,000	10	30	655871.00000	426691.09380	1998 BBL Sediment/Tissue Data Collected for FRG
730	1,100	10	30	655372.68750	426736.90630	1998 BBL Sediment/Tissue Data Collected for FRG
731	4,200	10	30	655771.50000	427396.68750	1998 BBL Sediment/Tissue Data Collected for FRG
732	2,000	10	30	656936.31250	428585.09380	1998 BBL Sediment/Tissue Data Collected for FRG
733	15,000	10	30	656171.87500	426950.68750	1998 BBL Sediment/Tissue Data Collected for FRG
734	90	10	30	657293.31250	429150.09380	1998 BBL Sediment/Tissue Data Collected for FRG
735	3,340	10	30	657518.50000	430923.00000	1998 BBL Sediment/Tissue Data Collected for FRG
736	10,300	10	30	654042.62500	423071.59380	1998 BBL Sediment/Tissue Data Collected for FRG
737	1,520	10	30	654263.68750	423040.18750	1998 BBL Sediment/Tissue Data Collected for FRG
738	1,860	10	30	654232.00000	423224.00000	1998 BBL Sediment/Tissue Data Collected for FRG
739	27,800	10	30	654247.62500	422770.50000	1998 BBL Sediment/Tissue Data Collected for FRG
740	17,900	10	30	654056.00000	422935.68750	1998 BBL Sediment/Tissue Data Collected for FRG
741	15,700	10	30	654025.50000	422804.31250	1998 BBL Sediment/Tissue Data Collected for FRG
742	710	10	30	653564.50000	421987.00000	1998 BBL Sediment/Tissue Data Collected for FRG
743	17,200	10	30	622103.81250	394050.18750	1998 BBL Sediment/Tissue Data Collected for FRG
744	720	10	30	622059.81250	395134.50000	1998 BBL Sediment/Tissue Data Collected for FRG
745	220	10	30	622826.87500	395345.18750	1998 BBL Sediment/Tissue Data Collected for FRG
746	75	10	30	622860.18750	395651.40630	1998 BBL Sediment/Tissue Data Collected for FRG
747	76	10	30	622331.18750	395892.59380	1998 BBL Sediment/Tissue Data Collected for FRG
748	2,150	10	30	622299.87500	396072.40630	1998 BBL Sediment/Tissue Data Collected for FRG
749	180	10	30	622803.12500	397972.81250	1998 BBL Sediment/Tissue Data Collected for FRG
750	140	10	30	623638.62500	397925.68750	1998 BBL Sediment/Tissue Data Collected for FRG
751	410	10	30	622465.31250	397264.68750	1998 BBL Sediment/Tissue Data Collected for FRG
752	650	10	30	651860.87500	419514.09380	1998 BBL Sediment/Tissue Data Collected for FRG
753	100	10	30	650629.37500	417122.31250	1998 BBL Sediment/Tissue Data Collected for FRG
754	69	10	30	651752.50000	418575.81250	1998 BBL Sediment/Tissue Data Collected for FRG
755	130	10	30	640397.00000	405514.18750	1998 BBL Sediment/Tissue Data Collected for FRG
756	155	10	30	640887.62500	405296.81250	1998 BBL Sediment/Tissue Data Collected for FRG
757	169	10	30	640868.50000	406010.59380	1998 BBL Sediment/Tissue Data Collected for FRG
758	54	10	30	641273.50000	405973.59380	1998 BBL Sediment/Tissue Data Collected for FRG
759	1,420	10	30	633379.62500	404149.00000	1998 BBL Sediment/Tissue Data Collected for FRG
820	27,000	10	30	632672.68750	403918.34380	1998 Deposit N Post-Dredge Sediment Data
821	63,400	10	30	632677.56250	403932.65630	1998 Deposit N Post-Dredge Sediment Data
825	18,800	10	30	632740.00000	403932.34380	1998 Deposit N Post-Dredge Sediment Data
827	6,040	10	30	632750.68750	403948.78130	1998 Deposit N Post-Dredge Sediment Data
832	1,500	10	30	632871.68750	403964.90630	1998 Deposit N Post-Dredge Sediment Data
833	4,260	10	30	632874.43750	403946.62500	1998 Deposit N Post-Dredge Sediment Data
834	3,100	10	30	632904.87500	403934.12500	1998 Deposit N Post-Dredge Sediment Data

Table 1 PCB Data Retained for 2002 Interpolation

Station ID	Total PCB (µg/kg)	Start Depth (cm)	End Depth (cm)	Easting	Northing	Source
835	4,500	10	30	632932.93750	403929.53130	1998 Deposit N Post-Dredge Sediment Data
836	3,140	10	30	632917.06250	403956.06250	1998 Deposit N Post-Dredge Sediment Data
837	3,040	10	30	632927.43750	403970.68750	1998 Deposit N Post-Dredge Sediment Data
838	784	10	30	632946.62500	403961.84380	1998 Deposit N Post-Dredge Sediment Data
840	48,600	10	30	632608.93750	403907.96880	1998 Deposit N Post-Dredge Sediment Data
841	450	10	30	632892.12500	403974.06250	1998 Deposit N Post-Dredge Sediment Data
842	5,500	10	30	632853.68750	403973.75000	1998 Deposit N Post-Dredge Sediment Data
845	37,200	10	30	632621.75000	403929.90630	1998 Deposit N Post-Dredge Sediment Data
847	74,200	10	30	632637.00000	403918.93750	1998 Deposit N Post-Dredge Sediment Data
850	36,400	10	30	632658.62500	403928.68750	1998 Deposit N Post-Dredge Sediment Data
851	5	10	30	622127.31250	395068.90630	1998 RI/FS Supplemental Data Collection
852	197	10	30	622059.00000	395130.96880	1998 RI/FS Supplemental Data Collection
853	169	10	30	622110.00000	395190.78130	1998 RI/FS Supplemental Data Collection
854	2,109	10	30	621982.50000	395296.87500	1998 RI/FS Supplemental Data Collection
855	7,344	10	30	622113.50000	395231.84380	1998 RI/FS Supplemental Data Collection
861	58	10	30	623005.31250	397186.93750	1998 RI/FS Supplemental Data Collection
862	29	10	30	622644.68750	397239.03130	1998 RI/FS Supplemental Data Collection
863	9	10	30	623721.75000	398105.93750	1998 RI/FS Supplemental Data Collection
864	527	10	30	623351.18750	398284.12500	1998 RI/FS Supplemental Data Collection
865	17	10	30	623876.87500	399049.90630	1998 RI/FS Supplemental Data Collection
866	81	10	30	623924.18750	399587.90630	1998 RI/FS Supplemental Data Collection
867	14	10	30	649720.31250	416636.75000	1998 RI/FS Supplemental Data Collection
868	190	10	30	649864.06250	416456.50000	1998 RI/FS Supplemental Data Collection
869	4,097	10	30	650293.12500	416683.15630	1998 RI/FS Supplemental Data Collection
870	51	10	30	649892.43750	416886.34380	1998 RI/FS Supplemental Data Collection
871	160	10	30	650610.00000	417130.28130	1998 RI/FS Supplemental Data Collection
872	20	10	30	650366.75000	417157.37500	1998 RI/FS Supplemental Data Collection
873	22	10	30	650156.75000	417239.78130	1998 RI/FS Supplemental Data Collection
874	173	10	30	651096.93750	417622.09380	1998 RI/FS Supplemental Data Collection
875	25	10	30	650733.93750	417808.84380	1998 RI/FS Supplemental Data Collection
876	134	10	30	651505.56250	418121.87500	1998 RI/FS Supplemental Data Collection
877	20	10	30	651688.93750	418257.59380	1998 RI/FS Supplemental Data Collection
878	15	10	30	651634.81250	418439.81250	1998 RI/FS Supplemental Data Collection
879	13	10	30	651278.50000	418455.06250	1998 RI/FS Supplemental Data Collection
880	18	10	30	651999.43750	419029.00000	1998 RI/FS Supplemental Data Collection
881	10	10	30	651771.75000	419175.81250	1998 RI/FS Supplemental Data Collection
882	91	10	30	652076.18750	419679.59380	1998 RI/FS Supplemental Data Collection
883	1,062	10	30	651953.50000	419721.81250	1998 RI/FS Supplemental Data Collection
884	27	10	30	652772.93750	420221.37500	1998 RI/FS Supplemental Data Collection
885	20	10	30	652612.31250	420311.09380	1998 RI/FS Supplemental Data Collection
886	9	10	30	653094.06250	420517.87500	1998 RI/FS Supplemental Data Collection
887	3,185	10	30	653125.87500	420883.62500	1998 RI/FS Supplemental Data Collection
888	203	10	30	653127.37500	421087.81250	1998 RI/FS Supplemental Data Collection
889	11	10	30	653597.93750	421520.28130	1998 RI/FS Supplemental Data Collection
890	20	10	30	653475.12500	421563.81250	1998 RI/FS Supplemental Data Collection
896	20	10	30	640568.62500	404835.65630	1998 RI/FS Supplemental Data Collection
897	20	10	30	640686.68750	405013.25000	1998 RI/FS Supplemental Data Collection
898	192	10	30	640600.75000	405178.09380	1998 RI/FS Supplemental Data Collection
899	23	10	30	641133.12500	405822.43750	1998 RI/FS Supplemental Data Collection
900	17	10	30	641283.06250	406148.87500	1998 RI/FS Supplemental Data Collection
901	11	10	30	640253.37500	405296.18750	1998 RI/FS Supplemental Data Collection
902	20	10	30	640476.00000	405456.65630	1998 RI/FS Supplemental Data Collection
903	6	10	30	640616.81250	405570.37500	1998 RI/FS Supplemental Data Collection
904	19	10	30	640796.93750	405799.15630	1998 RI/FS Supplemental Data Collection
905	14	10	30	640975.18750	406138.87500	1998 RI/FS Supplemental Data Collection
11001	1,190	30	50	623043.25902	397867.66114	2000–01 CH2M HILL
11002	3,500	30	50	623139.73195	397836.13803	2000–01 CH2M HILL
11003	5,220	30	50	623045.13412	397767.69608	2000–01 CH2M HILL
11005	736	30	50	623205.09085	397759.58726	2000–01 CH2M HILL
11006	26,250	30	50	623154.03831	397925.29576	2000–01 CH2M HILL
11007	406	30	50	623266.90297	397871.86000	2000–01 CH2M HILL
11008	31,150	30	50	623200.70989	397992.83908	2000–01 CH2M HILL
11010	102	30	50	622893.37341	397764.85120	2000–01 CH2M HILL
11011	329	30	50	622958.93820	397677.19080	2000–01 CH2M HILL
11012	7,310	30	50	623118.68847	397680.18706	2000–01 CH2M HILL
11014	26,300	30	50	622899.98973	396131.64189	2000–01 CH2M HILL
11015	36,350	30	50	622901.65364	396042.78429	2000–01 CH2M HILL
11017	117,400	30	50	622929.15855	395854.41080	2000–01 CH2M HILL

Table 1 PCB Data Retained for 2002 Interpolation

Station ID	Total PCB (µg/kg)	Start Depth (cm)	End Depth (cm)	Easting	Northing	Source
11018	34,750	30	50	622931.44675	395732.23166	2000–01 CH2M HILL
11020	77	30	50	622669.44123	395638.44145	2000–01 CH2M HILL
11021	77	30	50	622909.76482	395609.60367	2000–01 CH2M HILL
11022	315	30	50	622711.67514	395517.00904	2000–01 CH2M HILL
11023	77	30	50	622678.57039	396005.27753	2000–01 CH2M HILL
11024	77	30	50	622676.90953	396094.13512	2000–01 CH2M HILL
11032	77	30	50	623128.27678	395891.47632	2000–01 CH2M HILL
11033	1,024	30	50	622995.36580	395733.42905	2000–01 CH2M HILL
11036	77	30	50	622887.04232	395542.51175	2000–01 CH2M HILL
11037	109	30	50	622912.05249	395487.42457	2000–01 CH2M HILL
11038	81	30	50	623047.26094	395523.29085	2000–01 CH2M HILL
11039	149	30	45	622672.96982	395449.61921	2000–01 CH2M HILL
11041	127	30	50	622712.29803	395483.68747	2000–01 CH2M HILL
11043	77	30	50	622678.88428	395560.84043	2000–01 CH2M HILL
11046	77	30	50	622733.98417	395606.31470	2000–01 CH2M HILL
11048	77	30	50	622708.97591	395661.40253	2000–01 CH2M HILL
11050	77	30	50	622755.66937	395728.94204	2000–01 CH2M HILL
11051	77	30	50	622114.89419	395372.54797	2000–01 CH2M HILL
11052	333	30	50	621942.40859	395191.56545	2000–01 CH2M HILL
11053	366	30	50	621943.02751	395158.24390	2000–01 CH2M HILL
11054	266	30	50	622030.92363	395159.87709	2000–01 CH2M HILL
11055	399	30	50	622028.03321	395315.37767	2000–01 CH2M HILL
11058	77	30	50	622228.41278	395285.77229	2000–01 CH2M HILL
11059	77	30	50	622141.55154	395228.60050	2000–01 CH2M HILL
11060	77	30	50	622229.44677	395230.23636	2000–01 CH2M HILL
11061	77	30	50	622230.68754	395163.59326	2000–01 CH2M HILL
11062	77	30	50	622144.03128	395095.31430	2000–01 CH2M HILL
11063	159	30	50	622056.13427	395093.67961	2000–01 CH2M HILL
11069	77	30	50	622177.71691	394573.72297	2000–01 CH2M HILL
11070	77	30	40	622186.74157	394518.33580	2000–01 CH2M HILL
12000	151	30	50	623376.42687	397996.14183	2000–01 CH2M HILL
12001	1,940	30	50	623121.60689	397524.68591	2000–01 CH2M HILL
12002	756	30	50	622961.85283	397521.68966	2000–01 CH2M HILL
12003	283	30	50	622762.16025	397517.94981	2000–01 CH2M HILL
12005	77	30	50	622583.52506	397670.16491	2000–01 CH2M HILL
12006	107	30	50	622759.25036	397673.45095	2000–01 CH2M HILL
12007	77	30	50	622645.76385	397760.21710	2000–01 CH2M HILL
12090	2,330	30	50	622974.10122	395588.58645	2000–01 CH2M HILL
12097	171	30	50	622858.19995	395375.30569	2000–01 CH2M HILL
12101	310	30	50	622844.29773	395263.93476	2000–01 CH2M HILL
12103	291	30	50	622966.23486	395155.10677	2000–01 CH2M HILL
12104	195	30	50	623150.85170	395114.12287	2000–01 CH2M HILL
12105	362	30	50	623345.33974	394973.32959	2000–01 CH2M HILL
12107	77	30	50	623738.56431	394891.83973	2000–01 CH2M HILL
12121	143	30	50	621894.45575	393468.47056	2000–01 CH2M HILL
12122	106	30	50	621912.09010	393379.90999	2000–01 CH2M HILL
12123	2,540	30	50	621946.74146	393236.11044	2000–01 CH2M HILL
12125	81	30	50	621800.84830	392911.18575	2000–01 CH2M HILL
12132	6,375	30	50	622983.75601	395499.87861	2000–01 CH2M HILL
12133	536	30	50	622993.41099	395411.17079	2000–01 CH2M HILL
DA01S-02	77	30	36	622112.34081	394650.28398	2001 Blasland, Bouck, and Lee
DA01S-06	77	30	50	622290.21530	394542.48406	2001 Blasland, Bouck, and Lee
DA01S-08	77	30	50	622022.43205	394326.39335	2001 Blasland, Bouck, and Lee
DA01S-09	77	30	50	622203.75777	394463.09736	2001 Blasland, Bouck, and Lee
DA01S-10	77	30	50	622044.96176	394404.58907	2001 Blasland, Bouck, and Lee
DA01S-11	77	30	50	622308.68047	394409.49567	2001 Blasland, Bouck, and Lee
DA01S-12	77	30	50	622388.38822	394422.09178	2001 Blasland, Bouck, and Lee
DA01S-13	77	30	50	622125.28965	394383.86046	2001 Blasland, Bouck, and Lee
DA01S-14	77	30	50	622197.41987	394374.09128	2001 Blasland, Bouck, and Lee
DA01S-15	25	30	50	621991.08477	394292.47794	2001 Blasland, Bouck, and Lee
DA01S-16	20	30	50	621928.59544	394213.54043	2001 Blasland, Bouck, and Lee
DA01S-17	77	30	50	622152.15660	394228.80600	2001 Blasland, Bouck, and Lee
DA01S-18	81	30	50	622383.91569	394233.12095	2001 Blasland, Bouck, and Lee
DA01S-19	81	30	50	621945.40384	394169.40854	2001 Blasland, Bouck, and Lee
DA01S-20	77	30	50	622145.81759	394139.80002	2001 Blasland, Bouck, and Lee
DA01S-21	434	30	50	622027.59162	394048.71418	2001 Blasland, Bouck, and Lee
DA01S-22	1,535	30	50	622171.65260	394040.28149	2001 Blasland, Bouck, and Lee
DA01S-24	81	30	50	622371.86458	394021.78695	2001 Blasland, Bouck, and Lee

Table 1 PCB Data Retained for 2002 Interpolation

Station ID	Total PCB (µg/kg)	Start Depth (cm)	End Depth (cm)	Easting	Northing	Source
DE01S-02	0	30	50	622958.57438	396843.84995	2001 Blasland, Bouck, and Lee
DE01S-03	45	30	50	622790.39959	396862.92293	2001 Blasland, Bouck, and Lee
DE01S-05	3,100	30	50	622811.66245	397007.76522	2001 Blasland, Bouck, and Lee
DE01S-06	50	30	50	623035.54384	397000.84838	2001 Blasland, Bouck, and Lee
DE01S-07	0	30	50	622635.50410	397026.69256	2001 Blasland, Bouck, and Lee
DE01S-09	37	30	50	622889.46536	397120.33307	2001 Blasland, Bouck, and Lee
DE01S-10	0	30	50	622752.21147	397195.54149	2001 Blasland, Bouck, and Lee
DE01S-11	980	30	50	622966.64100	397266.22356	2001 Blasland, Bouck, and Lee
DE01S-12	790	30	50	622749.92555	397317.72090	2001 Blasland, Bouck, and Lee
DE01S-13	45	30	50	622581.34856	397359.01342	2001 Blasland, Bouck, and Lee
DE01S-14	2,110	30	50	623060.83044	397356.87861	2001 Blasland, Bouck, and Lee
DE01S-15	0	30	46	623220.17134	397382.09164	2001 Blasland, Bouck, and Lee
DE01S-16	0	30	50	622618.79681	397493.04644	2001 Blasland, Bouck, and Lee
DE01S-17	0	30	50	623336.23078	397584.27316	2001 Blasland, Bouck, and Lee
DE01S-18	27	30	50	623199.81519	397615.04330	2001 Blasland, Bouck, and Lee
DE01S-19	0	30	50	623333.51604	397728.66710	2001 Blasland, Bouck, and Lee
DE01S-20	0	30	50	623460.89732	397753.28557	2001 Blasland, Bouck, and Lee
DE01S-21	260	30	50	623378.93386	397862.85506	2001 Blasland, Bouck, and Lee
DE01S-22	0	30	50	623577.98855	397899.93558	2001 Blasland, Bouck, and Lee
DE01S-23	420	30	50	623481.51419	397931.45227	2001 Blasland, Bouck, and Lee
DE01S-24	0	30	50	623607.21656	398044.93157	2001 Blasland, Bouck, and Lee
DE01S-25	15,000	30	50	623271.75914	398038.61856	2001 Blasland, Bouck, and Lee
DE01S-26	30	30	50	623487.41033	398042.67496	2001 Blasland, Bouck, and Lee
DE01S-27	0	30	50	623151.11875	398080.79701	2001 Blasland, Bouck, and Lee
DE01S-28	110	30	50	622908.85214	397365.14078	2001 Blasland, Bouck, and Lee
DE01S-29	15,000	30	50	623349.33225	398162.29968	2001 Blasland, Bouck, and Lee
DE01S-30	0	30	50	623661.03204	398157.05775	2001 Blasland, Bouck, and Lee
DE01S-31	350	30	50	623516.84867	398176.56332	2001 Blasland, Bouck, and Lee
DE01S-33	0	30	42	623290.29185	398327.85703	2001 Blasland, Bouck, and Lee
DE01S-35	23,000	30	50	623482.60072	398298.14136	2001 Blasland, Bouck, and Lee
DE01S-36	2,200	30	50	623609.55170	398344.97746	2001 Blasland, Bouck, and Lee
DE01S-38	0	30	50	623751.63594	398436.54638	2001 Blasland, Bouck, and Lee
DE01S-39	290	30	50	623519.81512	398443.28743	2001 Blasland, Bouck, and Lee
PD-A/B-01	22	30	58	622144.76241	394512.45038	2002 Foth and Van Dyke
PD-A/B-03	50	30	60	622061.01005	394327.15623	2002 Foth and Van Dyke
PD-A/B-05	13,000	30	60	621934.27041	394214.98410	2002 Foth and Van Dyke
PD-A/B-07	120	30	60	621973.87922	394125.98514	2002 Foth and Van Dyke
PD-A/B-08	95	30	60	622057.71257	394122.99089	2002 Foth and Van Dyke
PD-A/B-11	1,400	30	60	622137.27207	394034.33780	2002 Foth and Van Dyke
PD-A/B-12B	22	30	60	622325.90308	394034.38848	2002 Foth and Van Dyke
PD-A/B-13	310	30	60	621996.50590	393954.15784	2002 Foth and Van Dyke
PD-A/B-14	130	30	50	622136.68399	393954.19542	2002 Foth and Van Dyke
324	3,831	30	50	621989.00000	393930.00000	Little Lake Butte des Morts RI/FS Deposit A - 1992, 1993 BBL
325	170	30	50	621979.00000	393951.00000	Little Lake Butte des Morts RI/FS Deposit A - 1992, 1993 BBL
327	1,240	30	50	621966.00000	394025.00000	Little Lake Butte des Morts RI/FS Deposit A - 1992, 1993 BBL
356	62	30	50	622176.00000	393933.00000	Little Lake Butte des Morts RI/FS Deposit A - 1992, 1993 BBL
357	1,300	30	50	622027.00000	394233.00000	Woodward Clyde Deposit A Sediment Samples - 1994
359	960	30	50	622019.00000	394225.00000	Woodward Clyde Deposit A Sediment Samples - 1994
360	1,900	30	50	622012.00000	394232.00000	Woodward Clyde Deposit A Sediment Samples - 1994
381	240	30	50	622102.00000	394329.00000	Woodward Clyde Deposit A Sediment Samples - 1994
382	245	30	50	622094.00000	394336.00000	Woodward Clyde Deposit A Sediment Samples - 1994
384	2,800	30	50	622087.00000	394329.00000	Woodward Clyde Deposit A Sediment Samples - 1994
409	1,300	30	50	622091.00000	394339.00000	Woodward Clyde Deposit A Sediment Samples - 1994
410	2,400	30	50	622084.00000	394347.00000	Woodward Clyde Deposit A Sediment Samples - 1994
411	2,200	30	50	622084.00000	394331.00000	Woodward Clyde Deposit A Sediment Samples - 1994
412	6,600	30	50	622076.00000	394338.00000	Woodward Clyde Deposit A Sediment Samples - 1994
414	448	30	50	622443.00000	396220.00000	1994 Sediment Data - SAIC and GAS
415	1,021	30	50	622513.00000	396216.00000	1994 Sediment Data - SAIC and GAS
416	2,017	30	50	622470.00000	396172.00000	1994 Sediment Data - SAIC and GAS
418	2,840	30	50	622476.00000	396123.00000	1994 Sediment Data - SAIC and GAS
431	9,133	30	50	622479.00000	396363.00000	1994 Sediment Data - SAIC and GAS
432	3,195	30	50	622540.00000	396307.00000	1994 Sediment Data - SAIC and GAS
433	234	30	50	653519.00000	421727.00000	1994 Sediment Data - SAIC and GAS
436	19,710	30	50	653652.00000	422206.00000	1994 Sediment Data - SAIC and GAS
437	3,800	30	50	653704.00000	422176.00000	1994 Sediment Data - SAIC and GAS
439	8,860	30	50	653746.00000	422276.00000	1994 Sediment Data - SAIC and GAS
440	1,352	30	50	653826.00000	422269.00000	1994 Sediment Data - SAIC and GAS
441	37,870	30	50	653801.00000	422372.00000	1994 Sediment Data - SAIC and GAS

Table 1 PCB Data Retained for 2002 Interpolation

Station ID	Total PCB (µg/kg)	Start Depth (cm)	End Depth (cm)	Easting	Northing	Source
442	4,665	30	50	653828.00000	422346.00000	1994 Sediment Data - SAIC and GAS
443	429	30	50	653913.00000	422298.00000	1994 Sediment Data - SAIC and GAS
444	5,860	30	50	653601.00000	421697.00000	1994 Sediment Data - SAIC and GAS
445	3,140	30	50	653875.00000	422430.00000	1994 Sediment Data - SAIC and GAS
446	40,430	30	50	653920.00000	422414.00000	1994 Sediment Data - SAIC and GAS
447	37	30	50	653979.00000	422382.00000	1994 Sediment Data - SAIC and GAS
448	11,510	30	50	653940.00000	422510.00000	1994 Sediment Data - SAIC and GAS
449	9,875	30	50	653971.00000	422493.00000	1994 Sediment Data - SAIC and GAS
450	58	30	50	653942.00000	422635.00000	1994 Sediment Data - SAIC and GAS
451	7,873	30	50	654000.00000	422587.00000	1994 Sediment Data - SAIC and GAS
455	6,825	30	50	653542.00000	421812.00000	1994 Sediment Data - SAIC and GAS
456	15,990	30	50	653597.00000	421815.00000	1994 Sediment Data - SAIC and GAS
463	990	30	50	622812.00000	396379.00000	1994 Sediment Data - SAIC and GAS
464	55	30	50	622943.00000	396367.00000	1994 Sediment Data - SAIC and GAS
465	506	30	50	622836.00000	396317.00000	1994 Sediment Data - SAIC and GAS
466	356	30	50	622772.00000	396227.00000	1994 Sediment Data - SAIC and GAS
467	59	30	50	622876.00000	396229.00000	1994 Sediment Data - SAIC and GAS
468	440	30	50	622813.00000	396127.00000	1994 Sediment Data - SAIC and GAS
469	12,430	30	50	622907.00000	396135.00000	1994 Sediment Data - SAIC and GAS
470	45,850	30	50	622921.00000	396039.00000	1994 Sediment Data - SAIC and GAS
471	635	30	50	622805.00000	396755.00000	1994 Sediment Data - SAIC and GAS
472	157	30	50	622968.00000	396735.00000	1994 Sediment Data - SAIC and GAS
473	1,828	30	50	623065.00000	396756.00000	1994 Sediment Data - SAIC and GAS
474	116	30	50	622938.00000	396643.00000	1994 Sediment Data - SAIC and GAS
475	228	30	50	623002.00000	396647.00000	1994 Sediment Data - SAIC and GAS
476	145	30	50	622940.00000	396545.00000	1994 Sediment Data - SAIC and GAS
477	1,389	30	50	622876.00000	396451.00000	1994 Sediment Data - SAIC and GAS
478	113	30	50	622933.00000	396454.00000	1994 Sediment Data - SAIC and GAS
514	755	30	50	622814.00000	396041.00000	1994 Sediment Data - SAIC and GAS
517	311	30	50	623222.00000	395725.00000	1994 Sediment Data - SAIC and GAS
519	663	30	50	623154.00000	395629.00000	1994 Sediment Data - SAIC and GAS
521	4,630	30	50	623286.00000	395612.00000	1994 Sediment Data - SAIC and GAS
527	1,269	30	50	623153.00000	395446.00000	1994 Sediment Data - SAIC and GAS
530	11,760	30	50	622951.00000	395945.00000	1994 Sediment Data - SAIC and GAS
532	154	30	50	622786.00000	395852.00000	1994 Sediment Data - SAIC and GAS
533	24,750	30	50	622946.00000	395855.00000	1994 Sediment Data - SAIC and GAS
536	49,000	30	50	653705.00000	423640.00000	1995 Sediment Data Collection - WDNR
540	50	30	50	653664.00000	423781.00000	1995 Sediment Data Collection - WDNR
550	50	30	50	654004.00000	424247.00000	1995 Sediment Data Collection - WDNR
552	260	30	50	653972.00000	424476.00000	1995 Sediment Data Collection - WDNR
553	50	30	50	654145.00000	424420.00000	1995 Sediment Data Collection - WDNR
554	62	30	50	654277.00000	424629.00000	1995 Sediment Data Collection - WDNR
555	50	30	50	654468.00000	424517.00000	1995 Sediment Data Collection - WDNR
558	21,000	30	50	654632.00000	425018.00000	1995 Sediment Data Collection - WDNR
559	93	30	50	654527.00000	425099.00000	1995 Sediment Data Collection - WDNR
560	10,000	30	50	654724.00000	425151.00000	1995 Sediment Data Collection - WDNR
562	3,400	30	50	654706.00000	425301.00000	1995 Sediment Data Collection - WDNR
563	12,000	30	50	654821.00000	425528.00000	1995 Sediment Data Collection - WDNR
564	1,700	30	50	654910.00000	425829.00000	1995 Sediment Data Collection - WDNR
565	16,000	30	50	655027.00000	425773.00000	1995 Sediment Data Collection - WDNR
566	72	30	50	655060.00000	425667.00000	1995 Sediment Data Collection - WDNR
568	17,000	30	50	655102.00000	425930.00000	1995 Sediment Data Collection - WDNR
569	1,800	30	50	654997.00000	426162.00000	1995 Sediment Data Collection - WDNR
570	28,000	30	50	655185.00000	426011.00000	1995 Sediment Data Collection - WDNR
574	12,000	30	50	655365.00000	426355.00000	1995 Sediment Data Collection - WDNR
575	1,900	30	50	655334.00000	426528.00000	1995 Sediment Data Collection - WDNR
576	200	30	50	655515.00000	426324.00000	1995 Sediment Data Collection - WDNR
577	56	30	50	655696.00000	426176.00000	1995 Sediment Data Collection - WDNR
579	71	30	50	655613.00000	426595.00000	1995 Sediment Data Collection - WDNR
580	11,000	30	50	655808.00000	426432.00000	1995 Sediment Data Collection - WDNR
582	3,400	30	50	655687.00000	426956.00000	1995 Sediment Data Collection - WDNR
585	15,000	30	50	655760.00000	427136.00000	1995 Sediment Data Collection - WDNR
586	32,000	30	50	655964.00000	426984.00000	1995 Sediment Data Collection - WDNR
589	10,000	30	50	656131.00000	427158.00000	1995 Sediment Data Collection - WDNR
592	29,000	30	50	656093.00000	427193.00000	1995 Sediment Data Collection - WDNR
594	84	30	50	656138.00000	427520.00000	1995 Sediment Data Collection - WDNR
595	31,000	30	50	656290.00000	427451.00000	1995 Sediment Data Collection - WDNR
596	68	30	50	656360.00000	427731.00000	1995 Sediment Data Collection - WDNR

Table 1 PCB Data Retained for 2002 Interpolation

Station ID	Total PCB (µg/kg)	Start Depth (cm)	End Depth (cm)	Easting	Northing	Source
597	140	30	50	656482.00000	427603.00000	1995 Sediment Data Collection - WDNR
598	2,900	30	50	656602.00000	427850.00000	1995 Sediment Data Collection - WDNR
600	3,600	30	50	656765.00000	427876.00000	1995 Sediment Data Collection - WDNR
605	710	30	50	657067.00000	428151.00000	1995 Sediment Data Collection - WDNR
607	4,100	30	50	657019.00000	428392.00000	1995 Sediment Data Collection - WDNR
608	9,500	30	50	656974.00000	428716.00000	1995 Sediment Data Collection - WDNR
610	1,700	30	50	657106.00000	428892.00000	1995 Sediment Data Collection - WDNR
611	2,400	30	50	657051.00000	429205.00000	1995 Sediment Data Collection - WDNR
613	17,000	30	50	657053.00000	429347.00000	1995 Sediment Data Collection - WDNR
614	20,000	30	50	657203.00000	429271.00000	1995 Sediment Data Collection - WDNR
615	24,000	30	50	657207.00000	429467.00000	1995 Sediment Data Collection - WDNR
616	8,300	30	50	657183.00000	429742.00000	1995 Sediment Data Collection - WDNR
617	5,000	30	50	657304.00000	429884.00000	1995 Sediment Data Collection - WDNR
618	56	30	50	657329.00000	430152.00000	1995 Sediment Data Collection - WDNR
619	3,300	30	50	657333.00000	430378.00000	1995 Sediment Data Collection - WDNR
620	50	30	50	657394.00000	430361.00000	1995 Sediment Data Collection - WDNR
621	93	30	50	657404.00000	430528.00000	1995 Sediment Data Collection - WDNR
622	17,000	30	50	657537.00000	430706.00000	1995 Sediment Data Collection - WDNR
625	50	30	50	657665.00000	431175.00000	1995 Sediment Data Collection - WDNR
626	2,900	30	50	658106.00000	431389.00000	1995 Sediment Data Collection - WDNR
630	50	30	50	658145.00000	432242.00000	1995 Sediment Data Collection - WDNR
632	150	30	50	658169.00000	432684.00000	1995 Sediment Data Collection - WDNR
634	1,300	30	50	658320.00000	432711.00000	1995 Sediment Data Collection - WDNR
637	1,500	30	50	658377.00000	433240.00000	1995 Sediment Data Collection - WDNR
640	240	30	50	658855.00000	433589.00000	1995 Sediment Data Collection - WDNR
646	3,200	30	50	656127.00000	427343.00000	1995 Sediment Data Collection - WDNR
662	9,300	30	50	658035.00000	431313.00000	1995 Sediment Data Collection - WDNR
663	30,000	30	50	656974.00000	428716.00000	1995 Sediment Data Collection - WDNR
676	73,000	30	50	656627.00000	428119.00000	1997 Segment 56/57 Demonstration Project
677	27,000	30	50	656664.00000	428155.00000	1997 Segment 56/57 Demonstration Project
678	350,000	30	50	656678.00000	428177.00000	1997 Segment 56/57 Demonstration Project
679	49,000	30	50	656711.00000	428224.00000	1997 Segment 56/57 Demonstration Project
680	15,000	30	50	656737.00000	428250.00000	1997 Segment 56/57 Demonstration Project
681	26,000	30	50	656759.00000	428303.00000	1997 Segment 56/57 Demonstration Project
682	300,000	30	50	656789.00000	428311.00000	1997 Segment 56/57 Demonstration Project
683	180,000	30	50	656793.00000	428333.00000	1997 Segment 56/57 Demonstration Project
684	61,000	30	50	656626.00000	428070.00000	1997 Segment 56/57 Demonstration Project
685	5,800	30	50	656675.00000	428128.00000	1997 Segment 56/57 Demonstration Project
686	6,600	30	50	656707.00000	428158.00000	1997 Segment 56/57 Demonstration Project
687	19,000	30	50	656715.00000	428182.00000	1997 Segment 56/57 Demonstration Project
688	34,000	30	50	656740.00000	428222.00000	1997 Segment 56/57 Demonstration Project
689	330,000	30	50	656768.00000	428265.00000	1997 Segment 56/57 Demonstration Project
690	14,000	30	50	656819.00000	428286.00000	1997 Segment 56/57 Demonstration Project
691	6,200	30	50	656833.00000	428314.00000	1997 Segment 56/57 Demonstration Project
692	9,000	30	50	656682.00000	428100.00000	1997 Segment 56/57 Demonstration Project
693	6,300	30	50	656736.00000	428118.00000	1997 Segment 56/57 Demonstration Project
694	28,000	30	50	656757.00000	428158.00000	1997 Segment 56/57 Demonstration Project
695	91,000	30	50	656775.00000	428175.00000	1997 Segment 56/57 Demonstration Project
696	59,000	30	50	656788.00000	428199.00000	1997 Segment 56/57 Demonstration Project
697	23,000	30	50	656813.00000	428232.00000	1997 Segment 56/57 Demonstration Project
698	20,000	30	50	656843.00000	428268.00000	1997 Segment 56/57 Demonstration Project
699	43,000	30	50	656851.00000	428311.00000	1997 Segment 56/57 Demonstration Project
700	27,000	30	50	656715.00000	428085.00000	1997 Segment 56/57 Demonstration Project
701	11,000	30	50	656732.00000	428107.00000	1997 Segment 56/57 Demonstration Project
702	6,000	30	50	656755.00000	428132.00000	1997 Segment 56/57 Demonstration Project
703	59,000	30	50	656775.00000	428162.00000	1997 Segment 56/57 Demonstration Project
704	12,000	30	50	656796.00000	428187.00000	1997 Segment 56/57 Demonstration Project
705	2,170	30	50	656824.00000	428217.00000	1997 Segment 56/57 Demonstration Project
706	2,450	30	50	656854.00000	428249.00000	1997 Segment 56/57 Demonstration Project
707	2,000	30	50	656881.00000	428292.00000	1997 Segment 56/57 Demonstration Project
708	6,493	30	50	653288.00000	424012.00000	1998 BBL Sediment/Tissue Data Collected for FRG
709	1,450	30	50	655727.00000	427334.00000	1998 BBL Sediment/Tissue Data Collected for FRG
710	35,560	30	50	653637.00000	424326.00000	1998 BBL Sediment/Tissue Data Collected for FRG
711	291	30	50	654056.00000	423914.00000	1998 BBL Sediment/Tissue Data Collected for FRG
712	346	30	50	651849.00000	419517.00000	1998 BBL Sediment/Tissue Data Collected for FRG
713	22,100	30	50	654053.00000	423000.00000	1998 BBL Sediment/Tissue Data Collected for FRG
714	12,410	30	50	656178.00000	426925.00000	1998 BBL Sediment/Tissue Data Collected for FRG
715	230	30	50	691202.00000	479467.00000	1998 BBL Sediment/Tissue Data Collected for FRG

Table 1 PCB Data Retained for 2002 Interpolation

Station ID	Total PCB (µg/kg)	Start Depth (cm)	End Depth (cm)	Easting	Northing	Source
716	160	30	50	683304.00000	473073.00000	1998 BBL Sediment/Tissue Data Collected for FRG
717	175	30	50	678371.00000	468225.00000	1998 BBL Sediment/Tissue Data Collected for FRG
718	86	30	50	622110.00000	394079.00000	1998 BBL Sediment/Tissue Data Collected for FRG
720	6,800	30	50	653451.00000	423753.00000	1998 BBL Sediment/Tissue Data Collected for FRG
721	29,000	30	50	653283.00000	423944.00000	1998 BBL Sediment/Tissue Data Collected for FRG
722	1,700	30	50	653937.00000	423816.00000	1998 BBL Sediment/Tissue Data Collected for FRG
723	220	30	50	654292.00000	424276.00000	1998 BBL Sediment/Tissue Data Collected for FRG
724	11,000	30	50	653563.00000	424264.00000	1998 BBL Sediment/Tissue Data Collected for FRG
725	25,000	30	50	653823.00000	424431.00000	1998 BBL Sediment/Tissue Data Collected for FRG
726	85	30	50	655574.00000	426060.00000	1998 BBL Sediment/Tissue Data Collected for FRG
727	1,450	30	50	654879.00000	426038.00000	1998 BBL Sediment/Tissue Data Collected for FRG
729	12,000	30	50	655871.00000	426691.00000	1998 BBL Sediment/Tissue Data Collected for FRG
730	1,100	30	50	655373.00000	426737.00000	1998 BBL Sediment/Tissue Data Collected for FRG
731	4,200	30	50	655772.00000	427397.00000	1998 BBL Sediment/Tissue Data Collected for FRG
732	2,000	30	50	656936.00000	428585.00000	1998 BBL Sediment/Tissue Data Collected for FRG
733	15,000	30	50	656172.00000	426951.00000	1998 BBL Sediment/Tissue Data Collected for FRG
734	90	30	50	657293.00000	429150.00000	1998 BBL Sediment/Tissue Data Collected for FRG
735	3,340	30	50	657519.00000	430923.00000	1998 BBL Sediment/Tissue Data Collected for FRG
736	10,300	30	50	654043.00000	423072.00000	1998 BBL Sediment/Tissue Data Collected for FRG
737	1,520	30	50	654264.00000	423040.00000	1998 BBL Sediment/Tissue Data Collected for FRG
738	1,860	30	50	654232.00000	423224.00000	1998 BBL Sediment/Tissue Data Collected for FRG
739	27,800	30	50	654248.00000	422771.00000	1998 BBL Sediment/Tissue Data Collected for FRG
740	17,900	30	50	654056.00000	422936.00000	1998 BBL Sediment/Tissue Data Collected for FRG
741	15,700	30	50	654026.00000	422804.00000	1998 BBL Sediment/Tissue Data Collected for FRG
742	710	30	50	653565.00000	421987.00000	1998 BBL Sediment/Tissue Data Collected for FRG
743	17,200	30	50	622104.00000	394050.00000	1998 BBL Sediment/Tissue Data Collected for FRG
744	720	30	50	622060.00000	395135.00000	1998 BBL Sediment/Tissue Data Collected for FRG
745	220	30	50	622827.00000	395345.00000	1998 BBL Sediment/Tissue Data Collected for FRG
746	75	30	50	622860.00000	395651.00000	1998 BBL Sediment/Tissue Data Collected for FRG
748	2,150	30	50	622300.00000	396072.00000	1998 BBL Sediment/Tissue Data Collected for FRG
749	180	30	50	622803.00000	397973.00000	1998 BBL Sediment/Tissue Data Collected for FRG
750	140	30	50	623639.00000	397926.00000	1998 BBL Sediment/Tissue Data Collected for FRG
752	650	30	50	651861.00000	419514.00000	1998 BBL Sediment/Tissue Data Collected for FRG
753	100	30	50	650629.00000	417122.00000	1998 BBL Sediment/Tissue Data Collected for FRG
754	69	30	50	651753.00000	418576.00000	1998 BBL Sediment/Tissue Data Collected for FRG
755	130	30	50	640397.00000	405514.00000	1998 BBL Sediment/Tissue Data Collected for FRG
756	155	30	50	640888.00000	405297.00000	1998 BBL Sediment/Tissue Data Collected for FRG
757	169	30	50	640869.00000	406011.00000	1998 BBL Sediment/Tissue Data Collected for FRG
758	54	30	50	641274.00000	405974.00000	1998 BBL Sediment/Tissue Data Collected for FRG
759	1,420	30	50	633380.00000	404149.00000	1998 BBL Sediment/Tissue Data Collected for FRG
820	27,000	30	50	632673.00000	403918.00000	1998 Deposit N Post-Dredge Sediment Data
835	4,500	30	50	632933.00000	403930.00000	1998 Deposit N Post-Dredge Sediment Data
836	3,140	30	50	632917.00000	403956.00000	1998 Deposit N Post-Dredge Sediment Data
837	3,040	30	50	632927.00000	403971.00000	1998 Deposit N Post-Dredge Sediment Data
838	784	30	50	632947.00000	403962.00000	1998 Deposit N Post-Dredge Sediment Data
842	5,500	30	50	632854.00000	403974.00000	1998 Deposit N Post-Dredge Sediment Data
851	15	30	50	622127.00000	395069.00000	1998 RI/FS Supplemental Data Collection
852	40	30	50	622059.00000	395131.00000	1998 RI/FS Supplemental Data Collection
854	39	30	50	621983.00000	395297.00000	1998 RI/FS Supplemental Data Collection
861	20	30	50	623005.00000	397187.00000	1998 RI/FS Supplemental Data Collection
862	36	30	50	622645.00000	397239.00000	1998 RI/FS Supplemental Data Collection
864	24	30	50	623351.00000	398284.00000	1998 RI/FS Supplemental Data Collection
866	48	30	50	623924.00000	399588.00000	1998 RI/FS Supplemental Data Collection
867	12	30	50	649720.00000	416637.00000	1998 RI/FS Supplemental Data Collection
868	7	30	50	649864.00000	416457.00000	1998 RI/FS Supplemental Data Collection
869	147	30	50	650293.00000	416683.00000	1998 RI/FS Supplemental Data Collection
870	20	30	50	649892.00000	416886.00000	1998 RI/FS Supplemental Data Collection
871	206	30	50	650610.00000	417130.00000	1998 RI/FS Supplemental Data Collection
872	20	30	50	650367.00000	417157.00000	1998 RI/FS Supplemental Data Collection
873	10	30	50	650157.00000	417240.00000	1998 RI/FS Supplemental Data Collection
874	20	30	50	651097.00000	417622.00000	1998 RI/FS Supplemental Data Collection
875	17	30	50	650734.00000	417809.00000	1998 RI/FS Supplemental Data Collection
876	26	30	50	651506.00000	418122.00000	1998 RI/FS Supplemental Data Collection
877	20	30	50	651689.00000	418258.00000	1998 RI/FS Supplemental Data Collection
879	20	30	50	651279.00000	418455.00000	1998 RI/FS Supplemental Data Collection
880	8	30	50	651999.00000	419029.00000	1998 RI/FS Supplemental Data Collection
881	20	30	50	651772.00000	419176.00000	1998 RI/FS Supplemental Data Collection
882	20	30	50	652076.00000	419680.00000	1998 RI/FS Supplemental Data Collection

Table 1 PCB Data Retained for 2002 Interpolation

Station ID	Total PCB (µg/kg)	Start Depth (cm)	End Depth (cm)	Easting	Northing	Source
883	15	30	50	651954.00000	419722.00000	1998 RI/FS Supplemental Data Collection
884	10	30	50	652773.00000	420221.00000	1998 RI/FS Supplemental Data Collection
887	363	30	50	653126.00000	420884.00000	1998 RI/FS Supplemental Data Collection
888	350	30	50	653127.00000	421088.00000	1998 RI/FS Supplemental Data Collection
890	20	30	50	653475.00000	421564.00000	1998 RI/FS Supplemental Data Collection
896	20	30	50	640569.00000	404836.00000	1998 RI/FS Supplemental Data Collection
899	6	30	50	641133.00000	405822.00000	1998 RI/FS Supplemental Data Collection
900	20	30	50	641283.00000	406149.00000	1998 RI/FS Supplemental Data Collection
901	20	30	50	640253.00000	405296.00000	1998 RI/FS Supplemental Data Collection
902	20	30	50	640476.00000	405457.00000	1998 RI/FS Supplemental Data Collection
904	20	30	50	640797.00000	405799.00000	1998 RI/FS Supplemental Data Collection
11001	128	50	100	623043.25902	397867.66114	2000–01 CH2M HILL
11002	353	50	100	623139.73195	397836.13803	2000–01 CH2M HILL
11003	248	50	100	623045.13412	397767.69608	2000–01 CH2M HILL
11005	105	50	100	623205.09085	397759.58726	2000–01 CH2M HILL
11006	6,550	50	100	623154.03831	397925.29576	2000–01 CH2M HILL
11007	97	50	100	623266.90297	397871.86000	2000–01 CH2M HILL
11008	1,366	50	100	623200.70989	397992.83908	2000–01 CH2M HILL
11010	77	50	100	622893.37341	397764.85120	2000–01 CH2M HILL
11011	99	50	100	622958.93820	397677.19080	2000–01 CH2M HILL
11012	726	50	100	623118.68847	397680.18706	2000–01 CH2M HILL
11014	36,350	50	100	622899.98973	396131.64189	2000–01 CH2M HILL
11015	63,750	50	100	622901.65364	396042.78429	2000–01 CH2M HILL
11017	124,400	50	100	622929.15855	395854.41080	2000–01 CH2M HILL
11018	1,510	50	100	622931.44675	395732.23166	2000–01 CH2M HILL
11020	77	50	100	622669.44123	395638.44145	2000–01 CH2M HILL
11022	178	50	100	622711.67514	395517.00904	2000–01 CH2M HILL
11023	77	50	90	622678.57039	396005.27753	2000–01 CH2M HILL
11032	77	50	100	623128.27678	395891.47632	2000–01 CH2M HILL
11033	152	50	63	622995.36580	395733.42905	2000–01 CH2M HILL
11038	77	50	60	623047.26094	395523.29085	2000–01 CH2M HILL
11041	77	50	100	622712.29803	395483.68747	2000–01 CH2M HILL
11043	77	50	100	622678.88428	395560.84043	2000–01 CH2M HILL
11046	77	50	100	622733.98417	395606.31470	2000–01 CH2M HILL
11048	77	50	100	622708.97591	395661.40253	2000–01 CH2M HILL
11050	77	50	100	622755.66937	395728.94204	2000–01 CH2M HILL
11052	101	50	100	621942.40859	395191.56545	2000–01 CH2M HILL
11053	81	50	75	621943.02751	395158.24390	2000–01 CH2M HILL
11054	77	50	100	622030.92363	395159.87709	2000–01 CH2M HILL
11055	122	50	90	622028.03321	395315.37767	2000–01 CH2M HILL
11058	77	50	100	622228.41278	395285.77229	2000–01 CH2M HILL
11059	158	50	83	622141.55154	395228.60050	2000–01 CH2M HILL
11060	77	50	100	622229.44677	395230.23636	2000–01 CH2M HILL
11061	77	50	100	622230.68754	395163.59326	2000–01 CH2M HILL
11062	77	50	100	622144.03128	395095.31430	2000–01 CH2M HILL
11069	77	50	90	622177.71691	394573.72297	2000–01 CH2M HILL
12000	119	50	100	623376.42687	397996.14183	2000–01 CH2M HILL
12001	175	50	100	623121.60689	397524.68591	2000–01 CH2M HILL
12002	158	50	100	622961.85283	397521.68966	2000–01 CH2M HILL
12003	77	50	100	622762.16025	397517.94981	2000–01 CH2M HILL
12005	77	50	100	622583.52506	397670.16491	2000–01 CH2M HILL
12006	77	50	100	622759.25036	397673.45095	2000–01 CH2M HILL
12090	5,475	50	100	622974.10122	395588.58645	2000–01 CH2M HILL
12097	77	50	66	622858.19995	395375.30569	2000–01 CH2M HILL
12101	149	50	72	622844.29773	395263.93476	2000–01 CH2M HILL
12103	81	50	84	622966.23486	395155.10677	2000–01 CH2M HILL
12104	77	50	62	623150.85170	395114.12287	2000–01 CH2M HILL
12105	240	50	71	623345.33974	394973.32959	2000–01 CH2M HILL
12107	84	50	73	623738.56431	394891.83973	2000–01 CH2M HILL
12121	242	50	86	621894.45575	393468.47056	2000–01 CH2M HILL
12122	1,132	50	84	621912.09010	393379.90999	2000–01 CH2M HILL
12123	1,012	50	95	621946.74146	393236.11044	2000–01 CH2M HILL
12133	523	50	70	622993.41099	395411.17079	2000–01 CH2M HILL
DA01S-06	77	50	100	622290.21530	394542.48406	2001 Blasland, Bouck, and Lee
DA01S-08	77	50	90	622022.43205	394326.39335	2001 Blasland, Bouck, and Lee
DA01S-09	77	50	100	622203.75777	394463.09736	2001 Blasland, Bouck, and Lee
DA01S-10	77	50	85	622044.96176	394404.58907	2001 Blasland, Bouck, and Lee
DA01S-11	77	50	100	622308.68047	394409.49567	2001 Blasland, Bouck, and Lee

Table 1 PCB Data Retained for 2002 Interpolation

Station ID	Total PCB (µg/kg)	Start Depth (cm)	End Depth (cm)	Easting	Northing	Source
DA01S-13	81	50	100	622125.28965	394383.86046	2001 Blasland, Bouck, and Lee
DA01S-14	81	50	100	622197.41987	394374.09128	2001 Blasland, Bouck, and Lee
DA01S-15	81	50	100	621991.08477	394292.47794	2001 Blasland, Bouck, and Lee
DA01S-16	81	50	91	621928.59544	394213.54043	2001 Blasland, Bouck, and Lee
DA01S-17	81	50	100	622152.15660	394228.80600	2001 Blasland, Bouck, and Lee
DA01S-18	81	50	76	622383.91569	394233.12095	2001 Blasland, Bouck, and Lee
DA01S-19	84	50	87	621945.40384	394169.40854	2001 Blasland, Bouck, and Lee
DA01S-20	77	50	100	622145.81759	394139.80002	2001 Blasland, Bouck, and Lee
DA01S-21	102	50	100	622027.59162	394048.71418	2001 Blasland, Bouck, and Lee
DA01S-22	109	50	100	622171.65260	394040.28149	2001 Blasland, Bouck, and Lee
DA01S-24	77	50	66	622371.86458	394021.78695	2001 Blasland, Bouck, and Lee
DE01S-02	0	50	100	622958.57438	396843.84995	2001 Blasland, Bouck, and Lee
DE01S-03	0	50	100	622790.39959	396862.92293	2001 Blasland, Bouck, and Lee
DE01S-05	0	50	100	622811.66245	397007.76522	2001 Blasland, Bouck, and Lee
DE01S-06	0	50	95	623035.54384	397000.84838	2001 Blasland, Bouck, and Lee
DE01S-07	0	50	100	622635.50410	397026.69256	2001 Blasland, Bouck, and Lee
DE01S-09	0	50	100	622889.46536	397120.33307	2001 Blasland, Bouck, and Lee
DE01S-10	268	50	84	622752.21147	397195.54149	2001 Blasland, Bouck, and Lee
DE01S-11	0	50	100	622966.64100	397266.22356	2001 Blasland, Bouck, and Lee
DE01S-12	0	50	100	622749.92555	397317.72090	2001 Blasland, Bouck, and Lee
DE01S-13	0	50	100	622581.34856	397359.01342	2001 Blasland, Bouck, and Lee
DE01S-14	184	50	100	623060.83044	397356.87861	2001 Blasland, Bouck, and Lee
DE01S-16	0	50	100	622618.79681	397493.04644	2001 Blasland, Bouck, and Lee
DE01S-17	0	50	53	623336.23078	397584.27316	2001 Blasland, Bouck, and Lee
DE01S-18	0	50	100	623199.81519	397615.04330	2001 Blasland, Bouck, and Lee
DE01S-19	0	50	100	623333.51604	397728.66710	2001 Blasland, Bouck, and Lee
DE01S-20	0	50	78	623460.89732	397753.28557	2001 Blasland, Bouck, and Lee
DE01S-21	0	50	100	623378.93386	397862.85506	2001 Blasland, Bouck, and Lee
DE01S-22	0	50	100	623577.98855	397899.93558	2001 Blasland, Bouck, and Lee
DE01S-23	0	50	100	623481.51419	397931.45227	2001 Blasland, Bouck, and Lee
DE01S-24	0	50	100	623607.21656	398044.93157	2001 Blasland, Bouck, and Lee
DE01S-25	7,300	50	100	623271.75914	398038.61856	2001 Blasland, Bouck, and Lee
DE01S-26	0	50	100	623487.41033	398042.67496	2001 Blasland, Bouck, and Lee
DE01S-27	0	50	76	623151.11875	398080.79701	2001 Blasland, Bouck, and Lee
DE01S-28	23	50	100	622908.85214	397365.14078	2001 Blasland, Bouck, and Lee
DE01S-29	3,100	50	100	623349.33225	398162.29968	2001 Blasland, Bouck, and Lee
DE01S-30	0	50	100	623661.03204	398157.05775	2001 Blasland, Bouck, and Lee
DE01S-31	36	50	100	623516.84867	398176.56332	2001 Blasland, Bouck, and Lee
DE01S-35	8,600	50	100	623482.60072	398298.14136	2001 Blasland, Bouck, and Lee
DE01S-36	250	50	100	623609.55170	398344.97746	2001 Blasland, Bouck, and Lee
DE01S-38	0	50	97	623751.63594	398436.54638	2001 Blasland, Bouck, and Lee
DE01S-39	0	50	100	623519.81512	398443.28743	2001 Blasland, Bouck, and Lee
PD-A/B-01	22	58	63	622144.76241	394512.45038	2002 Foth and Van Dyke
PD-A/B-03	78	60	71	622061.01005	394327.15623	2002 Foth and Van Dyke
PD-A/B-03	28	71	76	622061.01005	394327.15623	2002 Foth and Van Dyke
PD-A/B-05	300	60	76	621934.27041	394214.98410	2002 Foth and Van Dyke
PD-A/B-08	29	60	66	622057.71257	394122.99089	2002 Foth and Van Dyke
PD-A/B-11	73	60	91	622137.27207	394034.33780	2002 Foth and Van Dyke
PD-A/B-14	32	50	55	622136.68399	393954.19542	2002 Foth and Van Dyke
SD060010	952	10	100	643505.69688	418370.60463	2001 Blasland, Bouck, and Lee
SD050010	1,090	10	100	643136.57673	418030.32679	2001 Blasland, Bouck, and Lee
SD040010	13,240	10	100	642925.59385	416070.79553	2001 Blasland, Bouck, and Lee
SD030010	6,100	10	100	642008.92762	415509.24629	2001 Blasland, Bouck, and Lee
SD020010	95	10	100	642343.43544	414715.46960	2001 Blasland, Bouck, and Lee
SD010010	5,880	10	100	642142.48342	414345.06166	2001 Blasland, Bouck, and Lee
324	3,815	50	100	621988.75000	393929.71880	Little Lake Butte des Morts RI/FS Deposit A - 1992, 1993 BBL
382	245	50	100	622093.75000	394336.15630	Woodward Clyde Deposit A Sediment Samples - 1994
409	1,300	50	100	622091.31250	394338.90630	Woodward Clyde Deposit A Sediment Samples - 1994
410	2,400	50	100	622084.00000	394346.50000	Woodward Clyde Deposit A Sediment Samples - 1994
411	2,200	50	100	622084.31250	394330.96880	Woodward Clyde Deposit A Sediment Samples - 1994
412	6,600	50	100	622076.37500	394338.28130	Woodward Clyde Deposit A Sediment Samples - 1994
415	249	50	100	622512.93750	396216.37500	1994 Sediment Data - SAIC and GAS
416	459	50	100	622469.50000	396172.09380	1994 Sediment Data - SAIC and GAS
418	654	50	100	622475.93750	396122.68750	1994 Sediment Data - SAIC and GAS
431	9,133	50	100	622479.43750	396362.87500	1994 Sediment Data - SAIC and GAS
432	1,018	50	100	622540.43750	396307.12500	1994 Sediment Data - SAIC and GAS
433	155	50	100	653519.06250	421727.43750	1994 Sediment Data - SAIC and GAS
436	4,509	50	100	653652.43750	422206.06250	1994 Sediment Data - SAIC and GAS

Table 1 PCB Data Retained for 2002 Interpolation

Station ID	Total PCB (µg/kg)	Start Depth (cm)	End Depth (cm)	Easting	Northing	Source
437	3,800	50	100	653703.62500	422175.90630	1994 Sediment Data - SAIC and GAS
439	2,052	50	100	653746.37500	422275.87500	1994 Sediment Data - SAIC and GAS
440	1,352	50	100	653826.06250	422268.81250	1994 Sediment Data - SAIC and GAS
441	9,511	50	100	653800.50000	422372.25000	1994 Sediment Data - SAIC and GAS
442	1,582	50	100	653828.31250	422345.96880	1994 Sediment Data - SAIC and GAS
443	120	50	100	653913.06250	422297.90630	1994 Sediment Data - SAIC and GAS
444	1,409	50	100	653600.75000	421697.28130	1994 Sediment Data - SAIC and GAS
445	763	50	100	653875.43750	422429.81250	1994 Sediment Data - SAIC and GAS
446	8,948	50	100	653919.62500	422413.50000	1994 Sediment Data - SAIC and GAS
447	24	50	100	653978.75000	422382.21880	1994 Sediment Data - SAIC and GAS
448	2,582	50	100	653939.87500	422510.18750	1994 Sediment Data - SAIC and GAS
449	2,247	50	100	653970.68750	422493.37500	1994 Sediment Data - SAIC and GAS
451	1,861	50	100	654000.25000	422586.93750	1994 Sediment Data - SAIC and GAS
455	1,588	50	100	653542.25000	421812.31250	1994 Sediment Data - SAIC and GAS
456	3,701	50	100	653596.62500	421814.71880	1994 Sediment Data - SAIC and GAS
464	28	50	100	622942.93750	396367.15630	1994 Sediment Data - SAIC and GAS
465	127	50	100	622835.87500	396317.25000	1994 Sediment Data - SAIC and GAS
466	136	50	100	622772.12500	396226.84380	1994 Sediment Data - SAIC and GAS
467	59	50	100	622875.93750	396228.84380	1994 Sediment Data - SAIC and GAS
468	440	50	100	622813.06250	396127.46880	1994 Sediment Data - SAIC and GAS
469	3,401	50	100	622907.25000	396135.18750	1994 Sediment Data - SAIC and GAS
470	15,760	50	100	622921.06250	396038.59380	1994 Sediment Data - SAIC and GAS
471	155	50	100	622805.06250	396755.15630	1994 Sediment Data - SAIC and GAS
472	63	50	100	622968.00000	396735.37500	1994 Sediment Data - SAIC and GAS
473	763	50	100	623064.81250	396755.93750	1994 Sediment Data - SAIC and GAS
474	116	50	100	622937.75000	396643.18750	1994 Sediment Data - SAIC and GAS
475	66	50	100	623002.43750	396647.15630	1994 Sediment Data - SAIC and GAS
476	59	50	100	622940.31250	396544.90630	1994 Sediment Data - SAIC and GAS
477	396	50	100	622876.06250	396451.18750	1994 Sediment Data - SAIC and GAS
478	41	50	100	622933.31250	396453.87500	1994 Sediment Data - SAIC and GAS
514	755	50	100	622813.62500	396041.31250	1994 Sediment Data - SAIC and GAS
527	1,269	50	100	623153.43750	395445.87500	1994 Sediment Data - SAIC and GAS
530	13,410	50	100	622950.81250	395944.84380	1994 Sediment Data - SAIC and GAS
532	154	50	100	622786.06250	395852.12500	1994 Sediment Data - SAIC and GAS
533	83,080	50	100	622945.87500	395855.34380	1994 Sediment Data - SAIC and GAS
536	48,820	50	100	653705.31250	423639.87500	1995 Sediment Data Collection - WDNR
540	50	50	100	653663.62500	423780.59380	1995 Sediment Data Collection - WDNR
550	50	50	100	654004.37500	424246.71880	1995 Sediment Data Collection - WDNR
552	260	50	100	653972.25000	424475.84380	1995 Sediment Data Collection - WDNR
553	50	50	100	654145.00000	424419.53130	1995 Sediment Data Collection - WDNR
554	62	50	100	654277.06250	424629.37500	1995 Sediment Data Collection - WDNR
555	50	50	100	654467.75000	424517.37500	1995 Sediment Data Collection - WDNR
556	51	50	100	654492.75000	424620.21880	1995 Sediment Data Collection - WDNR
558	17,350	50	100	654631.62500	425017.53130	1995 Sediment Data Collection - WDNR
559	85	50	100	654526.62500	425099.12500	1995 Sediment Data Collection - WDNR
560	8,232	50	100	654723.87500	425150.68750	1995 Sediment Data Collection - WDNR
562	2,804	50	100	654705.56250	425301.37500	1995 Sediment Data Collection - WDNR
563	9,908	50	100	654820.87500	425528.25000	1995 Sediment Data Collection - WDNR
564	12,730	50	100	654910.00000	425828.62500	1995 Sediment Data Collection - WDNR
565	13,320	50	100	655026.75000	425772.50000	1995 Sediment Data Collection - WDNR
566	72	50	100	655060.31250	425667.34380	1995 Sediment Data Collection - WDNR
568	14,080	50	100	655101.93750	425929.50000	1995 Sediment Data Collection - WDNR
569	1,485	50	100	654996.93750	426161.87500	1995 Sediment Data Collection - WDNR
570	23,750	50	100	655185.25000	426011.34380	1995 Sediment Data Collection - WDNR
574	9,855	50	100	655364.87500	426354.96880	1995 Sediment Data Collection - WDNR
575	1,570	50	100	655334.37500	426528.18750	1995 Sediment Data Collection - WDNR
576	200	50	100	655515.37500	426323.93750	1995 Sediment Data Collection - WDNR
577	56	50	100	655695.56250	426175.59380	1995 Sediment Data Collection - WDNR
579	71	50	100	655613.43750	426594.68750	1995 Sediment Data Collection - WDNR
580	9,047	50	100	655807.75000	426431.68750	1995 Sediment Data Collection - WDNR
582	6,928	50	100	655686.87500	426956.34380	1995 Sediment Data Collection - WDNR
585	12,430	50	100	655760.37500	427135.75000	1995 Sediment Data Collection - WDNR
586	27,320	50	100	655964.31250	426984.09380	1995 Sediment Data Collection - WDNR
589	11,800	50	100	656130.81250	427158.34380	1995 Sediment Data Collection - WDNR
592	23,950	50	100	656092.68750	427193.15630	1995 Sediment Data Collection - WDNR
594	84	50	100	656137.87500	427520.28130	1995 Sediment Data Collection - WDNR
595	27,940	50	100	656290.31250	427451.12500	1995 Sediment Data Collection - WDNR
596	68	50	100	656360.12500	427730.84380	1995 Sediment Data Collection - WDNR

Table 1 PCB Data Retained for 2002 Interpolation

Station ID	Total PCB (µg/kg)	Start Depth (cm)	End Depth (cm)	Easting	Northing	Source
597	140	50	100	656481.62500	427602.62500	1995 Sediment Data Collection - WDNR
598	2,387	50	100	656602.18750	427850.21880	1995 Sediment Data Collection - WDNR
600	2,968	50	100	656765.18750	427876.37500	1995 Sediment Data Collection - WDNR
605	710	50	100	657066.75000	428150.59380	1995 Sediment Data Collection - WDNR
607	6,422	50	100	657019.37500	428391.93750	1995 Sediment Data Collection - WDNR
608	18,230	50	100	656973.62500	428716.46880	1995 Sediment Data Collection - WDNR
610	1,407	50	100	657105.56250	428891.75000	1995 Sediment Data Collection - WDNR
611	1,990	50	100	657050.68750	429205.31250	1995 Sediment Data Collection - WDNR
613	24,200	50	100	657053.18750	429346.90630	1995 Sediment Data Collection - WDNR
614	20,180	50	100	657203.12500	429271.43750	1995 Sediment Data Collection - WDNR
615	20,080	50	100	657206.87500	429466.59380	1995 Sediment Data Collection - WDNR
616	6,826	50	100	657183.25000	429741.84380	1995 Sediment Data Collection - WDNR
617	4,622	50	100	657303.62500	429884.21880	1995 Sediment Data Collection - WDNR
618	56	50	100	657328.68750	430151.96880	1995 Sediment Data Collection - WDNR
619	2,717	50	100	657332.87500	430377.87500	1995 Sediment Data Collection - WDNR
620	50	50	100	657394.12500	430360.81250	1995 Sediment Data Collection - WDNR
621	85	50	100	657403.62500	430527.78130	1995 Sediment Data Collection - WDNR
622	15,040	50	100	657537.18750	430705.68750	1995 Sediment Data Collection - WDNR
625	50	50	100	657665.31250	431175.40630	1995 Sediment Data Collection - WDNR
626	2,900	50	100	658105.87500	431388.78130	1995 Sediment Data Collection - WDNR
630	50	50	100	658144.56250	432242.37500	1995 Sediment Data Collection - WDNR
632	150	50	100	658168.56250	432683.84380	1995 Sediment Data Collection - WDNR
634	1,300	50	100	658320.25000	432710.87500	1995 Sediment Data Collection - WDNR
637	1,500	50	100	658376.62500	433240.37500	1995 Sediment Data Collection - WDNR
639	11,000	50	100	658537.18750	433660.37500	1995 Sediment Data Collection - WDNR
640	240	50	100	658854.75000	433589.40630	1995 Sediment Data Collection - WDNR
646	2,741	50	100	656127.12500	427343.31250	1995 Sediment Data Collection - WDNR
662	9,300	50	100	658035.06250	431313.31250	1995 Sediment Data Collection - WDNR
663	74,430	50	100	656973.62500	428716.46880	1995 Sediment Data Collection - WDNR
676	38,560	50	100	656627.31250	428118.56250	1997 Segment 56/57 Demonstration Project
677	30,840	50	100	656664.25000	428154.96880	1997 Segment 56/57 Demonstration Project
678	185,000	50	100	656678.06250	428176.59380	1997 Segment 56/57 Demonstration Project
679	136,800	50	100	656711.43750	428223.71880	1997 Segment 56/57 Demonstration Project
680	77,700	50	100	656736.87500	428249.96880	1997 Segment 56/57 Demonstration Project
681	168,900	50	100	656759.00000	428302.96880	1997 Segment 56/57 Demonstration Project
682	547,800	50	100	656788.87500	428310.50000	1997 Segment 56/57 Demonstration Project
683	169,800	50	100	656792.56250	428332.81250	1997 Segment 56/57 Demonstration Project
684	40,550	50	100	656626.06250	428070.06250	1997 Segment 56/57 Demonstration Project
685	9,916	50	100	656674.62500	428128.06250	1997 Segment 56/57 Demonstration Project
686	8,892	50	100	656707.25000	428157.84380	1997 Segment 56/57 Demonstration Project
687	123,300	50	100	656714.87500	428182.12500	1997 Segment 56/57 Demonstration Project
688	248,100	50	100	656740.43750	428221.93750	1997 Segment 56/57 Demonstration Project
689	444,600	50	100	656767.68750	428264.59380	1997 Segment 56/57 Demonstration Project
690	144,600	50	100	656818.87500	428285.90630	1997 Segment 56/57 Demonstration Project
691	270,800	50	100	656833.18750	428314.34380	1997 Segment 56/57 Demonstration Project
692	2,102	50	100	656681.93750	428100.12500	1997 Segment 56/57 Demonstration Project
693	20,890	50	100	656735.81250	428118.40630	1997 Segment 56/57 Demonstration Project
694	46,300	50	100	656756.75000	428157.81250	1997 Segment 56/57 Demonstration Project
695	45,460	50	100	656775.12500	428174.93750	1997 Segment 56/57 Demonstration Project
696	23,850	50	100	656788.25000	428198.71880	1997 Segment 56/57 Demonstration Project
697	5,615	50	100	656813.31250	428232.03130	1997 Segment 56/57 Demonstration Project
698	4,897	50	100	656842.50000	428267.93750	1997 Segment 56/57 Demonstration Project
699	77,220	50	100	656851.43750	428310.75000	1997 Segment 56/57 Demonstration Project
700	20,280	50	100	656714.56250	428085.18750	1997 Segment 56/57 Demonstration Project
701	37,460	50	100	656732.37500	428106.90630	1997 Segment 56/57 Demonstration Project
702	26,040	50	100	656754.75000	428131.84380	1997 Segment 56/57 Demonstration Project
703	31,460	50	100	656775.43750	428162.28130	1997 Segment 56/57 Demonstration Project
704	8,220	50	100	656795.81250	428187.15630	1997 Segment 56/57 Demonstration Project
705	588	50	100	656824.06250	428216.87500	1997 Segment 56/57 Demonstration Project
706	658	50	100	656854.00000	428249.06250	1997 Segment 56/57 Demonstration Project
707	1,916	50	100	656881.06250	428292.03130	1997 Segment 56/57 Demonstration Project
708	74,090	50	100	653287.87500	424012.18750	1998 BBL Sediment/Tissue Data Collected for FRG
709	12,530	50	100	655727.00000	427333.50000	1998 BBL Sediment/Tissue Data Collected for FRG
710	880	50	100	653636.81250	424326.40630	1998 BBL Sediment/Tissue Data Collected for FRG
711	81	50	100	654055.81250	423913.68750	1998 BBL Sediment/Tissue Data Collected for FRG
712	264	50	100	651848.68750	419516.90630	1998 BBL Sediment/Tissue Data Collected for FRG
713	4,998	50	100	654052.62500	422999.68750	1998 BBL Sediment/Tissue Data Collected for FRG
714	2,075	50	100	656178.00000	426925.40630	1998 BBL Sediment/Tissue Data Collected for FRG

Table 1 PCB Data Retained for 2002 Interpolation

Station ID	Total PCB (µg/kg)	Start Depth (cm)	End Depth (cm)	Easting	Northing	Source
715	130	50	100	691202.12500	479466.50000	1998 BBL Sediment/Tissue Data Collected for FRG
717	170	50	100	678371.18750	468225.31250	1998 BBL Sediment/Tissue Data Collected for FRG
719	180	50	100	678371.18750	468225.31250	1998 BBL Sediment/Tissue Data Collected for FRG
720	2,237	50	100	653450.81250	423753.18750	1998 BBL Sediment/Tissue Data Collected for FRG
721	9,913	50	100	653282.62500	423944.00000	1998 BBL Sediment/Tissue Data Collected for FRG
722	13,630	50	100	653937.00000	423816.18750	1998 BBL Sediment/Tissue Data Collected for FRG
723	126	50	100	654291.50000	424276.31250	1998 BBL Sediment/Tissue Data Collected for FRG
724	2,473	50	100	653563.12500	424263.68750	1998 BBL Sediment/Tissue Data Collected for FRG
725	6,442	50	100	653822.50000	424430.90630	1998 BBL Sediment/Tissue Data Collected for FRG
726	85	50	100	655573.50000	426059.59380	1998 BBL Sediment/Tissue Data Collected for FRG
727	1,450	50	100	654878.50000	426037.50000	1998 BBL Sediment/Tissue Data Collected for FRG
728	83	50	100	655143.37500	426271.81250	1998 BBL Sediment/Tissue Data Collected for FRG
729	17,460	50	100	655871.00000	426691.09380	1998 BBL Sediment/Tissue Data Collected for FRG
730	301	50	100	655372.68750	426736.90630	1998 BBL Sediment/Tissue Data Collected for FRG
731	18,860	50	100	655771.50000	427396.68750	1998 BBL Sediment/Tissue Data Collected for FRG
732	3,739	50	100	656936.31250	428585.09380	1998 BBL Sediment/Tissue Data Collected for FRG
733	11,880	50	100	656171.87500	426950.68750	1998 BBL Sediment/Tissue Data Collected for FRG
734	113	50	100	657293.31250	429150.09380	1998 BBL Sediment/Tissue Data Collected for FRG
735	14,930	50	100	657518.50000	430923.00000	1998 BBL Sediment/Tissue Data Collected for FRG
736	3,951	50	100	654042.62500	423071.59380	1998 BBL Sediment/Tissue Data Collected for FRG
737	3,930	50	100	654263.68750	423040.18750	1998 BBL Sediment/Tissue Data Collected for FRG
738	3,155	50	100	654232.00000	423224.00000	1998 BBL Sediment/Tissue Data Collected for FRG
739	7,192	50	100	654247.62500	422770.50000	1998 BBL Sediment/Tissue Data Collected for FRG
740	17,900	50	100	654056.00000	422935.68750	1998 BBL Sediment/Tissue Data Collected for FRG
741	5,412	50	100	654025.50000	422804.31250	1998 BBL Sediment/Tissue Data Collected for FRG
742	273	50	100	653564.50000	421987.00000	1998 BBL Sediment/Tissue Data Collected for FRG
743	4,026	50	100	622103.81250	394050.18750	1998 BBL Sediment/Tissue Data Collected for FRG
744	318	50	100	622059.81250	395134.50000	1998 BBL Sediment/Tissue Data Collected for FRG
746	75	50	100	622860.18750	395651.40630	1998 BBL Sediment/Tissue Data Collected for FRG
748	2,150	50	100	622299.87500	396072.40630	1998 BBL Sediment/Tissue Data Collected for FRG
749	164	50	100	622803.12500	397972.81250	1998 BBL Sediment/Tissue Data Collected for FRG
750	124	50	100	623638.62500	397925.68750	1998 BBL Sediment/Tissue Data Collected for FRG
752	252	50	100	651860.87500	419514.09380	1998 BBL Sediment/Tissue Data Collected for FRG
753	123	50	100	650629.37500	417122.31250	1998 BBL Sediment/Tissue Data Collected for FRG
754	84	50	100	651752.50000	418575.81250	1998 BBL Sediment/Tissue Data Collected for FRG
755	138	50	100	640397.00000	405514.18750	1998 BBL Sediment/Tissue Data Collected for FRG
756	152	50	100	640887.62500	405296.81250	1998 BBL Sediment/Tissue Data Collected for FRG
757	163	50	100	640868.50000	406010.59380	1998 BBL Sediment/Tissue Data Collected for FRG
758	106	50	100	641273.50000	405973.59380	1998 BBL Sediment/Tissue Data Collected for FRG
759	453	50	100	633379.62500	404149.00000	1998 BBL Sediment/Tissue Data Collected for FRG
836	3,140	50	100	632917.06250	403956.06250	1998 Deposit N Post-Dredge Sediment Data
11001	81	100	150	623043.25902	397867.66114	2000–01 CH2M HILL
11002	120	100	124	623139.73195	397836.13803	2000–01 CH2M HILL
11003	176	100	150	623045.13412	397767.69608	2000–01 CH2M HILL
11005	81	100	124	623205.09085	397759.58726	2000–01 CH2M HILL
11007	81	100	133	623266.90297	397871.86000	2000–01 CH2M HILL
11011	77	100	125	622958.93820	397677.19080	2000–01 CH2M HILL
11012	148	100	150	623118.68847	397680.18706	2000–01 CH2M HILL
11014	4,890	100	150	622899.98973	396131.64189	2000–01 CH2M HILL
11015	14,120	100	150	622901.65364	396042.78429	2000–01 CH2M HILL
11017	57,800	100	150	622929.15855	395854.41080	2000–01 CH2M HILL
11018	430	100	115	622931.44675	395732.23166	2000–01 CH2M HILL
11020	77	100	114	622669.44123	395638.44145	2000–01 CH2M HILL
11022	77	100	150	622711.67514	395517.00904	2000–01 CH2M HILL
11041	77	100	150	622712.29803	395483.68747	2000–01 CH2M HILL
11046	77	100	150	622733.98417	395606.31470	2000–01 CH2M HILL
11048	77	100	116	622708.97591	395661.40253	2000–01 CH2M HILL
11050	77	100	114	622755.66937	395728.94204	2000–01 CH2M HILL
11060	77	100	150	622229.44677	395230.23636	2000–01 CH2M HILL
11061	77	100	150	622230.68754	395163.59326	2000–01 CH2M HILL
12000	81	100	150	623376.42687	397996.14183	2000–01 CH2M HILL
12001	81	100	150	623121.60689	397524.68591	2000–01 CH2M HILL
12002	84	100	150	622961.85283	397521.68966	2000–01 CH2M HILL
12003	77	100	150	622762.16025	397517.94981	2000–01 CH2M HILL
12005	81	100	150	622583.52506	397670.16491	2000–01 CH2M HILL
12006	77	100	150	622759.25036	397673.45095	2000–01 CH2M HILL
DA01S-06	77	100	150	622290.21530	394542.48406	2001 Blasland, Bouck, and Lee
DA01S-11	77	100	124	622308.68047	394409.49567	2001 Blasland, Bouck, and Lee

Table 1 PCB Data Retained for 2002 Interpolation

Station ID	Total PCB (µg/kg)	Start Depth (cm)	End Depth (cm)	Easting	Northing	Source
DA01S-13	77	100	142	622125.28965	394383.86046	2001 Blasland, Bouck, and Lee
DA01S-14	77	100	110	622197.41987	394374.09128	2001 Blasland, Bouck, and Lee
DA01S-15	123	100	122	621991.08477	394292.47794	2001 Blasland, Bouck, and Lee
DA01S-21	111	100	129	622027.59162	394048.71418	2001 Blasland, Bouck, and Lee
DA01S-22	81	100	131	622171.65260	394040.28149	2001 Blasland, Bouck, and Lee
DE01S-02	0	100	106	622958.57438	396843.84995	2001 Blasland, Bouck, and Lee
DE01S-03	0	100	148	622790.39959	396862.92293	2001 Blasland, Bouck, and Lee
DE01S-05	0	100	150	622811.66245	397007.76522	2001 Blasland, Bouck, and Lee
DE01S-07	0	100	139	622635.50410	397026.69256	2001 Blasland, Bouck, and Lee
DE01S-09	0	100	112	622889.46536	397120.33307	2001 Blasland, Bouck, and Lee
DE01S-11	0	100	150	622966.64100	397266.22356	2001 Blasland, Bouck, and Lee
DE01S-12	0	100	111	622749.92555	397317.72090	2001 Blasland, Bouck, and Lee
DE01S-13	32	100	110	622581.34856	397359.01342	2001 Blasland, Bouck, and Lee
DE01S-14	0	100	150	623060.83044	397356.87861	2001 Blasland, Bouck, and Lee
DE01S-16	0	100	150	622618.79681	397493.04644	2001 Blasland, Bouck, and Lee
DE01S-18	0	100	142	623199.81519	397615.04330	2001 Blasland, Bouck, and Lee
DE01S-19	0	100	150	623333.51604	397728.66710	2001 Blasland, Bouck, and Lee
DE01S-21	0	100	150	623378.93386	397862.85506	2001 Blasland, Bouck, and Lee
DE01S-22	0	100	112	623577.98855	397899.93558	2001 Blasland, Bouck, and Lee
DE01S-23	0	100	150	623481.51419	397931.45227	2001 Blasland, Bouck, and Lee
DE01S-24	0	100	150	623607.21656	398044.93157	2001 Blasland, Bouck, and Lee
DE01S-25	290	100	150	623271.75914	398038.61856	2001 Blasland, Bouck, and Lee
DE01S-26	0	100	150	623487.41033	398042.67496	2001 Blasland, Bouck, and Lee
DE01S-28	0	100	150	622908.85214	397365.14078	2001 Blasland, Bouck, and Lee
DE01S-29	380	100	150	623349.33225	398162.29968	2001 Blasland, Bouck, and Lee
DE01S-30	0	100	150	623661.03204	398157.05775	2001 Blasland, Bouck, and Lee
DE01S-31	0	100	150	623516.84867	398176.56332	2001 Blasland, Bouck, and Lee
DE01S-35	680	100	150	623482.60072	398298.14136	2001 Blasland, Bouck, and Lee
DE01S-36	28	100	150	623609.55170	398344.97746	2001 Blasland, Bouck, and Lee
DE01S-39	0	100	150	623519.81512	398443.28743	2001 Blasland, Bouck, and Lee
PD-A/B-11	170	91	122	622137.27207	394034.33780	2002 Foth and Van Dyke
PD-A/B-11	32	122	132	622137.27207	394034.33780	2002 Foth and Van Dyke
415	31	100	150	622512.93750	396216.37500	1994 Sediment Data - SAIC and GAS
416	20	100	150	622469.50000	396172.09380	1994 Sediment Data - SAIC and GAS
418	38	100	150	622475.93750	396122.68750	1994 Sediment Data - SAIC and GAS
433	133	100	150	653519.06250	421727.43750	1994 Sediment Data - SAIC and GAS
436	123	100	150	653652.43750	422206.06250	1994 Sediment Data - SAIC and GAS
437	20	100	150	653703.62500	422175.90630	1994 Sediment Data - SAIC and GAS
439	132	100	150	653746.37500	422275.87500	1994 Sediment Data - SAIC and GAS
442	713	100	150	653828.31250	422345.96880	1994 Sediment Data - SAIC and GAS
443	33	100	150	653913.06250	422297.90630	1994 Sediment Data - SAIC and GAS
444	91	100	150	653600.75000	421697.28130	1994 Sediment Data - SAIC and GAS
445	92	100	150	653875.43750	422429.81250	1994 Sediment Data - SAIC and GAS
446	51	100	150	653919.62500	422413.50000	1994 Sediment Data - SAIC and GAS
448	64	100	150	653939.87500	422510.18750	1994 Sediment Data - SAIC and GAS
449	96	100	150	653970.68750	422493.37500	1994 Sediment Data - SAIC and GAS
451	165	100	150	654000.25000	422586.93750	1994 Sediment Data - SAIC and GAS
455	111	100	150	653542.25000	421812.31250	1994 Sediment Data - SAIC and GAS
456	115	100	150	653596.62500	421814.71880	1994 Sediment Data - SAIC and GAS
464	20	100	150	622942.93750	396367.15630	1994 Sediment Data - SAIC and GAS
465	20	100	150	622835.87500	396317.25000	1994 Sediment Data - SAIC and GAS
466	74	100	150	622772.12500	396226.84380	1994 Sediment Data - SAIC and GAS
470	7,268	100	150	622921.06250	396038.59380	1994 Sediment Data - SAIC and GAS
471	20	100	150	622805.06250	396755.15630	1994 Sediment Data - SAIC and GAS
475	20	100	150	623002.43750	396647.15630	1994 Sediment Data - SAIC and GAS
478	20	100	150	622933.31250	396453.87500	1994 Sediment Data - SAIC and GAS
530	13,870	100	150	622950.81250	395944.84380	1994 Sediment Data - SAIC and GAS
536	48,000	100	150	653705.31250	423639.87500	1995 Sediment Data Collection - WDNR
556	51	100	150	654492.75000	424620.21880	1995 Sediment Data Collection - WDNR
558	720	100	150	654631.62500	425017.53130	1995 Sediment Data Collection - WDNR
559	51	100	150	654526.62500	425099.12500	1995 Sediment Data Collection - WDNR
560	180	100	150	654723.87500	425150.68750	1995 Sediment Data Collection - WDNR
562	90	100	150	654705.56250	425301.37500	1995 Sediment Data Collection - WDNR
563	380	100	150	654820.87500	425528.25000	1995 Sediment Data Collection - WDNR
564	63,000	100	150	654910.00000	425828.62500	1995 Sediment Data Collection - WDNR
565	1,100	100	150	655026.75000	425772.50000	1995 Sediment Data Collection - WDNR
568	750	100	150	655101.93750	425929.50000	1995 Sediment Data Collection - WDNR
569	51	100	150	654996.93750	426161.87500	1995 Sediment Data Collection - WDNR

Table 1 PCB Data Retained for 2002 Interpolation

Station ID	Total PCB (µg/kg)	Start Depth (cm)	End Depth (cm)	Easting	Northing	Source
570	4,400	100	150	655185.25000	426011.34380	1995 Sediment Data Collection - WDNR
574	85	100	150	655364.87500	426354.96880	1995 Sediment Data Collection - WDNR
575	64	100	150	655334.37500	426528.18750	1995 Sediment Data Collection - WDNR
580	150	100	150	655807.75000	426431.68750	1995 Sediment Data Collection - WDNR
582	23,000	100	150	655686.87500	426956.34380	1995 Sediment Data Collection - WDNR
585	710	100	150	655760.37500	427135.75000	1995 Sediment Data Collection - WDNR
586	6,000	100	150	655964.31250	426984.09380	1995 Sediment Data Collection - WDNR
589	20,000	100	150	656130.81250	427158.34380	1995 Sediment Data Collection - WDNR
592	950	100	150	656092.68750	427193.15630	1995 Sediment Data Collection - WDNR
595	14,000	100	150	656290.31250	427451.12500	1995 Sediment Data Collection - WDNR
597	140	100	150	656481.62500	427602.62500	1995 Sediment Data Collection - WDNR
598	51	100	150	656602.18750	427850.21880	1995 Sediment Data Collection - WDNR
600	87	100	150	656765.18750	427876.37500	1995 Sediment Data Collection - WDNR
607	17,000	100	150	657019.37500	428391.93750	1995 Sediment Data Collection - WDNR
608	58,000	100	150	656973.62500	428716.46880	1995 Sediment Data Collection - WDNR
610	72	100	150	657105.56250	428891.75000	1995 Sediment Data Collection - WDNR
611	120	100	150	657050.68750	429205.31250	1995 Sediment Data Collection - WDNR
613	57,000	100	150	657053.18750	429346.90630	1995 Sediment Data Collection - WDNR
614	21,000	100	150	657203.12500	429271.43750	1995 Sediment Data Collection - WDNR
615	2,200	100	150	657206.87500	429466.59380	1995 Sediment Data Collection - WDNR
616	110	100	150	657183.25000	429741.84380	1995 Sediment Data Collection - WDNR
617	2,900	100	150	657303.62500	429884.21880	1995 Sediment Data Collection - WDNR
619	61	100	150	657332.87500	430377.87500	1995 Sediment Data Collection - WDNR
621	51	100	150	657403.62500	430527.78130	1995 Sediment Data Collection - WDNR
622	6,100	100	150	657537.18750	430705.68750	1995 Sediment Data Collection - WDNR
639	11,000	100	150	658537.18750	433660.37500	1995 Sediment Data Collection - WDNR
646	650	100	150	656127.12500	427343.31250	1995 Sediment Data Collection - WDNR
663	90,000	100	150	656973.62500	428716.46880	1995 Sediment Data Collection - WDNR
676	11,200	100	150	656627.31250	428118.56250	1997 Segment 56/57 Demonstration Project
677	21,080	100	150	656664.25000	428154.96880	1997 Segment 56/57 Demonstration Project
678	80,400	100	150	656678.06250	428176.59380	1997 Segment 56/57 Demonstration Project
679	227,200	100	150	656711.43750	428223.71880	1997 Segment 56/57 Demonstration Project
680	281,200	100	150	656736.87500	428249.96880	1997 Segment 56/57 Demonstration Project
681	479,200	100	150	656759.00000	428302.96880	1997 Segment 56/57 Demonstration Project
682	195,200	100	150	656788.87500	428310.50000	1997 Segment 56/57 Demonstration Project
683	201,200	100	150	656792.56250	428332.81250	1997 Segment 56/57 Demonstration Project
684	3,351	100	150	656626.06250	428070.06250	1997 Segment 56/57 Demonstration Project
685	56,720	100	150	656674.62500	428128.06250	1997 Segment 56/57 Demonstration Project
686	80,720	100	150	656707.25000	428157.84380	1997 Segment 56/57 Demonstration Project
687	67,560	100	150	656714.87500	428182.12500	1997 Segment 56/57 Demonstration Project
688	97,760	100	150	656740.43750	428221.93750	1997 Segment 56/57 Demonstration Project
689	64,160	100	150	656767.68750	428264.59380	1997 Segment 56/57 Demonstration Project
690	25,500	100	150	656818.87500	428285.90630	1997 Segment 56/57 Demonstration Project
691	96,960	100	150	656833.18750	428314.34380	1997 Segment 56/57 Demonstration Project
692	37	100	150	656681.93750	428100.12500	1997 Segment 56/57 Demonstration Project
693	88,280	100	150	656735.81250	428118.40630	1997 Segment 56/57 Demonstration Project
694	35,240	100	150	656756.75000	428157.81250	1997 Segment 56/57 Demonstration Project
695	8,183	100	150	656775.12500	428174.93750	1997 Segment 56/57 Demonstration Project
696	251	100	150	656788.25000	428198.71880	1997 Segment 56/57 Demonstration Project
697	51	100	150	656813.31250	428232.03130	1997 Segment 56/57 Demonstration Project
698	198	100	150	656842.50000	428267.93750	1997 Segment 56/57 Demonstration Project
699	9,408	100	150	656851.43750	428310.75000	1997 Segment 56/57 Demonstration Project
700	6,174	100	150	656714.56250	428085.18750	1997 Segment 56/57 Demonstration Project
701	35,200	100	150	656732.37500	428106.90630	1997 Segment 56/57 Demonstration Project
702	51,600	100	150	656754.75000	428131.84380	1997 Segment 56/57 Demonstration Project
703	22,640	100	150	656775.43750	428162.28130	1997 Segment 56/57 Demonstration Project
704	180	100	150	656795.81250	428187.15630	1997 Segment 56/57 Demonstration Project
705	50	100	150	656824.06250	428216.87500	1997 Segment 56/57 Demonstration Project
706	49	100	150	656854.00000	428249.06250	1997 Segment 56/57 Demonstration Project
707	2,480	100	150	656881.06250	428292.03130	1997 Segment 56/57 Demonstration Project
708	1,820	100	150	653287.87500	424012.18750	1998 BBL Sediment/Tissue Data Collected for FRG
709	18,280	100	150	655727.00000	427333.50000	1998 BBL Sediment/Tissue Data Collected for FRG
710	100	100	150	653636.81250	424326.40630	1998 BBL Sediment/Tissue Data Collected for FRG
711	84	100	150	654055.81250	423913.68750	1998 BBL Sediment/Tissue Data Collected for FRG
712	110	100	150	651848.68750	419516.90630	1998 BBL Sediment/Tissue Data Collected for FRG
713	510	100	150	654052.62500	422999.68750	1998 BBL Sediment/Tissue Data Collected for FRG
714	95	100	150	656178.00000	426925.40630	1998 BBL Sediment/Tissue Data Collected for FRG
720	460	100	150	653450.81250	423753.18750	1998 BBL Sediment/Tissue Data Collected for FRG

Table 1 PCB Data Retained for 2002 Interpolation

Station ID	Total PCB (µg/kg)	Start Depth (cm)	End Depth (cm)	Easting	Northing	Source
721	2,048	100	150	653282.62500	423944.00000	1998 BBL Sediment/Tissue Data Collected for FRG
722	16,440	100	150	653937.00000	423816.18750	1998 BBL Sediment/Tissue Data Collected for FRG
723	84	100	150	654291.50000	424276.31250	1998 BBL Sediment/Tissue Data Collected for FRG
724	103	100	150	653563.12500	424263.68750	1998 BBL Sediment/Tissue Data Collected for FRG
725	2,392	100	150	653822.50000	424430.90630	1998 BBL Sediment/Tissue Data Collected for FRG
726	85	100	150	655573.50000	426059.59380	1998 BBL Sediment/Tissue Data Collected for FRG
728	86	100	150	655143.37500	426271.81250	1998 BBL Sediment/Tissue Data Collected for FRG
729	8,422	100	150	655871.00000	426691.09380	1998 BBL Sediment/Tissue Data Collected for FRG
730	73	100	150	655372.68750	426736.90630	1998 BBL Sediment/Tissue Data Collected for FRG
731	11,380	100	150	655771.50000	427396.68750	1998 BBL Sediment/Tissue Data Collected for FRG
732	2,416	100	150	656936.31250	428585.09380	1998 BBL Sediment/Tissue Data Collected for FRG
733	3,681	100	150	656171.87500	426950.68750	1998 BBL Sediment/Tissue Data Collected for FRG
734	95	100	150	657293.31250	429150.09380	1998 BBL Sediment/Tissue Data Collected for FRG
735	8,126	100	150	657518.50000	430923.00000	1998 BBL Sediment/Tissue Data Collected for FRG
736	1,029	100	150	654042.62500	423071.59380	1998 BBL Sediment/Tissue Data Collected for FRG
737	2,090	100	150	654263.68750	423040.18750	1998 BBL Sediment/Tissue Data Collected for FRG
738	3,520	100	150	654232.00000	423224.00000	1998 BBL Sediment/Tissue Data Collected for FRG
739	680	100	150	654247.62500	422770.50000	1998 BBL Sediment/Tissue Data Collected for FRG
740	11,060	100	150	654056.00000	422935.68750	1998 BBL Sediment/Tissue Data Collected for FRG
741	1,188	100	150	654025.50000	422804.31250	1998 BBL Sediment/Tissue Data Collected for FRG
742	133	100	150	653564.50000	421987.00000	1998 BBL Sediment/Tissue Data Collected for FRG
749	154	100	150	622803.12500	397972.81250	1998 BBL Sediment/Tissue Data Collected for FRG
750	154	100	150	623638.62500	397925.68750	1998 BBL Sediment/Tissue Data Collected for FRG
752	129	100	150	651860.87500	419514.09380	1998 BBL Sediment/Tissue Data Collected for FRG
753	124	100	150	650629.37500	417122.31250	1998 BBL Sediment/Tissue Data Collected for FRG
754	67	100	150	651752.50000	418575.81250	1998 BBL Sediment/Tissue Data Collected for FRG
755	129	100	150	640397.00000	405514.18750	1998 BBL Sediment/Tissue Data Collected for FRG
756	122	100	150	640887.62500	405296.81250	1998 BBL Sediment/Tissue Data Collected for FRG
757	154	100	150	640868.50000	406010.59380	1998 BBL Sediment/Tissue Data Collected for FRG
758	120	100	150	641273.50000	405973.59380	1998 BBL Sediment/Tissue Data Collected for FRG
11003	81	150	200	623045.13412	397767.69608	2000–01 CH2M HILL
11012	81	150	200	623118.68847	397680.18706	2000–01 CH2M HILL
11014	2,180	150	200	622899.98973	396131.64189	2000–01 CH2M HILL
11015	405	150	190	622901.65364	396042.78429	2000–01 CH2M HILL
11017	1,795	150	175	622929.15855	395854.41080	2000–01 CH2M HILL
11060	77	150	175	622229.44677	395230.23636	2000–01 CH2M HILL
12000	81	150	200	623376.42687	397996.14183	2000–01 CH2M HILL
12001	77	150	190	623121.60689	397524.68591	2000–01 CH2M HILL
12006	81	150	200	622759.25036	397673.45095	2000–01 CH2M HILL
DE01S-05	0	150	174	622811.66245	397007.76522	2001 Blasland, Bouck, and Lee
DE01S-11	0	150	200	622966.64100	397266.22356	2001 Blasland, Bouck, and Lee
DE01S-14	0	150	182	623060.83044	397356.87861	2001 Blasland, Bouck, and Lee
DE01S-16	0	150	152	622618.79681	397493.04644	2001 Blasland, Bouck, and Lee
DE01S-19	0	150	200	623333.51604	397728.66710	2001 Blasland, Bouck, and Lee
DE01S-21	0	150	200	623378.93386	397862.85506	2001 Blasland, Bouck, and Lee
DE01S-23	0	150	180	623481.51419	397931.45227	2001 Blasland, Bouck, and Lee
DE01S-24	0	150	193	623607.21656	398044.93157	2001 Blasland, Bouck, and Lee
DE01S-25	0	150	200	623271.75914	398038.61856	2001 Blasland, Bouck, and Lee
DE01S-26	0	150	200	623487.41033	398042.67496	2001 Blasland, Bouck, and Lee
DE01S-28	0	150	200	622908.85214	397365.14078	2001 Blasland, Bouck, and Lee
DE01S-29	0	150	200	623349.33225	398162.29968	2001 Blasland, Bouck, and Lee
DE01S-31	0	150	200	623516.84867	398176.56332	2001 Blasland, Bouck, and Lee
DE01S-35	0	150	200	623482.60072	398298.14136	2001 Blasland, Bouck, and Lee
DE01S-36	0	150	200	623609.55170	398344.97746	2001 Blasland, Bouck, and Lee
DE01S-39	0	150	167	623519.81512	398443.28743	2001 Blasland, Bouck, and Lee
433	20	150	200	653519.06250	421727.43750	1994 Sediment Data - SAIC and GAS
437	20	150	200	653703.62500	422175.90630	1994 Sediment Data - SAIC and GAS
439	20	150	200	653746.37500	422275.87500	1994 Sediment Data - SAIC and GAS
444	43	150	200	653600.75000	421697.28130	1994 Sediment Data - SAIC and GAS
446	38	150	200	653919.62500	422413.50000	1994 Sediment Data - SAIC and GAS
449	36	150	200	653970.68750	422493.37500	1994 Sediment Data - SAIC and GAS
451	34	150	200	654000.25000	422586.93750	1994 Sediment Data - SAIC and GAS
455	20	150	200	653542.25000	421812.31250	1994 Sediment Data - SAIC and GAS
456	20	150	200	653596.62500	421814.71880	1994 Sediment Data - SAIC and GAS
478	20	150	200	622933.31250	396453.87500	1994 Sediment Data - SAIC and GAS
536	30,720	150	200	653705.31250	423639.87500	1995 Sediment Data Collection - WDNR
556	51	150	200	654492.75000	424620.21880	1995 Sediment Data Collection - WDNR
558	115	150	200	654631.62500	425017.53130	1995 Sediment Data Collection - WDNR

Table 1 PCB Data Retained for 2002 Interpolation

Station ID	Total PCB (µg/kg)	Start Depth (cm)	End Depth (cm)	Easting	Northing	Source
559	51	150	200	654526.62500	425099.12500	1995 Sediment Data Collection - WDNR
560	180	150	200	654723.87500	425150.68750	1995 Sediment Data Collection - WDNR
562	90	150	200	654705.56250	425301.37500	1995 Sediment Data Collection - WDNR
563	79	150	200	654820.87500	425528.25000	1995 Sediment Data Collection - WDNR
564	9,912	150	200	654910.00000	425828.62500	1995 Sediment Data Collection - WDNR
565	1,100	150	200	655026.75000	425772.50000	1995 Sediment Data Collection - WDNR
568	750	150	200	655101.93750	425929.50000	1995 Sediment Data Collection - WDNR
569	59	150	200	654996.93750	426161.87500	1995 Sediment Data Collection - WDNR
570	589	150	200	655185.25000	426011.34380	1995 Sediment Data Collection - WDNR
574	85	150	200	655364.87500	426354.96880	1995 Sediment Data Collection - WDNR
575	64	150	200	655334.37500	426528.18750	1995 Sediment Data Collection - WDNR
580	68	150	200	655807.75000	426431.68750	1995 Sediment Data Collection - WDNR
582	27,800	150	200	655686.87500	426956.34380	1995 Sediment Data Collection - WDNR
585	710	150	200	655760.37500	427135.75000	1995 Sediment Data Collection - WDNR
586	422	150	200	655964.31250	426984.09380	1995 Sediment Data Collection - WDNR
589	1,213	150	200	656130.81250	427158.34380	1995 Sediment Data Collection - WDNR
592	110	150	200	656092.68750	427193.15630	1995 Sediment Data Collection - WDNR
595	14,000	150	200	656290.31250	427451.12500	1995 Sediment Data Collection - WDNR
598	51	150	200	656602.18750	427850.21880	1995 Sediment Data Collection - WDNR
600	87	150	200	656765.18750	427876.37500	1995 Sediment Data Collection - WDNR
607	17,000	150	200	657019.37500	428391.93750	1995 Sediment Data Collection - WDNR
608	58,000	150	200	656973.62500	428716.46880	1995 Sediment Data Collection - WDNR
610	72	150	200	657105.56250	428891.75000	1995 Sediment Data Collection - WDNR
611	54	150	200	657050.68750	429205.31250	1995 Sediment Data Collection - WDNR
613	27,240	150	200	657053.18750	429346.90630	1995 Sediment Data Collection - WDNR
614	13,320	150	200	657203.12500	429271.43750	1995 Sediment Data Collection - WDNR
615	203	150	200	657206.87500	429466.59380	1995 Sediment Data Collection - WDNR
616	110	150	200	657183.25000	429741.84380	1995 Sediment Data Collection - WDNR
617	2,900	150	200	657303.62500	429884.21880	1995 Sediment Data Collection - WDNR
619	61	150	200	657332.87500	430377.87500	1995 Sediment Data Collection - WDNR
621	51	150	200	657403.62500	430527.78130	1995 Sediment Data Collection - WDNR
622	378	150	200	657537.18750	430705.68750	1995 Sediment Data Collection - WDNR
639	11,000	150	200	658537.18750	433660.37500	1995 Sediment Data Collection - WDNR
646	650	150	200	656127.12500	427343.31250	1995 Sediment Data Collection - WDNR
676	163	150	200	656627.31250	428118.56250	1997 Segment 56/57 Demonstration Project
677	15,460	150	200	656664.25000	428154.96880	1997 Segment 56/57 Demonstration Project
678	70,760	150	200	656678.06250	428176.59380	1997 Segment 56/57 Demonstration Project
679	26,500	150	200	656711.43750	428223.71880	1997 Segment 56/57 Demonstration Project
680	182,600	150	200	656736.87500	428249.96880	1997 Segment 56/57 Demonstration Project
681	641,500	150	200	656759.00000	428302.96880	1997 Segment 56/57 Demonstration Project
682	176,000	150	200	656788.87500	428310.50000	1997 Segment 56/57 Demonstration Project
683	270,800	150	200	656792.56250	428332.81250	1997 Segment 56/57 Demonstration Project
684	97	150	200	656626.06250	428070.06250	1997 Segment 56/57 Demonstration Project
685	130,400	150	200	656674.62500	428128.06250	1997 Segment 56/57 Demonstration Project
686	128,500	150	200	656707.25000	428157.84380	1997 Segment 56/57 Demonstration Project
687	46,000	150	200	656714.87500	428182.12500	1997 Segment 56/57 Demonstration Project
688	22,200	150	200	656740.43750	428221.93750	1997 Segment 56/57 Demonstration Project
689	4,988	150	200	656767.68750	428264.59380	1997 Segment 56/57 Demonstration Project
690	1,176	150	200	656818.87500	428285.90630	1997 Segment 56/57 Demonstration Project
691	8,214	150	200	656833.18750	428314.34380	1997 Segment 56/57 Demonstration Project
692	49	150	200	656681.93750	428100.12500	1997 Segment 56/57 Demonstration Project
693	78,640	150	200	656735.81250	428118.40630	1997 Segment 56/57 Demonstration Project
694	33,380	150	200	656756.75000	428157.81250	1997 Segment 56/57 Demonstration Project
695	111	150	200	656775.12500	428174.93750	1997 Segment 56/57 Demonstration Project
696	56	150	200	656788.25000	428198.71880	1997 Segment 56/57 Demonstration Project
697	51	150	200	656813.31250	428232.03130	1997 Segment 56/57 Demonstration Project
698	34	150	200	656842.50000	428267.93750	1997 Segment 56/57 Demonstration Project
699	3,186	150	200	656851.43750	428310.75000	1997 Segment 56/57 Demonstration Project
700	810	150	200	656714.56250	428085.18750	1997 Segment 56/57 Demonstration Project
701	31,620	150	200	656732.37500	428106.90630	1997 Segment 56/57 Demonstration Project
702	34,680	150	200	656754.75000	428131.84380	1997 Segment 56/57 Demonstration Project
703	1,672	150	200	656775.43750	428162.28130	1997 Segment 56/57 Demonstration Project
704	52	150	200	656795.81250	428187.15630	1997 Segment 56/57 Demonstration Project
705	50	150	200	656824.06250	428216.87500	1997 Segment 56/57 Demonstration Project
707	2,502	150	200	656881.06250	428292.03130	1997 Segment 56/57 Demonstration Project
720	75	150	200	653450.81250	423753.18750	1998 BBL Sediment/Tissue Data Collected for FRG
721	97	150	200	653282.62500	423944.00000	1998 BBL Sediment/Tissue Data Collected for FRG
722	16,000	150	200	653937.00000	423816.18750	1998 BBL Sediment/Tissue Data Collected for FRG

Table 1 PCB Data Retained for 2002 Interpolation

Station ID	Total PCB (µg/kg)	Start Depth (cm)	End Depth (cm)	Easting	Northing	Source
723	78	150	200	654291.50000	424276.31250	1998 BBL Sediment/Tissue Data Collected for FRG
724	130	150	200	653563.12500	424263.68750	1998 BBL Sediment/Tissue Data Collected for FRG
725	140	150	200	653822.50000	424430.90630	1998 BBL Sediment/Tissue Data Collected for FRG
726	85	150	200	655573.50000	426059.59380	1998 BBL Sediment/Tissue Data Collected for FRG
728	88	150	200	655143.37500	426271.81250	1998 BBL Sediment/Tissue Data Collected for FRG
729	110	150	200	655871.00000	426691.09380	1998 BBL Sediment/Tissue Data Collected for FRG
730	70	150	200	655372.68750	426736.90630	1998 BBL Sediment/Tissue Data Collected for FRG
731	2,250	150	200	655771.50000	427396.68750	1998 BBL Sediment/Tissue Data Collected for FRG
732	990	150	200	656936.31250	428585.09380	1998 BBL Sediment/Tissue Data Collected for FRG
733	806	150	200	656171.87500	426950.68750	1998 BBL Sediment/Tissue Data Collected for FRG
734	75	150	200	657293.31250	429150.09380	1998 BBL Sediment/Tissue Data Collected for FRG
735	211	150	200	657518.50000	430923.00000	1998 BBL Sediment/Tissue Data Collected for FRG
736	140	150	200	654042.62500	423071.59380	1998 BBL Sediment/Tissue Data Collected for FRG
737	110	150	200	654263.68750	423040.18750	1998 BBL Sediment/Tissue Data Collected for FRG
739	130	150	200	654247.62500	422770.50000	1998 BBL Sediment/Tissue Data Collected for FRG
740	320	150	200	654056.00000	422935.68750	1998 BBL Sediment/Tissue Data Collected for FRG
741	150	150	200	654025.50000	422804.31250	1998 BBL Sediment/Tissue Data Collected for FRG
742	120	150	200	653564.50000	421987.00000	1998 BBL Sediment/Tissue Data Collected for FRG
749	150	150	200	622803.12500	397972.81250	1998 BBL Sediment/Tissue Data Collected for FRG
750	180	150	200	623638.62500	397925.68750	1998 BBL Sediment/Tissue Data Collected for FRG
752	120	150	200	651860.87500	419514.09380	1998 BBL Sediment/Tissue Data Collected for FRG
753	120	150	200	650629.37500	417122.31250	1998 BBL Sediment/Tissue Data Collected for FRG
754	63	150	200	651752.50000	418575.81250	1998 BBL Sediment/Tissue Data Collected for FRG
755	120	150	200	640397.00000	405514.18750	1998 BBL Sediment/Tissue Data Collected for FRG
756	100	150	200	640887.62500	405296.81250	1998 BBL Sediment/Tissue Data Collected for FRG
757	150	150	200	640868.50000	406010.59380	1998 BBL Sediment/Tissue Data Collected for FRG

Table 2 PCB Data Not Included in 2002 Interpolation

Station ID	Total PCB (µg/kg)	Start Depth (cm)	End Depth (cm)	Easting	Northing	Source
8	22,680	0	10	622109.8125	394543.1875	1989/90 Mass Balance Sediment Data
14	183	0	10	622500.5000	394664.1563	1989/90 Mass Balance Sediment Data
17	8,755	0	10	622119.3750	395385.3750	1989/90 Mass Balance Sediment Data
18	50	0	10	643365.8750	408451.5000	1989/90 Mass Balance Sediment Data
19	890	0	10	643067.6250	408250.3438	1989/90 Mass Balance Sediment Data
24	300	0	10	649312.7500	415126.6875	1989/90 Mass Balance Sediment Data
25	470	0	10	649263.0000	415153.7188	1989/90 Mass Balance Sediment Data
26	145	0	10	649208.4375	415208.0313	1989/90 Mass Balance Sediment Data
27	70	0	10	648932.5625	414897.3750	1989/90 Mass Balance Sediment Data
28	50	0	10	648805.7500	414467.5000	1989/90 Mass Balance Sediment Data
29	435	0	10	623138.8750	396445.2188	1989/90 Mass Balance Sediment Data
30	14,650	0	10	623146.0000	397818.8125	1989/90 Mass Balance Sediment Data
31	2,900	0	10	623355.7500	397759.0625	1989/90 Mass Balance Sediment Data
32	190	0	10	623453.5625	397715.7188	1989/90 Mass Balance Sediment Data
37	2,520	0	10	623615.9375	398523.6875	1989/90 Mass Balance Sediment Data
38	1,400	0	10	623768.4375	398512.7813	1989/90 Mass Balance Sediment Data
42	940	0	10	624054.6875	399462.6563	1989/90 Mass Balance Sediment Data
43	1,715	0	10	624298.6250	399574.4063	1989/90 Mass Balance Sediment Data
44	1,300	0	10	624258.1250	399621.4063	1989/90 Mass Balance Sediment Data
47	2,250	0	10	623201.5625	397123.5625	1989/90 Mass Balance Sediment Data
49	4,925	0	10	622866.5625	397216.4375	1989/90 Mass Balance Sediment Data
50	2,090	0	10	640129.9375	405108.0625	1989/90 Mass Balance Sediment Data
52	21,100	0	10	623044.8125	397865.9375	1989/90 Mass Balance Sediment Data
53	95	0	10	649668.9375	416351.8750	1989/90 Mass Balance Sediment Data
60	260	0	10	650913.6250	417645.7500	1989/90 Mass Balance Sediment Data
64	2,450	0	10	649655.5625	416439.7813	1989/90 Mass Balance Sediment Data
65	1,300	0	10	651517.0000	418334.0313	1989/90 Mass Balance Sediment Data
83	150	0	10	653271.8125	420963.0938	1989/90 Mass Balance Sediment Data
97	520	0	10	650066.8750	416376.7813	1989/90 Mass Balance Sediment Data
105	670	0	10	649934.0000	416648.0000	1989/90 Mass Balance Sediment Data
109	1,955	0	10	622863.5625	398323.3750	1989/90 Mass Balance Sediment Data
110	1,395	0	10	622979.7500	398326.0000	1989/90 Mass Balance Sediment Data
130	1,450	0	10	655503.6875	426685.9688	1989/90 Mass Balance Sediment Data
133	2,800	0	10	656573.1250	427715.3750	1989/90 Mass Balance Sediment Data
135	860	0	10	654866.5625	425370.4375	1989/90 Mass Balance Sediment Data
138	4,900	0	10	654113.9375	424552.3438	1989/90 Mass Balance Sediment Data
143	1,900	0	10	658005.6250	431578.5000	1989/90 Mass Balance Sediment Data
145	905	0	10	657201.6250	428277.0000	1989/90 Mass Balance Sediment Data
151	130	0	10	625234.4375	399939.6563	1989/90 Mass Balance Sediment Data
157	2,100	0	10	653857.6250	423131.3438	1989/90 Mass Balance Sediment Data
159	2,700	0	10	633243.4375	404079.0313	1989/90 Mass Balance Sediment Data
163	1,400	0	10	623159.0625	396261.9375	1989/90 Mass Balance Sediment Data
164	1,700	0	10	633864.6875	403858.1563	1989/90 Mass Balance Sediment Data
165	50	0	10	634077.0000	403770.5313	1989/90 Mass Balance Sediment Data
166	90	0	10	635264.1875	403245.4063	1989/90 Mass Balance Sediment Data
167	735	0	10	635458.0000	403289.9375	1989/90 Mass Balance Sediment Data
168	750	0	10	635452.6250	403403.0938	1989/90 Mass Balance Sediment Data
169	4,750	0	10	636038.6250	403518.5938	1989/90 Mass Balance Sediment Data
170	1,285	0	10	640129.9375	405108.0625	1989/90 Mass Balance Sediment Data
178	250	0	10	640300.7500	404991.0313	1989/90 Mass Balance Sediment Data
187	18,500	0	10	622359.4375	394015.3125	1989/90 Mass Balance Sediment Data
195	2,500	0	10	622866.5625	397291.0938	1989/90 Mass Balance Sediment Data
196	2,713	0	10	622626.9375	397002.3125	1989/90 Mass Balance Sediment Data
197	50	0	10	649190.3125	415236.5000	1989/90 Mass Balance Sediment Data

Table 2 PCB Data Not Included in 2002 Interpolation

Station ID	Total PCB (µg/kg)	Start Depth (cm)	End Depth (cm)	Easting	Northing	Source
198	90	0	10	649009.0625	415069.1875	1989/90 Mass Balance Sediment Data
200	965	0	10	651961.5625	419301.4688	1989/90 Mass Balance Sediment Data
216	580	0	10	632938.3125	404121.5938	1989/90 Mass Balance Sediment Data
217	1,370	0	10	632794.3750	404129.4375	1989/90 Mass Balance Sediment Data
220	4,500	0	10	636097.7500	403564.3125	1989/90 Mass Balance Sediment Data
221	4,220	0	10	636023.3750	403561.6250	1989/90 Mass Balance Sediment Data
222	6,085	0	10	635990.6250	403455.9063	1989/90 Mass Balance Sediment Data
225	4,416	0	10	652938.2500	420660.9375	1989/90 Mass Balance Sediment Data
226	9,850	0	10	653729.0000	421898.9688	1989/90 Mass Balance Sediment Data
231	40,000	0	10	621966.0625	394063.1563	1989/90 Mass Balance Sediment Data
244	50	0	10	641856.6875	407662.4375	1989/90 Mass Balance Sediment Data
249	190	0	10	622199.6875	394796.0000	1989/90 Mass Balance Sediment Data
250	100	0	10	622329.6250	394693.8438	1989/90 Mass Balance Sediment Data
251	130	0	10	642462.7500	408113.6250	1989/90 Mass Balance Sediment Data
253	50	0	10	642983.5000	408190.3125	1989/90 Mass Balance Sediment Data
254	50	0	10	643216.0000	408374.9063	1989/90 Mass Balance Sediment Data
258	240	0	10	648895.3125	414906.5938	1989/90 Mass Balance Sediment Data
259	7,600	0	10	649173.9375	415223.9375	1989/90 Mass Balance Sediment Data
262	1,300	0	10	623686.3750	399018.5000	1989/90 Mass Balance Sediment Data
263	118	0	10	623145.2500	398318.4063	1989/90 Mass Balance Sediment Data
264	120	0	10	624213.6250	399750.0938	1989/90 Mass Balance Sediment Data
266	2,300	0	10	651605.9375	418919.3750	1989/90 Mass Balance Sediment Data
269	690	0	10	650744.8125	417278.7188	1989/90 Mass Balance Sediment Data
270	250	0	10	652910.7500	420354.5000	1989/90 Mass Balance Sediment Data
271	350	0	10	653173.8750	420656.8125	1989/90 Mass Balance Sediment Data
272	4,860	0	10	652951.3750	420644.3438	1989/90 Mass Balance Sediment Data
274	194	0	10	653325.3750	421137.5938	1989/90 Mass Balance Sediment Data
275	200	0	10	653466.9375	421379.3125	1989/90 Mass Balance Sediment Data
284	740	0	10	651381.3125	418627.8750	1989/90 Mass Balance Sediment Data
289	320	0	10	623019.8125	398459.0313	1989/90 Mass Balance Sediment Data
290	430	0	10	622905.5000	398386.0625	1989/90 Mass Balance Sediment Data
292	230	0	10	625317.1250	399903.7813	1989/90 Mass Balance Sediment Data
295	2,040	0	10	625966.8125	400454.7500	1989/90 Mass Balance Sediment Data
297	760	0	10	629445.4375	402390.6875	1989/90 Mass Balance Sediment Data
298	100	0	10	630625.6875	403378.5000	1989/90 Mass Balance Sediment Data
299	260	0	10	630707.5625	403151.0000	1989/90 Mass Balance Sediment Data
300	290	0	10	631398.1250	403555.3125	1989/90 Mass Balance Sediment Data
301	700	0	10	632267.8125	403680.1250	1989/90 Mass Balance Sediment Data
303	1,100	0	10	632884.8125	404120.4375	1989/90 Mass Balance Sediment Data
304	490	0	10	622353.7500	394497.8125	1989/90 Mass Balance Sediment Data
305	120	0	10	637056.6875	404121.5000	1989/90 Mass Balance Sediment Data
306	750	0	10	622448.8125	394024.0938	1989/90 Mass Balance Sediment Data
308	300	0	10	640016.6250	404594.2813	1989/90 Mass Balance Sediment Data
309	180	0	10	646730.5000	410095.1250	1989/90 Mass Balance Sediment Data
310	150	0	10	649916.9375	416213.5625	1989/90 Mass Balance Sediment Data
311	290	0	10	631259.8750	403677.3438	1989/90 Mass Balance Sediment Data
312	1,600	0	10	628809.8750	402065.8125	1989/90 Mass Balance Sediment Data
313	7,800	0	10	636111.7500	403584.5000	1989/90 Mass Balance Sediment Data
314	1,000	0	10	637445.8125	404483.3438	1989/90 Mass Balance Sediment Data
322	370	0	10	641325.1250	406686.9688	1989/90 Mass Balance Sediment Data
323	310	0	10	641720.5625	407013.7500	1989/90 Mass Balance Sediment Data
8	49,060	10	30	622109.8125	394543.1875	1989/90 Mass Balance Sediment Data
14	70	10	30	622500.5000	394664.1563	1989/90 Mass Balance Sediment Data
17	1,659	10	30	622119.3750	395385.3750	1989/90 Mass Balance Sediment Data

Table 2 PCB Data Not Included in 2002 Interpolation

Station ID	Total PCB (µg/kg)	Start Depth (cm)	End Depth (cm)	Easting	Northing	Source
18	50	10	30	643365.8750	408451.5000	1989/90 Mass Balance Sediment Data
19	165	10	30	643067.6250	408250.3438	1989/90 Mass Balance Sediment Data
24	50	10	30	649312.7500	415126.6875	1989/90 Mass Balance Sediment Data
25	0	10	30	649263.0000	415153.7188	1989/90 Mass Balance Sediment Data
26	50	10	30	649208.4375	415208.0313	1989/90 Mass Balance Sediment Data
27	57	10	30	648932.5625	414897.3750	1989/90 Mass Balance Sediment Data
28	50	10	30	648805.7500	414467.5000	1989/90 Mass Balance Sediment Data
29	50	10	30	623138.8750	396445.2188	1989/90 Mass Balance Sediment Data
30	9,022	10	30	623146.0000	397818.8125	1989/90 Mass Balance Sediment Data
31	1,640	10	30	623355.7500	397759.0625	1989/90 Mass Balance Sediment Data
32	50	10	30	623453.5625	397715.7188	1989/90 Mass Balance Sediment Data
37	416	10	30	623615.9375	398523.6875	1989/90 Mass Balance Sediment Data
38	2,500	10	30	623768.4375	398512.7813	1989/90 Mass Balance Sediment Data
42	50	10	30	624054.6875	399462.6563	1989/90 Mass Balance Sediment Data
43	999	10	30	624298.6250	399574.4063	1989/90 Mass Balance Sediment Data
47	560	10	30	623201.5625	397123.5625	1989/90 Mass Balance Sediment Data
49	2,459	10	30	622866.5625	397216.4375	1989/90 Mass Balance Sediment Data
50	293	10	30	640129.9375	405108.0625	1989/90 Mass Balance Sediment Data
52	18,380	10	30	623044.8125	397865.9375	1989/90 Mass Balance Sediment Data
53	110	10	30	649668.9375	416351.8750	1989/90 Mass Balance Sediment Data
60	111	10	30	650913.6250	417645.7500	1989/90 Mass Balance Sediment Data
64	17,170	10	30	649655.5625	416439.7813	1989/90 Mass Balance Sediment Data
65	50	10	30	651517.0000	418334.0313	1989/90 Mass Balance Sediment Data
83	50	10	30	653271.8125	420963.0938	1989/90 Mass Balance Sediment Data
105	145	10	30	649934.0000	416648.0000	1989/90 Mass Balance Sediment Data
109	723	10	30	622863.5625	398323.3750	1989/90 Mass Balance Sediment Data
110	340	10	30	622979.7500	398326.0000	1989/90 Mass Balance Sediment Data
130	1,500	10	30	655503.6875	426685.9688	1989/90 Mass Balance Sediment Data
133	3,600	10	30	656573.1250	427715.3750	1989/90 Mass Balance Sediment Data
138	6,425	10	30	654113.9375	424552.3438	1989/90 Mass Balance Sediment Data
143	1,850	10	30	658005.6250	431578.5000	1989/90 Mass Balance Sediment Data
145	860	10	30	657201.6250	428277.0000	1989/90 Mass Balance Sediment Data
157	1,300	10	30	653857.6250	423131.3438	1989/90 Mass Balance Sediment Data
159	5,850	10	30	633243.4375	404079.0313	1989/90 Mass Balance Sediment Data
164	4,827	10	30	633864.6875	403858.1563	1989/90 Mass Balance Sediment Data
165	50	10	30	634077.0000	403770.5313	1989/90 Mass Balance Sediment Data
166	50	10	30	635264.1875	403245.4063	1989/90 Mass Balance Sediment Data
167	69	10	30	635458.0000	403289.9375	1989/90 Mass Balance Sediment Data
168	125	10	30	635452.6250	403403.0938	1989/90 Mass Balance Sediment Data
169	6,365	10	30	636038.6250	403518.5938	1989/90 Mass Balance Sediment Data
170	1,100	10	30	640129.9375	405108.0625	1989/90 Mass Balance Sediment Data
178	120	10	30	640300.7500	404991.0313	1989/90 Mass Balance Sediment Data
187	6,257	10	30	622359.4375	394015.3125	1989/90 Mass Balance Sediment Data
195	288	10	30	622866.5625	397291.0938	1989/90 Mass Balance Sediment Data
196	2,152	10	30	622626.9375	397002.3125	1989/90 Mass Balance Sediment Data
197	49	10	30	649190.3125	415236.5000	1989/90 Mass Balance Sediment Data
198	50	10	30	649009.0625	415069.1875	1989/90 Mass Balance Sediment Data
200	145	10	30	651961.5625	419301.4688	1989/90 Mass Balance Sediment Data
216	248	10	30	632938.3125	404121.5938	1989/90 Mass Balance Sediment Data
217	900	10	30	632794.3750	404129.4375	1989/90 Mass Balance Sediment Data
218	6,600	10	30	633869.0000	403872.5625	1989/90 Mass Balance Sediment Data
219	480	10	30	633909.3125	403830.1563	1989/90 Mass Balance Sediment Data
220	1,540	10	30	636097.7500	403564.3125	1989/90 Mass Balance Sediment Data
221	2,092	10	30	636023.3750	403561.6250	1989/90 Mass Balance Sediment Data

Table 2 PCB Data Not Included in 2002 Interpolation

Station ID	Total PCB (µg/kg)	Start Depth (cm)	End Depth (cm)	Easting	Northing	Source
222	3,450	10	30	635990.6250	403455.9063	1989/90 Mass Balance Sediment Data
226	3,333	10	30	653729.0000	421898.9688	1989/90 Mass Balance Sediment Data
231	20,750	10	30	621966.0625	394063.1563	1989/90 Mass Balance Sediment Data
244	50	10	30	641856.6875	407662.4375	1989/90 Mass Balance Sediment Data
249	190	10	30	622199.6875	394796.0000	1989/90 Mass Balance Sediment Data
250	100	10	30	622329.6250	394693.8438	1989/90 Mass Balance Sediment Data
251	66	10	30	642462.7500	408113.6250	1989/90 Mass Balance Sediment Data
253	50	10	30	642983.5000	408190.3125	1989/90 Mass Balance Sediment Data
254	50	10	30	643216.0000	408374.9063	1989/90 Mass Balance Sediment Data
258	240	10	30	648895.3125	414906.5938	1989/90 Mass Balance Sediment Data
259	16,150	10	30	649173.9375	415223.9375	1989/90 Mass Balance Sediment Data
262	238	10	30	623686.3750	399018.5000	1989/90 Mass Balance Sediment Data
263	56	10	30	623145.2500	398318.4063	1989/90 Mass Balance Sediment Data
266	163	10	30	651605.9375	418919.3750	1989/90 Mass Balance Sediment Data
269	690	10	30	650744.8125	417278.7188	1989/90 Mass Balance Sediment Data
270	50	10	30	652910.7500	420354.5000	1989/90 Mass Balance Sediment Data
271	186	10	30	653173.8750	420656.8125	1989/90 Mass Balance Sediment Data
272	860	10	30	652951.3750	420644.3438	1989/90 Mass Balance Sediment Data
274	50	10	30	653325.3750	421137.5938	1989/90 Mass Balance Sediment Data
275	102	10	30	653466.9375	421379.3125	1989/90 Mass Balance Sediment Data
284	740	10	30	651381.3125	418627.8750	1989/90 Mass Balance Sediment Data
289	320	10	30	623019.8125	398459.0313	1989/90 Mass Balance Sediment Data
290	288	10	30	622905.5000	398386.0625	1989/90 Mass Balance Sediment Data
292	113	10	30	625317.1250	399903.7813	1989/90 Mass Balance Sediment Data
295	663	10	30	625966.8125	400454.7500	1989/90 Mass Balance Sediment Data
297	192	10	30	629445.4375	402390.6875	1989/90 Mass Balance Sediment Data
298	75	10	30	630625.6875	403378.5000	1989/90 Mass Balance Sediment Data
299	83	10	30	630707.5625	403151.0000	1989/90 Mass Balance Sediment Data
300	110	10	30	631398.1250	403555.3125	1989/90 Mass Balance Sediment Data
301	343	10	30	632267.8125	403680.1250	1989/90 Mass Balance Sediment Data
303	50	10	30	632884.8125	404120.4375	1989/90 Mass Balance Sediment Data
313	7,800	10	30	636111.7500	403584.5000	1989/90 Mass Balance Sediment Data
314	300	10	30	637445.8125	404483.3438	1989/90 Mass Balance Sediment Data
322	114	10	30	641325.1250	406686.9688	1989/90 Mass Balance Sediment Data
323	63	10	30	641720.5625	407013.7500	1989/90 Mass Balance Sediment Data
8	55,900	30	50	622110	394543	1989/90 Mass Balance Sediment Data
19	50	30	50	643068	408250	1989/90 Mass Balance Sediment Data
31	50	30	50	623356	397759	1989/90 Mass Balance Sediment Data
42	50	30	50	624055	399463	1989/90 Mass Balance Sediment Data
43	68	30	50	624299	399574	1989/90 Mass Balance Sediment Data
52	530	30	50	623045	397866	1989/90 Mass Balance Sediment Data
64	3,012	30	50	649656	416440	1989/90 Mass Balance Sediment Data
65	50	30	50	651517	418334	1989/90 Mass Balance Sediment Data
105	50	30	50	649934	416648	1989/90 Mass Balance Sediment Data
109	50	30	50	622864	398323	1989/90 Mass Balance Sediment Data
133	4,300	30	50	656573	427715	1989/90 Mass Balance Sediment Data
138	10,600	30	50	654114	424552	1989/90 Mass Balance Sediment Data
143	1,600	30	50	658006	431579	1989/90 Mass Balance Sediment Data
159	17,630	30	50	633243	404079	1989/90 Mass Balance Sediment Data
164	13,170	30	50	633865	403858	1989/90 Mass Balance Sediment Data
168	50	30	50	635453	403403	1989/90 Mass Balance Sediment Data
187	1,900	30	50	622359	394015	1989/90 Mass Balance Sediment Data
195	2	30	50	622867	397291	1989/90 Mass Balance Sediment Data
200	50	30	50	651962	419301	1989/90 Mass Balance Sediment Data

Table 2 PCB Data Not Included in 2002 Interpolation

Station ID	Total PCB (µg/kg)	Start Depth (cm)	End Depth (cm)	Easting	Northing	Source
216	50	30	50	632938	404122	1989/90 Mass Balance Sediment Data
218	19,280	30	50	633869	403873	1989/90 Mass Balance Sediment Data
219	50	30	50	633909	403830	1989/90 Mass Balance Sediment Data
221	50	30	50	636023	403562	1989/90 Mass Balance Sediment Data
222	50	30	50	635991	403456	1989/90 Mass Balance Sediment Data
231	3,032	30	50	621966	394063	1989/90 Mass Balance Sediment Data
244	50	30	50	641857	407662	1989/90 Mass Balance Sediment Data
249	190	30	50	622200	394796	1989/90 Mass Balance Sediment Data
251	50	30	50	642463	408114	1989/90 Mass Balance Sediment Data
258	240	30	50	648895	414907	1989/90 Mass Balance Sediment Data
259	6,096	30	50	649174	415224	1989/90 Mass Balance Sediment Data
262	50	30	50	623686	399019	1989/90 Mass Balance Sediment Data
266	50	30	50	651606	418919	1989/90 Mass Balance Sediment Data
269	50	30	50	650745	417279	1989/90 Mass Balance Sediment Data
270	50	30	50	652911	420355	1989/90 Mass Balance Sediment Data
284	50	30	50	651381	418628	1989/90 Mass Balance Sediment Data
289	320	30	50	623020	398459	1989/90 Mass Balance Sediment Data
290	430	30	50	622906	398386	1989/90 Mass Balance Sediment Data
295	50	30	50	625967	400455	1989/90 Mass Balance Sediment Data
297	50	30	50	629445	402391	1989/90 Mass Balance Sediment Data
298	50	30	50	630626	403379	1989/90 Mass Balance Sediment Data
301	50	30	50	632268	403680	1989/90 Mass Balance Sediment Data
322	50	30	50	641325	406687	1989/90 Mass Balance Sediment Data
323	50	30	50	641721	407014	1989/90 Mass Balance Sediment Data
64	50	50	100	649655.5625	416439.7813	1989/90 Mass Balance Sediment Data
164	20,000	50	100	633864.6875	403858.1563	1989/90 Mass Balance Sediment Data
219	50	50	100	633909.3125	403830.1563	1989/90 Mass Balance Sediment Data
222	50	50	100	635990.6250	403455.9063	1989/90 Mass Balance Sediment Data
258	240	50	100	648895.3125	414906.5938	1989/90 Mass Balance Sediment Data
269	50	50	100	650744.8125	417278.7188	1989/90 Mass Balance Sediment Data
284	50	50	100	651381.3125	418627.8750	1989/90 Mass Balance Sediment Data
290	430	50	100	622905.5000	398386.0625	1989/90 Mass Balance Sediment Data
297	50	50	100	629445.4375	402390.6875	1989/90 Mass Balance Sediment Data
323	50	50	100	641720.5625	407013.7500	1989/90 Mass Balance Sediment Data

ITEM 8

WHITE PAPER NO. 9
REFERENCES

6 REFERENCES

AGI, 2000. *Peer Review of Models Predicting the Fate and Export of PCBs in the Lower Fox River below the De Pere Dam: A Report of the Lower Fox River Fate and Transport Peer Review Panel*. J. C. Tracy and C. M. Keane (eds). American Geological Institute, Alexandria, Virginia. 88 p.

Bierman, V. J., J. V. DePinto, T. C. Young, P. W. Rodgers, S. C. Martin, R. Raghunathan, and S. C. Hintz, 1992. *Development and Validation of an Integrated Exposure Model for Toxic Chemicals in Green Bay, Lake Michigan*. Prepared for United States Environmental Protection Agency, Large Lakes and Rivers Research Branch, Environmental Research Laboratory, Duluth, Michigan. September 1.

Connolly, J. P., 1991. Application of a food chain model to polychlorinated biphenyl contamination of the lobster and winter flounder food chains in New Bedford Harbor. *Environ. Sci. Technol*. 25:760–770.

Connolly, J. P., T. F. Parkerton, J. D. Quadrini, S. T. Taylor and A. J. Thuman, 1992. *Development and Application of a Model of PCBs in the Green Bay, Lake Michigan Walleye and Brown Trout and Their Food Webs*. Report to the United States Environmental Protection Agency, Grosse Ile, Michigan. Cooperative Agreement CR-815396.

Connolly, J. P. and R. V. Thomann, 1992. Modeling the Accumulation of Organic Chemicals in Aquatic Food Chains. In: *Fate of Pesticides and Chemicals in the Environment*. J. L. Schnoor (ed). John Wiley & Sons, Inc. p. 385–406.

Connolly, J. P. and R. Tonelli, 1985. A model of kepone in the striped bass food chain of the James River Estuary. *Est. Coastal Shelf Sci*. 20:349–366.

DePinto, J. V, V. J. Bierman, and T. C. Young, 1993. *Recalibration of GBTOX: An Integrated Exposure Model For Toxic Chemicals in Green Bay, Lake Michigan*. Prepared for United States Environmental Protection Agency, Large Lakes and Rivers Research Branch, Environmental Research Laboratory, Grosse Ile, Michigan. December 31.

Dinehart, R. L., 2002. Bedform movement recorded by sequential single-beam surveys in tidal rivers. *Journal of Hydrology*. 258(1–4):25–39.

EPA, 2002. *White Paper No. 3 – Fox River Bathymetric Survey Analysis*. United States Environmental Protection Agency, Region 5, Superfund Division, FIELDS Team. December.

Gobas, F. A. P. C., 1993. A model for predicting the bioaccumulation of hydrophobic organic chemicals in aquatic food-webs: Application to Lake Ontario. *Ecological Modeling*. 69:1–17. December 8.

Gobas, F. A. P. C., M. N. Z'Graggen and X. Zhang, 1995. Time response of the Lake Ontario ecosystem to virtual elimination of PCBs. *Environmental Science & Technology*. 29(8):2038–2046.

HydroQual, Inc., 1995. *Addendum to Green Bay Final Report: Food Chain Model Projections*. Prepared for United States Environmental Protection Agency, Grosse Ile, Michigan.

HydroQual, Inc., 1996. *Green Bay Food Chain Model Documentation*. Prepared for United States Environmental Protection Agency, Grosse Ile, Michigan.

HydroQual, 2001. *Enhancement and Application of a PCB Fate and Transport Model for Green Bay – Lower Fox River/Green Bay Remedial Investigation and Feasibility Study*. Prepared for Wisconsin Department of Natural Resources by HydroQual, Inc. June.

LTI, 2002. *Measurement of Burial Rates and Mixing Depths Using High Resolution Radioisotope Cores in the Lower Fox River*. Limno-Tech, Inc., Ann Arbor, Michigan. 95 p.

QEA. 2001. *A Model of PCB Bioaccumulation in the Lower Fox River and Green Bay: GBFood*. Prepared for ThermoRetec Consulting Corporation by QEA, LLC, Montvale, New Jersey. June.

RETEC. 2002a. *Final Remedial Investigation for the Lower Fox River and Green Bay, Wisconsin, Remedial Investigation and Feasibility Study*. Prepared for Wisconsin Department of Natural Resources by The RETEC Group, Inc., St. Paul, Minnesota. December.

RETEC. 2002b. *Final Feasibility Study for the Lower Fox River and Green Bay, Wisconsin, Remedial Investigation and Feasibility Study*. Prepared for Wisconsin Department of Natural Resources by The RETEC Group, Inc., Seattle, Washington. December.

RETEC. 2002c. *Final Baseline Human Health and Ecological Risk Assessment for the Lower Fox River and Green Bay, Wisconsin, Remedial Investigation and Feasibility Study*. Prepared for Wisconsin Department of Natural Resources by The RETEC Group, Inc., Seattle, Washington and Pittsburgh, Pennsylvania. December.

Steuer, J., S. Jaeger, and D. Patterson, 1995. *A Deterministic PCB Transport Model for the Lower Fox River Between Lake Winnebago and De Pere, Wisconsin*. PUBL WR 389-95. Wisconsin Department of Natural Resources. May. 283 p.

Tetra Tech, Inc., 2000. *Overview of Sediment-Contaminant Transport and Fate Models for Use in Making Site-Specific Contaminated Sediment Remedial Action Decisions*. Prepared for United States Environmental Protection Agency OERR (5204G) by Tetra Tech, Inc., Fairfax, Virginia.

ThermoRetec, 2001. *Lower Fox River/Green Bay Remedial Investigation and Feasibility Study: Fox River Food (FRFood) Model Documentation Memorandum*. Prepared for Wisconsin Department of Natural Resources by ThermoRetec Consulting Corporation. June.

TMWL, 2002. *Time Trends in PCB Concentrations in Sediment and Fish: Lower Fox River and Green Bay, Wisconsin*. Prepared for Wisconsin Department of Natural Resources by The Mountain-Whisper-Light Statistical Consulting, Seattle, Washington and The RETEC Group, Inc., Seattle, Washington. December.

Velleux, M. and D. Endicott, 1994. Development of a mass balance model for estimating PCB export from the Lower Fox River to Green Bay. *Journal of Great Lakes Research*. 20(2):416–434.

Velleux, M., D. Endicott, J. Steuer, S. Jaeger, and D. Patterson, 1995. Long-term simulation of PCB export from the Fox River to Green Bay. *Journal of Great Lakes Research*. 21(3):359–372.

Velleux, M., J. Gailani, and D. Endicott, 1996. Screening-level approach for estimating contaminant export from tributaries. *ASCE Journal of Environmental Engineering*. 122(6):503–514.

Velleux, M., J. Killian, G. Statz, S. Jaeger, D. Damiani, and E. Garland, 2001. *Development and Application of a PCB Transport Model for the Lower Fox River – Lower Fox River/Green Bay Remedial Investigation and Feasibility Study*. Prepared by Wisconsin Department of Natural Resources. June 15.

WDNR, 1997. *Polychlorinated Biphenyl (PCB) Contaminated Sediment in the Lower Fox River: Modeling Analysis of Selective Sediment Remediation*. PUBL-WT-482-97. Wisconsin Department of Natural Resources, Bureau of Watershed Management, Madison, Wisconsin. February.

WDNR, 1999a. *Technical Memorandum 2d: Compilation and Estimation of Historical Discharges of Total Suspended Solids and PCB from Lower Fox River Point Sources*. Wisconsin Department of Natural Resources, Madison, Wisconsin. February 23.

WDNR, 1999b. *Technical Memorandum 2g: Quantification of Lower Fox River Sediment Bed Elevation Dynamics through Direct Observations*. Wisconsin Department of Natural Resources, Madison, Wisconsin. July 23.

WDNR, 1999c. *Technical Memorandum 2e: Estimation of Lower Fox River Sediment Bed Properties*. Wisconsin Department of Natural Resources, Madison, Wisconsin. March 31.

WDNR, 1999d. *Analysis of COE Sounding Data at 56/57*. Memorandum prepared by Jim Killian. Wisconsin Department of Natural Resources, Madison, Wisconsin. September 27.

WDNR, 2000a. *Addendum to Technical Memorandum 2e: Estimation of Sediment Bed Properties for the Lower Fox River (4 reach effort)*. Memorandum prepared by G. Fritz Statz. Wisconsin Department of Natural Resources, Madison, Wisconsin. October 26.

WDNR, 2000b. *Technical Memorandum 2f: Estimation of Sediment Bed Properties for Green Bay*. Wisconsin Department of Natural Resources, Madison, Wisconsin. December 15.

WDNR, 2000c. *Screening-Level Model of PCB Transport in the Sheboygan River*. Wisconsin Department of Natural Resources, Madison, Wisconsin. December 31.

WDNR, 2000d. *Post-Dredging Results for SMU 56/57*. Memorandum prepared by Bob Paulson. Wisconsin Department of Natural Resources, Madison, Wisconsin. February 21.

WDNR, 2001a. *Development and Application of a PCB Transport Model for the Lower Fox River*. Wisconsin Department of Natural Resources, Madison, Wisconsin. June 15.

WDNR, 2001b. *Estimation of Contemporary Net Burial Rates from the Depth of PCB Occurrence in the Lower Fox River Sediments*. Memorandum prepared by Mark Velleux. Wisconsin Department of Natural Resources, Madison, Wisconsin. March 23.

WDNR, 2002. *2002 Benthic and Sediment Sampling at Fox River Remediation Site Hotspot 56/57*. Memorandum prepared by Jim Killian. Wisconsin Department of Natural Resources, Madison, Wisconsin. November 26.

WDNR and EPA, 2001. *Proposed Remedial Action Plan, Lower Fox River and Green Bay*. Wisconsin Department of Natural Resources, Madison and Green Bay, Wisconsin and United States Environmental Protection Agency, Region 5, Chicago, Illinois. October.

WNDR and RETEC, 2002. *Final Model Documentation Report for the Lower Fox River and Green Bay, Wisconsin, Remedial Investigation and Feasibility Study*. Wisconsin Department of Natural Resources, Madison, Wisconsin and The RETEC Group, Inc., Seattle, Washington. December.