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REMEDIAL ALTERNATIVES ARRAY DOCUMENT AND DATA GAPS ANALYSIS REPORT

Waukegan Harbor Area of Concern
Waukegan, Illinois

Technical Assistance

WA No. 228-TATA-0528 / Contract No. 68-W6-0025

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Executive Summary

This Remedial Alternatives Array Document and Data Gaps Analysis Report (RAAD/DGAR) presents the development and evaluation of remedial action alternatives that could be used to remediate contaminated sediment within the Waukegan Harbor Area of Concern (AOC). The results of the analysis will be used to identify remedial alternatives that should be evaluated in a more detailed manner in a subsequent Feasibility Study (FS). Data gaps have also been identified that will need to be addressed during further investigation activities prior to the FS.

Site Description

Waukegan Harbor is located on the western shore of Lake Michigan, about 60 km north of Chicago, Illinois in the city of Waukegan, Illinois. The harbor is a largely man-made structure that is approximately 35 to 40 acres in area with average water depths of about 20 feet. A natural clay/glacial till harbor bottom underlies the softer sediments which consist of organic silts and/or coarse lake sands. Based on current uses and historical activities, the harbor has been divided into the following harbor segments:

- Approach Channel
- Outer Harbor
- Entrance Channel
- Inner Harbor
- Marina
- Inner Harbor Extension
- Slip 1
- North Harbor (includes Slip 4)

The federal navigation channel of Waukegan Harbor includes the Approach Channel, Outer Harbor, Entrance Channel, the Inner Harbor, and the Inner Harbor Extension.

Waukegan Harbor is part of the Outboard Marine Corporation, Inc. (OMC) Superfund site. The OMC site includes four operable units (OU): the Waukegan Harbor sites (OU 1 and OU 3), the Waukegan Coke Plant site (OU 2) on the eastern edge of the Harbor, and the OMC Plant 2 site (OU 4) north of the harbor. OMC Plant 2 is the source of the PCB contamination in Waukegan Harbor sediments, causing the harbor to be listed as an International Joint Commission Great Lakes AOC. In February 1992, OMC completed a sediment remediation project in the harbor that entailed the dredging, treatment, and disposal of approximately 38,000 cubic yards of PCB-contaminated sediment from the North Harbor area. Dredged sediments were placed in a permanent containment cell constructed in the former Slip 3. Remediated sediments contained an estimated 1,000,000 pounds of PCBs with a maximum PCB concentration of 500,000 ppm. Sampling of surficial sediments conducted in 1996 indicated moderate levels (typically < 25 ppm) of PCB contamination throughout the harbor from the north harbor area down to the entrance channel.

OMC dredged the northern harbor area to achieve a cleanup level of 50 ppm for PCBs. The database compiled from sampling events following the most recent dredging activities includes 92 (75 core and 17 grab) samples collected from 58 locations throughout harbor. PCBs were detected in about 78 percent of the samples, ranging in concentration from 0.0277 to 29.8 parts per billion (ppb) and averaging about 3.8 ppb.

Recent fish tissue samples were also found to contain high levels of PCBs. In order to achieve acceptable PCB levels in fish, PCB levels in sediments would need to be lowered five-fold to reach a cancer level of 1 in 10,000 (level for fish advisories) and about ten-fold to achieve an acceptable noncancer risk. Current average PCB levels in sediment of 2.5 ppm PCB would, therefore, need to be reduced to an overall surface weighted average of 0.25 ppm PCB to properly protect public health.

Site Specific Remedial Action Objectives

Site-specific remedial action objectives (RAOs) were developed based on an understanding of the PCB-contaminated sediments, potential exposure routes, identification of remediation target limits, and other stakeholder input. The RAOs for the sediment in Waukegan Harbor include:

- Protect human health and the environment from the adverse effects of PCBs attributable to the site.
- Reduce PCBs in sediment throughout the harbor to a remedial action level of 1 mg/kg at any single location and a SWAC of 0.25 mg/kg.
- Minimize potential human health and environmental risks that may be associated with remedial activities, to the extent practical.
- Deepen the navigational channel of the harbor for commercial shipping. Preliminary USACE project depths to be assumed in this report are the outer harbor (25 feet project depth), entrance channel (23 feet project depth), inner harbor (23 feet project depth), and the inner harbor extension (23 feet project depth).
- Do not reduce the depth to top of sediment in the North Harbor segment where depths are less than 16 feet below LWD or in the Marina segment where depths are 10 feet below LWD as a result of sediment capping. Sediment removal solely for the purpose of recreational boating is not an objective for these two segments.
- Minimize adverse effects on recreational and commercial shipping during remedial activities, to the extent practicable.

Remedial Alternative Array

Upon identification and screening of technologies and process options remedial alternatives were developed to satisfy the RAOs. The assembled alternatives are presented in Table ES-1.

The assembled alternatives were analyzed with regard to the following three evaluation criteria:

- Effectiveness (ability to address contamination and reduce risk)
- Implementability (ability to successfully implement and carry out the remedial alternative, with consideration of potential regulatory and public acceptance barriers to implementation)
- Cost (financial costs of each alternative)

The comparison of the nine assembled alternatives to the three alternative screening criteria of effectiveness, implementability and cost is summarized in Table ES-2.

Data Gaps

The existing sediment physical and chemical data were used in the development of the remedial alternatives array and the cost estimates in this document. However, the current data are not considered sufficient for a FS because of the data limitations in defining the lateral and vertical extent of PCB contamination. By far, the greatest data need is for determining the volume of PCB contaminated sediment. In general, the relatively thin sediment layer of the North Harbor, Inner Harbor Extension, and Inner Harbor will not require a large amount of additional characterization. More substantial sampling is anticipated for the Marina because the sediment in this segment is relatively thick and the cost of sediment removal is high given the presence of docks and piles throughout the area.

Additional sampling is also recommended for the Entrance Channel and Outer Harbor because of the limited sampling in the past and because of the very large volumes of sediment that would be dredged for navigational purposes. Much of the sediment in these two segments is sand that is much less contaminated than the siltier sediments of other harbor segments. Defining the depth of uncontaminated sand is important for disposal purposes since much less costly disposal options are available for uncontaminated sand. Also, it is likely that the PCB contamination is associated with the fine sediment fractions that could be separated from the sands. Testing should be conducted on the contaminated sand from these segments to determine whether particle segregation of the sands would reduce or eliminate the PCB contamination in the coarser fraction and allow less expensive disposal. In addition, low concentrations of PCBs detected in the till could have implications for beneficial resute of the glacial till in areas outside of the OMC Superfund site.

Other data needs consist of determining sediment dewatering characteristics, water treatment requirements, and evaluation of hydraulic vs. mechanical dredging. Dewatering, water treatment and dredging techniques have large effects on a dredging project's cost, and data to allow more precise estimates of these costs is needed.

TABLE ES-1
Summary of Remedial Alternatives
Waukegan Harbor Area of Concern

Remedial Technologies or Process Options	Alternative 1 No Action	Alternative 2 Environmental Sediment Removal and YCL Disposal	Alternative 3 MNR, Navigational Channel Sediment Removal, and YCL Disposal	Alternative 4 Capping, Navigational Channel Sediment Removal, and YCL Disposal	Alternative 5 Capping and Limited Navigational Sediment Removal , and YCL Disposal	Alternative 6 Sediment Removal and Near-Site Disposal	Alternative 7 Sediment Removal and JMS/YCL Disposal	Alternative 8 Sediment Removal and YCL Disposal	Alternative 9 Sediment Removal and YCL/Subtitle D Disposal
Primary Technologies	No Action	Dredging	Monitored Natural Recovery and Dredging	Capping and Dredging	Capping and Dredging	Dredging	Dredging	Dredging	Dredging
Segments Dredged	None	All except Outer Harbor	Navigational Channel	Navigational Channel	Navigational Channel	All	All	All	All
Segments Capped	None	Residuals Capped in North Harbor and Marina	None	North Harbor Marina	North Harbor Marina Inner Harbor Entrance Channel	Residuals Capped in North Harbor and Marina	Residuals Capped in North Harbor	Residuals Capped in North Harbor	Residuals Capped in North Harbor
Final Segment Depths (ft LWD)									
North Harbor[a, b]	15	14	15	13	13	14	14	14	14
Inner Harbor Extension	20[a]	20[a]	23	23	20	23	23	23	23
Inner Harbor	19[a]	19	23	23	20 (100-ft width)[c]	23	23	23	23
Marina[a,b]	9	9	9	7	7	11	11	11	11
Entrance Channel	19[a]	22	23	23	20 (100-ft width)[c]	23	23	23	23
Outer Harbor	19[a]	19	25	25	23 (100-ft width)[c]	25	25	25	25
Contaminated Sediment Dredged									
Estimated Volume (cy)	0	181,000	127,000	170,000	56,000	256,000	256,000	256,000	256,000
Disposal Location		YCL	YCL	YCL	YCL	Confined Disposal Facility (170,000 cy) Waukegan Coke Plant Site (86,000 cy)	YCL	YCL	Solid Waste Landfill
Uncontaminated Sediment Dredged									
Estimated Volume (cy)	0	87,000	100,000	106,000	121,000	106,000	106,000	106,000	106,000
Disposal Location		Re-Use	Unconfined Lake Disposal	Re-Use (91,000 cy) Unconfined Lake Disposal (15,000 cy)	Re-Use	Re-Use (77,000 cy) Unconfined Lake Disposal (29,000 cy)	Re-Use (87,000 cy) Johns-Manville Site (19,000 cy)	Re-Use (87,000 cy) YCL (19,000 cy)	Re-Use (87,000 cy) YCL (19,000 cy)
Uncontaminated Till Dredged									
Estimated Volume (cy)	0	0	104,000	127,000	28,000	131,000	131,000	131,000	131,000
Disposal Location			Waukegan Coke Plant Site	Waukegan Coke Plant Site	Waukegan Coke Plant Site	Waukegan Coke Plant Site (64,000 cy) Johns-Manville Site (67,000 cy)	Johns-Manville Site	YCL	YCL

Navigational Channel includes the Outer Harbor, Entrance Channel, Inner Harbor and Inner Harbor Extension
YCL = Yeoman Creek Landfill. The identification of Yeoman Creek Landfill as the disposal location serves as a proxy for similar nearby disposal sites within Waukegan.
JMS = Johns Manville Site
WCP = Waukegan Coke Plant Site

[a]Depth is the average depth to top of the sediment for the harbor segment based on core and probe data.
[b]The final depths presented for this segment have been calculated using the average depth to the top of the sediment and are presented just for comparison purposes. Because the removal depths are not The final depths will vary across the segment.
[c]Depth indicated corresponds to a limited 100-foot wide channel through these segments. The areas outside the channel will be about 3 feet deeper than the existing depth.

TABLE ES-2
Comparison to Alternative Screening Criteria
Waukegan Harbor Area of Concern

Performance Criteria	Alternative 1 No Action	Alternative 2 Environmental Sediment Removal and YCL Disposal	Alternative 3 Monitored Natural Recovery, Navigational Channel Sediment Removal, and YCL Disposal	Alternative 4 Capping, Navigational Channel Sediment Removal, and YCL Disposal	Alternative 5 Capping and Limited Navigational Sediment Removal and YCL Disposal	Alternative 6 Sediment Removal and Near-Site Disposal	Alternative 7 Sediment Removal and JMS/YCL Disposal	Alternative 8 Sediment Removal and YCL Disposal	Alternative 9 Sediment Removal and YCL/Subtitle D Disposal
Effectiveness									
Meet RAO goal of 1 mg/kg at any single location and an overall SWAC of 0.25 mg/kg	POOR Will not meet overall SWAC goal in a reasonable time frame	GOOD Will achieve overall SWAC goal.	POOR Will not meet SWAC goal until contaminated sediments in North Harbor and Marina attenuate.	GOOD Will achieve overall SWAC goal.	GOOD Will achieve overall SWAC goal.	GOOD Will achieve overall SWAC goal.	GOOD Will achieve overall SWAC goal.	GOOD Will achieve overall SWAC goal.	GOOD Will achieve overall SWAC goal.
Ability to Prevent Future Increase in PCB SWAC (erosion from prop wash etc.)	Not effective	GOOD Dredged residuals covered.	POOR Prop wash and physical disturbances of North Harbor and Marina sediments could potentially cause recontamination of dredged segments.	MODERATE Erosion of caps in North Harbor and Marina segments could potentially spread PCB-contaminated sediment throughout harbor. Dredged residuals covered.	MODERATE Erosion of caps in North Harbor and Marina segments could potentially spread PCB-contaminated sediment throughout harbor. Dredged residuals covered..	GOOD Dredged residuals covered.	GOOD Dredged residuals covered.	GOOD Dredged residuals covered.	GOOD Dredged residuals covered.
Operation and Maintenance Considerations	None	Long-term cap maintenance.	None	Long-term cap maintenance..	Long-term cap maintenance. in North Harbor, Marina and navigational channel. Armored cap in navigational channel will make future dredging difficult.	Long-term cap maintenance.	Long-term cap maintenance.	Long-term cap maintenance.	Long-term cap maintenance.
Implementability									
Construction Impacts to Community	Not Applicable	MODERATE Noise and street damage from trucking 181,000 cy of sediment to YCL.	GOOD Noise and street damage from trucking 127,000 cy of sediment to YCL.	MODERATE Noise and street damage from trucking 170,000 cy of sediment to YCL.	VERY GOOD Noise and street damage from trucking 56,000 cy of sediment to YCL.	VERY GOOD	POOR Noise and street damage from trucking 256,000 cy of sediment to YCL.	POOR Noise and street damage from trucking 387,000 cy of sediment to YCL.	POOR Noise and street damage from trucking 387,000 cy of sediment to YCL and Solid Waste Landfill.
Construction Impacts to Harbor Users	Not Applicable	MODERATE Sequencing important to minimize impacts to shipping and recreational users.	MODERATE Sequencing important to minimize impacts to shipping and recreational users.	MODERATE Sequencing important to minimize impacts to shipping and recreational users.	POOR Sequencing to minimize impact to shipping is the most difficult because of the narrower channel (100 ft wide) to be dredged. Dredging will need to be scheduled during non-shipping season.	POOR Sequencing important to minimize impact to shipping and recreational users. Construction of CDF in North Harbor may cause more disruption to recreational boating than other alternatives.	MODERATE Sequencing important to minimize impact to shipping and recreational users.	MODERATE Sequencing important to minimize impact to shipping and recreational users.	MODERATE Sequencing important to minimize impact to shipping and recreational users.
Public acceptance	Unacceptable	MODERATE Lack of inclusion of dredging all harbor segments for navigation may make this unacceptable to some of the public.	POOR May encounter resistance from a portion of the public because it does not actively remediate all PCB contaminated sediment in the North Harbor, Marina and Inner Harbor. Decades may be needed for MNR to eventually result in meeting PCB sediment goals.	GOOD Public expected to be in general support of this alternative because harbor sediments are remediated and harbor is dredged to allow navigation.	GOOD Public expected to be in general support of this alternative because harbor sediments are remediated and harbor is dredged to allow navigation.	MODERATE Public expected to be in general support of this alternative because harbor sediments are remediated and harbor is dredged to allow navigation. However construction of CDF in North Harbor may be viewed negatively for long-term land use.	GOOD Public expected to be in general support of this alternative because harbor sediments are remediated and harbor is dredged to allow navigation	GOOD Public expected to be in general support of this alternative because harbor sediments are remediated and harbor is dredged to allow navigation.	GOOD Public expected to be in general support of this alternative because harbor sediments are remediated and harbor is dredged to allow navigation.
Cost	None	$18,000,000	$21,000,000	$25,000,000	$24,000,000	$31,000,000	$33,000,000	$34,000,000	$46,000,000

Navigational Channel includes the Outer Harbor, Entrance Channel, Inner Harbor and Inner Harbor Extension
YCL = Yeoman Creek Landfill. The identification of Yeoman Creek Landfill as the disposal location serves as a proxy for similar nearby disposal sites within Waukegan.
JMS = Johns Manville Site
WCP = Waukegan Coke Plant Site

Contents

Executive Summary ..... **iii**

Abbreviations and Acronyms ..... **xv**

1. Introduction **1-1**
- 1.1 Purpose and Scope 1-1
- 1.2 Organization 1-1
- 1.3 Stakeholders 1-2

2. Site Description **2-1**
- 2.1 Background 2-1
  - 2.1.1 History of Waukegan Harbor 2-1
  - 2.1.2 History of Contamination 2-2
  - 2.1.3 Activities at the Outboard Marine Corporation Site 2-3
  - 2.1.4 Waukegan Harbor Dredging Activities 2-6
  - 2.1.5 Previous Investigations 2-7
- 2.2 Local Demography and Land Use 2-9
- 2.3 Physical Characteristics 2-10
  - 2.3.1 Topography 2-10
  - 2.3.2 Hydrology 2-10
  - 2.3.3 Geologic and Hydrogeologic Setting 2-14
- 2.4 Chemical Characteristics 2-15
  - 2.4.1 Surface Water 2-15
  - 2.4.2 Sediment 2-16
  - 2.4.3 Fish Tissue 2-17
- 2.5 Risk Evaluation 2-18

3. Remedial Action Objectives **3-1**
- 3.1 NCP and CERCLA Objectives 3-1
- 3.2 Site-Specific Exposure Routes 3-10
- 3.3 Applicable or Relevant and Appropriate Requirements 3-10
  - 3.3.1 Definition of Applicable or Relevant and Appropriate Requirements 3-10
  - 3.3.2 Determination of Applicable or Relevant and Appropriate Requirements 3-11
- 3.4 Site-Specific Remedial Action Objectives 3-14
- 3.5 Sediment Remediation Areas 3-14

4. Identification and Screening of Technologies and Process Options **4-1**
- 4.1 No Action 4-8
- 4.2 Natural Attenuation 4-9
  - 4.2.1 Monitored Natural Recovery 4-9
  - 4.2.2 Enhanced Natural Recovery—Thin Layer Placement 4-9
- 4.3 Monitoring 4-10
  - 4.3.1 Sampling and Analysis 4-10
- 4.4 Institutional Controls 4-10

4.5 Containment 4-11
4.5.1 Cap Sediment In Situ 4-11
4.5.2 Clean Layer Placement 4-12
4.5.3 Active Cap 4-12
4.6 In Situ Treatment 4-13
4.6.1 Fixation/Stabilization 4-13
4.7 Sediment Removal 4-13
4.7.1 Dry Excavation 4-14
4.7.2 Mechanical Dredging 4-15
4.7.3 Hydraulic Dredging 4-16
4.8 Ex Situ Treatment 4-17
4.9 Sediment Dewatering 4-17
4.9.1 Passive Dewatering 4-17
4.9.2 Mechanical Dewatering 4-17
4.10 Sediment Processing and Stabilization 4-17
4.10.1 Particle Size Segregation 4-18
4.10.2 Reagent Addition 4-18
4.11 Water Treatment 4-18
4.11.1 Filtration 4-18
4.11.2 Activated Carbon Adsorption 4-19
4.12 Sediment Transport 4-19
4.12.1 Trucking 4-19
4.12.2 Pipeline 4-19
4.13 Disposal 4-20
4.13.1 Confined Disposal Facility (in-water) 4-20
4.13.2 Waukegan Coke Plant 4-20
4.13.3 Cap Other Segment 4-21
4.13.4 Unconfined Lake Disposal 4-21
4.13.5 Yeoman Creek Landfill 4-21
4.13.6 Johns-Manville Site 4-22
4.13.7 Subtitle D Solid Waste Landfill 4-22
4.13.8 RCRA Hazardous Waste Landfill 4-22

5. Development and Screening of Alternatives 5-1
5.1 Introduction 5-1
5.1.1 Alternative Development 5-1
5.1.2 Evaluation Criteria 5-5
5.2 Alternative 1: No Action 5-5
5.2.1 Description 5-5
5.2.2 Effectiveness 5-6
5.2.3 Implementability 5-6
5.2.4 Cost 5-6
5.3 Alternative 2: Environmental Sediment Removal and YCL Disposal 5-6
5.3.1 Description 5-6
5.3.2 Effectiveness 5-9
5.3.3 Implementability 5-10
5.3.4 Cost 5-11

5.4 Alternative 3: Monitored Natural Recovery, Navigational Channel Sediment Removal, and YCL Disposal 5-11
5.4.1 Description 5-11
5.4.2 Effectiveness 5-13
5.4.3 Implementability 5-14
5.4.4 Cost 5-14
5.5 Alternative 4: Capping, Navigational Channel Sediment Removal, and YCL Disposal 5-15
5.5.1 Description 5-15
5.5.2 Effectiveness 5-16
5.5.3 Implementability 5-18
5.5.4 Cost 5-18
5.6 Alternative 5: Capping, Limited Navigational Channel Sediment Removal, and YCL Disposal 5-18
5.6.1 Description 5-18
5.6.2 Effectiveness 5-21
5.6.3 Implementability 5-22
5.6.4 Cost 5-22
5.7 Alternative 6: Sediment Removal and Near-Site Disposal 5-22
5.7.1 Description 5-22
5.7.2 Effectiveness 5-24
5.7.3 Implementability 5-26
5.7.4 Cost 5-27
5.8 Alternative 7: Sediment Removal and JMS/YCL Disposal 5-27
5.8.1 Description 5-27
5.8.2 Effectiveness 5-28
5.8.3 Implementability 5-28
5.8.4 Cost 5-28
5.9 Alternative 8: Sediment Removal and YCL Disposal 5-29
5.9.1 Description 5-29
5.9.2 Effectiveness 5-29
5.9.3 Implementability 5-30
5.9.4 Cost 5-30
5.10 Alternative 9: Sediment Removal and YCL/Subtitle D Disposal 5-30
5.10.1 Description 5-30
5.10.2 Effectiveness 5-31
5.10.3 Implementability 5-32
5.10.4 Cost 5-32

6. Data Gaps 6-1
6.1 Introduction 6-1
6.2 Data Gaps 6-1
6.3 Other Important Issues 6-2

7. References Cited 7-1

Appendixes

A Source Data
B Summary of Physical and Chemical Data
C SWAC Evaluation for Waukegan Harbor Sediments
D Hydraulic Dredging Description
E Cost Tables

Tables

ES-1 Summary of Remedial Alternatives vii
ES-2 Comparison to Alternative Screening Criteria ix
1-1 Stakeholders for Waukegan Harbor 1-2
2-1 Summary of Information Sources 2-7
2-2 Estimated Annual Shoal Rates 2-11
2-3 Summary of Sediment Depths and Volume 2-13
3-1 Summary of Potential Federal ARARs 3-2
3-2 Summary of Potential State ARARs 3-7
3-3 Baseline SWACs 3-15
4-1 Remedial Technology Screening 4-2
5-1 Assembly of Remedial Alternatives 5-2
5-2 Capping and Residual Layer Placement Plan for Alternative 2 5-8
5-3 Capping and Clean Layer Placement Plan for Alternative 4 5-17
5-4 Capping and Clean Layer Placement Plan for Alternative 5 5-20
5-5 Capping and Clean Layer Placement Plan for Alternative 6 5-25
6-1 Data Gap Evaluation 6-3

Figures

2-1 Site Location Map
2-2 Site Base Map
2-3 Vicinity Features
2-4 PCB Sample Locations
2-5 Sediment Probe Locations
2-6 Cross Section A-A'
2-7 Cross Section B-B'
2-8 Depth to Top of Sediment, Probe Data
2-9 Depth to Probe Refusal
2-10 Estimated Sediment Thickness, Probe Data
2-11 Estimated Sediment Thickness Based on Core Data
2-12 Total PCB Concentrations, 0 to 2 Feet
2-13 Total PCB Concentrations, >2 Feet
2-14 Total PCB Concentrations, Till
5-1 Post-Remedial Action Water Depths, Alternative 1
5-2 Post-Remedial Action Water Depths, Alternative 2
5-3 Post-Remedial Action Water Depths, Alternative 3
5-4 Post-Remedial Action Water Depths, Alternative 4
5-5 Post-Remedial Action Water Depths, Alternative 5
5-6 Post-Remedial Action Water Depths, Alternative 6
5-7 Post-Remedial Action Water Depths, Alternatives 7, 8, and 9

Abbreviations and Acronyms

AOC	Area of concern
ARAR	Applicable or relevant and appropriate requirement
CAA	Clean Air Act
CAG	Citizen Advisory Group
CDF	Confined disposal facility
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CRA	Conestoga-Rovers & Associates
CWA	Clean Water Act
DGAR	Data Gaps Analysis Report
EJ&E	Elgin, Joliet, and Eastern
ELCR	Excess Lifetime Cancer Risk
ENR	enhanced natural recovery
EO	Executive Order
FDA	Food and Drug Administration
FS	feasibility study
GPS	global positioning system
HI	hazard index
IAC	Illinois Administrative Code
IEPA	Illinois Environmental Protection Agency
IJC	International Joint Commission
JMS	Johns-Manville Site
LDR	land disposal restriction
LWD	low water datum
MNA	monitored natural attenuation
MNR	monitored natural recovery
NCP	National Oil and Hazardous Substances Contingency Plan
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
NSSD	North Shore Sanitary District
OMC	Outboard Marine Corporation
OU	operable unit
PAH	polynuclear aromatic hydrocarbon
PCB	polychlorinated biphenyls

ppb	parts per billion
ppm	parts per million
PRG	preliminary remediation goal
RAAD	Remedial Alternative Array Document
RAO	Remedial Action Objective
RCRA	Resource Conservation and Recovery Act
RI	remedial investigation
RME	reasonable maximum exposure
ROD	Record of Decision
SARA	Superfund Amendments and Reauthorization Act
SOW	statement of work
SWAC	surface weighted average concentration
TBC	to be considered
TSCA	Toxic Substances Control Act
ULD	unconfined lake disposal
USACE	U.S. Army Corps of Engineers, Chicago District
USEPA	U.S. Environmental Protection Agency
WCP	Waukegan Manufactured Gas and Coke Plant
YCL	Yeoman Creek Landfill

SECTION 1

Introduction

1.1 Purpose and Scope

This Remedial Alternatives Array Document and Data Gaps Analysis Report (RAAD/DGAR) presents the development and evaluation of remedial action alternatives for the Waukegan Harbor Area of Concern (AOC) and identifies data needed prior to completion of a feasibility study (FS). The work was performed for the U.S. Environmental Protection Agency (USEPA) in accordance with the Work Assignment No. 142-TATA-0528 Statement of Work (SOW).

The purpose of this RAAD/DGAR is to identify and screen a wide array of potential remedial alternatives that could be used to remediate contaminated sediment within the Waukegan Harbor AOC. The results of the analysis will be used to identify remedial alternatives that should be evaluated in a more detailed manner in a subsequent FS. Also, data gaps will be identified that will need to be addressed during further remedial investigation (RI) activities prior to the FS. Evaluation criteria for the remedial alternatives identified in the RAAD/DGAR include:

- Effectiveness (ability to address contamination and reduce risk)
- Implementability (ability to successfully implement and carry out the remedial alternative, with consideration of potential regulatory and public acceptance barriers to implementation)
- Cost (financial costs of each alternative)

Based on current uses and historical activities, the harbor is divided into separate segments that are evaluated as individual areas. The feasibility of remedial alternatives within each segment is evaluated individually based on the levels of contamination and depth of sediments present, physical properties of the sediments, and current and future site uses. The most efficient remedial plan for the harbor may, therefore, incorporate different remedial alternatives within each harbor segment.

1.2 Organization

This document is comprised of seven sections. Section 1 presents this introduction. Section 2 summarizes the background information, such as description, history, land use, previous investigations and dredging operations, physical and chemical characteristics of the site, and summary of risks. The development of the Remedial Action Objectives (RAOs) and Preliminary Remediation Goals (PRGs) are discussed in Section 3. Section 4 introduces the identification and screening of the technology types and process options. The development and screening of the alternatives is presented in Section 5. The data gaps analysis is presented in Section 6. The references cited are provided in Section 7.

1.3 Stakeholders

The stakeholders associated with the Waukegan Harbor AOC that have been identified to date are listed in Table 1-1.

TABLE 1-1
Stakeholders for Waukegan Harbor

Organization / Agency	Role / Responsibilities
Federal	
National Oceanic and Atmospheric Administration	Responsible for commerce in waters of U.S.; federal natural resource trustee
U.S. Army Corps of Engineers	Regulates dredge and fill activities; authorized to conduct routine maintenance dredging in Waukegan Harbor
U.S. Coast Guard	Responsible for navigable waterways
U.S. Environmental Protection Agency	Federal regulatory agency overseeing project
U.S. Fish and Wildlife Service	Responsible for federally threatened and endangered wildlife species; federal natural resources trustee
State	
Illinois Department of Public Health	State regulatory agency that issues fish consumption advisories for fish from Lake Michigan
Illinois Environmental Protection Agency	State regulatory agency overseeing project
Local	
City of Waukegan	Owner of property adjacent to Waukegan Harbor (property formerly owned by Outboard Marine Corporation); currently developing land use and redevelopment plans for City of Waukegan, including Waukegan Harbor area
Larsen Marine Service, Inc.	Property owner at the north end of harbor, operates out of Slip 4
Gold Bond Building Products (National Gypsum)	Property owner on northwest side of harbor between Slip 1 and former Slip 3
LaFarge Corporation	Commercial user of harbor located south of Slip 1
St. Mary's Cement Company	Commercial user of harbor located west of Slip 1
Waukegan Citizens Advisory Group	Consists of business, civic, education, environment, government, industry, and recreational groups interested in restoration of water uses in the harbor and along the lakefront; worked with IEPA to prepare the Waukegan Harbor Remedial Action Plans
Waukegan Port District	Property owner adjacent to Waukegan Harbor; currently preparing plans for redevelopment of area
Waukegan Harbor Environmental Justice Committee	Consists of residents interested in assuring environmental justice related to Waukegan Harbor remediation
Waukegan Water Treatment Plant	Located north of Entrance Channel

SECTION 2

Site Description

Waukegan Harbor is in the city of Waukegan, in Lake County, Illinois, on the western shore of Lake Michigan. The site is about 40 miles north of Chicago and 10 miles south of the Illinois/Wisconsin border (Figure 2-1). The harbor is a largely man-made structure constructed in the late 1800s and early 1900s. A natural inlet and portions of adjacent wetlands were filled to form the present shape of the harbor area. Waukegan Harbor comprises 35 to 40 acres, with water depths varying from 14 to 25 feet. The harbor sediments consist of 1 to 7 feet of very soft organic silt (muck) overlying 4 feet of medium dense fine to coarse sand. Underlying the sand is very stiff clay (glacial till) that ranges from 50 to 100 feet thick. The entire harbor is bordered by 20- to 25-foot-long steel sheet piling, except at the Waukegan Port District boat launching areas and at the retaining wall near the harbor mouth (IEPA 1994; USEPA 2002).

Based on the current uses and historical activities, the harbor has been divided into the following harbor segments:

- Approach Channel
- Outer Harbor
- Entrance Channel
- Inner Harbor
- Marina
- Inner Harbor Extension
- Slip 1
- North Harbor (includes Slip 4)

The harbor segments are shown in Figure 2-2. The federal navigation channel of Waukegan Harbor includes the Approach Channel, Outer Harbor, Entrance Channel, the Inner Harbor, and the Inner Harbor Extension. The Approach Channel is not included as part of this study. In addition, Slip 1 was recently dredged to 19 feet Low Water Datum (LWD), and all of the unconsolidated sediments were removed. Slip 1 was, therefore, also not included in this evaluation.

2.1 Background

Federal, state, and provincial governments are required under The Great Lakes Water Quality Agreement to designate geographic AOCs in the Great Lakes where conditions have caused or are likely to cause impairment of beneficial uses (IEPA 1994). The International Joint Commission (IJC), the USEPA and the Illinois Environmental Protection Agency (IEPA) designated Waukegan Harbor as an AOC in 1981. This designation was prompted by the discovery of high levels of polychlorinated biphenyls (PCBs) in harbor sediments.

2.1.1 History of Waukegan Harbor

Waukegan Harbor, Illinois, is one of seven Lake Michigan harbors maintained by the U.S. Army Corps of Engineers, Chicago District (USACE). The following information from the USACE web site (at http://lrc.usace.army.mil/topics/waukhist.htm) briefly describes its involvement in Waukegan Harbor.

In 1879, in response to requests from the citizens of Waukegan, the USACE formulated a plan for creating an artificial harbor off the shoreline. In 1882, the project was modified to include dredging an interior basin in the low ground between the shore and the bluff and connecting the artificial interior basin with the exterior basin by a narrow channel. The configuration of the outer basin consisted of two piers 850 feet apart at the shoreline and, while the southern pier extended straight out into the lake, the north pier zigzagged toward the south pier until the distance between them was only 235 feet.

Interest in improving the harbor originated as a result of the population and industrial growth during the final decade of the 19th century. When harbor improvements began in 1880, the only lake trade was in tanning bark from Michigan and lumber for local use. In 1889, Waukegan became the terminal of the Elgin, Joliet, and Western Railroad that connected with more than 30 railroads to all parts of the country. The Elgin, Joliet, and Eastern (EJ&E) Railroad constructed slips in the harbor. The City of Waukegan dredged the channel between the piers and in 1900 constructed a 412-foot timber dock. As a result of the city's dredging, a 17-foot deep channel was available for vessels carrying coal. A coal company equipped with modern coal handling appliances obtained privileges at one of the slips. In addition, an elevator company with large grain elevators in South Chicago obtained dock privileges at a slip still to be constructed. Waukegan began to provide space for commerce that wanted to avoid the congestion of the Chicago Harbor. The River and Harbor Act of June 30, 1902, provided for a 20-foot depth at the harbor, extension of the piers, and construction of a breakwater. These projects were completed in 1904 (USACE 2003).

2.1.2 History of Contamination

The Waukegan Harbor watershed has seen commercial and heavy industrial use since the late 1800s. Several industries have operated on land directly adjacent to the harbor, discharging waste into the harbor.

The Waukegan Harbor AOC contains the Outboard Marine Corporation (OMC) National Priorities List (NPL) site that includes three operable units (OUs): the Waukegan Harbor site (OUs #1 and #3) and the former Waukegan Manufactured Gas and Coke Plant (WCP) property (OU #2). The now-abandoned OMC Plant 2 site may soon be added to the OMC NPL site description as OU #4.

2.1.2.1 Waukegan Harbor and Outboard Marine Corporation Plant 2

OMC, a recreational marine product manufacturer, used hydraulic fluid containing PCBs as a lubricant in its aluminum dye casting machines from 1961 to 1972. Reports indicate that OMC purchased about 8 million gallons of PCBs. During the manufacturing process, some of the hydraulic fluid spilled into floor drains that discharged to an oil interceptor system, which then discharged to the North Ditch, a tributary to Lake Michigan. Some of the PCBs escaped from a portion of the oil interceptor, diversion, and pump system, and were released directly to Waukegan Harbor. This discharge was located in the western end of Slip 3, and the discharge on the northern portion of the property was to the Crescent Ditch (Figure 2-3). As a result, large quantities of PCBs were released into Slip 3; and on the OMC property in the North Ditch, Oval Lagoon, and Crescent Ditch; and in the Parking Lot. By the time the discharge pipe to the harbor was sealed in 1976, about 300,000 pounds of PCBs had been released into Waukegan Harbor, and another 700,000 pounds had been discharged

on OMC property. It has also been estimated that hundreds of thousands of pounds of PCBs were discharged into Lake Michigan (USEPA 2002).

The areas of concern within the harbor were former Slip 3 and the North Harbor, where large quantities of PCBs were deposited in the sediments after OMC discharged PCBs and other fluids from its manufacturing facility (OMC Plant 2). Sediment PCB concentrations in former Slip 3 were greater than 500 parts per million (ppm) and PCB concentrations were between 50 and 500 ppm in the North Harbor. The PCB concentrations in Crescent Ditch, Oval Lagoon, and North Ditch ranged from 50 to greater than 10,000 ppm. Another area of concern was the 9-acre Parking Lot area, north of OMC Plant 2. PCB concentrations in this area were between 50 and 5,000 ppm.

OMC Plant 2 is a 1-million-square-foot facility in which OMC manufactured outboard engine parts from about 1949 until it declared bankruptcy in December 2000. The facility was the source of PCB contaminants in the harbor and it has recently been shown to have a large amount of chlorinated solvent beneath the building in the ground and groundwater (USEPA 2002).

2.1.2.2 Waukegan Manufactured Gas and Coke Plant

The 36-acre WCP site lies between OMC Plants 1 and 2 on the peninsula separating Waukegan Harbor on the west from Lake Michigan on the east (Figure 2-3). The EJ&E Railroad purchased the WCP site in 1893 and operated a railroad tie creosote wood-treating plant from about 1908 to 1917. The site was used as a large manufactured gas plant and then as a coke plant under various owners from 1928 through 1969. The remaining coke plant structures were demolished in 1972. Between 1973 and 1989, OMC used the property for fire training. Other more current uses include waste oil storage, public parking, stockpiling of sand from dredging operations, and snowmobile testing. Larsen Marine currently uses the northwestern portion of the site for seasonal boat and trailer storage.

Contamination at the WCP site was discovered during the cleanup of the Waukegan Harbor, when the replacement boat slip for former Slip 3 was excavated on the coke plant property. The excavated material was tested and found to contain high levels of polynuclear aromatic hydrocarbons (PAHs). Further investigation at the WCP site revealed arsenic and creosote contaminants in soil and high levels of ammonia, arsenic, phenol, and benzene in groundwater.

2.1.3 Activities at the Outboard Marine Corporation Site

The IEPA conducted effluent sampling of outfalls on Lake Michigan in an attempt to identify sources of PCB contamination. In 1976, the IEPA notified the USEPA that high concentrations of PCBs had been found in the discharge of the OMC plant. The IEPA estimated a rate of 9 to 10 pounds of PCBs per day were discharged (USEPA July 2000). The USEPA collected 15 sediment samples in 1976 and found levels of PCBs ranging from 0.1 mg/kg east of the entrance channel to 4,200 mg/kg at the upper end of the harbor in Slip 3 (USEPA 1976). Harbor sediment sampling in 1985 and 1986 by the Illinois Department of Energy and Natural Resources found the highest levels of PCBs in Slip 3 (17,251 ppm), with decreasing concentrations toward the harbor mouth (IEPA 1994). The studies indicated that PCBs were distributed throughout the sediments of Waukegan Harbor, with about 50,000 cubic yards with concentrations above 50 ppm, and substantially more with concentrations above 10 ppm (USEPA 1983).

2.1.3.1 Outboard Marine Corporation and Waukegan Harbor

In 1984, the USEPA selected a remedy consisting of a mixture of onsite containment and offsite disposal that targeted three areas for remediation: the North Harbor and Slip 3; the OMC parking lot; and the North Ditch/Crescent Ditch/Oval Lagoon area. Components of the remedy were later modified, and embodied in a 1988 Consent Decree. In March 1989, the Record of Decision (ROD) was correspondingly modified and the Consent Decree was entered into the U.S. District Court in April 1989. By terms of the Consent Decree, OMC was to finance a Trust to implement the cleanup and to ensure performance of the requirements of the Consent Decree. The final remedy included the following (USEPA 2002):

- A new boat slip was built on the east side of the North Harbor on the WCP property to replace PCB-contaminated Slip 3. Larsen Marine was relocated from Slip 3 to this new slip.
- A double sheet pile cut-off wall was built to isolate Slip 3 from the North Harbor. A low permeability 3-foot-thick clay slurry wall was anchored 3.5 feet into the underlying clay till, and Slip 3 became a permanent containment cell.
- A total of 8,000 cubic yards of sediment in Slip 3 with PCB concentrations above 500 ppm were removed and isolated for treatment. About 30,000 cubic yards of sediment in the North Harbor with PCB concentrations between 50 and 500 ppm were removed and placed in the new Slip 3 containment cell.
- Two other containment cells (termed the East and West Containment Cells) were built with a similar design as the Slip 3 Containment Cell. The East Containment Cell encompasses the Plant 2 Parking Lot area and the land east of the lot, and the West Containment Cell encompasses the Crescent Ditch and Oval Lagoon. Before construction, all areas containing PCB contamination over 10,000 ppm were excavated and removed for treatment. The soils excavated from the Parking Lot area did not require treatment before placement into the East Containment Cell because they were below the treatment criterion. About 5,000 cubic yards were removed from the North Ditch, 2,900 cubic yards of sediment and soil were removed from Oval Lagoon, and 3,800 cubic yards of sediment and soil were removed from Crescent Ditch.
- Material removed from designated hotspots was treated by a low-temperature extraction procedure that removed at least 97 percent of the PCBs by mass to separate the PCB oils from the sediments. Residual treated soil was placed in the West Containment Cell that was then closed and capped. About 30,000 gallons of extracted PCB oil were removed offsite for destruction at a Toxic Substances Control Act (TSCA) approved facility.
- Construction and operation of a water treatment plant to treat water generated during construction and operation of the remedial action.
- Installation and operation of an extraction well system at each containment cell to prevent the migration of PCBs from the cells by maintaining an inward hydraulic gradient.

In February 1992, the USEPA completed the sediment remediation project in the harbor that entailed the dredging, thermal treatment, and disposal of PCB-contaminated sediment from the North Harbor. Remediated sediments contained an estimated 1 million pounds of PCBs with a maximum PCB concentration of 500,000 ppm (USEPA July 2000). Final construction activities for OU #1 and OU #3 were completed in December 1994. Operation and

maintenance of the site is ongoing. Initial monitoring (1994 to 1996 samples) indicated that fish tissue contaminant concentrations in the harbor had decreased. Warning signs from within the harbor have been removed because sampling has recently shown declines in concentrations to the same level as the greater Lake Michigan area (USEPA July 2000). However, results from more current samples (1997 to 2000) indicate that levels are holding steady at 4 to 5 ppm, still above the Food and Drug Administration (FDA) action level, and may be increasing. Based on the recent results and that current PCB cleanup levels at sediment sites are set as low as 0.25 to 1 ppm, the USEPA in their 5-year review concluded that the 50 ppm cleanup level for PCB may not be sufficiently protective of human health and the environment (USEPA September 2002).

2.1.3.2 Waukegan Manufactured Gas and Coke Plant

In the fall of 1989, during predesign field investigations, additional contamination in the form of PAHs was discovered in the soil area of the new slip. PAHs reflect coking and wood treating operations that existed on the property before OMC's ownership. After consulting with the USEPA, OMC constructed a temporary storage area, excavated the PAH-contaminated soil above 5 ppm and placed it in the temporary storage area, and covered it with a high-density polyethylene liner. Because the area was within the former WCP property owned by OMC, the USEPA designated the area as OU #2 of the OMC NPL site.

The USEPA identified several other potentially responsible parties for WCP. One of them, North Shore Gas Company, entered into an Administrative Order on Consent with the USEPA in September 1990 for completion of an RI/FS. The RI was completed in February 1995 and a final FS was released in November 1998.

The USEPA signed a ROD on September 30, 1999, for the final cleanup of the WCP site based on a future industrial land use. The selected remedy consists of the following tasks (USEPA 2002):

- The temporary stockpile of PAH-contaminated soils generated from the new slip construction and impacted soil from other areas would be excavated and sent offsite for thermal treatment or disposal in a suitable landfill.
- Arsenic-contaminated soil would be excavated and disposed of in an offsite Subtitle D landfill.
- Marginally-contaminated soil (as defined by the ROD) would be covered by a combination of asphalt (parking lot), building(s), and/or vegetated soil cover (cap).
- Groundwater will be cleaned up to remove arsenic, ammonia, and benzene using a mobile pump and treat program. After groundwater cleanup targets are met, a Monitored Natural Attenuation (MNA) remedy would be implemented.

The design phase for this work is currently under way. The remedial activities are anticipated to begin in fall 2003 and continue through 2008 (USEPA 2002).

2.1.3.3 Outboard Marine Corporation Plant 2

When OMC declared bankruptcy in December 2000, it began shedding all of its assets, including its Waukegan-area properties. OMC Plant 1 was sold to Bombardier, Inc., and is

not believed to require action under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA). OMC Plant 2 had no buyers, so the bankruptcy trustee made a motion in bankruptcy court to abandon the facility. In August 2002, the OMC bankruptcy trustee, the USEPA, and the IEPA agreed to a settlement action whereupon the trustees would perform a limited number of cleanup actions inside the plant. These actions included the removal of chemical containers and the cleanup of certain highly-contaminated areas. Once the trustees completed these cleanup actions, per the settlement agreement they legally abandoned OMC Plant 2. Since abandonment by the trustees, the USEPA also conducted additional interior cleanup work to prevent the release of PCBs and other compounds into the environment. The USEPA and the IEPA are also planning to expand the OMC NPL site description to include OMC Plant 2 as OU #4.

2.1.4 Waukegan Harbor Dredging Activities

2.1.4.1 U.S. Army Corps of Engineers Dredging Operations

Both the inner harbor and outer areas of Waukegan Harbor are affected by sediment accumulation. The breakwaters and piers that define and protect the outer harbor trap sandy sediments eroded from beaches at Illinois Beach State Park north of Waukegan and those carried by the littoral drift (IEPA, 1999). The Approach Channel and the Outer Harbor are maintained at a depth of -22 feet LWD, and the Entrance Channel and Inner Harbor are authorized for dredging to a depth of 18 feet LWD (USACE 1995b). The current USACE dredging project includes revising the channel depths to -23 feet LWD in the Entrance Channel, Inner Harbor, and Inner Harbor Extension and to –25 feet LWD in the Approach Channel and Outer Harbor.

The USACE periodically dredges deposited sediments to maintain authorized depths in the federal navigational channel for commercial navigation. Each year, about 40,000 to 50,000 cubic yards of sand are dredged from the approach channel as an aid to navigation (USEPA January 2003). The USACE has dredged the Approach Channel since 1985 and as recently as June 2000. Dredged materials removed from the Approach Channel were classified as clean, sandy sediments that were suitable for unconfined lake disposal (ULD) or for use as nourishment materials for beaches. Before 1988, the sediment was deposited at a deep-water, offshore site. The most recently used disposal site for approach channel material is a near-shore site (water depths from 6 to 12 feet), about 2,000 feet south of the Waukegan Port Authority South Harbor. All dredged materials from these areas have been disposed of in open water and, thus, have required water quality certification pursuant to Section 401 of the Clean Water Act (CWA).

Dredging of the inner portions of Waukegan Harbor, west of the North Pier, was discontinued after 1972 because the sediments were classified as polluted (USACE 1989). The North Harbor area was partially dredged as part of the OMC Superfund cleanup completed in 1992. The Inner Harbor area is authorized to be dredged to 23 feet, and was last dredged to 18 feet in 1972. Three of the four main commercial users have altered normal shipping procedures (e.g., reduced ship loads) to accommodate shallow water depths in the harbor.

2.1.4.2 Dredging of Slip 1

In July 2003, the shipping companies that use Slip 1 (LaFarge, National Gysum, and St. Mary's Cement) funded the dredging of Slip 1. Before dredging, a composite sample of sediment in Slip 1 was collected to characterize the material for landfill disposal. The

composite sample contained 0.424 mg/kg of PCBs (Aroclor 1248). Hardpan samples were also collected at four locations using a hydraulic excavator from a barge. None of the samples contained detectable concentrations of PCBs, confirming that the hardpan was not contaminated. The hardpan was dredged with a clamshell bucket from a barge to a depth of 19 feet. Periodic sampling of excavated materials during the dredging also indicated that PCB concentrations in Slip 1 were relatively low (< 1 ppm), and the materials were stabilized and sent to a landfill for disposal (Tanner Environmental 2003).

2.1.4.3 Larsen Marine (Slip 4)

Larsen Marine Service provides brokerage of boats, repair services, and docking for recreational boats in Slip 4. Because of the low lake levels, Larsen Marine dredged about 1 foot of soft sediment from Slip 4 in 2001 and an additional 1.5 feet from the eastern portion of Slip 4 in 2002. The 2002 operation was stopped because black, oily sediment was reportedly observed while attempting to dredge between two piers (Piers 25 and 26) in the central portion of the slip along the southern wall adjacent to the WCP. In response to the report, Conestoga-Rovers & Associates (CRA), consultants working on the WCP project, collected five core samples from the area in April 2003. The sediment samples were collected from a small barge. Oily samples were not observed in any of the locations investigated. Three of the core samples were submitted to a laboratory for analysis. Low levels of PAHs and PCBs (0.22 to 0.76 mg/kg of Aroclor 1248) were detected in all of the samples (CRA 2003).

In 2003, the dredging of the soft sediments was completed in the western portion of Slip 4 using a small backhoe on a barge. The slip has a depth of about 11 feet in the western portion and becomes shallower to about 4 feet at the launch ramp.

2.1.5 Previous Investigations

Numerous investigations have been conducted in the harbor since the completion of the sediment remediation project in 1992, and information has been compiled and recorded in various documents. The sources for the analytical or geotechnical data used in the assessment for this report are presented in Table 2-1. Sediment depth and thickness data from probing and the 2002 Citizen Advisory Group (CAG) investigation results were provided directly from the USEPA.

TABLE 2-1
Summary of Information Sources

	Data Type	
Investigation/ Document	**Analytical**	**Physical**
Report of Findings, Waukegan Harbor Sampling and Analysis (USACE 1995a)	Analytical results from 9 core samples of unconsolidated sediment. Samples analyzed for landfill acceptance and included chlorine, reactive cyanide, free liquids, moisture content, specific gravity, pH, PCBs, TCLP inorganics[a], TCLP VOCs, TCLP phenol, and TCLP SVOCs. Sample locations identified with prefix: WIH-0995-000*.	Sample descriptions summarized in table. Additional analysis includes specific gravity, total solids, and free liquids.

TABLE 2-1
Summary of Information Sources

Investigation/ Document	Data Type: Analytical	Data Type: Physical
Report on the Collection of Sediment Samples from Waukegan Inner Harbor (QST Environmental Inc. 1998)	Analytical results from 9 core samples consisting of 9 unconsolidated sediment samples and 3 clay or hardpan samples. Samples were analyzed for VOCs, SVOCs, pesticides/PCBs, total metals[b], ammonia as nitrate, chemical oxygen demand, total organic carbon, total Kjeldahl nitrogen, total recoverable petroleum hydrocarbon, total phenol, total phosphorus, cyanide, and asbestos. Sample locations identified with prefix: WH-1197-00*.	Boring logs provided in report. Geotechnical analysis performed on 8 samples includes moisture content, Atterberg limits, grain size analysis, specific gravity, and bulk density.
Evaluation of Toxicity and Bioaccumulation of Contaminants in Sediments from Waukegan Harbor, Illinois (USEPA October 1999)	Analytical results from 18 surface grab samples and 1 core sample. Samples were analyzed for acid volatile solids and simultaneously extractable metals, total metals, organochlorine pesticides, PCBs, and PAHs. Toxicity and bioaccumulation of contaminants from sediments were evaluated using chemical characterization of tissue samples, sediment toxicity tests with amphipods, sediment bioaccumulation tests with oligiochates, and sediment toxicity tests with Microtox® protocols. Sample locations identified with prefix: WH-0496-**.	Physical characterization included moisture content, grain size analysis, and total organic carbon.
Investigation Report for Waukegan CDF Geotechnical Boring and Laboratory Program, Waukegan Illinois (Patrick Engineering Inc. 2003)	Analytical results from samples collected from 15 environmental borings and 2 structural borings obtained directly by the USEPA. Samples were analyzed for ammonia as nitrogen, phenol, metals[c], PCBs, benzo(a)pyrene, total organic carbon, total volatile solids, and total solids. Sample locations identified with prefix: WH-2000-**.	Boring logs provided in report. Geotechnical analysis performed on samples from the 2 structural borings and included uncompressive strength as measured by pocket penetrometer and moisture content.
CAG 2002	Analytical results from samples collected from cores collected at 8 locations in Inner Harbor and Entrance Channel. Samples were analyzed for metals[d], ammonia as nitrogen, phosphorus, total Kjeldahl nitrogen, BTEX, PCBs, PAHs[e], total organic carbon, phenol, total solids, and asbestos. Sample locations identified with prefix: CAG-0502-*.	
Sediment Sampling Event, Waukegan Harbor Slip Number 4 (Letter report submitted to the USEPA by CRA 2003)	Analytical results from 3 sediment samples collected from cores in Slip 4. Samples were analyzed for arsenic, PCBs, PAHs[e] and TPH (as diesel). Samples identified with prefix: SD-*.	
USEPA 2003		Sediment thickness and depths measured at 197 locations based on probe measurements.

[a] TCLP inorganics included copper, mercury, nickel, zinc, silver, arsenic, barium, cadmium, chromium, and lead.
[b] Total metals included arsenic, barium, cadmium, chromium, lead, mercury, selenium, silver and zinc.
[c] Metals included arsenic, barium, cadmium, chromium, copper, iron, lead, mercury, nickel, and zinc.
[d] Metals included antimony, arsenic, barium, cadmium, chromium, copper, lead, nickel, and zinc.
[e] PNAs included acenaphthene, acenaphthylene, anthracene, benzo(a)anthracene, benzoa)pyrene, benzo(b)fluoranthene, benzo(ghi)perylene, benzo(k)fluoranthene, chrysene, Dibenz (a,h)anthracene, fluoranthene, fluorene, Indeno(1,2,3-cd)pyrene, naphthalene, phenanthrene, and pyrene.

The analytical sample locations and the probe locations are provided in Figures 2-4 and 2-5, respectively. The analytical and geotechnical data tables from the various investigations used in this report are included in Appendix A. The USEPA provided electronic files that compiled the PCB data from the different investigations and the probe depths. Data for each harbor segment are summarized in Appendix B.

2.2 Local Demography and Land Use

Waukegan Harbor is an industrial and commercial harbor used by lake-going freighters and recreational boaters. At one time, the Inner Harbor consisted of three operating slips. At a later date, Slip 2 was filled in and National Gypsum built a plant on the site. Slip 3 was taken out of service in 1991 as part of the remedial activities for the OMC site and made into a permanent containment cell by constructing a cutoff wall in the harbor. Slip 4 was constructed to replace Slip 3, and officially opened to the public in July 1991. Slip 4 is used for repair, supply, and as docking facilities for private boats (Larsen Marine). Presently, Slip 1 is the only operating slip for commercial traffic. Recreational boat traffic uses Slip 4 and the public marina located in the southwest corner of the harbor.

The Lake County Board and the City of Waukegan classified land use areas in Lake County in 1987. Land surrounding the northern portion of Waukegan Harbor has been classified as urban, while the beach areas and water filtration plant properties have been classified as open-space areas. The remaining land in the immediate harbor area is classified as special use (Lake County) or residential (City of Waukegan). The Waukegan Port District property is located within this special-use area.

In December 2000, OMC, Inc., declared Chapter 13 bankruptcy, and began liquidation in August 2001. Subsequently, the City of Waukegan purchased the WCP site and has reportedly acquired options on portions of the OMC Plant 2 property. The WCP site has been rezoned to high-density-residential, and the City and other entities are working to revitalize the Waukegan lakefront area. Because of this, land use assumptions near the site may be changing in the future.

The current land use surrounding the harbor is primarily marine-recreational and industrial, but also includes utilities and a public beach on the east side of the harbor peninsula (Figure 2-3). During 1990, there were about 75 commercial ships docking at Waukegan Harbor. The Waukegan Port District was contacted regarding current industrial uses of the harbor. The major portion of waterborne commerce in Waukegan Harbor is the receipt of building cement and gypsum that are offloaded from commercial ships in Slip 1 for further distribution by land. Gold Bond Building Products (a division of National Gypsum), LaFarge Corporation, and St. Mary's Cement are the major commercial users of the harbor. Gold Bond Building Products stores gypsum in large outdoor piles north of Slip 1. St. Mary's Cement stores cement in silos located west of the slip and LaFarge Corporation has silos located to the south of Slip 1.

The Port of Waukegan is also home to a number of small- and large-scale industries that do not receive raw materials or supplies by ship. These include Lone Star Industries, Mineral Solutions, and Bombardier (located in the former OMC Plant 1). OMC Plant 2 and the WCP are closed

industrial sites located around the upper Waukegan Harbor area. Two marine contractors, Kadinger Marine Service and Larsen Marine Service, are also located on the harbor.

Larsen Marine Service, Inc., located on the North Harbor along Slip 4, is the largest lakefront yacht dealer in the Chicago metropolitan area. The company provides yacht brokerage for new and used powerboats and sailboats, and offers marine repair services. Larsen Marine can accommodate 15 recreation boats in Slip 4.

Currently, the Waukegan Water Utility water treatment plant lies north of the entrance channel. The plant has a nominal capacity of 18 million gallons per day. The principal raw water intake is located 6,200 feet southeast of the Government Pier and is in about 25 feet of water. An emergency intake is located 1,275 feet southeast of Government Pier and is in roughly 20 feet of water. The old emergency intake located in the north seawall of the Waukegan Harbor channel is sealed and is not in use (IEPA 1994). The intake lines to the plant cross under the Entrance Channel at a depth of about 35 feet. Two 24-inch high-pressure mains run west of the plant beneath the Inner Harbor area. The centerline depth for these lines is about 25 feet and they are buried in the clay till.

The Waukegan Harbor area is also a major recreational area. The Waukegan Port District operates 1,000 slips and moors for recreational boats. The public beaches to the north and east of the harbor are used for swimming, sunbathing, and public events. Recreational facilities in the harbor area, in addition to the boat mooring and public launching areas, include Waukegan Yacht Club, the Warren G. Sievert Park, and the Government Pier. The Yacht Club owns a clubhouse adjacent to the harbor. The Warren Sievert Park is a small park immediately west of the boat mooring areas. The Government Pier is used for sightseeing, sunbathing, bird-watching, walking, and fishing. This pier ends at the lighthouse that marks the entrance to the harbor.

2.3 Physical Characteristics

2.3.1 Topography

The general topography of the area is relatively flat. Some slight variations exist between filled areas and natural ground. Manmade high areas include a gypsum storage pile on the Gold Bond Building Products property adjacent to the harbor. The bathymetry of Waukegan Harbor is discussed later.

2.3.2 Hydrology

2.3.2.1 Lake Michigan

Lake Michigan influences Waukegan Harbor in several ways. Most significantly, the nearly continual exchange of water between the lake and harbor, caused predominantly by wind-induced seiches, prevents stagnation of the harbor water. Average wind-induced currents in and out of the harbor are sufficient to exchange the volume of water in the harbor in 1 to 8 days (USEPA 1999). The lake also causes mixing in the harbor by direct waves entering the harbor through the entrance channel. In addition large ships and tug boats re-suspend large amounts of sediment as a result of the use of the props and bow thrusters to maneuver within the narrow navigational channel.

An additional small tributary to Lake Michigan drains surface runoff from about 0.11 square mile of OMC and North Shore Sanitary District (NSSD) property. This drainage system, which includes the North Ditch, also drains surface runoff from areas west of OMC property, the railroad tracks, and large portions of the City of Waukegan stormwater runoff via the Gillette Avenue storm sewer that discharges to the western end of the North Ditch. The North Ditch is about 2,000 feet in length and varies in width from 10 to 20 feet.

2.3.2.2 Waukegan Harbor

Drainage Area. Waukegan Harbor is contiguous with Lake Michigan and has no tributary flows. The Waukegan Harbor drainage area is bounded on the north by the North Ditch, by the Zion Moraine bluff to the west, and the Government Pier to the south. The Waukegan Harbor watershed consists of approximately 0.47 square mile of industrial, commercial, municipal, and open/vacant lands and receives stormwater runoff at seven discharge points, as well as from overland flow. The Waukegan River, which passes south of the harbor area and is a tributary to Lake Michigan, consists of approximately 5.8 stream miles. Its watershed area consists of about 9.68 square miles (IEPA 1994).

Sediment Deposition. Based on historical dredging operations, the USACE estimated the future anticipated shoaling rates and required dredging intervals for Waukegan Harbor, as shown in Table 2-2. The total annual shoaling rate is about 30,000 cubic yards of material (USACE 1995b).

TABLE 2-2
Estimated Annual Shoal Rates

Harbor Section	Shoal Rate (yd^3/yr)	Dredging Interval (yr)
Approach Channel	25,000	2
Outer Harbor	1,500	10 or more
Entrance Channel	2,000	10
Inner Harbor	1,500	> 10

Source: Waukegan Harbor Approach Channel Dredging, Tier 1 Sediment Evaluation (USACE 1995b).

The estimated shoaling rates indicate that the majority of the shoaling takes place in the Approach Channel. Differences between the Approach Channel and other areas in shoaling rates and sediment chemistry indicate the main source of sediment in the Approach Channel is littoral transport of Lake Michigan sands from areas north of Waukegan Harbor (USACE 1995b).

Historical studies indicate that deposition of materials in the Outer Harbor is probably the result of beach sand overtopping the north pier and passing through gaps in the sections of the pier (USACE 1995b).

Sediment Stratigraphy and Properties. The generalized stratigraphy of the sediments in Waukegan Harbor includes a thin layer of soft organic silt overlying medium dense fine to coarse sand. Underlying the sand is a very stiff silty clay till. The sediment profiles along an east-west transect (i.e., from the Outer Harbor to the Inner Harbor) and a south-north transect

(i.e., from the Inner Harbor to the North Harbor) are presented in Figures 2-6 and 2-7, respectively. The transect locations are presented in Figure 2-4. A summary of the properties of the sediment samples collected from Waukegan Harbor is provided in Appendix B.

The uppermost fine-grained sediments are generally described in boring logs as black to gray, loose, very soft to soft silts and clays (USCS soil classification of OL, ML, MH, or CL). These soft silts and clays have relatively high organic contents (about 1 to 19 percent, averaging about 6 percent) and moisture contents (20 to 94 percent, averaging 52 percent). The soft silt and clays were generally observed in samples throughout the harbor, except in the Inner Harbor Extension and the Outer Harbor areas. These materials were encountered at depths of about -13 to -23 feet LWD and range in thickness from about 0.5 foot to 10.5 feet.

In some portions of the Outer Harbor and Entrance Channel, the uppermost sediments encountered consist of gray, loose to very loose, soft sand to silty sand (SM). These sands were typically less than 2 feet thick and, when reported on the boring logs, the blow counts over these intervals were recorded as "weight of hammer."

The remaining unconsolidated sediments encountered in Waukegan Harbor are comprised of gray, moderately dense, medium grained sand with varying amounts of silts and clays (USCS soil classification of SC, SM, SP, SW). The sands have about half the amount of organic content (0.04 to 8 percent, averaging 3 percent) and moisture content (16 to 48, averaging 16) as measured in the silts and clays. The depth to the top of the sand layer ranged from about -6 to -24 feet LWD (average of -18 feet LWD). A laterally continuous layer of sand lies from the Outer Harbor area, through the Entrance Channel, and into the eastern portion of the Inner Harbor (Figure 2-6). The thickness of the sand layer in the Outer Harbor area ranges from 6.5 to 10 feet, in the Entrance Channel from 0.2 foot to 10.5 feet and, in the eastern portion of the Inner Harbor, about 4 feet. The sand in the rest of the Inner Harbor, Inner Harbor Extension, and the North Harbor was generally less than 1 foot thick.

The harbor sediments are underlain by a clay till that is described in boring logs as dark gray, silty clay, firm with low plasticity, with trace amounts of fine to coarse sand and shale (USCS soil classification of CL, ML). Boring logs from cores within the harbor indicate that the glacial till surface generally slopes to the east, ranging from -15.8 feet LWD in the North Harbor area (WIH-1197-007) to greater than -25 feet LWD in the Outer Harbor. The samples of clay till contained lower moisture contents than the surficial silt and clay samples (9.5 to 16 percent, averaging about 13 percent). Geotechnical data of the glacial till indicate that the clays have an apparent unconfined compressive strength of 4.5 tons per square foot or greater.

In order to estimate potential volumes of material for USACE dredging of Waukegan Harbor, the USEPA conducted an investigation to determine the top of the sediment and the top of the consolidated material. The USEPA measured the depths at 197 probe locations throughout Waukegan Harbor (Figure 2-5); the results of the sediment probe investigation and estimated volumes of unconsolidated sediment for each harbor segment are summarized in Table 2-3. Graphical representations of depth to the top of the sediments, depth to the bottom of the sediment, and sediment thickness are presented in Figures 2-8, 2-9, and 2-10, respectively.

TABLE 2-3
Summary of Sediment Depths and Volume

	Core Data				Probe Data			
Harbor Segment	**Depth to Top (ft LWD)**	**Top of Till (ft LWD)**	**Thickness (ft)**	**Volume (yd^3)**	**Depth to Top (ft LWD)**	**Bottom of Sediment* (ft LWD)**	**Thickness (ft)**	**Volume (yd^3)**
Outer Harbor	15.2 to 24	25.2 to 27	6.5 to 10	177,900	13.8 to 21.3	13.9 to 23.8	0.1 to 5.8	12,500
Entrance Channel	10 to 21	22.1 to 30	4.2 to 10.5	81,800	9.6 to 22.0	9.8 to 27	0.2 to 11.1	31,000
Inner Harbor	13.3 to 26.1	15.8 to 27.4	0.5 to 6	66,300	9.5 to 24.4	11.7 to 27.5	0.1 to 13.2	80,000
Inner Harbor Extension	19 to 22.2	19.4 to 22.4	0.1 to 2.3	3,900	10.5 to 23.6	17.0 to 23.7	0 to 7.0	6,600
Marina	5.6 to 15.5	15.1 to 26	9.5 to 10.5	73,700	4.3 to 13.7	4.9 to 24.5	0.5 to 11.5	57,200
North Harbor	14.8 to 23.1	16.1 to 24	0.3 to 2	12,300	4.7 to 22.5	7.4 to 22.8	0.1 to 4.3	26,400

*Bottom of Sediment as defined as probe refusal.

Based on the probe data, there are about 213,700 cubic yards of unconsolidated sediments on the bottom of Waukegan Harbor. Comparison of the results to the cross sections developed from the boring logs and individual boring logs, however, shows that the top of the unconsolidated material, as defined by probe refusal, is not equivalent to the top of the clay till (Figures 2-10 and 2-11). The probe refusal may have resulted from the inability to penetrate the dense sand. A comparison of the top of till depths based on the limited core samples and the probe data is presented in Table 2-3. Comparisons of individual core to probe data are also provided in Appendix B. Because of the significant differences in the estimated thickness and corresponding volume of unconsolidated sediments between the probe and core results, the probe results were not used to estimate material volumes.

2.3.3 Geologic and Hydrogeologic Setting

The geologic and hydrogeologic settings presented below are discussed in terms of regional conditions and those encountered at the WCP site.

2.3.3.1 Geology

The geology near the harbor is characterized by near-surface fill materials that were placed over a fine-grained sand unit. The sand overlies an 80-foot-thick till unit, which overlies a sequence of dolomitic bedrock formations. At the WCP site, the fill deposits extend to 2 to 12 feet below ground surface. The fill typically consists of reworked sand deposits with demolition and construction debris, as well as WCP-related materials such as coal, coke, and slag.

The naturally occurring material underlying the fill consists of medium grained sand with gravel and near lake deposits of glacial Lake Chicago. These materials are part of the Equality Formation (IEPA 1991). The sand unit is generally 20 to 25 feet thick. It consists of a well-sorted fine to very fine sand containing 5 to 15 percent silt. Deeper portions of the sand unit typically show finer grain sizes than shallow portions. Measured porosity values range from 33 to 41 percent.

Underlying the Equality Formation is the Wadsworth Till. Beneath the WCP site, the till is about 80 feet thick and consists of a hard, gray, lean clay with sand and some gravel. The till's surface is overlain by a thin discontinuous zone of silty gravel or gravel with sand, which, where present, has an average thickness of 0.3 foot. The surface of the till is irregular, and generally slopes gently downward from west to east beneath the peninsula (USEPA 1999).

Silurian age dolomite comprises the uppermost bedrock in the area. This shallow bedrock is fractured and contributes to groundwater flow in the Silurian dolomite. Underlying the Silurian dolomite are the Maquoketa Group shales that act as an aquitard separating the Silurian dolomites from the deeper bedrock units.

2.3.3.2 Hydrogeology

Lake Michigan and Waukegan Harbor serve as discharge areas for shallow groundwater. Groundwater near the harbor is driven by precipitation, which flows through the sand unit before discharging into the surrounding surface water. The sand unit is underlain by the very low permeability till layer. At the WCP site, groundwater in the sand was encountered at a depth of about 4 to 5 feet. Groundwater flow beneath the WCP site to the west toward the harbor wall was calculated to be about 60 feet per year based on an estimated hydraulic

conductivity of 31 feet per day (1.1×10^{-2} cm/s) for the sand aquifer. The groundwater discharges directly to the harbor through the sheet-pile joints and any gaps that may exist in the wall (USEPA 1999).

Based on the lake/harbor water exchange and groundwater discharge rates to the harbor, harbor waters provide net flows to mix with site groundwater at ratios of 6,000 to 1 to 800 to 1. The average mixing ratio is about 1,600 to 1. Groundwater flow to the harbor is a gradual phenomenon dispersed over a large area (USEPA 1999).

2.4 Chemical Characteristics

The quality of harbor water and sediment are impacted by overland flow, storm sewer discharges, and permitted discharges. Land use in the watershed draining to the harbor is primarily commercial and industrial, with significant areas of railroad and highway right-of-way, and lesser areas of open and urban residential areas. Both municipal and private storm sewers discharge to the harbor. Part of the downtown area of Waukegan drains to the harbor by storm sewer. Discharges from industrial activities to Waukegan Harbor include non-contact cooling water and other permitted discharges under the National Pollutant Discharge Elimination System (NPDES) program. In the early 1980s, oil from releases at the railroad tracks located west of the harbor washed through the Madison Street sewer system into Waukegan Harbor (IEPA 1994).

The risk evaluation conducted by the USEPA indicated that, because PCBs do not appreciably degrade or attenuate, they have remained bioavailable in the harbor. Other chemicals detected in the sediments, such as asbestos, arsenic, and benzo(a)pyrene, are at very low levels in sediments and, unlike PCBs, will not bioaccumulate appreciably in fish. They would not, therefore, cause significant health risks to persons swimming or having direct contact with sediments (Clark 2003); thus, the following discussion of chemical characteristics of media within Waukegan Harbor focuses mainly on PCBs. Analytical results for other parameters detected in the Waukegan Harbor sediments are provided in Appendix A and summarized for each harbor segment in Appendix B.

2.4.1 Surface Water

Water samples were collected at seven stations in the Waukegan Harbor area by the IEPA in November 1990. Five locations were within the harbor, one at Waukegan North Beach, and one outside the South Harbor. The analytical results were compared to the then-current Illinois water quality standards, including Lake Michigan, Public Water Supply, and General Use Standards (35 Illinois Administrative Code 302). Water quality conditions were worse in the upper harbor and tended to improve toward the harbor mouth. Ammonia, cyanide, phenols, and dissolved oxygen were of most concern. All samples contained concentrations of total phosphorus, ammonia, and sulfate exceeding their respective standards. In addition to having higher concentrations, harbor samples also exceeded the standards for pH, dissolved oxygen (percent saturation), chloride, phenols, and conductivity. PCBs were not detected in any of the water samples (IEPA 1999).

Additional information on water quality in Waukegan Harbor area is presented in the updated *Final Stage III Report* (IEPA 1999).

2.4.2 Sediment

The harbor is dredged periodically in order to maintain access for freighters, barges, and private boats. Both dredging and passage of boats cause sediments in the harbor to be routinely disturbed. Such disturbances mix sediments into the water column, disrupt the benthic zone, and influence harbor water quality.

The frequency and distribution of PCBs in the Waukegan Harbor sediments are based on CH2M HILL's evaluation of data from 92 (75 core and 17 grab) samples collected from 58 locations throughout the harbor following the most recent dredging activities for the particular segment. PCBs were detected in about 78 percent of the samples, ranging in concentration from 0.0277 to 29.8 parts per billion (ppb) and averaging about 3.8 ppb. The most frequently detected and highest concentration of PCB was Aroclor 1248. Aroclor 1242 and Aroclor 1254 were also detected in a few samples.

The analytical data evaluated were from samples that varied in depth intervals from surface grab samples (0 to 2 inches) to composite samples from cores up to 126 inches. Based on the available data, the PCB results were divided into three intervals: unconsolidated sediment from 0 to 2 feet, unconsolidated sediment greater than 2 feet, and till samples. The 2-foot surface layer was selected based on potential dredging operations, rather than the depth of the "biologically active zone" typically used to calculate the surface-weighted average concentrations. In addition, the analysis assumes that the PCB concentration remains the same throughout the entire sampled interval. The distributions of total PCB concentrations detected in the different intervals are presented in Figures 2-12, 2-13, and 2-14.

2.4.2.1 Polychlorinated Biphenyls in Shallow Sediments (0 to 2 feet)

PCBs were detected in 55 of the 57 samples collected within or across the 0- to 2-foot-depth interval. The PCB concentrations ranged from 0.0488 to 29.80 ppm and averaged about 4.3 ppm. The distribution of PCB concentrations in the shallow sediments (i.e., 0 to 2 feet) is relatively consistent with the source of the PCBs, dredging operations, and boat traffic (Figure 2-12). Low concentrations of PCBs were detected in the Outer Harbor and Entrance Channel samples. The PCB concentrations detected in the six Outer Harbor sample locations were all less than 1 ppm, ranging from 0.058 to 0.726 ppm. Detected PCB concentrations in the 12 Entrance Channel samples ranged from 0.0594 to 6.3 ppm. Four of the Entrance Channel samples contained PCB concentrations greater than 1 ppm.

All of the samples collected from the Inner Harbor (15 samples), the Inner Harbor Extension (four samples), Marina (four samples), and the North Harbor (14 samples) contained detectable concentrations of PCBs. The highest concentrations were found in the Inner Harbor (13.9 and 29.8 ppm) and the Inner Harbor Extension (24.97 ppm). These were the only three samples with PCB concentrations greater than 10 ppm (Figure 2-12).

Sediments in the Marina and the North Harbor contained PCB concentrations generally greater than 1 ppm. Four of the five sample locations in the Marina contained PCB concentration greater than 5 ppm (5.2 to 8.9 ppm). The samples collected from the structural borings along the southern wall of the Marina contained PCB concentrations of less than 1 ppm. The concentrations detected in the North Harbor ranged from 0.169 to 9.34 ppm and averaged about 4.7 ppm.

2.4.2.2 Polychlorinated Biphenyls in the Deeper Sediments (> 2 feet)

The description of PCBs in the deeper unconsolidated sediments focuses on those results that were considered representative of subsurface conditions. Because many sediment samples were composited over depths from above and below the 2-foot depth, only samples with at least half of the sampled interval from deeper than 2 feet (24 inches) were included in this evaluation. Because only a thin sediment layer exists in the Inner Harbor Extension and North Harbor, samples were not collected from depths greater than 2 feet in these areas (Figures 2-11 and 2-13). In addition, only one deep sample was collected from the Marina (4.92 ppm).

The frequency of PCBs detected in the deeper sediments from the Inner Harbor, Entrance Channel, and Outer Harbor were similar to the surficial sediment samples. PCBs were detected in 92 percent (25 of 27 samples) of samples representing sediments deeper than 2 feet. The total PCB concentrations ranged from 0.0436 to 23.1 ppm and averaged about 4 ppm. The highest concentration was detected at the same location in the Inner Harbor (WH-2002-09 from 4 to 4.8 feet) that contained the highest PCB concentration in the shallow sediment (29.8 ppm from sample interval of 0 to 3.5 feet). All of the Inner Harbor samples contained total PCB concentrations exceeding 1 ppm. The PCB concentrations detected in the Entrance Channel and Outer Harbor ranged from 0.0436 to 9.34 ppm. Only four of the 19 samples collected from these harbor segments contained PCB concentrations greater than 1 ppm. It should be noted that the vertical extent of the PCB contamination in the deeper sediments is not well defined in the Outer Harbor and Entrance Channel where greater thickness of sand exist. The highest concentration of PCB (9.34 ppm) detected in the Entrance Channel was collected from sample WH-2002-05 from the interval 18 to 36 inches. PCB was not detected in the next sample collected from the interval between 126 to 144 inches that crossed the sand/till interface.

2.4.2.3 Polychlorinated Biphenyls in the Till

Sixteen samples throughout the harbor were comprised of the interval including the base of the sand and top of the till (Figure 2-14). PCBs were detected in seven of the 16 till samples, ranging in concentration from 0.0277 to 0.197 ppm and averaging 0.0754 ppm. The results indicate that the till layer is not significantly impacted by the PCBs that occur in the unconsolidated sediments. Low levels of PCBs were detected in the Inner Harbor, Inner Harbor Extension, and the North Harbor. PCBs were not detected in the till of the Marina (one sample), Entrance Channel (three samples), or the Outer Harbor (two samples).

2.4.3 Fish Tissue

PCB has been one of the fish contaminants of greatest concern in Lake Michigan. The FDA action levels for PCBs (2 ppm) in fish were regularly exceeded in samples taken of Illinois Lake Michigan fish. This led to the posting of signs warning that fish from the Waukegan North Harbor are not to be consumed. Recent monitoring data indicate, however, that contaminant concentrations in fish tissue continue to decrease. Warning signs from within the harbor have been removed because sampling has recently shown declines in concentrations to the same level as the greater Lake Michigan area (USEPA 2000).

Carp have been selected as the target species for monitoring fish flesh contaminant levels for Waukegan Harbor, since they are bottom feeders and harbor residents. Significant reductions of PCBs have been observed in carp since the 1993 harbor dredging was

completed (from 19 ppm in 1991 to an average of about 3 ppm in 1993). Although the average PCB levels in carp have fallen to less than half of the level found prior to dredging, averages among all samples have increased somewhat in recent years. Average PCB levels among all size groups were 4.17 ppm in 1996, 5.04 ppm in 1997, and 6.77 ppm in 1998.

In 1999 and early 2000, however, two individual fish contaminant samples from Waukegan Harbor showed uncharacteristically high levels of PCBs. This prompted additional sampling using carp as the target species. In September and October 2000, 19 carp samples were tested from Waukegan Harbor. Results showed that PCB concentrations are in line with fish samples collected by other Lake Michigan states. In the carp samples, total PCB values ranged from less than 1 to 7.2 ppm, with a mean of 3.2 ppm. The historical data for Waukegan Harbor carp tested since 1993 includes 57 samples averaging 5.2 ppm PCBs. The Lake Michigan Fish Consumption Advisory issued by Illinois now warns the public not to eat carp from Lake Michigan waters of Illinois (USEPA September 2003).

Additional information on chemicals detected in Waukegan Harbor fish samples can be found in the *Final Stage I and II Report, Waukegan Harbor Remedial Action Plan* and the updated *Final Stage III Report* (IEPA 1994 and 1999, respectively).

2.5 Risk Evaluation

The USEPA evaluated the short- and long-term risks associated with PCB contamination existing in Waukegan Harbor sediments. Waukegan Harbor has been primarily an industrial and commercial area, and includes a recreational boating area. The USEPA determined, based on PCB concentrations in sediment and fish, that the current levels of PCBs in Waukegan Harbor sediments pose cancer and non-cancer risks above USEPA and IEPA criteria. Since PCBs do not appreciably degrade or easily attenuate and have remained bioavailable in this harbor, action is recommended by the USEPA to reduce environmental risks associated with exposure to PCB-contaminated harbor sediments.

The USACE data used in the risk evaluation indicated that the average PCB level in harbor area sediments is about 2.5 ppm, with a few discrete sediment samples several times higher than the overall average. The average levels are about ten-fold higher than those (0.25 ppm) needed to protect public health and provide for acceptable risks to fish consumers. Action to achieve a resultant surface weighted average of 0.25 ppm PCB in sediments is recommended by the USEPA (Clark 2003).

People fish in the harbor and the fish caught are reportedly eaten. The city is now exploring redeveloping harbor commercial/industrial properties for residential use. An increase in harbor residential development may increase the number of persons using the harbor for recreational fishing. Current PCB levels in harbor sediments are causing unacceptably high PCB concentrations in fish, leading to a public health risk. The State of Illinois fish advisory system establishes 0.05 ppm PCB as a safe level in fish considering non-cancer health risks, such as neurobehavorial effects on developing fetuses and effects on the immune system. The advisory level is set at a cancer risk of approximately 1 in 10,000 (Clark 2003).

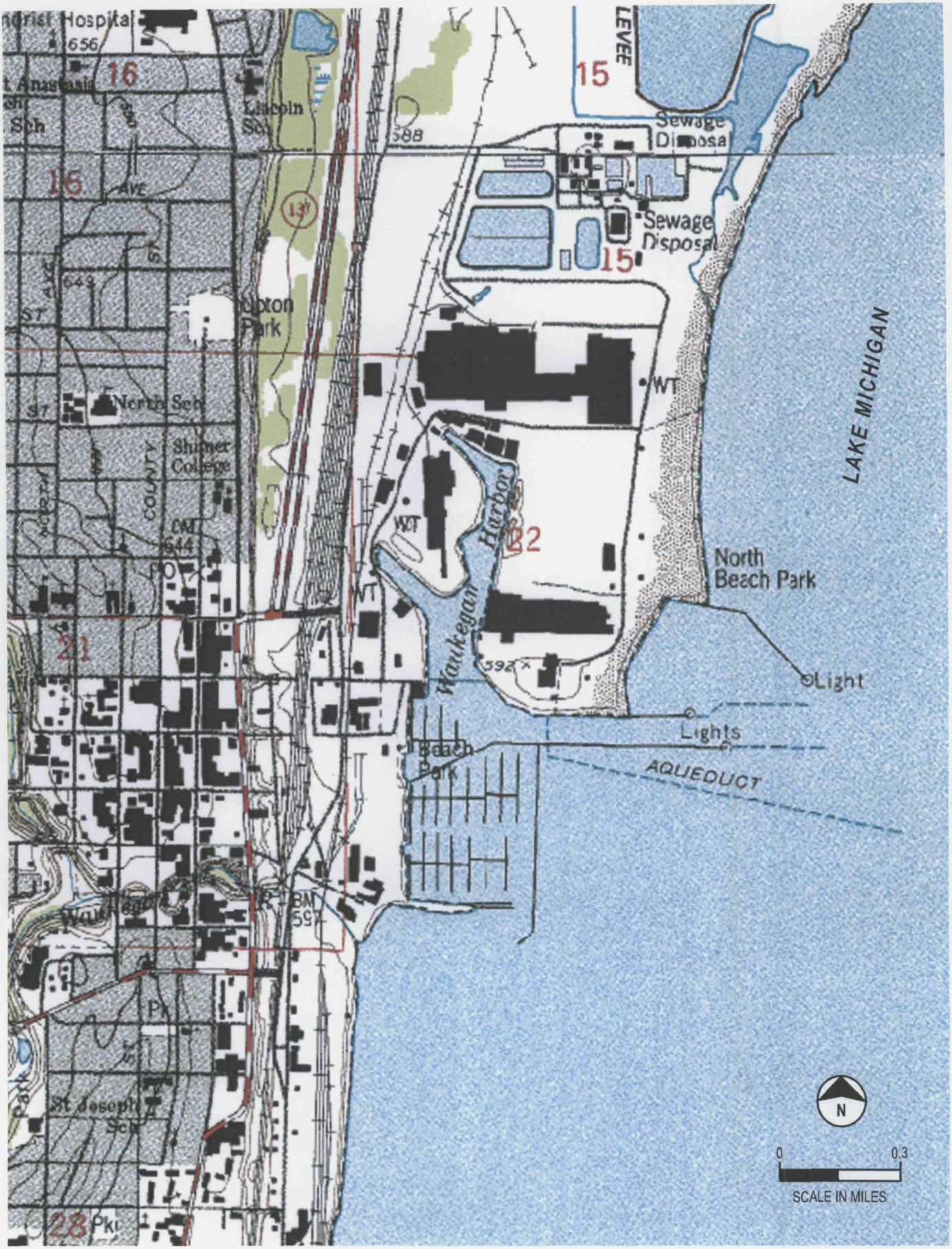
While PCBs have low water solubility, they have biomagnification factors in the million-fold range, so minute water concentrations coming from contaminated sediments can yield unacceptably high concentrations in fish. Carp fillets taken from Waukegan Harbor in 2000

and 2001 averaged, respectively, 4.5 and 3.8 ppm PCB, and the Illinois Department of Health has specified that no carp from Waukegan Harbor should be consumed. The carp average twice the state's do-not-eat criteria of 1.9 ppm, and some are as high as eight times the criteria. In addition, the carp are approximately 100 times the state's safe risk level of 0.05 ppm PCB.

Other fish, such as whole rock bass, average 2.6 ppm, yielding approximately 0.5 ppm PCB for fillets, assuming a 20-percent whole fish to fillet ratio. At 0.5 ppm, rock bass can only be eaten a rate of one meal per month. Such fish are 10 times the state's safe level for fish (Clark 2003).

In accordance with Superfund risk assessment guidelines, risks need to be calculated to the reasonable maximum exposed (RME) individual. Cancer risks from fish consumption are 5 in 10,000 for a high-intake person (1) eating 59 grams per day with 25 percent mixture from carp and 75 percent from rock bass, (2) assuming a 50-percent reduction from cooking and cleaning, and (3) having 30 years of consumption. Noncancer Hazard Index (dose from the intake of PCBs from fish consumption divided by acceptable or Reference Dose of $2.0E^{-5}$) would be 11, an order of magnitude higher than an acceptable level of 1 (one), indicating the potential for neurobehavorial and immune effects. Both cancer and noncancer risks from eating fish with PCBs are higher than the risk guidelines established by the USEPA and the IEPA (Clark 2003).

In order to achieve acceptable PCB levels in fish, PCB levels in sediments would need to be lowered five-fold to reach a cancer level of 1 in 10,000 (level for fish advisories) and about ten-fold to achieve an acceptable noncancer risk. Current average PCB levels in sediment of 2.5 ppm PCB would, therefore, need to be reduced to an overall surface weighted average of 0.25 ppm PCB to properly protect public health. In recent RODs, the USEPA has specified a sediment remediation level of 1 ppm to achieve a surface weighted average concentration (SWAC) of 0.25 ppm PCB to protect public health from PCBs in fish (Clark 2003).



SOURCE: USGS Waukegan Quadrangle Map

Figure 2-1
Site Location Map
Waukegan Harbor

Figure 2-2
Site Base map
Waukegan Harbor

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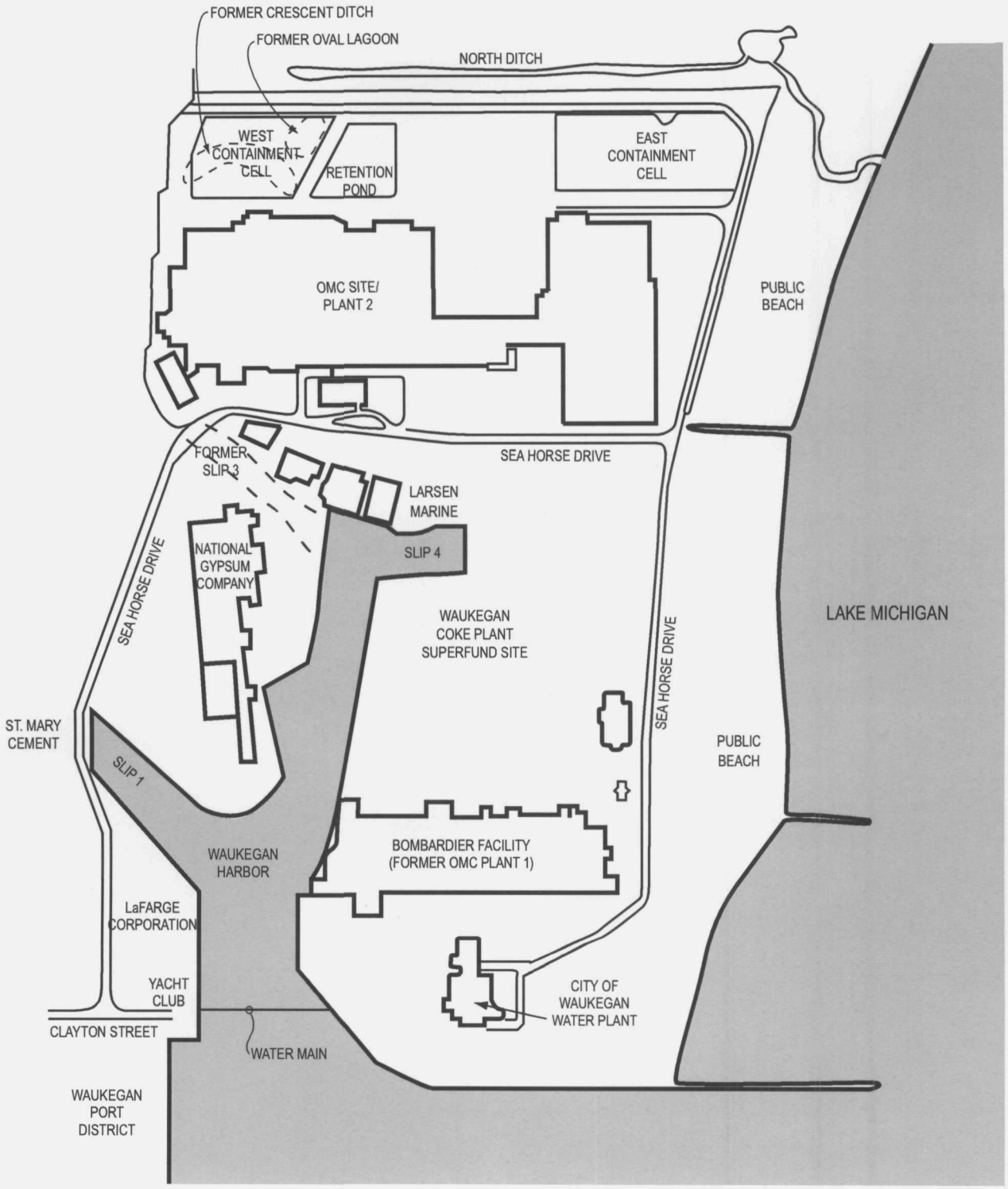
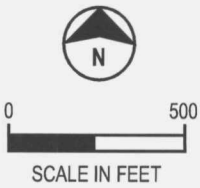
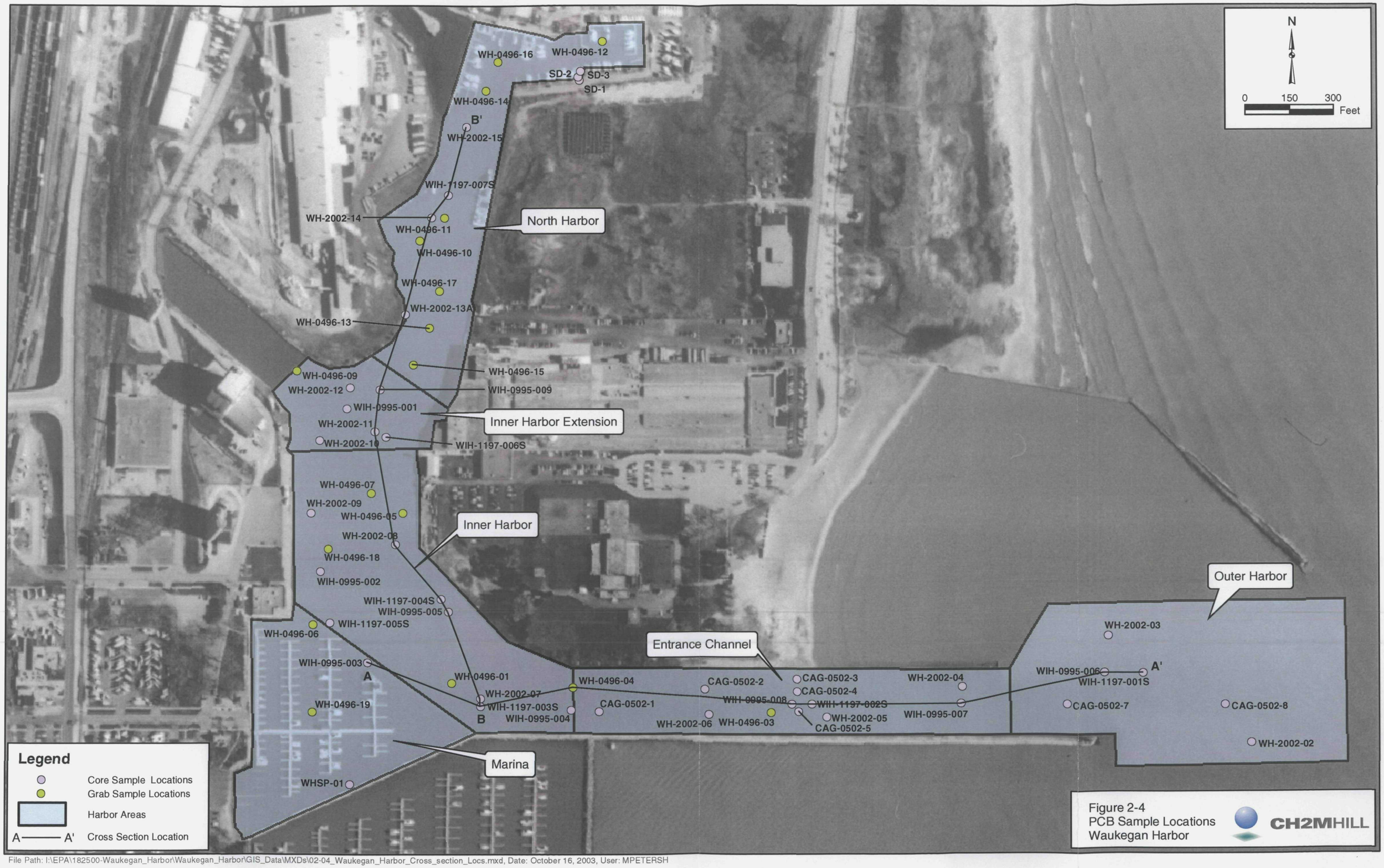




SOURCE: ADAPTED FROM USEPA 2002

Figure 2-3
Vicinity Features
Waukegan Harbor



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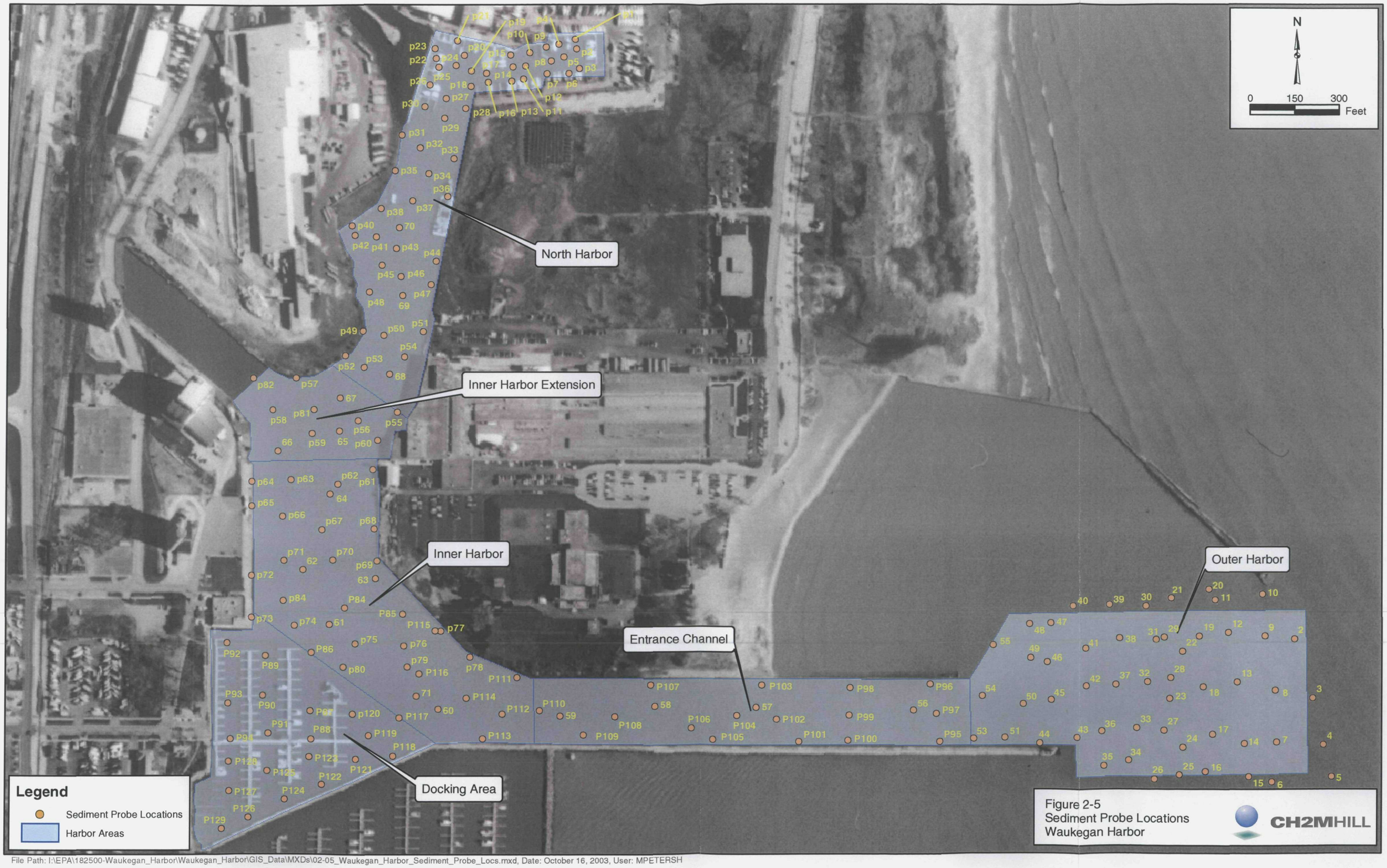

Figure 2-5
Sediment Probe Locations
Waukegan Harbor

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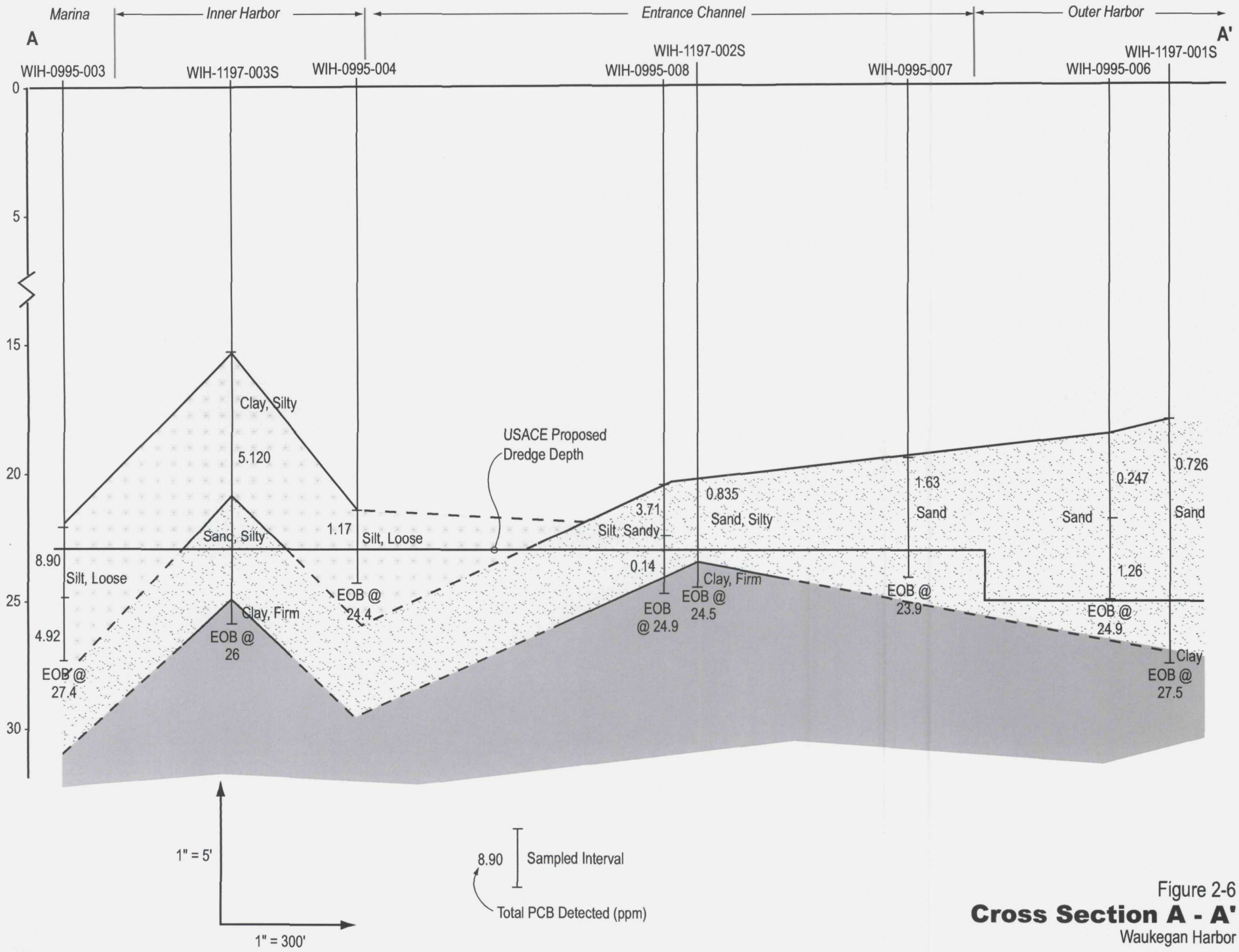

Figure 2-6
Cross Section A - A'
Waukegan Harbor

E092003005MKE 182500.PP.01 Cross Section A-A' 9-16-03tll

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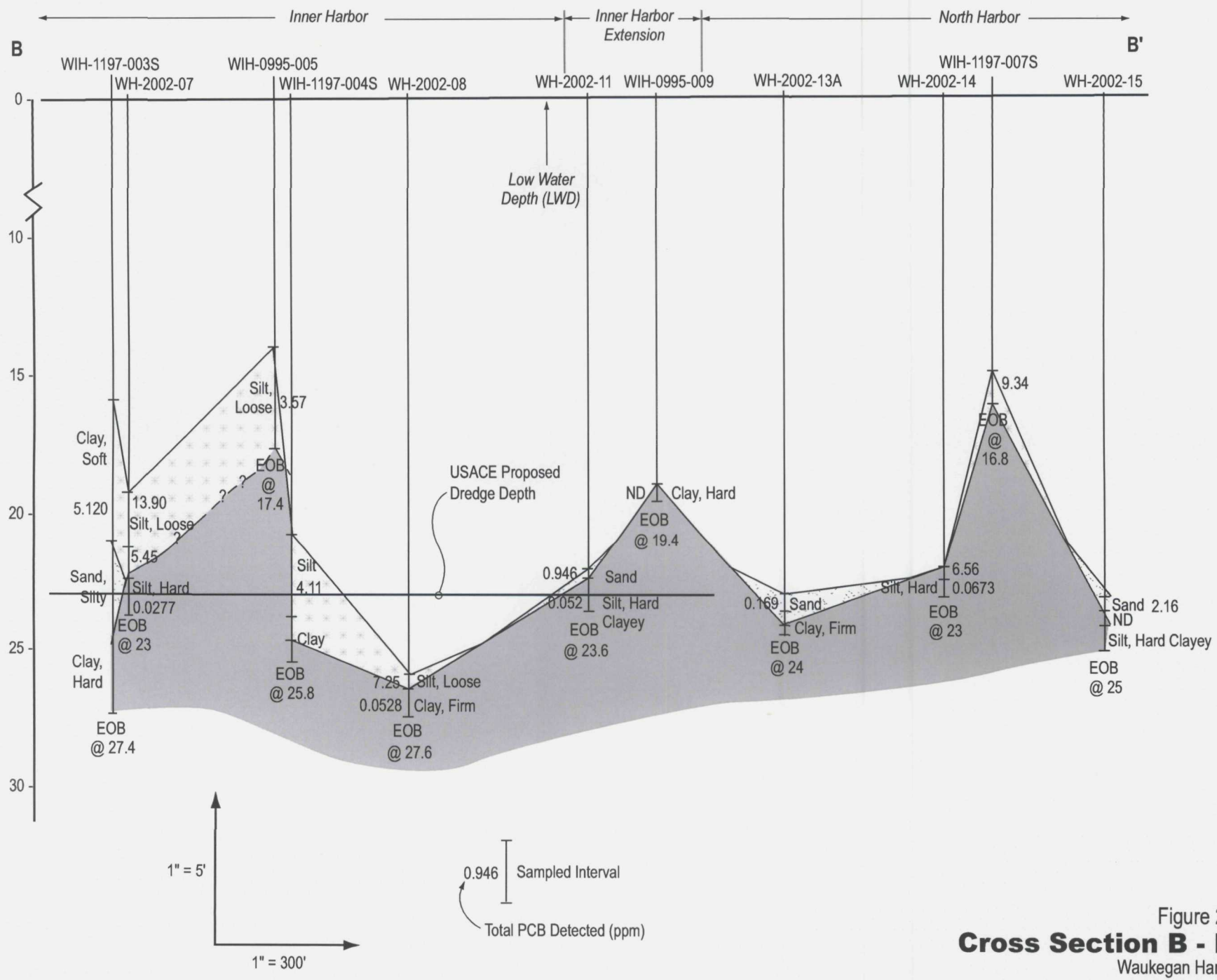

Figure 2-7
Cross Section B - B'
Waukegan Harbor

E092003005MKE 182500.PP.01 Cross Section B-B' 9-15-03ll

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Figure 2-8
Depth to Top of Sediment
Probe Data
Waukegan Harbor

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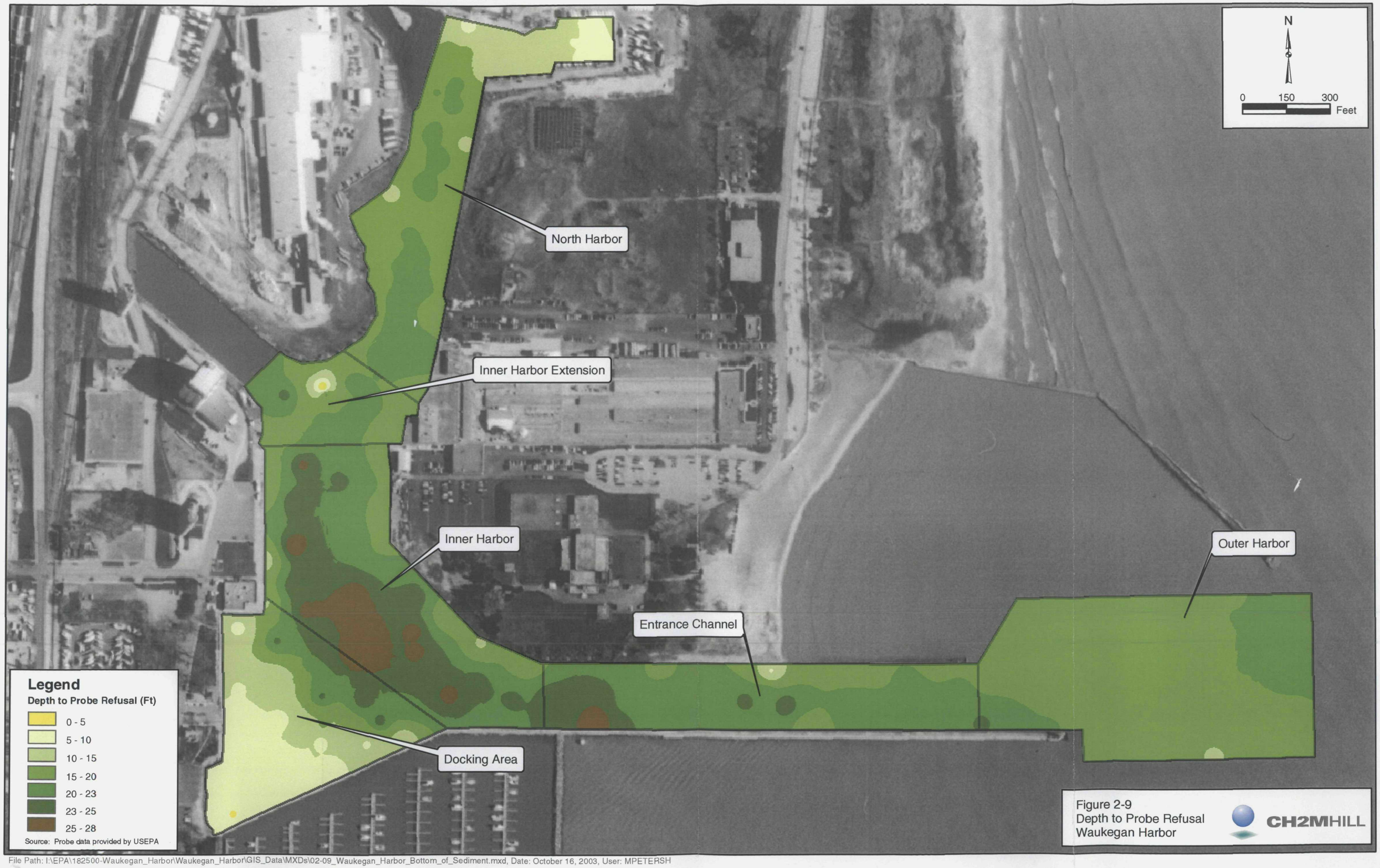

Figure 2-9
Depth to Probe Refusal
Waukegan Harbor

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Figure 2-10
Estimated Sediment Thickness
Probe Data
Waukegan Harbor

CH2MHILL

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Figure 2-11
Estimated Sediment Thickness
Based on Core Data
Waukegan Harbor

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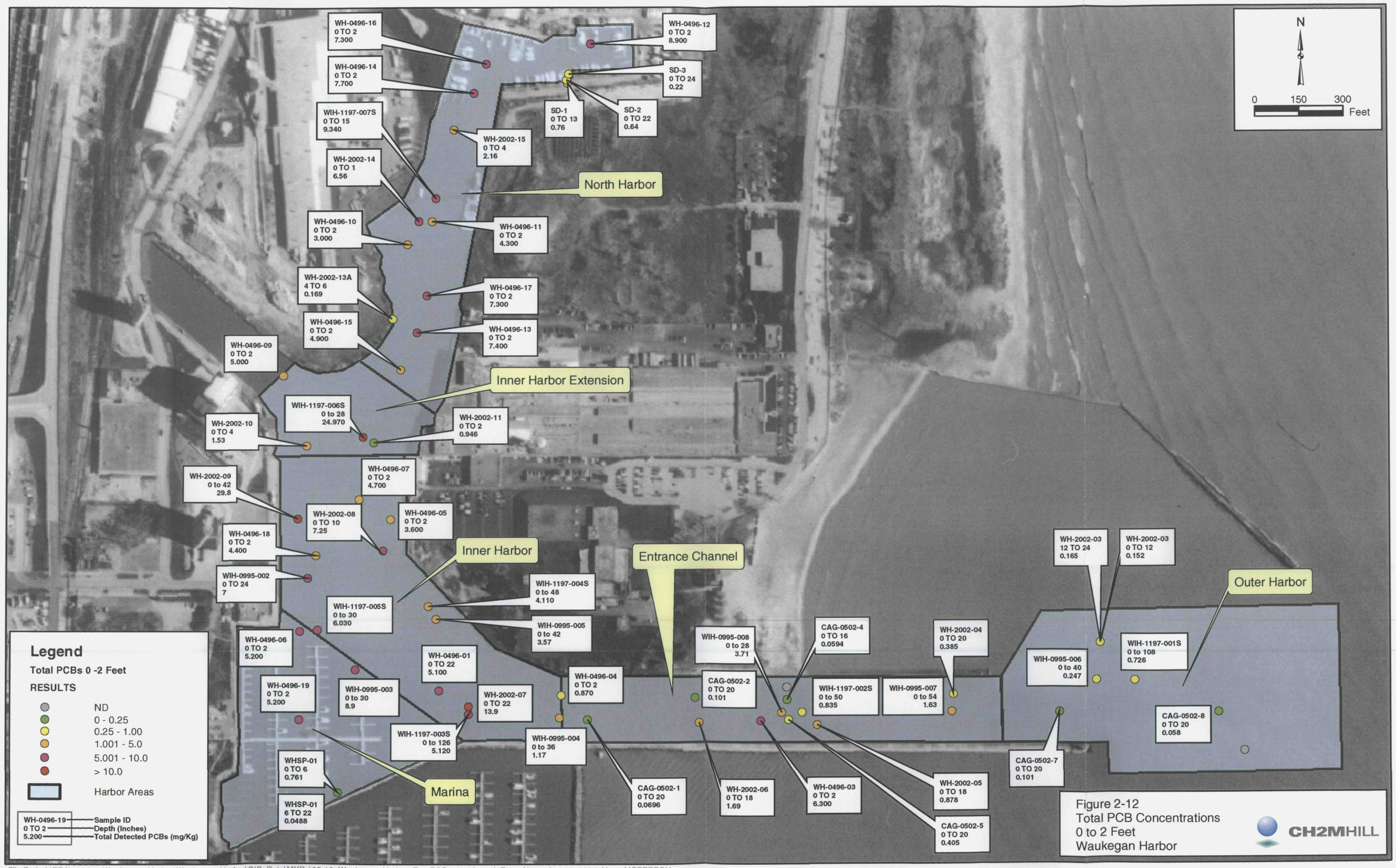

Figure 2-12
Total PCB Concentrations
0 to 2 Feet
Waukegan Harbor

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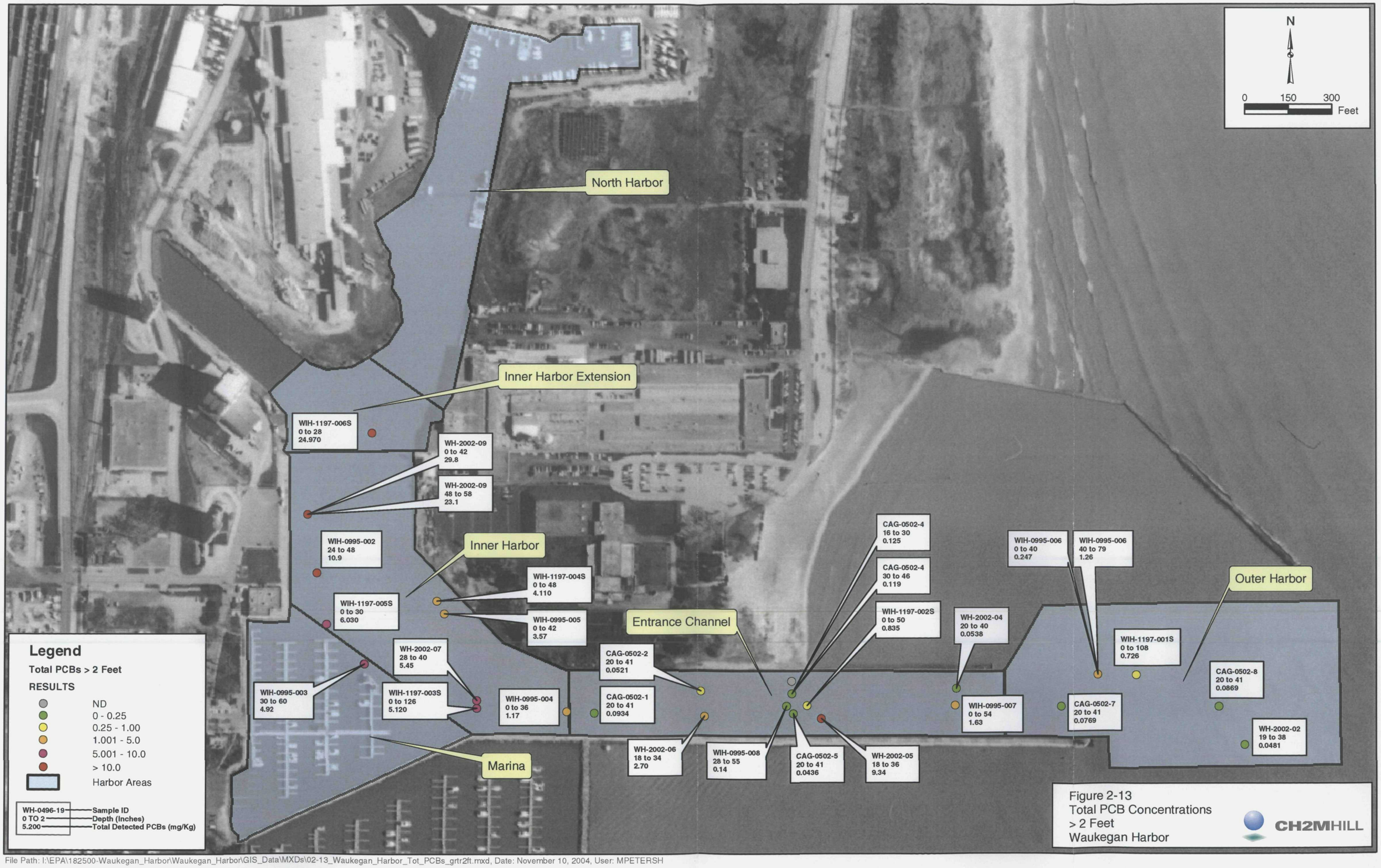

Figure 2-13
Total PCB Concentrations
> 2 Feet
Waukegan Harbor

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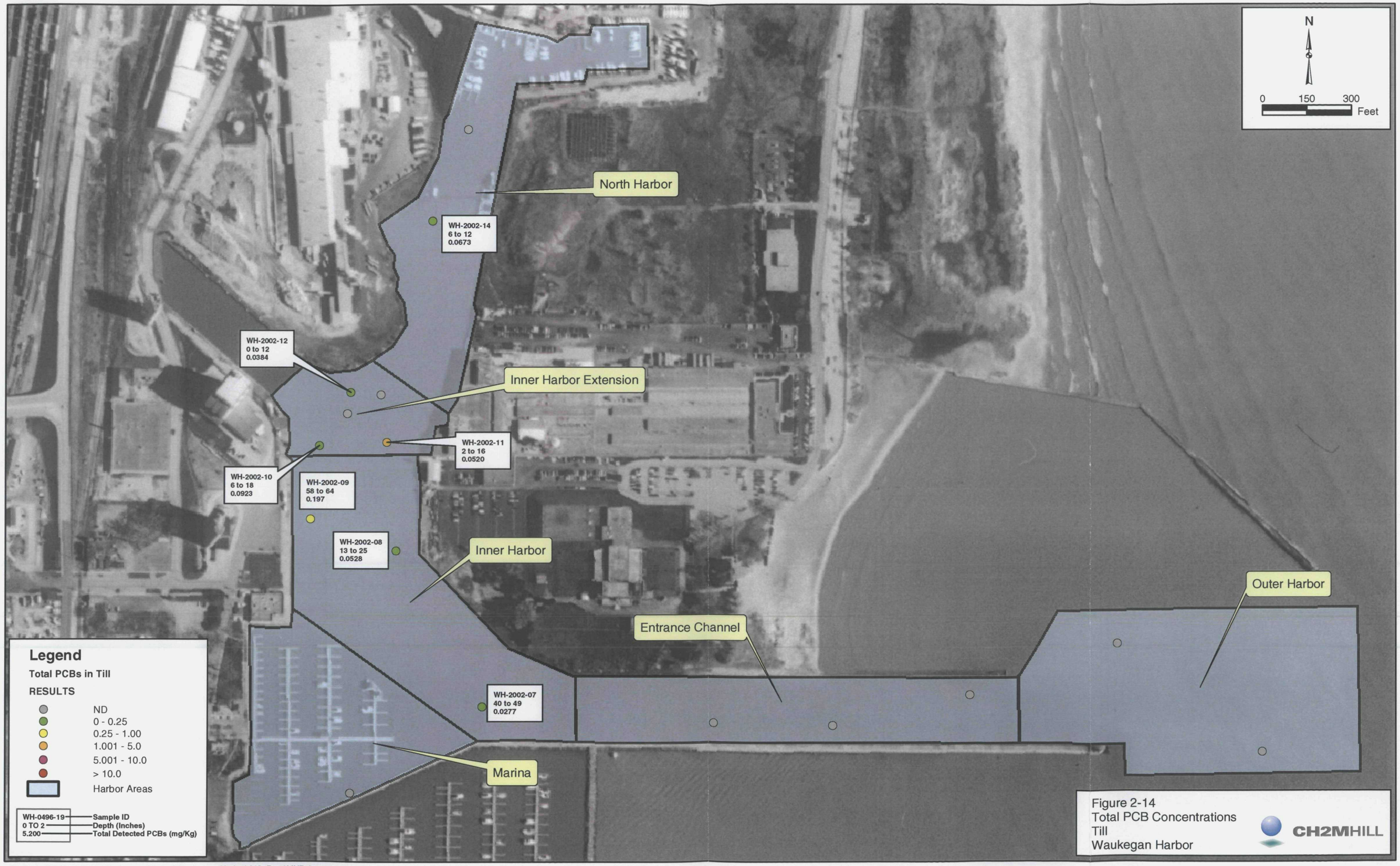

Figure 2-14
Total PCB Concentrations
Till
Waukegan Harbor

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SECTION 3

Remedial Action Objectives

RAOs are requirements that remedial alternatives should achieve to provide adequate protection of human health and the environment. This section presents general and site-specific remedial action objectives for the contaminated sediment in Waukegan Harbor AOC. In addition, the remedial action objectives include the USACE's proposal for deepening the navigational channel for commercial shipping.

General remedial objectives are defined in the USEPA's 1990 *National Oil and Hazardous Substances Contingency Plan* (NCP) and Section 121 of CERCLA as amended by the Superfund Amendments and Reauthorization Act (SARA). These objectives relate to the statutory requirements for remedy development. Site-specific objectives usually relate to specific contaminated media such as sediment or groundwater, potential exposure routes, and identification of target remediation levels. This analysis is focused on the contaminated sediments in Waukegan Harbor.

The site-specific objectives are based on an understanding of the contaminants, an evaluation of risk to public health and the environment, and the applicable or relevant and appropriate state and federal environmental laws (ARARs) (Tables 3-1 and 3-2). The USACE's objective of deepening the harbor for navigational purposes is also included.

3.1 NCP and CERCLA Objectives

According to the NCP,

> "The appropriate extent of remedy shall be determined by the lead agency's selection of a cost-effective remedial alternative that effectively mitigates and minimizes threats to and provides adequate protection of public health and the environment (40 CFR 300.68(i))."

The USEPA is the lead agency for the Waukegan Harbor AOC.

The statutory scope of CERCLA was amended in 1986 by SARA to include the provision that the selected remedy comply with or attain the level of any

> "standard, requirement, criteria or limitation under any Federal environmental law or an promulgated standard, requirement, criteria, or limitation under a State environmental or facility siting law that is more stringent than any federal standard, requirement, criteria, or limitation" [Section 121(d)(2)(A)]."

These constitute the general objectives for remedial actions at all CERCLA sites.

TABLE 3-1
Summary of Potential Federal ARARs

Citation	Requirement/Purpose	Alternatives Affected	ARAR Status
Chemical-Specific ARARs/TBCs			
Clean Water Act Section 404 3 USC 144; 33 CFR 323 40 CFR Parts 230 33 CFR Parts 320–330 40 CFR Part 132	Requires approval from USACE for discharge of dredged or fill material into waters of the United States (CWA Section 404 Permit). The Corps and USEPA regard the use of mechanized earth-moving equipment to conduct land-clearing, ditching, channelization, in-stream mining or other earth-moving activity in waters of the United States as resulting in a discharge of dredged material unless project-specific evidence shows that the activity results in only incidental fallback. Discharges of dredged or fill materials are not permitted unless there is no practicable alternative that would have less adverse impact on the aquatic ecosystem. Any proposed discharge must avoid, to the fullest extent practicable, adverse effects, especially on aquatic ecosystems. Unavoidable impacts must be minimized, and impacts that cannot be minimized must be mitigated. 40CFR Part 132 provides guidance for setting discharge limits for bioaccumulative contaminants such as PCBs.		The substantive requirements of a permit for discharge of dredged materials will be met. Though actual discharge of dredged material back into the harbor is not anticipated, excavation within the harbor constitutes discharge of dredged material. Requirements are likely to include measures to minimize re-suspension of sediments and erosion of sediments during excavation. Discharge limits for PCBs will likely be set at nondetectable levels.
Federal Water Pollution Control Act as amended by the Clean Water Act of 1977, Section 208(b)	The proposed action must be consistent with regional water quality management plans as developed under Section 208 of Clean Water Act.		Substantive requirements adopted by the state pursuant to Section 208 of the Clean Water Act would be applicable to direct discharge of treatment system effluent or other discharges to surface water.
Federal Water Pollution Control Act as amended by the Clean Water Act of 1977, Section 304	Establishes water quality criteria for specific pollutants for the protection of human health and aquatic life. These federal water quality criteria are non-enforceable guidelines used by the state to set water quality standards for surface water.		TBC. Point source discharges from sediment dewatering will meet requirements of NPDES discharge permit. Water quality criteria are TBCs used in setting standards for discharges to surface water.

TABLE 3-1
Summary of Potential Federal ARARs

Citation	Requirement/Purpose	Alternatives Affected	ARAR Status
40 CFR Parts 122, 125	Requires the development and implementation of a stormwater pollution prevention plan or a stormwater best management plan. Also outlines monitoring and reporting requirement for a variety of facilities.		May be applicable to runoff from construction activities depending on the nature of the remedial action selected.
40 CFR Part 131–Water Quality Standards	States are granted enforcement jurisdiction over direct discharges and may adopt reasonable standards to protect or enhance the uses and qualities of surface water bodies in the state.		Applicable to direct discharge of treatment system effluent.
Location-Specific ARARs/TBC			
Great Lakes Water Quality Agreement of 1978	Calls for prohibition of the discharge of toxic substances in toxic amounts and for the virtual elimination of the discharge of persistent substances.		TBC. Standards established by the agreement are policies to be considered.
Fish and Wildlife Coordination Act 16 USC §661 et seq. 16 USC §742 a 16 USC §2901 40 CFR 6.302 50 CFR 402–Fish and Wildlife Coordination Act	Requires consultation when a modification of a stream or other water body is proposed or authorized and requires protection of fish and wildlife from adverse effects of site action.		ARAR. Relevant and appropriate for Waukegan Harbor AOC for removal of contaminated sediment.
Coastal Zone Management Act 16 USC §1451 et. seq. 15 CFR 930	Requires that Federal agencies conducting activities directly affecting the coastal zone conduct those activities in a manner that is consistent, to the maximum extent practicable, with approved State coastal zone management programs.		Applicable to dredging and in situ capping, and any construction in the coastal zone.

TABLE 3-1
Summary of Potential Federal ARARs

Citation	Requirement/Purpose	Alternatives Affected	ARAR Status
Endangered Species Act of 1973 16 USC §1531 et seq. 50 CFR 200	Requires that Federal agencies insure that any action authorized, funded, or carried out by the agency is not likely to jeopardize the continued existence of any threatened or endangered species or destroy or adversely modify critical habitat.		No endangered species known to be present that would be effected by sediment excavation activities.
Rivers and Harbors Act of 1899 Section 10 (33 USC §401et. seq.) 33 CFR 403 33 CFR 322	Requires approval from USACE for dredging and filling work performed in a navigable waterway of the U.S. Activities that could impede navigation and commerce are prohibited.		ARAR. The substantive requirements of a permit will be met. Permits are not required for Superfund response actions. Typical requirements of dredging permits include measures to minimize re-suspension of sediments and erosion of sediments and stream banks during excavation.
National Historical Preservation Act 16 USC §661 et seq. 36 CFR Part 65	Establishes procedures to provide for preservation of scientific, historical, and archaeological data that might be destroyed through alteration of terrain as a result of a federal construction project or a federally licensed activity or program. If scientific, historical, or archaeological artifacts are discovered at the site, work in the area of the site affected by such discovery will be halted pending the completion of any data recovery and preservation activities required pursuant to the act and its implementing regulations.		May be relevant and appropriate during the remedial activities if scientific, historic, or archaeological artifacts are identified during implementation of the remedy.
Executive Order11990 50 CFR Part 6, Appendix A	Requires actions to minimize the destruction, loss, or degradation of wetlands and to preserve and enhance the natural and beneficial values of wetlands.		TBC. Will be considered for wetlands if present within sediment disposal areas.
Executive Order 11988 50 CFR Part 6, Appendix A	Requires actions to reduce the risk of flood loss; to minimize the impact of floods on human safety, health, and welfare; and to restore and preserve the natural and beneficial values served by floodplains.		TBC. Will be considered for floodplains if present within sediment disposal areas.
Great Lakes Water Quality Initiative Part 132, Appendix E	Provides guidance to Great Lakes states regarding wastewater discharge, stating that lowering of water quality standards via wastewater discharge should be minimized.		TBC. Considered as guidance.

TABLE 3-1
Summary of Potential Federal ARARs

Citation	Requirement/Purpose	Alternatives Affected	ARAR Status
Action-Specific ARARs/TBC			
Clean Air Act 40 CFR 50-99	Specifies requirements for air emissions such as particulates, sulfur dioxide, VOCs, hazardous air pollutants, and asbestos.		ARAR. Particulates are not likely to be generated during excavation of sediments. Best available practices to control particulates will be used, as needed, during the dewatering of sediments.
40 CFR 241–Guidelines for Land Disposal of Solid Wastes	Offsite solid waste land disposal units must meet the federal guidelines for the land disposal of solid wastes.		Applicability depends on waste classification for soil and water treatment residuals.
Subtitle D, 40 CFR 257–Criteria for Classification of Solid Waste Disposal Facility and Practices	Sets standards for land disposal facilities for nonhazardous waste.		Applicable to water treatment residuals and to transport and disposal of any nonhazardous solid waste offsite.
40 CFR 262 and 263 49 CFR 100 through 199	Establishes responsibilities for transporters of hazardous waste in handling, transportation, and management of the waste. Sets requirements for manifesting, record keeping, and emergency response action in case of a spill.		Not ARARs. The sediments are not hazardous waste.
Subtitle C, 40 CFR 260 through 264	Regulates the generation, transport, storage, treatment, and disposal of hazardous wastes generated in the course of a remedial action. Regulates the construction, design, monitoring, operation, and closure of hazardous waste facilities.		Not ARARs. The sediments do not have to be managed as containing listed hazardous waste because specific documentation of the release of a listed waste to the sediments is not available. The sediments also are not characteristic waste, and are exempted from regulation under RCRA because CWA Section 404 applies to the cleanup activity (40 CFR 261).
40 CFR 264, Subpart K–Surface Impoundments (40 CFR 264.221 to 264.228)	Establishes the design and operating, monitoring, and closure requirements for surface impoundments containing hazardous waste. Requires that all impoundments have a liner system to prevent any migration of wastes out of the impoundment to the adjacent subsurface soil or groundwater or surface water any time during the life of the impoundment.		Not ARARs. The sediments are not hazardous waste.

TABLE 3-1
Summary of Potential Federal ARARs

Citation	Requirement/Purpose	Alternatives Affected	ARAR Status
40 CFR 264, Subpart M–Land Treatment (40CFR 264.271 to 264.280)	Establishes the demonstration program, design and operating, monitoring, and closure requirements for hazardous waste land treatment units.		Not ARARs. The sediments are not hazardous waste.
40 CFR 268 Land Disposal Restrictions	The land disposal restrictions require treatment before land disposal for a wide range of hazardous wastes.		Not ARARs. The sediments are not hazardous waste.
Toxic Substances Control Act (TSCA) PCB Remediation Wastes 40 CFR 761.61	Specifies requirements for self-implementing on-site cleanup of PCB remediation waste.		Not an ARAR. Requirements are not binding on CERCLA sites (761.61 (a)(1)(ii)). Self-implementing requirements are not applicable to sediments.
TSCA Site Cleanup. (761.61(a)(5)(B)(2)(iii).	Remediation waste with PCBs > 50 mg/kg must be disposed of in a TSCA chemical waste landfill or a RCRA hazardous waste landfill.		Not an ARAR. Sediments have PCB concentrations < 50 mg/kg. If PCBs > 50 mg/kg are excavated, however, disposal will be performed in accordance with these requirements.
TSCA Performance-based Cleanup (761.61(b)(3)).	Material that has been dredged or excavated from waters of the United States must be managed in accordance with a permit issued under section 404 of the Clean Water Act, or the equivalent of such a permit.		ARAR. Although a permit is not necessary for a Superfund site, the substantive requirements of the permit must be met.
TSCA (40CFR 761.65) Storage for Disposal	Bulk PCB remediation waste containing > 50 mg/kg PCBs may be stored onsite for up to 180 days, provided controls are in place for prevention of dispersal by wind or generation of leachate. Storage site requirements include a foundation below the liner, a liner, a cover, and a run-on control system.		Not an ARAR. Sediments have PCB concentrations < 50 mg/kg; however, if PCBs > 50 mg/kg are excavated, storage piles will be designed to meet these requirements. An extension on the 180-day storage limit could be obtained if needed through a notification to EPA per 40 CFR 761.65 (a).

TABLE 3-2
Summary of Potential State ARARs

Citation	Requirement/Purpose	Alternatives Affected	ARAR Status
Chemical-Specific ARARs/TBCs			
Title 35, Subtitle B: Air Pollution	Regulations contain specific requirements that pertain to allowable emissions of criteria pollutants from a number of air contaminant source categories and processes.		ARAR. Substantive requirements for air emission control must be met.
IAC 35, Part 212 Visible and Particulate Matter Emissions	Regulations contain specific requirements that pertain to allowable emissions of fugitive particulate matter.		ARAR. Dust control must be implemented to control visible particulate emissions.
IAC 35, Part 245 Odors	Regulations specify how to determine whether a nuisance odor is present.		ARAR. Odor control may be necessary if it is determined that a nuisance odor is present as a result of sediment remediation.
IAC 35, Part 302 Surface Water Standards	Designates surface water quality standards used in setting effluent limits for discharges to surface water.		TBC. The standards are not ARARs themselves but are used in setting the discharge limits for discharges to surface water. These are TBCs for discharge of water from sediment dewatering.
IAC 35, Part 304 Effluent Standards	Designates specific effluent limits for discharges to surface water.		ARAR. Substantive requirements must be met for discharges to surface water of water from sediment dewatering.
IAC 35, Part 309 Permits	Designates process used in setting NPDES effluent limits for discharges to surface water.		ARAR. Substantive requirements must be met for discharges to surface water of water from sediment dewatering.
IAC 35, Part 307 Sewer Discharge Criteria, 1101-1103 General and Specific Pretreatment Requirements.	Designates general requirements for discharges to POTWs such as no discharge of pollutants which pass through the POTW or interfere with the operation and performance of the POTW. Also gives specific limits for discharge of certain pollutants.		ARAR. Substantive requirements must be met for discharges to Northshore Sanitary District POTW of water from sediment dewatering.
IAC 35, Part 310 Pretreatment Programs. 310.201-202.	Designates general requirements for discharges to POTWs such as no discharge of pollutants which pass through the POTW or interfere with the operation and performance of the POTW. Also requires POTWs to develop Pretreatment programs.		ARAR. Used by Northshore Sanitary District in setting pretreatment discharge requirements for discharge of water from sediment dewatering.

TABLE 3-2
Summary of Potential State ARARs

Citation	Requirement/Purpose	Alternatives Affected	ARAR Status
IAC 35, Subtitle G: Waste Disposal, Subchapter c: Hazardous Waste Operating Requirements, Parts 720- 729.	Standards applicable to hazardous waste generators, transporters and operators of hazardous waste treatment storage and disposal facilities.		Not an ARAR. The sediments are not required to be managed as containing listed hazardous waste because specific documentation of the release of a listed waste to the sediments is not available. The sediments also are not characteristic waste. Also the sediments are exempted from regulation under RCRA because CWA Section 404 applies to the cleanup activity (40 CFR 261(g)).
IAC 35, Subtitle G: Subchapter f: Part 740 Site Remediation Program, Section 740.535 Establishment of Soil Remediation Zones.	Presents requirements for the site remediation program and specific requirements for establishment of soil management zones (SMZ). SMZs can be used for onsite placement of contaminated soils for structural fill or land reclamation or consolidation of contaminated soils within a remediation site. Soil with contaminants exceeding criteria cannot be placed in areas of soil meeting criteria.		ARAR. Remediation program requirements must be met for remediation of PCBs in sediment. SMZ can be used for placement of contaminated sediment onsite.
IAC 35, Subtitle G: Subchapter f: Part 742. Tiered Approach to Remedial Action Objectives.	Presents requirements for the tiered approach to corrective action objectives (TACO).		ARAR. Remediation program requirements must be met for remediation of PCBs in sediment.
IAC 35, Subtitle G: Subchapter i: Parts 807 to 815 Solid Waste and Special Waste Hauling.	Presents requirements for hauling and disposing solid wastes and special wastes. Includes requirements for new solid waste landfills.		ARAR. Contaminated sediment must be transported and disposed in accordance with requirements of IAC 35 Subchapter i. New landfills for offsite disposal of contaminated sediment must meet the requirements of Part 811.
IAC 35, Subtitle G: Subchapter i: Part 808 Special Waste Classifications.	Special waste must be treated, stored or disposed at a facility permitted to manage special waste. Presents the special waste classes and the method to determine whether the solid waste is a special waste and if so, whether it is Class A (all non-Class B special wastes) or Class B (low or moderate hazard special wastes). RCRA hazardous waste is not included within the special waste classes.		ARAR. Contaminated sediment with PCBs is a Class A special waste. The main factor affecting the classification is the large volume of contaminated sediment to be disposed rather than the PCB concentration. Offsite disposal of PCB contaminated sediment must be at a Solid Waste landfill permitted to receive Class A special waste unless IEPA specifically allows otherwise.

TABLE 3-2
Summary of Potential State ARARs

Citation	Requirement/Purpose	Alternatives Affected	ARAR Status
Title 35, Subtitle H: Noise	Regulations contain specific requirements that pertain to nuisance noise levels.		ARAR. Noise levels will need to be controlled if noise reaches nuisance levels.
Lake County Stormwater Management Commission, Watershed Development Ordinance	Regulations specify performance standards for stormwater control.		ARAR. Activities such as sediment dewatering or sediment disposal need to be evaluated relative to stormwater controls.

3.2 Site-Specific Exposure Routes

Site-specific objectives are based on the exposure setting for which protection will be provided (e.g., protection from dermal contact with contaminated soil). The major exposure route and risks related to the PCB-contaminated sediment in Waukegan Harbor, as identified by the USEPA, are based on consumption of fish caught in the harbor. Exposure routes are an important consideration because protection can be achieved by reducing exposure rather than lowering contaminant levels.

The USEPA and the IEPA have established that cancer risks at uncontrolled hazardous waste sites (e.g., Superfund sites) which pose an excess lifetime cancer risk (ELCR) greater than 1 in 10,000 (i.e., ELCR of 1×10^{-4}) or a noncancer risk greater than a Hazard Index (HI) of 1 (one) should be addressed by remedial action. NCP and CERCLA require the full risk range of 1×10^{-4} to 1×10^{-6} ELCR to be considered during development of remedial alternatives. Generally, noncancer risks are required to meet an HI of 1, the USEPA's *Risk Evaluation of Waukegan Harbor Sediments* (Clark 2003) estimated the ELCRs from fish consumption to be 5×10^{-4} for a high-intake person eating 59 grams per day of a mixture of 25 percent carp and 75 percent rock bass. The HI would be 11, an order of magnitude higher than an acceptable level of 1. Both cancer and noncancer risks from eating fish with PCBs are higher than the risk guidelines established by the USEPA and the IEPA (Clark 2003).

In order to achieve acceptable PCB levels in fish, PCB levels in sediments would need to be lowered five-fold to reach an ELCR of 1×10^{-5} (level for fish advisories) and about ten-fold to achieve an acceptable noncancer risk. Current average PCB levels in sediment of 2.5 ppm PCB would, therefore, need to be reduced to an overall SWAC of 0.25 ppm PCB to properly protect public health (Clark 2003).

3.3 Applicable or Relevant and Appropriate Requirements

Remedial actions must attain the standards defined by the ARARs established by the USEPA and the IEPA for the site. Remedial actions must also take into account the "to be considered" (TBC) criteria or guidelines if the ARARs do not address a particular situation.

3.3.1 Definition of Applicable or Relevant and Appropriate Requirements

Remedial actions must be protective of public health and the environment. Section 121 of CERCLA requires that primary consideration be given to remedial alternatives that attain or exceed ARARs. The purpose of this requirement is to make CERCLA response actions consistent with other pertinent federal and state environmental requirements, as well as to adequately protect public health and the environment.

Definitions of ARARs and the TBC criteria are given below:

- *Applicable requirements* are cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that directly and fully address a hazardous substance, pollutant, contaminant, environmental action, location, or other circumstance at a CERCLA site. For a requirement

to be applicable, the remedial action or the circumstance at the site must satisfy all the jurisdictional prerequisites of that requirement.

- *Relevant and appropriate requirements* are cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that, although not "applicable" to a hazardous substance, pollutant, contaminant, environmental action, location, or other circumstance at a CERCLA site, address problems or situations sufficiently similar (relevant) to those encountered at the CERCLA site, that their use is well suited (appropriate) to the particular site. The relevance and appropriateness of a requirement can be judged by comparing the factors addressed in the requirement with the features of the site, characteristic of the remedial action, and the hazardous substances in question.

- *TBC* criteria are nonpromulgated, nonenforceable criteria, advisories, guidance, and proposed standards that, while not legally binding, may provide useful information or recommend procedures when ARARs do not address a particular site condition or if existing ARARs are not protective of human health and/or the environment. In such situations, these TBC criteria or guidelines serve to establish protective cleanup levels and to help identify preferred remedial action alternatives.

An additional factor in determining which requirements must be addressed is whether the requirement is substantive or administrative. Onsite CERCLA response actions must comply with substantive requirements but not with administrative requirements. Substantive requirements are those that pertain directly to actions or conditions in the environment. Examples of substantive requirements include quantitative health- or risk-based restrictions that limit exposure to types of hazardous substances and restrictions upon activities in certain special locations. Administrative requirements are mechanisms that facilitate the implementation of the substantive requirements of a statue or regulation. In general, administrative requirements prescribe methods and procedures (e.g., fees, permitting, inspection, documentation, reporting, and enforcement requirements) by which substantive requirements are made effective for purposes of a particular environmental or public health program (i.e., onsite CERCLA response action must meet the intent of the law, but need not conform with all applicable administrative rules). This distinction applies only to onsite actions; offsite response actions are subject to the full requirements of applicable standards or regulations, including administrative requirements such as permits.

3.3.2 Determination of Applicable or Relevant and Appropriate Requirements

ARARs are grouped into three types: chemical-specific, location-specific, and action-specific. ARARs for the Waukegan Harbor AOC, based on federal and state regulations, have been identified and are presented in Tables 3-1 and 3-2, respectively. The potential ARARs important in setting site-specific remedial goals and developing remedial alternatives are discussed below. The state ARARs generally mirror the federal ARARs.

3.3.2.1 Chemical-Specific Applicable or Relevant and Appropriate Requirements

Chemical-specific ARARS include laws and requirements that regulate the release to the environment of specific substances having chemical or physical characteristics, or materials containing specified chemical compounds. At the Waukegan Harbor AOC, they are important in determining the residual levels of contaminants allowable after treatment.

The Resource Conservation and Recovery Act. The applicability or relevancy and appropriateness of the Resource Conservation and Recovery Act (RCRA) are discussed first by summarizing the classification of wastes present in the Waukegan Harbor sediments.

Classification of Wastes. Sediment to be excavated and disposed of offsite should be classified as to its RCRA status to determine whether RCRA requirements are ARARs. RCRA is not an ARAR for contaminated sediments if the sediments are remediated under CWA Section 404. RCRA specifically excludes sediments managed under a Section 404 permit as follows: *"40 CFR 261(g). Dredged material that is not a hazardous waste. Dredged material that is subject to the requirements of a permit that has been issued under 404 of the Federal Water Pollution Control Act (33 U.S.C.1344) or section 103 of the Marine Protection, Research, and Sanctuaries Act of 1972 (33 U.S.C. 1413) is not a hazardous waste."*

Land Disposal Restrictions. Land disposal restrictions (LDRs) apply to hazardous wastes that are intended for land disposal. Because the sediments are not hazardous waste, LDRs do not apply and are not ARARs for the sediment.

Clean Water Act. The CWA provides regulations for the discharge of pollutants into the waters of the United States. It required the USEPA to set water quality standards for all contaminants in surface waters, and required that permits be obtained for discharge of pollutants from a point source into navigable waters.

A federal program called The Great Lakes Water Quality Initiative was begun in 1989 to develop uniform water quality criteria for the Great Lakes Basin and resulted in the publication of criteria and methodologies for development of water quality criteria. These criteria were promulgated in the Great Lakes Critical Program's Act of 1990 and are incorporated into the Code of Federal Regulations (CFR) in 40 CFR Part 132. Based on these criteria, it is likely that NPDES limits for PCBs will be set at nondetectable levels.

Regulations promulgated under the authority of the CWA require a permit to be obtained for dredging or excavation of sediments in navigable water such as Waukegan Harbor. While CERCLA response actions are not required to obtain permits, the substantive requirements that such a permit would contain must be met. As a result, consultations with the USACE, the permitting agency, will be held to determine which requirements would apply to the dredging and excavation of harbor sediment. Typical requirements include actions to minimize resuspension of sediments and control erosion during dredging or excavation.

3.3.2.2 Location-Specific Applicable or Relevant and Appropriate Requirements

Location-specific ARARs relate to the geographical position of the site. The location-specific requirements identified as potential ARARs deal with environmentally sensitive areas (e.g., wetlands, floodplains, caves, fault zones, endangered species). The most important location-specific ARARs for the Waukegan Harbor AOC are the following:

- **Fish and Wildlife Coordination Act**—Enacted to protect fish and wildlife when actions result in the control or structural modification of a natural stream or body of water. The statute requires that any action takes into consideration the effect that water-related projects would have on fish and wildlife, and then take action to prevent loss or damage to these resources.
- **Executive Orders 11988 (Floodplain Management) and 11990 (Protection of Wetlands), 50 CFR § 6 Appendix A**—These are TBCs. They set forth USEPA policy for carrying out the provisions of Executive Orders (EOs) 11988 and 11990. EO 11988 requires that actions

be taken to reduce the risk of flood loss; to minimize the impact of floods on human safety, health, and welfare; and to restore and preserve the natural and beneficial values served by floodplains. EO 11990 requires that actions at the site be conducted in ways that minimize the destruction, loss, or degradation of wetlands.

- **River and Harbors Act**—Section 10 prohibits the creation of obstructions to the capacity of, or excavation or fill within the limits of, the navigable waters of the United States. Typical requirements of dredging permits include measures to minimize resuspension of sediments and erosion of sediments and stream banks during excavation.

3.3.2.3 Action-Specific Applicable or Relevant and Appropriate Requirements

Action-specific ARARs are requirements that define acceptable treatment and disposal procedures for hazardous substances. They generally set performance, design, or other similar action-specific controls or restrictions on particular kinds of activities related to management of hazardous substances or pollutants. These requirements are triggered by the remedial activities selected to accomplish a remedy. Since there are usually several alternative actions for any remedial site, very different requirements can come into play. The action-specific requirements do not in themselves determine the remedial alternative; they indicate how or to what level treatment or cleanup will be achieved.

Comprehensive Environmental Response, Compensation, and Liability Act. CERCLA requires the selected remedy to meet the substantive requirements of all environmental rules and regulations that are ARARs unless a specific waiver of the requirement is granted. Waiver of ARARs may be requested (per the NCP 300.430(f)(1)(ii)(C)) based on any one of six circumstances. It is not anticipated that any ARAR waivers under CERCLA will be necessary.

Toxic Substances Control Act. TSCA regulates the remediation of soils contaminated with PCBs under 40 CFR 761.61 (a) *Self-implementing on-site cleanup and disposal of PCB remediation waste.* However this section specifically excludes remediation of sediment from the self-implementing rules. As a result, the TSCA self-implementing rules are not ARARs for the harbor sediment remediation. Contaminated sediments are addressed under 40 CFR 761.61(b) (3) *Performance-based cleanup.* This section specifically requires that sediment dredged or excavated from waters of the United States be managed in accordance with a permit issued under Section 404 of the CWA, or the equivalent of such a permit. While a permit is not required for CERCLA response actions, consultations with the USACE, the permitting agency, will be held to determine which requirements would apply to the creek sediment dredging and excavation.

TSCA also requires soil contaminated with PCBs at concentrations of 50 mg/kg or greater to be disposed of at either a hazardous waste landfill permitted under RCRA or at a chemical waste landfill permitted under TSCA. None of the sediment has been found to exceed 50 mg/kg. As a result, the chemical waste landfill requirements under 40 CFR 761.75 do not have to be met and are not ARARs for excavated sediment. They could become ARARs, however, if further sampling identifies sediment in excess of 50 mg/kg.

Clean Air Act. Requirements of the Clean Air Act (CAA) are potentially applicable to remedial actions that result in air emissions, such as excavation activities. Illinois Administrative Code (IAC) Title 35, Subtitle B: Air Pollution, contains requirements that pertain to allowable emissions from construction activities. Mitigative measures to reduce air emissions during excavation will be adhered to as part of the construction plan.

3.4 Site-Specific Remedial Action Objectives

The RAOs for the sediment in Waukegan Harbor include:

- Protect human health and the environment from the adverse effects of PCBs attributable to the site.
- Reduce PCBs in sediment throughout the harbor to a remedial action level of 1 mg/kg at any single location and a SWAC of 0.25 mg/kg.
- Minimize potential human health and environmental risks that may be associated with remedial activities, to the extent practical.
- Deepen the navigational channel of the harbor for commercial shipping. Preliminary USACE project depths to be assumed in this report are the outer harbor (25 feet project depth), entrance channel (23 feet project depth), inner harbor (23 feet project depth), and the inner harbor extension (23 feet project depth).
- Do not reduce the depth to top of sediment in the North Harbor segment where depths are less than 16 feet below LWD or in the Marina segment where depths are 10 feet below LWD as a result of sediment capping. Sediment removal solely for the purpose of recreational boating is not an objective for these two segments.
- Minimize adverse effects on recreational and commercial shipping during remedial activities, to the extent practicable.

3.5 Sediment Remediation Areas

The evaluation of sediment remediation areas is based on identifying the segments that have a SWAC that exceeds 0.25 ppm of PCB. The evaluations of the SWACs for the individual harbor segments and the overall harbor are provided in Appendix C, and are summarized in Table 3-3.

TABLE 3-3
Baseline SWACs

Harbor Segment	SWAC (ppm)	Contaminated Sediment Volume (yd^3)	Additional Sediment and Till Volume to Achieve USACE Project Depths (yd^3)
Outer Harbor	0.26	76,000	85,000
Entrance Channel	1.24	25,000	36,000
Marina	4.61	74,000	N/A
Inner Harbor	7.89	66,000*	74,000
Inner Harbor Exten.	2.6	4,000	10,000
North Harbor	5.75	12,000	N/A
Overall Harbor	**3.71**	**256,000**	**205,000**

* Includes 43,000 CY below USACE project depth.

The SWACs are based on the uppermost sample from each sample location for which data are available after 1993 (post-North Harbor sediment remediation). As shown in Table 3-3, the PCBs are present throughout all harbor segments in the soft sediment at concentrations exceeding the 0.25 mg/kg remedial goal.

Table 3-3 identifies the volumes of sediment, by harbor segment, both that have detectable concentrations of PCBs and that require removal to meet the project depths for navigation. The total volume of contaminated sediment is estimated to be 256,000 cubic yards. The additional sediment and glacial till volume that requires removal to achieve project depths for navigation is 205,000 cubic yards. This latter volume of 205,000 cubic yards is not contaminated with PCBs based on current data, and does not require disposal as a solid waste. Additional sampling of these sediments will be performed to verify this assumption.

SECTION 4

Identification and Screening of Technologies and Process Options

This section describes the identification and screening of remedial technologies and process options based on the remedial objectives identified in Section 3. The first step in the process was to identify general response actions that can meet the remedial objectives. Within each general response action, remedial technologies and their associated process options were identified. These were then screened, and those capable of meeting the objectives for the contaminated media were retained. If several process options within a remedial technology were deemed capable of meeting the objectives, the options judged to best represent their category were retained. Those retained were then used to develop remedial alternatives.

General response actions are broad categories of remedial actions that alone or in conjunction with other actions can be used to meet RAOs in the remediation of a site. The actions are identified based upon the review and consideration of action-specific ARARs and remedial actions used or considered for use at similar sites. For each general response action, several remedial technologies may exist, each of which may be subdivided according to process options for screening purposes. General response actions that may be applicable to the project include:

- No action
- Natural attenuation
- Monitoring
- Institutional controls
- Containment
- In situ treatment
- Sediment removal
- Ex situ treatment
- Sediment dewatering
- Sediment processing and stabilization
- Water treatment
- Sediment transport
- Disposal

For each general response action (except No Action), CH2M HILL identified remedial technologies and associated process options considered to be potentially appropriate and effective for the contaminated sediments within the various segments of Waukegan Harbor. They were identified based on professional experience, published sources, computer databases, and other available documentation and resources.

The available technology types and process options were screened to identify technologies that may be applicable for remediating the sediments from Waukegan Harbor. This screening step may eliminate a general response action from the FS process if no feasible technologies are identified. The objective, however, is to retain the best technology types and process options within each general response action and to use them to develop remedial alternatives. Table 4-1 summarizes the evaluation and screening of technology types and process options for the contaminated sediments to clarify and facilitate review. Each technology type and process option is either a demonstrated, proven process, or a process that has undergone laboratory trials or bench-scale testing.

TABLE 4-1
Remedial Technology Screening

General Response Action	Remedial Technology/ Process Option	Description	Screening Criteria: Effectiveness	Screening Criteria: Implementability	Screening Criteria: Relative Cost	Screening Comments
No Action	None	No further actions to address contaminated sediment.	Some natural attenuation will occur as PCBs slowly biodegrade over time and sediments are redistributed and buried.	None	None	Retained for comparison.
Natural Attenuation	Monitored Natural Recovery	Allow naturally occurring physical, chemical, and biological processes to reduce the bioavailability and/or toxicity of PCBs to acceptable levels.	Some natural attenuation will occur as PCBs slowly biodegrade over time and sediments are redistributed and buried. May be effective in reducing PCB concentrations.	Easily implementable.	Low	Retained.
	Enhanced Natural Recovery – Thin Layer Placement	Augment natural sediment with placement of thin layer (6") of clean sand or sediment. Naturally occurring processes (bioturbation) mix clean material with sediment and reduce sediment concentrations, accelerating natural recovery.	May be effective in reducing PCB concentrations. Limited history of use makes effectiveness assessment difficult.	Easily implementable.	Low to Moderate	Not retained due to uncertainty in effectiveness.
Monitoring	Sampling and Analysis	Routine long-term sampling and analysis of sediment at selected locations to record site conditions and contamination levels.	Not effective in reducing concentrations or controlling exposure but can be used in conjunction with other technologies to allow monitoring of effectiveness.	Easily implementable.	Low	Retained. This technology includes monitoring the natural decline in PCB concentrations or monitoring the effectiveness of remedial technologies.
Institutional Controls	Access Restrictions	Public access to the harbor is restricted through fencing.	Effective in isolating PCBs from human receptors.	Easily implementable.	Low	Retained.
	Deed Restrictions	Put constraints on future use of the harbor and adjacent properties.	Effective in isolating PCBs from human receptors.	Easily implementable.	Low	Retained.
	Fish Consumption Advisories	Issue/maintain advisories on how fish consumption should be limited.	Can be effective. Some members of the public may ignore advisories.	Easily implementable; already in place.	Low	Retained.
Containment	Cap Sediment In-Situ	Place one or more layers of clean material over the sediment in-situ to isolate sediments and reduce the amount of contaminant flux to the environment.	Can be effective if cap remains in place.	Easily implementable. Long-term monitoring and maintenance necessary.	Low to Moderate	Retained.

TABLE 4-1
Remedial Technology Screening

General Response Action	Remedial Technology/ Process Option	Description	Screening Criteria: Effectiveness	Screening Criteria: Implementability	Screening Criteria: Relative Cost	Screening Comments
	Clean Layer Placement	A layer of clean material is placed to reduce surface concentrations resulting from settlement of fine sediments suspended during dredging.	Will be effective in lowering surface concentrations in areas where strong propeller wash makes traditional capping infeasible.	Easily implementable. Long-term monitoring and maintenance is not necessary.	Low to Moderate	Retained.
	Active Cap	Placement of zero-valent iron, coke, or other material to treat dissolved-phase contaminants in groundwater upwelling through contaminated sediments.	Technologies are only now being applied in field situations. Effectiveness uncertain. Groundwater is not a contaminant transport pathway at this site.	Feasibility of implementation uncertain.	Moderate to High	Not retained due to uncertainty in effectiveness and implementability.
In-Situ Treatment	Fixation/ Stabilization	Immobilize contaminants by physically binding or enclosing the sediments within a stabilized mass or chemically treating these to become immobile. In-situ treatment requires temporary dewatering prior to treatment of sediments.	Can be effective in preventing downstream erosion or bioaccumulation. Solidified sediments would be poor substrate for aquatic organisms.	In-situ treatment of sediment is difficult to implement because of need to temporarily dewater sediments while treatment is performed.	High	Not retained due to difficulty in implementation and poor post-treatment characteristics for aquatic organism growth.
Sediment Removal	Dry Excavation	Install sheet piling to create cells, dewater the cells, and excavated sediment using conventional earthmoving equipment.	Effective in removing PCB-contaminated sediments.	Availability of workspace nearby (coke plant site) makes implementation possible, but shutdown of portions of the harbor for one or two full summers is undesirable.	High	Not retained. Closing of portions of the harbor for entire seasons is not desirable.
	Mechanical Dredging	Use a clamshell or bucket excavator to remove contaminated sediments.	Effective in removing PCB-contaminated sediments.	Availability of workspace nearby (coke plant site makes implementation possible.	High	Retained. Control measures must be implemented to reduce chance of suspended sediment migrating from harbor during remediation.

TABLE 4-1
Remedial Technology Screening

General Response Action	Remedial Technology/ Process Option	Description	Screening Criteria: Effectiveness	Screening Criteria: Implementability	Screening Criteria: Relative Cost	Screening Comments
	Hydraulic Dredging	Use a cutterhead or suction dredge to remove contaminated sediments.	Effective in removing PCB-contaminated sediments.	Implementation is possible.	High	Retained. Control measures must be implemented to reduce amount of contaminated sediment resuspension and settlement after removal is completed.
Ex-Situ Treatment	Biological	Excavated soils are placed on impermeable pad and aerated either by tilling or through a network of air lines.	Poor effectiveness because PCBs are only slowly biodegradable.	Excavation of sediment required to implement.	High	Not retained because of poor effectiveness and treatment to reduce PCB concentrations is likely not cost effective after excavation is already done.
	Fixation/ Stabilization (to immobilize contaminants)	Immobilize contaminants by physically binding or enclosing the sediments within a stabilized mass or chemically treating these to become immobile.	Can be effective in immobilizing contaminants.	Excavation of sediment is required to implement.	High	Not retained because treatment to reduce concentrations or immobilize PCBs is likely not cost effective after excavation is already done.
	Chemical Extraction	One or more solvents are used to extract PCBs from the contaminated sediments	Usually effective for high concentrations of PCBs. Only lower concentrations (<33 ppm) are present in Waukegan Harbor.	Excavation of sediment is required to implement.	High	Not retained because of limited effectiveness and treatment to reduce PCB concentrations is likely not cost effective after excavation is already done.
	Soil Washing	Contaminants sorbed onto fine particles separated from bulk soil in aqueous-based system. Wash may be augmented by leaching agents, surfactants, pH adjustments, or chelating agents to remove organics or heavy metals.	Can be effective for high concentrations of PCBs if sufficient washing steps are included. Only lower concentrations (<33 ppm) are present in Waukegan Harbor.	Multiple unit processes make this technology relatively complex and difficult to implement. Excavation of sediment is required to implement.	High	Not retained because soil washing is excessively costly for relatively low PCB concentrations, and treatment to reduce PCB concentrations is likely not cost effective after excavation is already done.

TABLE 4-1
Remedial Technology Screening

General Response Action	Remedial Technology/ Process Option	Description	Screening Criteria: Effectiveness	Screening Criteria: Implementability	Screening Criteria: Relative Cost	Screening Comments
	Low-Temperature Thermal Desorption	Desorb contaminants by heating the sediment with low temperatures (90 to 320°C).	Poor effectiveness because PCBs are not volatile. Very high temperatures would be required to drive off PCBs, likely beyond the range of low-temperature units.	Excavation of sediment is required to implement.	High	Not retained because of limited effectiveness and treatment to reduce PCB concentrations is likely not cost effective after excavation is already done.
	Incineration	Combust soils at high temperatures in a rotary kiln or fluidized bed incinerator.	Potentially effective.	Excavation of is sediment required to implement.	High	Not retained because treatment to reduce PCB concentrations is likely not cost effective after excavation is already done.
Sediment Dewatering	Passive Dewatering	Sediment dewatering is achieved utilizing natural settling, evaporation, consolidation, and drainage.	Effective as an initial dewatering step.	Easily implementable.	Low	Retained. Can be used in conjunction with other technologies.
	Mechanical Dewatering	Sediment dewatering is achieved using a hydrocyclone, filtration, gravity thickening, or active evaporation	Effective for dewatering sediments.	Easily implementable.	Moderate	Retained. Can be used in conjunction with other technologies.
Sediment Processing and Stabilization	Particle Size Segregation	Vibrating or fixed screens, hydrocyclones, or gravity separation is used to segregate particle sizes in the sediment.	Effective	Easily implementable.	Low	Retained.
	Reagent Addition	Lime, cement kiln dust, cement, or some other reagent is thoroughly mixed with excavated sediment for the purpose of providing physical stability.	Effective for dewatering sediments.	Easily implementable.	Moderate	Retained. Can be used in conjunction with other technologies.
Water Treatment	Filtration	Solids, and PCBs adhered to solids, are removed from aqueous stream by passing through various media (e.g.., sand, bag filters).	Potentially effective.	Easily implementable.	Low to moderate	Retained.
	Activated Carbon Adsorption	PCBs are removed from aqueous phase by passing it through granular activated carbon.	Potentially effective	Easily implementable.	Low to moderate	Retained.

TABLE 4-1
Remedial Technology Screening

General Response Action	Remedial Technology/ Process Option	Description	Screening Criteria: Effectiveness	Screening Criteria: Implementability	Screening Criteria: Relative Cost	Screening Comments
Sediment Transport	Trucking	Sediment is loaded into trucks and transported to the disposal facility.	Effective.	Implementable. May encounter some public resistance because of noise and increase in traffic.	Moderate.	Retained.
	Pipeline	Sediment slurry is pumped via pipeline to treatment facility.	Effective.	Implementable. Temporary access must be obtained along route.	Moderate	Retained. Utilizing this technology, sediment dewatering facilities can be set up at the disposal facility.
Disposal	Confined Disposal Facility (in-water)	Excavated sediments (either contaminated or uncontaminated) are placed within specially engineered confinement cells within the harbor.	Effective.	Potentially implementable. Possible space available along the western side of the North Harbor.	Low to Moderate.	Retained.
	Waukegan Coke Plant (WCP)	Excavated sediments (either contaminated or uncontaminated) are placed at the WCP site for final disposal. Contaminated sediments would be covered with uncontaminated sediment or soil as a final site cover.	Effective.	Potentially implementable.	Low	Retained.
	Cap Other Segment	Clean sand is transported and used as a cap over other segments within the harbor.	Effective.	Easily implementable, especially if hydraulic dredging is used.	Low	Retained.

TABLE 4-1
Remedial Technology Screening

General Response Action	Remedial Technology/ Process Option	Description	Screening Criteria			Screening Comments
			Effectiveness	Implementability	Relative Cost	
	Unconfined Lake Disposal	Disposal of excavated uncontaminated sand in the lake outside the outer harbor or within the harbor as capping material.	Effective.	Easily implementable. Only sandy materials exhibiting no detection of PCBs can be disposed in the lake or in the harbor.	Low	Retained.
	Yeoman Creek Landfill (YCL)	Excavated sediments (either contaminated or uncontaminated) are placed within YCL before placement of the final cover at the site.	Effective.	Potentially implementable.	Low	Retained. Additional material from the harbor would be used to provide sufficient slopes for the YCL cap to reduce infiltration.
	Johns-Manville Site (JMS)	Excavated sediments (noncontaminated only) are placed at the JMS for final disposal.	Effective.	Potentially implementable. Only materials exhibiting no detection of PCBs can be placed at the JMS.	Low	Retained.
	Subtitle D Solid Waste Landfill	Solid non-hazardous wastes (contaminated sediments) are permanently disposed of in a Subtitle D Solid Waste landfill.	Expected to be effective because of poor mobility of PCBs in a landfill environment.	Easily implementable.	Moderate	Retained.
	RCRA Hazardous Waste Landfill	Solid wastes are permanently disposed of in RCRA Subtitle C hazardous waste permitted landfill.	Expected to be effective because of poor mobility of PCBs in a landfill environment.	Easily implementable.	High	Not retained because sediments are below the 50 mg/kg limit that requires disposal in a TSCA or RCRA Subtitle C Landfill. Because PCBs do not migrate appreciably in a landfill, disposal of low concentration PCBs in a Subtitle D Solid Waste Landfill is equally protective.

Note: Highlighted technologies are excluded from further evaluation in the assembly of remedial alternatives.

Process options were evaluated using a qualitative comparison based on effectiveness, implementability, and cost. Effectiveness is the ability of the process option to perform as part of a comprehensive remedial plan to meet RAOs under the conditions and limitations present at the site. The NCP defines effectiveness as the "degree to which an alternative reduces toxicity, mobility, or volume through treatment, minimizes residual risk, affords long-term protection, complies with ARARs, minimizes short-term impacts, and how quickly it achieves protection." This is a relative measure for comparison of process options that perform the same or similar functions. Implementability refers to the relative degree of difficulty anticipated in implementing a particular process option under regulatory, technical, and schedule constraints posed by circumstances at Waukegan Harbor. At this point, the cost criterion is comparative only. Similar to effectiveness, it is used to preclude further evaluation of process options that are costly, if other lower-cost choices perform similar functions with equivalent effectiveness. The cost criterion includes costs of construction and any long-term costs to operate and maintain technologies that are part of an alternative.

The NCP preference is for solutions that use treatment technologies to permanently reduce the toxicity, mobility, or volume of hazardous substances. Available treatment processes are typically divided into three technology types—biological, physical/chemical, and thermal—that are applied in one or more general response actions. Existing treatment processes, however, were found to be either not effective for PCBs at the relatively low concentrations present in the harbor or not implementable at the scale required for the site.

The response actions and the associated remedial technologies that remained following screening were:

- No action
- Natural attenuation using monitored natural recovery
- Monitoring through sampling and analysis
- Institutional controls using deed and access restrictions and fish consumption advisories
- Containment using an in situ sediment cap or clean layer placement
- Sediment removal using mechanical or hydraulic dredging
- Sediment dewatering using passive or mechanical dewatering
- Sediment processing and stabilization using particle size segregation or reagent addition
- Water treatment using filtration or activated carbon adsorption
- Sediment transport using trucking or slurry pipeline
- Sediment disposal at a confined disposal facility, WCP site, ULD, Yeoman Creek Landfill (YCL), Johns Manville Site (JMS), or a RCRA Subtitle D solid waste landfill

4.1 No Action

Under a no action alternative, no remedial response is performed. This alternative is typically used as a baseline to which other remedial options are compared. A no action alternative may be appropriate where current site conditions present little or no human health or environmental risk.

The no action alternative is retained for the purpose of comparison with other remedial options.

4.2 Natural Attenuation

Two specific technologies are considered under this general response action: monitored natural recovery (MNR) and enhanced natural recovery (ENR)—thin layer placement.

4.2.1 Monitored Natural Recovery

MNR involves the reliance upon naturally occurring physical, chemical, and biological processes to reduce the bioavailability and/or toxicity of contaminants to acceptable levels. For instance, exposure levels are reduced by a decrease in contaminant concentration levels in the near-surface sediment zone through burial or mixing-in-place with cleaner sediment. Contaminated sediments located in depositional areas can gradually be buried by cleaner sediments. This alternative can be implemented only after all continuing sources of contaminants to the system have been eliminated.

Typically, MNR is required to occur within a set amount of time. A remedial alternative that involves MNR will require a comprehensive long-term monitoring program to verify that such processes are taking place and that anticipated human health and environmental risk reductions are being achieved. MNR is appropriate at sediment sites where sources are controlled; short-term human health and environmental risks are low, are declining, and institutional controls effectively restrict human exposure; where natural recovery processes have a high degree of certainty to continue; where the sediment bed is stable and likely to remain stable; where sediment excavation could cause significant resuspension and recontamination downstream; and where space limitations preclude ex situ remedial options and are not considered cost effective relative to the risk reduction achieved.

Removal of contaminated sediments from the North Harbor segment of Waukegan Harbor was performed between 1990 and 1994. All sediments with PCB contamination exceeding 50 ppm were excavated and placed into the Slip 3 containment cell. Sediment containing more than 500 ppm of PCBs was also thermally treated prior to disposal in the Slip 3 containment cell. Subsequent sediment sampling indicates residual PCB concentrations exist ranging from no detection to 32 ppm. With the bulk of the PCB contamination removed from Waukegan Harbor, MNR can be considered as a remedial alternative and is, therefore, retained for further consideration.

4.2.2 Enhanced Natural Recovery—Thin Layer Placement

ENR consists of placement of a small amount of clean material (i.e., several inches of sand or sediment) above contaminated sediment. This thin layer of material is sized and placed such that it will not erode from the action of currents, waves, ice, or storm events.

The idea behind ENR is that the natural process of bioturbation will mix the clean, imported material with the contaminated sediment throughout the biologically active zone, thus reducing the contaminant concentrations and helping benthic communities to re-establish themselves. Long-term monitoring is necessary to verify the success of this alternative.

Similar to most other remedial alternatives, ENR is best implemented following removal of any continuing source of contamination to the sediment bed. This has already been done at Waukegan Harbor. ENR has been implemented at a very limited number of sites, however, and data on its effectiveness are also limited; therefore, this technology will not be evaluated further.

4.3 Monitoring

4.3.1 Sampling and Analysis

Monitoring can be implemented in combination with any remedial technology as an early warning for the need of additional remedial action or to monitor the effectiveness of a chosen remedial action. Monitoring could include sampling and analysis of sediment, soil, groundwater, surface water, groundwater/surface water interface, fish tissue, toxicity tests, and/or bioaccumulation tests. A sampling plan is developed in accordance with the final remedial alternative to ensure that remedial objectives are met.

Regardless of the technologies or combination of technologies selected for implementation at Waukegan Harbor, monitoring will likely be required; therefore, it is retained.

4.4 Institutional Controls

Institutional controls are administrative and/or legal restrictions placed on uses of a property or waterway. Institutional controls can also take the form of issuance of public health advisories. These include deed restrictions, access restrictions, and fish consumption advisories.

Deed and access restrictions can be put in place on a contaminated property and serve to limit its future use. For example, a property upon which a confined disposal facility (CDF) is constructed to dispose of excavated contaminated sediment may have a restriction that no subsurface construction is done on it. Similarly, public waterways can be regulated through the establishment of recreational use limitations, such as swimming bans and "no wake" zones to minimize the potential for sediment disturbance. Fences can be built around the perimeter of contaminated properties to prevent entry by unauthorized persons. Since CDFs could potentially be used to dispose of contaminated Waukegan Harbor sediments, deed and access restrictions are retained for potential incorporation into alternatives.

Fish consumption advisories are intended to give guidelines to members of the public who may eat fish with elevated contamination levels. The Illinois Department of Public Health removed signs warning anglers not to consume fish caught in the North Harbor segment of Waukegan Harbor in February 1997, and subsequent sampling has shown that PCB concentrations in fish from the harbor are approximately equal to PCB concentrations in fish from other harbors in Lake Michigan and in the open lake. The warning had been in effect since 1993. The State of Illinois, however, maintains a Lake Michigan Fish Consumption Advisory that warns people not to eat carp from anywhere in Lake Michigan. Restricted consumption of other species of fish from Lake Michigan is also recommended under the lake-wide advisory. Since these advisories are currently in use, this option will be kept for incorporation into alternatives.

4.5 Containment

4.5.1 Cap Sediment In Situ

Capping of sediments involves subaqueous placement of a layer of clean material over the contaminated sediment in situ for the purposes of physically isolating the contaminated sediments, impeding contaminant flux to the environment, and/or stabilization of contaminated sediments to prevent transport and redeposition elsewhere. Capping has been successfully implemented at numerous sites.

Development of a complete in situ capping remedial alternative involves the following steps:

- Definition of project objectives and performance standards
- Characterization of the physical, chemical, and biological properties of the sediments, both laterally and vertically
- Characterization of hydrodynamic conditions of the harbor, which includes bathymetry, currents, depths, waterway uses, and geotechnical conditions such as layer stratification and physical properties of foundation layers
- Determination of the feasibility of capping, which may apply to some portions of the site and not other areas
- Design of the cap, considering types and thickness of materials
- Determination of appropriate equipment and methods for placement of the cap materials
- Determination of methods to verify that the final cap design meets the standards and objectives
- Development of a suitable long-term monitoring and management program, allowing for maintenance and repair

Feasibility of capping is dependent upon characteristics of contaminants, physical and hydrological site conditions, and current and anticipated future uses of the waterway. Contaminant transport through the cap is dictated by contaminant type (i.e., organic or inorganic), diffusivity, and adsorption potential on the cap material. Little upward transport of PCBs would be expected because they are highly adsorbable and there is little upward advective groundwater flux because of the low permeability glacial till underlying the harbor. Capping is more appropriate for contaminated sediments located in areas with low surface water velocities and less groundwater seepage. Consideration should be given to existing and future uses of the waterway, such as recreation, navigation, or use as a water source, that may preclude the implementation of an in situ cap. At the Waukegan Harbor site, the harbor is used by cargo ships with large propellers and bow thrusters that would quickly erode typical sand caps in the navigational segments of the harbor. Caps in the Inner Harbor Extension, Inner Harbor, Entrance Channel, and Outer Harbor would have to be armored to prevent erosion. Typical sand caps could be used in the North Harbor and Marina because only small recreational boats use these harbor segments.

Components of caps can include sand, clean sediment, geotextiles, gravel, specially manufactured material (such as Aquablok©), or a combination of these. If the cap is placed in a higher-energy environment, with exposure to currents, waves, ice, or propeller wash, an armoring layer of geotextile in combination with gravel or riprap is typically placed as a final layer of the cap.

Placement methods for capping materials seek to minimize disturbance to the sediments and reduce sediment resuspension and cap/sediment mixing. Common techniques include using a bottom dump scow or a split hull barge to deliver cap materials. Other options include using a fire hose to wash cap materials off a barge into the water, or using a hydraulic dredge to deliver materials from a stockpile onshore. Delivery method selection also incorporates the relative importance of cap thickness consistency and the water depth at the capping site, which could limit delivery options if water depth is shallow.

Capping may be an appropriate technology for one or more segments in Waukegan Harbor, and, therefore, will be evaluated further.

4.5.2 Clean Layer Placement

Placement of a layer of clean material over contaminated material can be done to reduce the overall concentration to which biota are exposed. Clean layer placement is differentiated from the more traditional cap described above in that an allowance is made for mixing of the contaminated material with the clean material; in a cap, armoring is done to prevent this from occurring, if necessary. Clean layer placement can therefore be done in areas exposed to extreme erosional forces where installation of a cap with a rigorous armoring layer is either impractical or prohibitively expensive.

Thickness of the clean layer is determined by estimating the contaminant mass within the soft sediment and then calculating the desired contaminant concentration after addition of the clean material. Complete mixing is assumed. Clean layer placement is especially effective where most of the contaminant mass has already been removed.

All segments within the navigational channel at Waukegan Harbor are exposed to very strong erosional forces as a result of propeller wash from large cargo ships. Armoring a traditional cap within these segments would be a very difficult undertaking, and significant costly maintenance would be required in the long term. However, clean layer placement could be used within the navigational channel to reduce the post-dredging residual sediment contamination. Clean layer placement is therefore retained for further evaluation.

4.5.3 Active Cap

This remedial alternative involves placement of a layer of reactive material on top of contaminated sediment. The reactive material is intended to reduce contaminant concentrations in groundwater where an upward groundwater gradient exists through the sediment column. Several different types of reactive materials have been considered for active caps, including zero-valent iron, coke and apatite, and organo-modified clay. These are mostly still in the experimental stage and have yet to be implemented on a full scale.

Since active caps have not yet been successfully demonstrated and because groundwater is not a significant transport pathway for PCBs at this site, this technology will not be retained for further evaluation.

4.6 In Situ Treatment

In situ treatment methods are implemented without excavation of contaminated sediments. The only in situ treatment technology applicable to contaminated sediments is fixation/stabilization. Dewatering of sediments before treatment would be necessary.

4.6.1 Fixation/Stabilization

This technology involves the immobilization of contaminants by physically binding or enclosing the sediments within a stabilized mass, or chemically treating the contaminants. Portland cement, lime, or some other additive is mixed with the sediments in situ to encapsulate the sediments and/or reduce the solubility, mobility, and toxicity of the contaminants. Potential problems with this technology include the facts that contaminant release due to erosion may still be possible, and post-treatment physical characteristics of the sediment are not very amenable to growth of aquatic organisms. The application of this technology would require dewatering of sediments; otherwise, substantial resuspension of sediments would occur. Dewatering of the sediments would require construction of sheet pile walls within the harbor to partition areas to be dewatered. The walls would add considerable cost to the alternative while also impeding commercial and recreational shipping.

Because of the potential difficulties stated above, in situ fixation/stabilization will not be retained for further evaluation at Waukegan Harbor.

4.7 Sediment Removal

Removal of contaminated sediment offers the advantage of contaminant mass reduction in the aquatic environment and can reduce the bioaccumulation of PCBs in fish. Sediment removal can be performed through several different methods. Removal of sediments "in the dry" can be performed by damming water to create a cell, dewatering the cell, and excavating using conventional earthmoving equipment. Sediment removal can also be achieved without dewatering using a hydraulic or mechanical dredge.

A USACE navigational dredging proposal consists of removing sediment and underlying materials (i.e., glacial till) from within the Inner Harbor down to 23 feet below LWD, and from within the Outer Harbor down to 25 feet below LWD for navigational purposes. One of the three sediment removal techniques described herein would be used to accomplish this. Analytical sampling has shown contaminated sediments, noncontaminated sediments, and noncontaminated glacial till would be removed under this scenario.

Property owners along the North Harbor have indicated a desire to have that segment dredged down to a depth of 16 feet below LWD for recreational boating purposes.

4.7.1 Dry Excavation

Excavation of sediments in the dry requires the installation of a water barrier around the perimeter of the area to be remediated, pumping out or otherwise diverting water from the "cell," and excavating sediments using a backhoe or other suitable piece of equipment. Dry excavation has been successfully performed at many sites with contaminated sediments.

The most likely water barrier for the harbor would be steel sheet piling. Once the barrier is constructed, the harbor water would be pumped out. As the water level diminishes to the sediment elevation, water treatment will likely be needed before discharge back into the lake.

Depending upon the nature of the sediment and its final deposition location after excavation, addition of lime, cement, or other stabilization reagent may be required during excavation. If the sediments are fine-grained, they may not readily drain following dewatering, and may require stabilization before they are transported out of the cell. After dewatering and, if necessary, stabilization, sediments are transported to their final disposal location, usually by truck.

Perimeter air monitoring for total suspended particulates (especially if a stabilizing reagent prone to producing dust is used) and PCBs will likely be needed. Turbidity monitoring in the water body may also be required during any potential sediment-disturbing activity, which might include sheet pile and turbidity barrier installation and dewatering activities. If visual checks or stratigraphy change is not sufficient or appropriate to determine the extent of excavation activities, confirmation sampling is done to verify cleanup goals have been achieved.

The main advantage of sediment removal by dry excavation is the greater likelihood that all contaminated sediment will be removed. If unanticipated or unusual conditions are present within or beneath contaminated sediments (i.e., presence of free-phase product), the dry excavation method greatly increases the likelihood of discovering these circumstances, as well as affording greater flexibility for dealing with them, as compared to excavation conducted without lowering the normal water level. Sediment resuspension is not an issue as it is for other wet excavation methods such as mechanical or hydraulic dredging. Contaminated sediment spreading downstream or elsewhere within the water body does not happen with dry excavation once dewatering begins, as an inward hydraulic gradient is maintained.

Dry excavation can present some difficulties during implementation. The location of the contaminated sediments may dictate whether or not dry excavation can be used. A fairly substantial land area will be required near the dewatered cell or cells to perform a dry excavation sediment remedial action. Space must be available for loading/offloading and temporary storage of stabilized sediment, as well as space for support trailers, decontamination facilities, and, if necessary, water treatment facilities. If trucks are used to transport the sediment to an offsite disposal area, additional noise will be present and potential damage to roads along the haul route can occur.

An additional disadvantage of dry excavation, common to all sediment removal options, is the fact that the aquatic environment is greatly disturbed during removal. In some cases, if all sediment is removed, placement of imported materials may be necessary to expedite the re-establishment of native aquatic species.

In the case of Waukegan Harbor, the presence of the WCP site adjacent to the harbor offers ample space to set up operations for dry excavation. Dry excavation will, however, require that portions of the harbor be enclosed in sheet piling for an entire season, and it will likely take two entire seasons to completely remove all sediment (and glacial till in the navigational channel). Since the harbor is active during the summer months, this is not an acceptable scenario. Therefore, dry excavation will not be kept for further evaluation for removal of Waukegan Harbor sediments.

4.7.2 Mechanical Dredging

Mechanical dredging (and also hydraulic dredging) differs from dry excavation in that sediments are not dewatered before removing them from the water body. Mechanical dredging is typically done using a number of possible different pieces of equipment. These include a clamshell bucket, dragline dredge, dipper dredge, backhoe dredge, or bucket ladder dredge. Most of these can either be land-based or placed on a barge.

Of the mechanical dredging equipment listed above, the clamshell bucket dredge is probably the most commonly used. The clamshell bucket is suspended from a derrick on a barge or platform. Another commonly used piece of equipment is the backhoe dredge, which is simply a land-based excavator used to remove sediments. Other types of equipment are less desirable for excavation of contaminated sediments because of limited availability and/or the greater potential for sediment resuspension. Some mechanical dredges have global positioning system (GPS) equipment that track the locations that have been excavated.

Mechanical dredging is performed either from the shore adjacent to the area of contaminated sediments, or from a barge that is moved around the area as needed. Excavated materials are either stockpiled on shore or placed in a barge and transported to another area for offloading when the barge is full. Unless the sediments are granular and drain readily, dewatering and/or stabilization will be required before final disposal.

Mechanical dredging can effectively remove the contamination from the aquatic environment, eliminating the potential for future bioaccumulation. Mechanical dredging is also advantageous because much less water is generated than during implementation of other removal technologies, meaning reduced costs for water treatment. Fugitive odor and dust emissions are not likely during the actual excavation activities, since the sediment is wet; these may occur as the sediment is processed for disposal.

At least a minimal amount of sediment resuspension occurs with mechanical dredging. Turbidity control barriers must be installed around the perimeter of the contaminated sediment to prevent migration of suspended sediment to other areas within the water body. Also, a final "cleanup" pass may be needed after suspended sediment is allowed to settle. However, it is expected that some resettlement of contaminated sediment will occur following completion of sediment removal. It is possible that the resettled sediment would be of similar concentration as the removed sediment. However, as new sediment naturally settles over time, the average concentration of the sediment would diminish.

Another disadvantage of mechanical dredging is the difficulty in knowing exactly when dredging is complete. Although x, y coordinates may be known from GPS equipment, depth of excavation is less known. Bathymetric surveys may be needed to determine if final depths have been reached. Some over-dredging of sediments may be necessary to ensure removal

of all contaminated sediment, which will add some cost. Also, similar to dry excavation, a sizeable amount of land near the area of contaminated sediment is necessary for sediment processing, handling, and support facilities. Mechanical dredging also has the disadvantage of significant disruption to the aquatic environment because of the sediment removal.

As was mentioned above for dry excavation, ample space exists adjacent to the harbor at the WCP site for sediment processing, handling, and support facilities for the dredging operation. An advantage of mechanical dredging over dry excavation is that the turbidity screens or curtains used as barriers for suspended sediment are movable. Sediment can thus be removed from discreet areas, and after that portion has been completed, the turbidity barriers can be moved to the next location, and the first area opened up to boat traffic. Mechanical dredging is, therefore, retained for further evaluation.

4.7.3 Hydraulic Dredging

Hydraulic dredging has been used at many sites to remove contaminated sediment. A cutter head or suction dredge is used to pump sediments (in a 5- to 20-percent solids by weight slurry) through a pipeline. The hydraulic dredge is moved over the area of contaminated sediment, making adjacent overlapping passes. If deeper sediment removal is desired, additional passes are made. After the final target removal depth has been achieved, one final cleanup pass is made to remove resuspended, contaminated sediment that has settled.

One advantage to hydraulic dredging is that since the sediments are pumped in a slurry form through a pipeline from the dredge, the processing area does not necessarily have to be located adjacent to the contaminated sediment area. The slurry can be piped directly to the disposal area, using booster pumps, if necessary, or to another location where sediment and water processing can occur. Significant lateral area for processing is required for hydraulic dredging, since significantly more processing steps for both water and sediment are necessary with hydraulic dredging than either mechanical dredging or dry excavation. If sufficient space is available near the sediment disposal area, no offsite trucking of sediments will be required, and impacts to the community will be lessened accordingly. Treated water can be returned to the water body using a return pipeline.

Other advantages to hydraulic dredging include the potential for complete contaminant removal from the aquatic environment. Fugitive dust and odor problems are unlikely during the sediment removal itself, similar to mechanical dredging.

Disadvantages of hydraulic dredging include the need to maintain turbidity control measures and turbidity monitoring to address the issue of contaminated sediment resuspension, the need to make multiple passes for complete sediment removal, and the need to treat the significant volume of water generated. Underwater obstructions such as tree stumps or other large debris or highly consolidated clays are problematic for hydraulic dredging and may need to be removed using other dredging techniques.

Overall, the hydraulic dredging process, including sediment and water processing, has many more steps than either dry excavation or mechanical dredging and, therefore, has many more potential problems with implementation than the other sediment removal technologies. On the other hand, a well-designed process can be very successful at contaminated sediment removal. This is especially true for larger projects such as Waukegan Harbor where potential problems can be ironed out during an initial shakedown

period, followed by many months of continuous sediment removal. Hydraulic dredging uses the same temporary, moveable turbidity barriers as mechanical dredging and, therefore, only closes much smaller areas of the harbor for brief periods of time. The discharge line running from the dredge will require the routing of a second pipeline around the entire harbor when the side opposite the processing area is hydraulically dredged to maintain flow of boat traffic past the remediation area.

Hydraulic dredging is retained for further evaluation.

4.8 Ex Situ Treatment

As the name insinuates, ex situ treatment methods are implemented following excavation of contaminated soils or sediments. This general response action can involve biological, chemical, thermal, or physical processes. Several different technologies were considered but all of these ex situ treatment technologies have been eliminated from further evaluation. The relatively low levels of PCBs in the Waukegan Harbor sediments (0 to 35 ppm) do not justify the additional cost of treatment before disposal.

4.9 Sediment Dewatering

Dewatering of sediments will be necessary to some extent for any remedial action that involves sediment removal. The selected removal technology (mechanical or hydraulic dredging) will play a large role in determining the dewatering technology or technologies to be implemented.

4.9.1 Passive Dewatering

Passive dewatering involves some or all of the following: natural settling, evaporation, consolidation, and drainage. If hydraulic dredging is used to remove sediments, large volumes of low-solids-content slurry will be generated, with the slurry flow rate varying greatly during the workday. One or more large settling ponds will, therefore, likely be used as a first step both to provide a means of equalizing the slurry flow rate for subsequent sediment dewatering and water treatment, and to achieve some degree of solids concentration increase through passive dewatering.

4.9.2 Mechanical Dewatering

Equipment and methods for mechanical dewatering include hydrocyclones, belt filter presses, plate and frame filter presses, vacuum filtration, gravity thickening, and active evaporation. Mechanical dewatering may be required to increase the solids content of the excavated sediment before final disposal.

Both passive dewatering and mechanical dewatering are retained for further evaluation.

4.10 Sediment Processing and Stabilization

Although ex situ treatment solely to achieve PCB concentration reduction has been ruled out as not economically justifiable, some physical stabilization of the excavated sediment beyond

dewatering may be useful or necessary if sediment removal and disposal is selected as a remedial alternative. Technologies considered are particle size segregation and reagent addition.

4.10.1 Particle Size Segregation

Inclusion of a particle size separation step in a remedial alternative involving sediment removal may be desirable if it is determined that PCB contamination is associated with a certain particle size in the sediment. For example, if PCB contamination is entirely within the finer grained materials in the sediment, and a significant quantity of clean sand can be sorted out, then the sand could possibly be disposed of more cheaply than the contaminated fraction or be used as a beneficial fill. This process does have the disadvantage of concentrating the contamination in a smaller portion of the sediment. This should not be problematic for Waukegan Harbor sediments, however, since existing PCB concentrations are relatively low (0 to 35 ppm).

Possible methods of particle size segregation include using vibrating or fixed-based screens, including a hydrocyclone in the processing train, or using gravity separation if particles with significant density difference are present within the sediment. Particle size segregation is relatively simple to implement and, therefore, will be evaluated further.

4.10.2 Reagent Addition

The addition of a reagent to the sediment may be necessary as a step prior to final disposal. Mixing lime, cement, cement kiln dust, or some other reagent with the sediment serves to dewater and solidify it, which may be needed to meet criteria for disposal. For example, solid waste landfills require waste to be sufficiently dewatered to meet the paint filter test, and this can be achieved through the addition of lime. The amount of reagent added to the sediment can be varied as field conditions dictate.

Reagent addition is retained for further evaluation.

4.11 Water Treatment

Water would be generated during sediment removal, dewatering, and handling for any remedial alternative requiring sediment removal. This water would most likely require treatment before discharge back into the harbor, as it would contain solids and low levels of PCB contamination. Two potential technologies for the treatment of this water are filtration and activated carbon adsorption. Other commonly used water treatment technologies, such as air stripping and chemical precipitation, are probably not necessary to treat the water generated during a sediment removal remedial action in Waukegan Harbor.

4.11.1 Filtration

Filtration removes solids and any contaminants adhered to solids in water. Typically, filtration is accomplished by passing the water stream through a filter media housed in a chamber. A variety of media types can be used, including sand, clay, ceramics, other specially manufactured material, or bag filters. Filtration is considered for further evaluation.

4.11.2 Activated Carbon Adsorption

Contaminants can be removed from water generated during the sediment removal and/or stabilization process by passing it through activated carbon in one or a series of fixed beds. The activated carbon would need to be replaced occasionally, and the total amount of carbon required is a function of the volume of water and concentration of contamination in the water.

Removal of contaminants in water generated during remedial activities will be required before returning it to Waukegan Harbor, and activated carbon adsorption is probably the simplest and most cost-effective way to do this. It is, therefore, retained for further evaluation.

4.12 Sediment Transport

If a remedial action involving sediment removal is undertaken, sediments will need to be transported to the final disposal location (assuming it is not an in-harbor confined disposal facility located adjacent to the area being dredged), either by trucking or by pipeline.

4.12.1 Trucking

Trucking of sediments could be done at two different steps under a removal scenario. First, sediments could be excavated or dredged from the harbor, stabilized at a property adjacent to the harbor, and then trucked to a remote disposal facility. Second, sediments could be excavated, immediately placed into trucks, and then transported to a specially prepared handling facility, most likely located adjacent to the disposal facility. This second scenario is probably not as likely as the first, since some amount of stabilization may be required to get the sediments dewatered to the point that they could be transported.

Trucking of sediments is easily implemented, but some inconvenience to the public will occur. Trucks transporting contaminated sediments will be covered and the tires and exterior will be decontaminated after loading to reduce the chance of contamination spreading along the haul route(s), but that possibility does exist. Certainly, the noise level and traffic volume will increase along the haul route(s). Some additional wear to the roadways will also occur, especially if they were not originally designed to handle a large volume of heavy trucks. After the project is completed, road repairs may need to be done.

Trucking of sediments is retained for further consideration.

4.12.2 Pipeline

Sediment transport by pipeline would only be used if hydraulic dredging is selected as a remedial alternative. The sediment slurry from the hydraulic dredge is already transported from the point of removal to the slurry handling area via pipeline, so a pipeline could be constructed all the way to a slurry handling area located near the final disposal site. One or more booster pumps would be required along the pipeline route. Also, a return pipeline may be needed to bring process water back to the harbor following treatment.

One of the difficulties in implementing this option is selection of a route, and obtaining access easements along that route. If YCL is selected as a disposal facility for excavated Waukegan Harbor sediments, as has been suggested (see below), a likely pipeline route would be along the railway corridor to the west and north of the harbor, and then west

along the ComEdison electric corridor to the landfill. The number of access agreements required for the pipeline route could, therefore, be kept to a minimum. This option is kept for further evaluation.

4.13 Disposal

Contaminated sediments must be disposed of somewhere once they are removed. A number of options are presented below. One or more than one of these could be used. Also, consideration must be given to the disposal of noncontaminated materials, if excavation or dredging for navigational purposes is used.

4.13.1 Confined Disposal Facility (in-water)

A CDF is a specially engineered area where contaminated materials are placed. Vertical barriers, such as sheet piling or slurry walls, are used around the perimeter of the CDF. The bottom of the CDF must be a relatively impermeable material if the contaminants placed within it are mobile to any extent. An in-water CDF can only be constructed where a natural clay deposit exists to form the bottom, and sheet piling or a combination of sheet piling and slurry is typically used to form the vertical barriers. Obviously, ample space must be available for creation of a CDF.

CDFs have already been used at Waukegan Harbor to dispose of contaminated sediments. During the 1992 dredging of the north harbor, a CDF was constructed within the former Slip 3. Since this disposal option has already been implemented for Waukegan Harbor sediments that contained high concentrations of PCBs, it can be done again, if sufficient space can be found. Potentially, a portion of the north harbor could be used by dividing it lengthwise and leaving enough channel width for the passage of watercraft to the existing marina at the north end. The CDF could be built up to existing ground surface elevation. An estimated 170,000 cubic yards of materials could be placed within a CDF constructed in this manner.

This process option for disposal of contaminated sediment is retained for further consideration.

4.13.2 Waukegan Coke Plant

Disposal of materials removed from Waukegan Harbor at the WCP site (refer to Section 1) could be done. Since the WCP is part of the Waukegan Harbor Superfund Site and the current ROD for the WCP site includes covering of contaminated soils, materials contaminated with PCBs and noncontaminated materials could be disposed of at the site. About 20 acres of the WCP site could be available for disposal of excavated materials, corresponding to about 30,000 cubic yards of capacity for every 1 foot in height of sediment placed on the property. Assuming sediment could be placed up to 5 feet high on the WCP site without negatively affecting sight lines and the overall aesthetics of the harbor area, about 150,000 cubic yards of sediment could be disposed of. In order to be consistent with the WCP ROD and be protective of public health and the environment, the upper 6 to 8 inches of material would have to be uncontaminated sediments. These sediments used as the final cover would likely either be uncontaminated till or sand removed from the harbor for navigational purposes.

Some stabilization of soft sediments would likely be necessary if these materials are placed on the WCP site. Stabilization might consist of dewatering, reagent addition, and/or mixing

silty sediments with more granular sediments to improve geotechnical (i.e., shear strength and compaction) characteristics. This disposal option does have the advantage of being very low in cost because of its proximity to Waukegan Harbor and, thus, it is a relatively inexpensive option. This process option for disposal of contaminated and uncontaminated sediment and till is retained for further consideration.

4.13.3 Cap Other Segment

Clean sand from one segment of the harbor can be used to cover contaminated material in other segments of the harbor. This can either be for a cap or for clean layer placement. Clean sand required to be removed to achieve dredge depths can be disposed of in this manner. This process option for disposal of uncontaminated granular sediment is retained for further consideration.

4.13.4 Unconfined Lake Disposal

Disposal of clean, granular dredged materials has been done previously in an area about 2,000 feet south of Waukegan Harbor. An unlimited amount of material meeting these criteria can be disposed of in this manner. Noncontaminated silty materials or glacial till cannot be disposed of with this option, nor can any material with detected concentrations of PCBs.

Results of borings advanced within the outer harbor and entrance channel indicate a significant percentage of the materials requiring removal for navigational purposes in these segments is sand and, thus, are eligible for ULD. This option for disposal of uncontaminated granular sediment is, therefore, retained for further consideration.

4.13.5 Yeoman Creek Landfill

The YCL Superfund Site is located in Waukegan, about 2.1 miles northwest of Waukegan Harbor. The 70-acre YCL site consists of three separate landfills: the Yeoman Creek, Edwards Field, and Rubloff Landfills. These landfills operated between 1958 and 1978, and accepted a variety of wastes. Currently, a remedial action is being performed at the YCL site, which consists of clearing and grubbing, and installation of an engineered landfill cover and gas collection system. The remedial action is currently partially complete.

Weston Solutions, Inc., of Vernon Hills, Illinois (Weston) completed a *Conceptual Design Summary Report* for the USEPA in June 2003 (Weston 2003). As part of this report, Weston analyzed the placement of materials dredged from Waukegan Harbor within the YCL site. The evaluation of holding capacity determined that in excess of 500,000 cubic yards could be placed at the YCL site, with even more capacity available by modifying the design slightly. This should be sufficient to dispose of all the excavated materials from Waukegan Harbor, if necessary. For a more detailed evaluation of the disposal of materials at the YCL site, refer to Weston's report. This disposal option for contaminated and uncontaminated sediment and till is retained for further evaluation.

It should be noted that the use of YCL as a disposal site is still under discussion and evaluation, and it is not yet clear that YCL will ultimately prove to be a viable disposal option for the sediments. The identification of YCL as a disposal site serves as a proxy for similar disposal sites within the Waukegan area for the purposes of evaluation and comparison for this report.

4.13.6 Johns-Manville Site

The JMS is a 150-acre area located about 1.2 miles north of Waukegan Harbor. Sludge containing asbestos fibers and some heavy metals was historically disposed of on the property. The main property was remediated primarily by placing clean soil or paving over contaminated areas to reduce the risk of exposure to airborne asbestos fibers. Additional contaminated areas off the property were discovered, and most of them remain to be remediated.

According to the USEPA WAM, overseeing cleanup at the JMS, future remedial activities could require importation of between 200,000 and 300,000 cubic yards of clean imported fill. An important caveat to this need is that the remedial activities will most likely be completed within a few years, so the clean fill will be needed soon. A potential remedial action for Waukegan Harbor that involves sediment removal may not be initiated by that time. This disposal option for uncontaminated sediment and till is retained for further evaluation.

4.13.7 Subtitle D Solid Waste Landfill

Contaminated materials from Waukegan Harbor could be trucked to a nearby Subtitle D landfill for disposal. Recent sampling (after the 1992 remediation of Slip 3 and the North Harbor) has shown PCB concentrations in the harbor sediments are between 0 and 33 ppm, which would not classify the sediments as hazardous waste. Disposal at a Subtitle D solid waste facility can be done; therefore, this disposal option for contaminated sediment is retained for further evaluation.

4.13.8 RCRA Hazardous Waste Landfill

Since sediments do not classify as hazardous waste and are below the 50 ppm level for disposal at a TSCA or RCRA hazardous waste landfill based on recent sampling, transportation and disposal of Waukegan Harbor sediments to a RCRA hazardous waste (Subtitle C) landfill is not economically justifiable. Disposal at a Subtitle D landfill would be less costly and just as effective. This disposal option is not retained for further evaluation.

SECTION 5

Development and Screening of Alternatives

5.1 Introduction

The remaining technologies and process options following screening were assembled in various alternatives, each developed to satisfy the RAOs. The specific details of the remedial components discussed for each alternative are intended to serve as representative examples to allow comparative cost estimates. Options within the same remedial technology that achieve the same objectives may be re-evaluated during the subsequent FS or remedial design activities for the site. Following alternative assembly, each alternative was screened using effectiveness, implementability, and cost as the criteria. Relative rankings of each alternative are presented and recommendations for alternatives to be evaluated further in a subsequent FS are presented.

5.1.1 Alternative Development

Table 5-1 lists the remedial technologies that remained following screening and their incorporation into the alternatives. The alternatives were assembled in order of increasing active remediation and cost, ranging from Alternative 1, no action, to Alternative 9, which includes complete sediment removal and disposal at a Subtitle D landfill. The wide range of alternatives is intended to allow stakeholders to evaluate the advantages and disadvantages of the major response action strategies such as MNR, capping, and removal as well as the major disposal options such as CDFs, YCL, and Subtitle D landfills. One alternative, Alternative 2, was developed to allow comparison of an alternative that remediated sediment purely for environmental reasons against alternatives that remediate sediment for both environmental and navigational objectives. In addition, Alternative 5, developed by the CAG, varies the navigational dredging depths from the original USACE proposal.

Hydraulic dredging is considered to be more efficient to implement than mechanical dredging for those alternatives that involve sediment removal. The majority of these alternatives involve capping and clean layer placement, both of which involve the removal, transport, and placement of clean sand from one harbor segment to another. This process is less costly using hydraulic dredging than mechanical dredging since direct, continuous pumping of materials can be done without the step by step process of dredging, transporting, and dumping required using mechanical dredging. Underwater obstructions are expected to be minimal within the harbor, with the exception of the Marina, where divers with specialized equipment will be needed to remove sediment around the piles of the dock. Therefore, although both hydraulic and mechanical dredging have been retained as viable process options, hydraulic dredging is being retained as the representative process option for sediment removal. This is applicable for all alternatives that involve some form of sediment removal (Alternatives 2 through 9). Refer to Appendix D for a more detailed description of the hydraulic dredging and materials handling processes.

TABLE 5-1
Assembly of Remedial Alternatives

Remedial Technologies or Process Options	Alternative 1 No Action	Alternative 2 Environmental Sediment Removal and YCL Disposal	Alternative 3 Monitored Natural Recovery, Navigational Channel Sediment Removal, and YCL Disposal	Alternative 4 Capping, Navigational Channel Sediment Removal, and YCL Disposal	Alternative 5 Capping, Limited Navigational Channel Sediment Removal, and YCL Disposal	Alternative 6 Sediment Removal and Near-Site Disposal	Alternative 7 Sediment Removal and JMS/YCL Disposal	Alternative 8 Sediment Removal and YCL Disposal	Alternative 9 Sediment Removal and YCL/Subtitle D Disposal
No action	X								
Monitored natural recovery			X						
Sampling and analysis		X	X	X	X	X	X	X	X
Fish consumption advisories	X		X						
Navigational Channel sediment removal (navigation depths)			X	X		X	X	X	X
Limited depth Navigational Channel sediment removal					X				
Overdredge in Navigational Channel				X	X	X	X	X	X
Environmental sediment removal only (soft sediment) in Navigational Channel		X							
Sediment removal in Marina and North Harbor		X				X	X	X	X
Material dredged from Outer Harbor			X	X	X	X	X	X	X
Clean layer placement in Navigational Channel and Capping in North Harbor		X		X	X	X	X	X	X
Cap in Marina				X	X	X			
Clean layer placement in Marina		X					X	X	X

TABLE 5-1
Assembly of Remedial Alternatives

Remedial Technologies or Process Options	Alternative 1 No Action	Alternative 2 Environmental Sediment Removal and YCL Disposal	Alternative 3 Monitored Natural Recovery, Navigational Channel Sediment Removal, and YCL Disposal	Alternative 4 Capping, Navigational Channel Sediment Removal, and YCL Disposal	Alternative 5 Capping, Limited Navigational Channel Sediment Removal, and YCL Disposal	Alternative 6 Sediment Removal and Near-Site Disposal	Alternative 7 Sediment Removal and JMS/YCL Disposal	Alternative 8 Sediment Removal and YCL Disposal	Alternative 9 Sediment Removal and YCL/Subtitle D Disposal
Mechanical and/or hydraulic dredging		X	X	X	X	X	X	X	X
Passive and mechanical dewatering		X	X	X	X	X	X	X	X
Water treatment (filtration, GAC)		X	X	X	X	X	X	X	X
Trucking or piping (sediment transport)		X	X	X	X	X	X	X	X
Confined Disposal Facility *Maximum capacity = 170,000 CY*						X			
CON Soft sediment						170,000			
Disposal at WCP *Maximum capacity = 150,000 CY*			X	X	X	X			
CON soft sediment			0	0	0	86,000			
NC sand or glacial till			104,000	127,000	28,000	64,000			
Beneficial reuse of sediment – capping or clean layer placement in other segments		X 87,000		X 91,000	X 121,000	X 77,000	X 87,000	X 87,000	X 87,000
Unconfined lake disposal *Unlimited maximum capacity*			X	X		X			
NC soft sediment (sand)			100,000	15,000		29,000			

TABLE 5-1
Assembly of Remedial Alternatives

Remedial Technologies or Process Options	Alternative 1 No Action	Alternative 2 Environmental Sediment Removal and YCL Disposal	Alternative 3 Monitored Natural Recovery, Navigational Channel Sediment Removal, and YCL Disposal	Alternative 4 Capping, Navigational Channel Sediment Removal, and YCL Disposal	Alternative 5 Capping, Limited Navigational Channel Sediment Removal, and YCL Disposal	Alternative 6 Sediment Removal and Near-Site Disposal	Alternative 7 Sediment Removal and JMS/YCL Disposal	Alternative 8 Sediment Removal and YCL Disposal	Alternative 9 Sediment Removal and YCL/Subtitle D Disposal
Disposal at Yeoman Creek Landfill[a]		X	X	X	X		X	X	X
Maximum capacity = 450,000 CY									
CON. soft sediment		181,000	127,000	170,000	56,000		256,000	256,000	0
NC soft sediment (sand)								19,000	19,000
NC glacial till								131,000	131,000
Disposal at Johns-Manville Site						X	X		
Maximum capacity = 200,000 CY									
NC soft sediment (sand)						0	19,000		
NC glacial till						67,000	131,000		
Disposal at Subtitle D Solid Waste Landfill									X
Unlimited maximum capacity									
CON soft sediment									256,000

Note: CON = contaminated sediment; NC = not contaminated; JMS = Johns Manville Site; YCL = Yeoman Creek Landfill

[a]The identification of Yeoman Creek Landfill (YCL) as the disposal location serves as a proxy for similar nearby disposal sites within Waukegan.

5.1.2 Evaluation Criteria

Each alternative was analyzed with regard to the three alternative screening criteria prescribed by USEPA guidance (USEPA 1988) of effectiveness, implementability, and cost. These criteria are defined as follows:

- Effectiveness is the ability of the process option to perform as part of a comprehensive remedial plan to meet RAOs under the conditions and limitations present at the site. It is also the degree to which an alternative reduces toxicity, mobility, or volume through treatment, minimizes residual risk, affords long-term protection, complies with ARARs, minimizes short-term impacts, and how quickly it achieves protection.

- Implementability refers to the relative degree of difficulty anticipated in implementing a particular process option under regulatory, technical, and schedule constraints. The Waukegan Harbor RAAD/DGAR SOW also includes consideration of general public acceptance of the alternative under the implementability criteria.

- Cost estimates are made for capital, annual operation and maintenance, future periodic costs, and present worth. Capital costs are both direct and indirect and include construction, nonconstruction, and overhead costs. Present worth is a method of evaluating expenditures, such as construction, operations, and maintenance that occur over different lengths of time. The present worth of a project represents the amount of money, if invested in the initial year of the remedy and disbursed as needed, would be sufficient to cover all costs associated with the remedial action. Costs developed for the screening level analysis are based on information available at the time of the evaluation and on many assumptions made regarding implementation of the various alternatives. In particular, substantial assumptions had to be made relative to contaminated sediment volumes because of the limited analytical data available. As a result, the cost estimates are not expected to have the plus 50 percent to minus 30 percent accuracy of detailed analysis cost estimates. Actual costs will vary from the costs estimates provided in this report depending on actual labor and material costs, actual site conditions, productivity, competitive market conditions, final alternative scope, schedule, and other variable factors. The estimates do not include escalation of financial costs. Cost documentation is provided in Appendix E.

5.2 Alternative 1: No Action

5.2.1 Description

The NCP requires that a no action alternative be included in the assembly of alternatives. Under Alternative 1, all sediments are left in place, no containment is done, and no further action is performed. Figure 5-1 presents the post remediation water depths (below the LWD) for this alternative. This alternative does not provide any specific response actions for environmental monitoring, controlling the migration of contaminants, or mitigating their concentrations. However, the existing Lake Michigan-wide fish consumption advisory will continue.

5.2.2 Effectiveness

The SWACs of PCBs in the individual harbor segments and the overall SWAC for Waukegan Harbor were shown in Table 3-3. All segments by themselves have a SWAC above the level deemed protective of human health of 0.25 mg/kg, based upon the fish consumption route of exposure. The SWAC for the entire harbor is 3.71 mg/kg, which significantly exceeds 0.25 mg/kg. Based on the shoal rates presented in Section 2, and assuming the prop wash from large cargo ships results in near complete mixing of sediments in the federal navigational channel segments, it is estimated it would take over 100 years before sufficient sediment would be deposited to result in meeting the SWAC of 0.25 mg/kg. Because of the smaller vessel size of boat and barge traffic in the Marina and the North Harbor segments., PCBs may be buried below cleaner sediments more rapidly in these segments. Although natural recovery processes such as dilution and degradation will certainly diminish the levels of contaminants over time, there is no provision for periodically assessing these processes. Therefore, this alternative is not protective of human health. Also, the navigational channel is not deepened under this alternative.

5.2.3 Implementability

This alternative is readily implementable, since only a continuation of the lake-wide fish consumption advisory is required. It is anticipated that this alternative would encounter some public resistance because it does nothing active to remediate the PCBs in sediment.

5.2.4 Cost

There is no cost associated with this alternative.

5.3 Alternative 2: Environmental Sediment Removal and YCL Disposal

5.3.1 Description

This alternative provides the stakeholders with an alternative that achieves environmental objectives while not addressing the need for navigational dredging. Although this is inconsistent with the overall RAOs, it allows the advantages and disadvantages of environmental sediment remediation alone to be compared against the combination of environmental sediment remediation and navigational dredging included in subsequent alternatives.

5.3.1.1 Sediment Removal

No dredging for navigational purposes is performed. Only dredging to reduce the overall harbor SWAC to a level below 0.25 mg/kg of PCBs is performed.

All contaminated sediments will be removed within all segments of the harbor, except the Outer Harbor. The Outer Harbor has low enough PCB contamination levels currently that sediment removal is not necessary to reduce the overall harbor SWAC below 0.25 mg/kg. Uncontaminated material will not be removed from the Inner Harbor, Inner Harbor Extension, Marina, or North Harbor. Uncontaminated sand will be removed from the Entrance Channel to provide material for placement in other harbor segments after they

have been dredged as a clean layer over dredging residuals. Additional clean sand will be needed from the Approach Channel after clean sand from the Entrance Channel is depleted.

The following volumes of materials will be removed from the harbor:

Contaminated sediments	181,000 cubic yards
Uncontaminated sediments for residuals clean layer (sand)	87,000 cubic yards

5.3.1.2 Sediment Disposal

All contaminated materials removed from the harbor under this alternative (181,000 cubic yards) will be handled and processed at a specially constructed facility on the WCP site located adjacent to the harbor. After processing, all contaminated sediments will be trucked for disposal to YCL, which is about 2.1 miles to the northwest of the harbor.

5.3.1.3 Capping

Capping and clean layer placement will be necessary after dredging since a small amount of fine sediment will be suspended during dredging activities that will settle out after operations have been completed. This fine material will likely have some contamination associated with it. Without adding clean material, achievement of an overall harbor SWAC of 0.25 mg/kg of PCBs is likely not possible in the short term.

The North Harbor dredging residuals will be capped after removal of all contaminated sediment. This will be done to isolate the thin layer of contaminated sediment that will be suspended during dredging and resettle shortly thereafter. This will enable the SWAC for the North Harbor to be lowered to the estimated value of one-half the detection limit for PCBs and help to lower the overall harbor-wide SWAC below 0.25 mg/kg. The cap placed in the North Harbor will consist of clean sand placed in several layers until it is 2 feet thick.

5.3.1.4 Clean Layer Placement

Clean layer placement will involve placement of clean sand in some segments where all of the contaminated sediment has been removed. This layer will serve to lower the total average concentration that will remain after sediment suspended during dredging operations resettles. A 1-inch thick layer of sediment is assumed to resettle, and the concentration of PCBs in the resettlement layer is assumed to be equal to the pre-dredge SWAC for the segment. Clean layer placement will be used in segments where sediments will be exposed to severe propeller wash from large cargo ships. Even though significant disturbance and mixing will result from this prop wash, the entire sediment column is estimated to have the same lowered SWAC after application of the clean material. Clean layer placement will also be done within the Marina, even though propeller wash is not expected to be problematic in that segment.

Table 5-2 shows the capping and clean layer placement plan to be implemented under Alternative 2. Post-implementation SWACs for the individual segments and the whole harbor are also shown.

TABLE 5-2
Capping and Residual Layer Placement Plan for Alternative 2

Harbor Segment	Lateral Area (sq. ft)	Pre-Dredge SWAC (ppm)	Post-Dredge Resettlement Thickness (in.)	Post-Dredge Resettlement Concentration (ppm)	Capping or Clean Layer Placement (CLP)?	Post-Dredge Clean Sand Addition (in.)	Volume Clean Sand Added (cy)	Post-Remedial Action SWAC (ppm)
North Harbor	380,000	5.75	1.0	5.75	Capping	24.0	27,900	0.02
Inner Harbor Extension	190,000	2.61	1.0	2.61	CLP	12.0	7,100	0.22
Inner Harbor	480,000	7.89	1.0	7.89	CLP	18.0	26,600	0.43
Marina	350,000	4.61	1.0	4.61	CLP	12.0	12,900	0.37
Entrance Channel	330,000	1.24	1.0	1.24	CLP	12.0	12,400	0.11
Outer Harbor	590,000	0.26	not dredged	0.26	None	0.0	0	0.26
Entire Harbor	**2,320,000**	**3.71**	-	-	-	-	**86,900**	**0.25**

5.3.1.5 Procedure

Dredging operations are assumed to progress from the north end of the harbor to the south. Contaminated sediment will be dredged (in order) from the North Harbor, Inner Harbor Extension, Inner Harbor, Marina, and Entrance Channel. After contaminated sediment removal has been completed in the Entrance Channel, dredging of uncontaminated sand in the Entrance Channel will be done. Note that it is assumed that the lower sands in the Entrance Channel will be uncontaminated. This assumption will be evaluated in additional field investigations prior to dredging. Initially, the sand will be placed in the North Harbor as a cap. Once 2 feet of clean sand have been placed, clean layer placement in the Inner Harbor Extension will be started. This will be followed by the clean layer placement in the Inner Harbor and Marina. Uncontaminated sand from the Entrance Channel will continue to be used until the glacial till underneath is reached. Once sand in the Entrance Channel is depleted, uncontaminated sand from the Approach Channel in the Outer Harbor will be used. Dredging of uncontaminated sand from the Approach Channel will cease after clean layer placement in the Entrance Channel has been finished.

5.3.1.6 Post-Remedial Conditions Versus Current Conditions

After Alternative 2 is implemented, conditions will be as described below:

- In the North Harbor, water depth will be about 1 foot shallower than pre-dredge conditions, except in the shallowest portions, where the water depth will be about the same.
- In the Inner Harbor and Inner Harbor Extension, water depth will be approximately the same as pre-dredge conditions. Propeller wash from large cargo ships will redistribute the sediment thickness to be similar to pre-dredge conditions.
- The northeastern portion of the Marina adjacent to the Inner Harbor will have a water depth several feet deeper than before. The remainder of the Marina will be approximately the same water depth as before.
- In the Entrance Channel, the water depth will generally be several feet deeper than before dredging activities. Propeller wash may eventually redistribute the sediment, resulting in filling-in of this area.
- In the Approach Channel, the clean sand used for clean layer placement over other harbor segments will likely be slowly replaced by sand migration as a result of longshore drift currents.

Figure 5-2 presents the post-remediation water depths (below the LWD) for this alternative.

The overall SWAC for the entire harbor should be below 0.25 mg/kg immediately following remedial activities. This is the level deemed protective of human health and the environment.

5.3.2 Effectiveness

Immediately after the completion of remedial activities, the SWAC for the entire harbor will be near 0.25 mg/kg. Future monitoring of the capped areas will be conducted to verify the SWAC remains at or below 0.25 mg/kg. Therefore, this alternative is protective of human health and the environment. Compliance with ARARs is not expected to be problematic for this alternative. The navigational channel is not deepened under this alternative, and

capping in the North Harbor and clean layer placement in the Marina may reduce the water depth in portions of these segments, with some areas becoming slightly shallower than 16 feet below LWD in the North Harbor and 10 feet below LWD in the Marina.

Long-term monitoring is performed to assess the effectiveness of the capping in the North Harbor. Some long-term maintenance may be required for the cap, which could involve placement of additional clean materials to supplement and/or replace the cap where erosion has occurred. Also, small sections of the cap may need to be armored with geotextile fabric and riprap if future monitoring indicates the need.

All materials disposed of at the YCL site will be integrated into the current closure plan for the YCL site and be placed either immediately above the gas collection layer or incorporated into the vegetative cover, as described in Weston's *Conceptual Design Summary Report* (Weston 2003). Any inclusion of material at the YCL site will be done only after a thorough design has been completed, which will include considerations for sediment dewatering and stabilization so that stability of the landfill cover and sideslopes is maintained. Post-construction monitoring at the YCL site will be required as part of the existing remedial activities. Also, PCB concentrations in the sediments from Waukegan Harbor are relatively low, and PCBs are generally not very mobile in the environment. Therefore, disposal at the YCL site is effective in the long term.

In the portions of the harbor that are dredged, significant disruption to the benthic community will occur. This is unavoidable, and re-establishment of aquatic organisms should occur naturally after the remedial activities have been completed. Placement of clean sand in most segments of the harbor should help this recovery.

The risk of short-term human health impacts will be minimized during remedial activities by using devices and processes designed to reduce the spread of contamination. Chances for spreading contaminated sediment beyond the remedial area will be reduced through the use of sediment removal technologies that are designed to minimize sediment resuspension, such as hydraulic dredging, or use of an environmental bucket if mechanical dredging is done. Also, turbidity screens and curtains will be used. Air monitoring will be performed during all activities with the potential to generate emissions, especially during sediment handling and processing if reagents with the potential to create dust are used. Unacceptable health risks to either workers or the community will not occur if appropriate health and safety guidelines and practices are employed during remedial activities.

5.3.3 Implementability

Dredging has been successfully performed using a variety of methods both at Waukegan Harbor and at other locations. A contaminated sediment removal was performed in the early 1990s within the North Harbor segment in Waukegan Harbor. This remedial action successfully met its goal of removing sediments with PCB concentrations above 50 mg/kg. Additional dredging activities can be implemented, though their effectiveness will be more difficult to achieve because of the low SWAC remedial goal of 0.25 mg/kg. However, the incorporation of capping and clean layer placement over the residuals settled out of the water column after dredging should be sufficient to meet the SWAC.

Sequencing of the dredging of the various segments will need to take into account the need to keep the harbor open to recreational boats and cargo ships. By limiting the dredge

operations to certain portions of the segments at any one time and dredging during times of minimal boating or shipping, this alternative is implementable.

Facilities for sediment dewatering, handling, and stabilizing, as well as water treatment facilities, need to be constructed near the harbor. The WCP site offers a sizeable area where such facilities could be established.

Placement of clean material in segments of the harbor to reduce surface concentrations from settlement of contaminated material suspended during dredging should be easily implemented. If hydraulic dredging is used, the clean sand can be pumped directly to the placement location as it is dredged, greatly reducing costs associated with dewatering and handling. This method can also be used for placement of clean sand for capping in the North Harbor.

Disposal of contaminated materials at the YCL site is implementable, assuming the City of Waukegan agrees to allow this disposal. Trucking of the sediments from the stabilization facility to YCL will cause a significant increase in heavy truck traffic along the haul route(s), and may be seen as a nuisance by the public. Repair of some city streets may be necessary after the project has been completed.

Overall the public is expected to be in general support of this alternative because it remediates the sediments to levels below those posing unacceptable risk. This alternative, however, would likely be opposed by those in support of deepening the harbor for navigational purposes.

5.3.4 Cost

A breakdown of costs for Alternative 2 is included in Appendix E. The total cost is estimated to be $18,000,000.

5.4 Alternative 3: Monitored Natural Recovery, Navigational Channel Sediment Removal, and YCL Disposal

5.4.1 Description

Under Alternative 3, sediments within the Marina and North Harbor segments are left in place. MNR is employed for these segments. Dredging for navigational purposes within the navigational channel is performed. No capping or clean layer placement is done following dredging; reduction of residual contamination in these segments is also achieved through MNR. Contaminated sediments are disposed of at YCL, uncontaminated till is disposed of at the WCP site, and uncontaminated granular sediments are disposed of in Lake Michigan.

5.4.1.1 Sediment and Glacial Till Removal

Dredging for navigational purposes within the federal channel is performed. Dredge depth is only that necessary for navigational purposes; no overdredging is done. Dredge depths in each harbor segment are as follows:

Outer Harbor	25 feet below LWD
Entrance Channel	23 feet below LWD
Inner Harbor	23 feet below LWD
Inner Harbor Extension	23 feet below LWD

Marina	no dredging
North Harbor	no dredging

Navigational dredging is the only dredging performed, generating the following materials:

Contaminated sediments	127,000 cubic yards
Uncontaminated sediments (sand)	100,000 cubic yards
Uncontaminated glacial till	104,000 cubic yards

5.4.1.2 Sediment and Glacial Till Disposal

All contaminated materials removed from the harbor under this alternative (127,000 cubic yards) will be handled and processed at a specially constructed facility on the WCP site located adjacent to the harbor. After processing, all contaminated sediments will be transported for disposal to YCL.

Uncontaminated sediments (sand) would all be disposed of by ULD. The USACE has used ULD for clean sands dredged from the Approach Channel to Waukegan Harbor. The area used for this operation is located about 2,000 feet south of the harbor. Only uncontaminated clean sands would be disposed of in this manner. The areas and depths of sediment that can be classified as environmentally clean sand will be determined during the predesign investigation, but for this report it is assumed that 100,000 cubic yards of material from the Outer Harbor and Entrance Channel meet these criteria.

The WCP site would be used to dispose of the uncontaminated glacial till. The WCP site is adjacent to the North Harbor on its east side. It is currently undergoing a remedial design, with remedial activities slated to begin soon that will involve excavation and treatment of soils contaminated with coal tar and oily residues. Clean soil is needed for the final cover over the site.

About 20 acres of open space are available on the WCP site where materials could potentially be disposed of. Materials could be placed on the site up to an estimated 5 feet high without significantly impacting the visual aesthetics of the area. The total capacity for disposal of materials at the WCP site is 150,000 cubic yards. Only 104,000 cubic yards of glacial till are estimated for disposal under this alternative, so the capacity of the WCP site would be sufficient.

5.4.1.3 Monitored Natural Recovery

The MNR portion of this alternative relies upon naturally occurring physical, chemical, and biological mechanisms to reduce the level of biologically available PCBs in the sediments within segments of Waukegan Harbor that are not dredged (Marina and North Harbor). For these segments, this alternative is similar to Alternative 1 (no action), except that regular, periodic monitoring is performed to provide ongoing assessment of the progress in reducing bioavailable PCB concentrations.

For the purposes of evaluating this alternative and providing a cost estimate, sampling frequencies and duration for each media were assumed. Fish monitoring, consisting of fish collection and tissue analyses, will be performed annually. Sediment probing (to determine if sedimentation is occurring and burying contaminated sediments), sampling, and analysis will be performed every 5 years. Total duration of the monitoring program is assumed to be 30 years, with an evaluation of the entire monitoring program every 5 years to assess if it should be modified or eliminated. The fish consumption advisories that are applicable for

all of Lake Michigan will be maintained for Waukegan Harbor, unless analytical data indicate that modification or elimination of this advisory is warranted.

Although these assumptions have been made for this report, the actual monitoring plan, if implemented, would be established during a remedial design phase.

A very thin residual layer (probably 1 inch or less in thickness) of contaminated sediment will resettle over the segments within the navigation channel after dredging has been completed. MNR could be effective in reducing the PCB concentrations for these segments. However, significant propeller wash from cargo vessels will likely continually suspend and mix this residual sediment layer up, which may inhibit MNR, but may also reduce the residual contaminant mass in the navigational channel segments as small amounts will flow out of the channel into the lake gradually over the course of years.

5.4.1.4 Post-Remedial Conditions Versus Current Conditions

The entire navigational channel will be dredged to a depth of 23 feet below LWD, with the exception of the Outer Harbor, which will be dredged to a depth of 25 feet below LWD. Water depths in the North Harbor and Marina will remain as they are currently, since no dredging will be performed in these segments.

For those segments where navigational dredging is performed, a thin layer of sediment suspended during the dredging activities will settle. This sediment layer, likely less than 1 inch in thickness, will probably have average PCB concentrations similar to the pre-dredge SWACs for each segment. For the Marina and North Harbor, MNR alone will be used, and these two segments will have no appreciable change in PCB concentrations initially. Therefore, fish consumption advisories will remain in place until monitoring indicates modification or elimination is justified. Figure 5-3 presents the post-remediation water depths (below the LWD) for this alternative.

5.4.2 Effectiveness

The overall protection of human health and the environment under this alternative does not occur immediately, but may occur after natural processes degrade and dilute the PCB contamination remaining in the North Harbor and Marina segments. Currently, the SWAC for Waukegan Harbor as a whole is 3.71 mg/kg of PCBs. Assuming a fraction of the sediment becomes suspended during dredging and settles afterwards, a thin layer of contaminated material will settle over all segments within the navigational channel. The PCB concentration of this residual layer is likely to be similar to the pre-dredge SWAC of 3.71 mg/kg.

Development of a model that would estimate the length of time required for MNR to reduce PCB concentrations in the harbor to 0.25 mg/kg of PCBs is beyond the scope of this document. However, experience and professional judgement indicate the chance of this occurring in the short term is small due to the very low degradation rate of PCBs. Physical processes (i.e., natural sedimentation over existing contaminated sediments) would likely dominate SWAC reduction compared to chemical and biological degradation processes, especially within the navigational channel, where erosion from propeller wash can be very significant. Based on the shoal rates presented in Section 2, and assuming that 1 inch of material settles after dredging is completed, the overall post-dredge SWAC for the harbor would decrease from 3.71 mg/kg to about half that value over the course of 50 to 100 years due to the introduction of clean sediment. This, combined with the slow PCB degradation

rate, indicates that time required for the harbor-wide SWAC to drop to 0.25 mg/kg of PCBs may be many decades. During this time, the lake-wide fish consumption advisory would be relied upon to reduce human health risks, but like all advisories, it is not enforceable.

Compliance with ARARs is not expected to be problematic for this alternative.

As discussed for Alternative 2, disposal at the YCL site is expected to be effective in the long term. All materials disposed of at the WCP site under this alternative are uncontaminated till. As a result, disposal at the WCP site should be effective in the long term.

Environmentally clean sand will be disposed of by ULD. This will be done about 2,000 feet south of the harbor. The USACE already disposes of clean sand from dredging operations in this manner. Therefore, this disposal option will be effective in the long term.

In the portions of the harbor that are dredged for navigational purposes, significant disruption to the benthic community and organisms will occur. However, this already occurs because the federal navigational channel is dredged periodically to maintain the required depths.

As discussed for Alternative 2, the risk of short-term human health impacts will be minimal during remedial activities by the use of devices and processes designed to reduce the spread of contamination. Also, as described for Alternative 2, there will be a potential for spreading contaminated sediment beyond the remedial area, though this will be reduced through the use of sediment removal technologies and control devices that are designed to minimize sediment resuspension and control spreading.

5.4.3 Implementability

This alternative is considered implementable. Implementability concerns that need to be addressed during design and construction are similar to those described for Alternative 2. The main concerns relate to the potential for disruption of harbor boat and cargo ship traffic, space adjacent to the site for dewatering of sediments, the city's agreement to accept contaminated sediment at YCL, trucking impacts from noise, and street damage. Disposal of uncontaminated till at the WCP site introduces another implementability issue because it will require coordination with the WCP site potentially responsible party to incorporate it into the design and construction schedule for the ongoing WCP site remediation efforts. This should not be insurmountable, however.

It is anticipated that this alternative would encounter some public resistance because it does not actively remediate the PCBs in sediment of the North Harbor and the Marina and leaves contaminated sediments in the Inner Harbor at concentrations above the remedial goal of 1 mg/kg and a SWAC of 0.25 mg/kg. Many people may consider the time frame of many decades to eventually meet the goals excessive.

5.4.4 Cost

A breakdown of costs for Alternative 3 is included in Appendix E. The total cost is estimated to be $21,000,000.

5.5 Alternative 4: Capping, Navigational Channel Sediment Removal, and YCL Disposal

5.5.1 Description

Under Alternative 4, sediments within the Marina and North Harbor segments are left in place and capped. Dredging for navigational purposes within the navigational channel is performed. Clean layer placement is done following dredging of the navigational channel; therefore, some overdredging below navigational depths is necessary to give room for addition of the clean material. Contaminated sediments are disposed of at YCL, most uncontaminated sediments are used in other segments for capping or clean layer placement, excess uncontaminated sediments are disposed of via ULD, and uncontaminated glacial till is disposed of at the WCP site.

5.5.1.1 Sediment and Glacial Till Removal

Overdredging is done in some segments of the navigational channel to allow space for clean layer placement. Navigational dredging plus overdredging will yield the following total depths in each segment:

Outer Harbor	25 feet below LWD	no overdredging
Entrance Channel	24 feet below LWD	12 inches of overdredging
Inner Harbor	24 feet below LWD	12 inches of overdredging
Inner Harbor Extension	24 feet below LWD	12 inches of overdredging
Marina	no dredging	
North Harbor	no dredging	

Dredging to depths listed above will generate the following materials:

Contaminated sediments	170,000 cubic yards
Uncontaminated sediments (sand)	106,000 cubic yards
Uncontaminated glacial till	127,000 cubic yards

5.5.1.2 Sediment and Glacial Till Disposal

All contaminated materials removed from the harbor under this alternative (170,000 cubic yards) will be handled and processed at a specially constructed facility on the WCP site adjacent to the harbor. After processing, all contaminated sediments will be transported for disposal to YCL.

Most of the uncontaminated sediments (sand) will be used for capping or clean layer placement on other portions of the harbor. About 91,000 cubic yards will be needed. Uncontaminated sand not used for capping or clean layer placement would be disposed of by ULD. About 15,000 cubic yards will be disposed of in this manner.

The WCP site would be used to dispose of the uncontaminated glacial till. The total capacity for disposal of materials at the WCP is 150,000 cubic yards. However, only 127,000 cubic yards are estimated for disposal under this alternative.

5.5.1.3 Capping and Clean Layer Placement

Similarly to Alternative 2, capping and clean layer placement will be necessary. Table 5-3 shows the capping and clean layer placement plan to be implemented under Alternative 4.

Both the North Harbor and Marina will be capped. The caps will consist of clean sand placed in several layers until it is 2 feet thick.

Clean layer placement will be used in most of the segments in the navigational channel, including the Inner Harbor Extension, Inner Harbor, and Entrance Channel. Post-implementation SWACs for the individual segments and the whole harbor are also shown on Table 5-3.

5.5.1.4 Post-Remedial Conditions Versus Current Conditions

After implementing this remedial alternative, depths in the entire navigational channel will be 23 feet below LWD, with the exception of the Outer Harbor, where the depth will be 25 feet below LWD. Water depths in the North Harbor and Marina will be about 2 feet shallower than they are currently due to the cap placed in these segments. Figure 5-4 presents the post-remediation water depths (below the LWD) for this alternative.

The overall SWAC for the entire harbor should be below 0.25 ppm immediately following the completion of remedial activities (Table 5-3).

5.5.2 Effectiveness

Immediately after the completion of remedial activities, the SWAC for the entire harbor will be less than 0.25 mg/kg. Future monitoring of the capped areas will ensure that the SWAC remains at or below 0.25 mg/kg. Therefore, this alternative is protective of human health and the environment. Compliance with ARARs is not expected to be problematic for this alternative.

The long-term effectiveness of capping of the North Harbor and Marina sediments may be compromised if the caps are eroded from prop wash or physical abrasion with ship bottoms, keels or anchors. A single occurrence of a large cargo ship prop wash too close to the Marina or North Harbor caps could severely erode the caps and cause redistribution of the contaminated sediment across the harbor.

Allowances can be made during construction to minimize impacts on recreational and commercial shipping. The navigational channel is also deepened under this alternative. These project-specific RAOs are met. However, capping in the North Harbor and Marina may make the water depth shallower over some portions of these segments than 16 feet below LWD and 10 feet below LWD, respectively. This RAO may not be met with the implementation of this alternative.

Some long-term maintenance may be required for the caps in the North Harbor and Marina, which could involve placement of additional clean materials to supplement and/or replace the cap where erosion has occurred. Also, small sections of the cap may need to be armored with geotextile fabric and riprap if future monitoring indicates the need.

As discussed for previous alternatives, disposal at the YCL site is expected to be effective in the long term. All materials disposed of at the WCP site under this alternative are uncontaminated till. As a result, disposal at the WCP site should be effective in the long term. Environmentally clean sand not used for clean layer placement or capping will be disposed of by ULD. This disposal option will be effective in the long term, as discussed under Alternative 3.

TABLE 5-3
Capping and Clean Layer Placement Plan for Alternative 4

Harbor Segment	Lateral Area (sq. ft)	Pre-Dredge SWAC (ppm)	Post-Dredge Resettlement Thickness (in.)	Post-Dredge Resettlement Concentration (ppm)	Capping or Clean Layer Placement (CLP)?	Post-Dredge Clean Sand Addition (in.)	Volume Clean Sand Added (cy)	Post-Remedial Action SWAC (ppm)
North Harbor	380,000	5.75	not dredged	n/a	Capping	24.0	27,900	0.02
Inner Harbor Extension	190,000	2.61	1.0	2.61	CLP	12.0	7,100	0.22
Inner Harbor	480,000	7.89	1.0	7.89	CLP	12.0	17,700	0.62
Marina	350,000	4.61	not dredged	n/a	Capping	24.0	25,700	0.02
Entrance Channel	330,000	1.24	1.0	1.24	CLP	12.0	12,400	0.11
Outer Harbor	590,000	0.26	1.0	0.26	None	0.0	0	0.26
Entire Harbor	**2,320,000**	**3.71**	-	-	-	-	**90,800**	**0.23**

As discussed under Alternative 3, portions of the harbor that are regularly dredged for navigational purposes will undergo periodic disruption to the benthic community and organisms. Also mentioned previously under other alternatives is the minimal risk of short-term human health impacts due to the use of devices and processes designed to reduce the spread of contamination. Chances for spreading contaminated sediment beyond the remedial area will be reduced through the use of sediment removal technologies that are designed to minimize sediment resuspension.

5.5.3 Implementability

This alternative is considered implementable. Implementability concerns for Alternative 4 are similar to those discussed for other dredging alternatives, including potential for disruption of harbor boat and cargo ship traffic, space adjacent to the site for dewatering of sediments, and noise and street damage impacts from truck traffic. Implementability of WCP site material disposal requires coordination with the WCP site potentially responsible party, as described under Alternative 3. Disposal of contaminated materials at YCL is implementable.

Similar to Alternative 2, placement of clean material in segments of the harbor to reduce surface concentrations from settlement of contaminated material suspended during dredging should be easily implemented. Disposal of contaminated materials at the YCL site and using ULD is implementable.

Overall, the public is expected to be in general support of this alternative because it remediates the sediments to levels below those posing unacceptable risk and it includes dredging of the navigational channel.

5.5.4 Cost

A breakdown of costs for Alternative 4 is included in Appendix E. The total cost is estimated to be $25,000,000.

5.6 Alternative 5: Capping, Limited Navigational Channel Sediment Removal, and YCL Disposal

5.6.1 Description

Alternative 5 involves dredging for navigational purposes within the federal channel to a shallower depth. Also, most of the navigational channel (the Outer Harbor, Entrance Channel, and Inner Harbor) will only be 100 feet wide, rather than the entire current width of the channel. A 1:5 side slope will be dredged along each side of the deeper channel up to existing sediment profile in these three segments. Buoys will be set to demarcate the edges of the deeper channel within the harbor. The Inner Harbor Extension will be dredged to its full current lateral dimensions to provide a turnaround for large cargo ships leaving Slip 1. Clean layer placement will be done in the Inner Harbor Extension, and capping will be done in the North Harbor, Marina, Inner Harbor, and Entrance Channel. Armoring will be added to the cap in the Inner Harbor and Entrance Channel. Contaminated materials will be disposed of at YCL, uncontaminated sand from the Approach Channel will be used for clean layer placement and capping, and uncontaminated glacial till will be disposed of at the WCP site.

5.6.1.1 Sediment and Glacial Till Removal

Overdredging is done in some segments of the navigational channel to allow space for a full 2-foot-thick clean sand cap, and an additional 1 foot for riprap reinforcement. In the Inner Harbor Extension, all sediment will be removed, and a 1-foot-thick layer of clean sand will be placed after dredging to reduce the surficial PCB concentrations to less than 1 ppm PCBs after the residual sediment suspended during dredging settles. Overdredging in each segment will yield the following total depths:

Outer Harbor	23 feet below LWD; 100 feet wide	no overdredging
Entrance Channel	23 feet below LWD; 100 feet wide	3 feet overdredging
Inner Harbor	23 feet below LWD; 100 feet wide	3 feet overdredging
Inner Harbor Extension	21 feet below LWD	1 feet overdredging
Marina	no dredging	
North Harbor	no dredging	

Clean sand will be needed for capping and clean layer placement. This will be most efficiently accomplished by dredging clean sand from the Approach Channel and pumping it directly to the respective segments for placement. Dredging to these depths and widths, including the extra overdredging for capping, will generate the following materials:

Contaminated sediments	56,000 cubic yards
Uncontaminated sediments (sand)	121,000 cubic yards
Uncontaminated glacial till	28,000 cubic yards

5.6.1.2 Sediment and Glacial Till Disposal

All contaminated materials removed from the harbor under this alternative (56,000 cubic yards) will be handled and processed at a specially constructed facility on the WCP site adjacent to the harbor. After processing, all contaminated sediments will be transported for disposal to YCL.

Uncontaminated sand used for capping or clean layer placement will be removed from the Approach Channel. Approximately 121,000 cubic yards will be needed for this purpose.

The WCP site would be used to dispose of the uncontaminated glacial till (28,000 cubic yards).

5.6.1.3 Capping and Clean Layer Placement

The capping and clean layer placement plan is shown in Table 5-4. The North Harbor and Marina are not dredged at all under Alternative 5, so a 2-foot-thick cap is installed in these segments. The Inner Harbor and Entrance Channel are dredged, but residual contaminated sediments resulting from suspension during dredging are left in place. Two-foot-thick caps are also installed in these segments over the entire segment, including the deeper channel, the 1:5 side slopes, and the undredged portions along the deeper channel. Additional armoring of the cap is necessary due to the extreme erosion potential from large cargo vessels. This armoring will consist of subaqueous placement of a geotextile fabric and large riprap.

All contaminated sediment will be removed from the Inner Harbor Extension. However, a clean layer of sand will be added to reduce the concentration of PCBs present after the residual sediment that is suspended during dredging settles out.

TABLE 5-4
Capping and Clean Layer Placement Plan for Alternative 5

Harbor Segment	Lateral Area (sq. ft)	Pre-Dredge SWAC (ppm)	Post-Dredge Concentration (ppm)	Capping or Clean Layer Placement (CLP)?	Post-Dredge Clean Sand Addition (in.)	Volume Clean Sand Added (cy)	Post-Remedial Action SWAC (ppm)
North Harbor	380,000	5.75	5.75 (not dredged)	Capping	24.0	27,900	0.02
Inner Harbor Extension	190,000	2.61	2.61	CLP	12.0	7,100	0.22
Inner Harbor	480,000	7.89	7.89	Capping	24.0	35,400	0.02
Marina	350,000	4.61	4.61 (not dredged)	Capping	24.0	25,700	0.02
Entrance Channel	330,000	1.24	1.24	Capping	24.0	24,800	0.02
Outer Harbor	590,000	0.26	0.26 (not dredged)	None	0.0	0	0.26
Entire Harbor	**2,320,000**	**3.71**	-	-	-	**120,900**	**0.09**

Some contaminated sediment will be dredged from the Outer Harbor, but concentrations remaining after removal of this sediment for navigational purposes are expected to be low. Therefore, no capping or clean layer placement will be necessary for this segment.

5.6.1.4 Post-Remedial Conditions Versus Current Conditions

After implementation of this remedial alternative, depths in a 100-foot-wide portion of the navigational channel will be 20 feet below LWD, with the exception of the Outer Harbor, where the depth will be 23 feet below LWD. Water depths outside of the deepest portion of the navigational channel in the Entrance Channel and Inner Harbor will be about 2 to 3 feet shallower than they currently are due to the placement of the cap and armoring. Water depths in the North Harbor and Marina will be about 2 feet shallower than they are currently due to the cap placed in these segments. Placement of caps in the North Harbor and Marina is not expected to decrease the water depth significantly more than 8 feet below LWD in the Marina and 13 feet below LWD in the North Harbor. Figure 5-5 presents the post-remediation water depths (below the LWD) for this alternative.

The overall SWAC for the entire harbor should be significantly below 0.25 ppm immediately following the completion of remedial activities.

5.6.2 Effectiveness

Immediately after the completion of remedial activities, the SWAC for the entire harbor will be less than 0.25 mg/kg. Future monitoring of the capped areas will ensure that the SWAC remains at or below 0.25 mg/kg. Therefore, this alternative is protective of human health and the environment. Compliance with ARARs is not expected to be problematic for this alternative.

This alternative is considered the "compromise alternative" and involves dredging to a reduced width and shallower depth for navigational purposes. Therefore, two RAOs that require the navigational channel to be deepened to 23 feet below LWD (25 feet below LWD in the Outer Harbor) and avoid making water depth in the North Harbor and Marina shallower than 16 feet below LWD and 10 feet below LWD, respectively, do not apply. The replacement RAOs for this alternative would be maintenance of water depth in the reduced width navigational channel at 20 feet below LWD (23 feet below LWD in the Outer Harbor) and maintenance of water depth in the North Harbor and Marina at 13 feet below LWD and 8 feet below LWD. Also, under this alternative, the PCBs in the sediment throughout the harbor are reduced to a SWAC of less than 0.25 mg/kg immediately following completion of remedial activities. These three RAOs can be met. Although some impacts to recreational and commercial shipping will likely occur during implementation, these will be minimized to the extent practicable.

Capping is generally considered effective, although there is a potential for erosion of the Marina and North Harbor caps as discussed under Alternative 4. Long-term monitoring and maintenance of capping is important as has been mentioned under other alternatives. The armoring placed within the Inner Harbor and Entrance Channel presents some problems that should be considered. One issue deals with future dredging. If the narrow navigational channel is to be maintained at a depth of 20 feet below LWD, it will most likely be necessary to come back and dredge the channel within the next 20 or 30 years. At that time, it will be difficult to dredge back down to 20 feet below LWD without damaging or dredging part of the riprap armoring and underlying geotextile fabric. Another problem is the potential for

damage from ships dragging anchors, which has happened at other sites where capping has been done in navigational channels. Finally, this armoring can still be vulnerable to propeller wash from cargo vessels, and significant effort will need to be spent during design and installation to ensure that it can withstand erosion from prop wash. At any rate, diligent monitoring of the cap in these segments will be necessary.

As discussed for previous alternatives, disposal at the YCL and WCP sites is expected to be effective in the long term. Also mentioned previously under other alternatives is the minimal risk of short-term human health impacts due to the use of devices and processes designed to reduce the spread of contamination. Chances for spreading contaminated sediment beyond the remedial area will be reduced through the use of sediment removal technologies that are designed to minimize sediment resuspension.

5.6.3 Implementability

This alternative is generally considered implementable. Implementability concerns for Alternative 5 are similar to those discussed for other dredging alternatives, including potential for disruption of harbor boat and cargo ship traffic, space adjacent to the site for dewatering of sediments, and noise and street damage impacts from truck traffic. Implementability of WCP site material disposal requires coordination with the WCP site potentially responsible party. Disposal of contaminated materials at the YCL site is implementable.

Construction of the armoring layer in the Entrance Channel and Inner Harbor will be very difficult to perform. It will involve subaqueous placement of geotextile and riprap, which will involve the use of divers, making it very expensive and time-consuming. This procedure will also impede the flow of boat traffic for a much longer period of time and over a larger portion of the harbor than the more simple clean layer placement done in the navigational channel in many of the other alternatives.

Overall, the public is expected to be in general support of this alternative because it remediates the sediments to levels below those posing unacceptable risk and it includes dredging of the navigational channel.

5.6.4 Cost

A breakdown of costs for Alternative 5 is included in Appendix E. The total cost is estimated to be $24,000,000.

5.7 Alternative 6: Sediment Removal and Near-Site Disposal

5.7.1 Description

Under Alternative 6, all sediments exceeding the remedial goals of 1 mg/kg and a SWAC of 0.25 mg/kg are removed and dredging for navigational purposes within the navigational channel is performed. Clean layer placement is done following dredging to address resettlement of suspended sediments; therefore, some overdredging below navigational depths is necessary to provide room for the clean material. All sediment is dredged from the North Harbor and Marina. After all sediment has been removed from these segments, the settlement residuals in both the North Harbor and the Marina are capped. Disposal of

removed material is done in a CDF, at the WCP site, as beneficial reuse on other segments (clean sand only), through ULD (clean sand only), and at the JMS facility (uncontaminated glacial till only).

5.7.1.1 Sediment and Glacial Till Removal

Overdredging is done in some segments of the navigational channel to allow space for clean layer placement. Overdredging in each segment will yield the following total depths:

Outer Harbor	25 feet below LWD	no overdredging
Entrance Channel	24 feet below LWD	12 inches of overdredging
Inner Harbor	24.5 feet below LWD	18 inches of overdredging
Inner Harbor Extension	24 feet below LWD	12 inches of overdredging
Marina	all sediments	no overdredging
North Harbor	all sediments	no overdredging

All of the dredging described above will generate the following materials:

Contaminated sediments	256,000 cubic yards
Uncontaminated sediments (sand)	106,000 cubic yards
Uncontaminated glacial till	131,000 cubic yards

5.7.1.2 Sediment and Glacial Till Disposal

All contaminated materials removed from the harbor under this alternative (256,000 cubic yards) will be handled and processed at a specially constructed facility on the WCP site adjacent to the harbor. After processing, most of the contaminated sediments will be disposed of in a harbor-side CDF.

The CDF consists of a specially engineered holding cell located within the existing North Harbor. It would be located along the western side of the North Harbor and constructed within a sheet pile wall similar to the existing Slip 3 CDF. Its maximum dimensions could be about 1,200 feet long by 120 feet wide and it could contain up to 32 feet of space for excavated materials, bringing the top of the CDF even with existing ground surface elevation. This gives a total maximum capacity of 170,000 cubic yards. A 75-foot-wide channel would be left for transportation of recreational vessels to and from Larson Marine. Since over 170,000 cubic yards of contaminated sediments are removed under this scenario, the CDF would be used to dispose of 170,000 cubic yards, and the remaining 86,000 cubic yards would be disposed of at the WCP site.

The entire perimeter of the CDF will consist of a double sheet pile wall driven 3 feet apart. The sheet piling will be driven several feet into the glacial till below the sediment and sand in the North Harbor, both to reduce water movement at the base of the sheet piling and to provide stability for the cantilever wall. A bentonite slurry mixture will be pumped into the narrow space between the sheet piling all around the CDF. After filling the CDF with contaminated materials, the top will be provided with an engineered cap consisting of an HDPE liner and appropriate soil layer for water infiltration reduction and frost action protection. A water removal system may also be needed to minimize PCB migration by maintaining an inward hydraulic gradient. The cost estimate assumes it is installed, although the design would evaluate this in greater detail. The predesign investigation will also determine if integration of water treatment with the existing CDF in Slip 3 is practical.

Access and/or deed restrictions will be used to prevent public exposure to contaminated materials within the CDF.

Most of the uncontaminated sediments (sand) will be used for capping or clean layer placement on other portions of the harbor. About 77,000 cubic yards will be needed. Uncontaminated sand not used for capping or clean layer placement would be disposed of by ULD. About 29,000 cubic yards will be disposed of in this manner.

The WCP site would be used to dispose of most of the uncontaminated glacial till. The total capacity for disposal of materials at the WCP site is 150,000 cubic yards. After disposal of 86,000 cubic yards of contaminated sediment, a total of 64,000 cubic yards of excess capacity exist for glacial till disposal. The remaining 67,000 cubic yards of glacial till will be disposed of at the JMS facility.

5.7.1.3 Capping and Clean Layer Placement

The capping and clean layer placement plan is shown in Table 5-5. The North Harbor and Marina will be capped with 2 feet of clean sand, and clean layer placement will be used in the Inner Harbor Extension, Inner Harbor, and Entrance Channel. The North Harbor will only have about one-half the area that it currently has due to the construction of the CDF.

5.7.1.4 Post-Remedial Conditions Versus Current Conditions

After implementation of this remedial alternative, depths in the entire navigational channel will be 23 feet below LWD, with the exception of the Outer Harbor, where the depth will be 25 feet below LWD. Water depth in the North Harbor will be about 1 foot shallower than pre-dredge conditions, except in the shallowest portions, where the water depth will be about the same. In the Marina, the northeastern portion adjacent to the Inner Harbor will be several feet deeper than before, and the southwestern portion will be slightly shallower than before. Figure 5-6 presents the post-remediation water depths (below the LWD) for this alternative.

The overall SWAC for the entire harbor should be near 0.25 ppm immediately following the completion of remedial activities. This is the level deemed protective of human health and the environment.

5.7.2 Effectiveness

Immediately after the completion of remedial activities, the SWAC for the entire harbor will be near 0.25 mg/kg. Future monitoring of the capped areas will ensure that the SWAC remains at or below 0.25 mg/kg. Therefore, this alternative is protective of human health and the environment. Compliance with ARARs is not expected to be problematic for this alternative.

Allowances can be made during construction to minimize impacts on recreational and commercial shipping. The navigational channel is also deepened under this alternative. These project-specific RAOs are met. However, capping in the North Harbor and Marina may make the water depth over some portions of these segments shallower than 16 feet below LWD and 10 feet below LWD, respectively. This RAO may not be met with the implementation of this alternative.

Some long-term maintenance may be required for the caps in the North Harbor and Marina, which could involve placement of additional clean materials to supplement and/or replace the cap where erosion has occurred. Also, small sections of the cap may need to be armored with geotextile fabric and riprap if future monitoring indicates the need.

TABLE 5-5
Capping and Clean Layer Placement Plan for Alternative 6

Harbor Segment	Lateral Area (sq. ft)	Pre-Dredge SWAC (ppm)	Post-Dredge Concentration (ppm)	Capping or Clean Layer Placement (CLP)?	Post-Dredge Clean Sand Addition (in.)	Volume Clean Sand Added (cy)	Post-Remedial Action SWAC (ppm)
North Harbor	190,000	5.75	5.75	Capping	24.0	14,000	0.02
Inner Harbor Extension	190,000	2.61	2.61	CLP	12.0	7,100	0.22
Inner Harbor	480,000	7.89	7.89	CLP	12.0	17,700	0.62
Marina	350,000	4.61	4.61	Capping	24.0	25,700	0.02
Entrance Channel	330,000	1.24	1.24	CLP	12.0	12,400	0.11
Outer Harbor	590,000	0.26	0.26	None	0.0	0	0.26
Entire Harbor	**2,130,000**	**3.71**	-	-	-	**76,900**	**0.25**

Some materials disposed of at the WCP site under this alternative are contaminated. All materials disposed of at the WCP site will be included in the final design for the WCP site. Considerations for stability, strength, and final cover over the material will be included during the design process. Onsite disposal of sediments containing PCBs previously dredged from the harbor is already part of the selected remedy for the WCP site. These sediments have similar levels of PCBs as those that will be dredged under this alternative. In addition, post-construction monitoring will be done at the WCP site. Therefore, disposal at the WCP site should be effective in the long term.

Disposal of contaminated sediment within CDFs was done during remedial activities in the early 1990s. These CDFs continue to protect the community and harbor environment from impacts from the contaminated materials placed within them. Therefore, use of a new, similarly constructed CDF should provide similar protection.

Uncontaminated material will be disposed of at the JMS facility. The JMS facility will need large amounts of clean fill over the next several years. Since the material will be either clean sand or glacial till, no long-term hazards will be associated with disposal at this facility.

As mentioned previously under other alternatives, the risk of short-term human health impacts is minimal due to the use of devices and processes designed to reduce the spread of contamination. Chances for spreading contaminated sediment beyond the remedial area will be reduced through the use of sediment removal technologies that are designed to minimize sediment resuspension.

5.7.3 Implementability

This alternative is considered implementable. Implementability concerns for Alternative 6 are similar to those discussed for other dredging alternatives, including potential for disruption of harbor boat and cargo ship traffic, space adjacent to the site for dewatering of sediments, and noise and street damage impacts from truck traffic. Implementability of WCP site material disposal requires coordination with the WCP site PRP group, as described previously.

Similar to other alternatives, placement of clean material in segments of the harbor to reduce surface concentrations from settlement of contaminated material suspended during dredging should be easily implemented.

Disposal of contaminated materials within a CDF has already been done in the harbor within former Slip 3 and can therefore be implemented again. Disposal of clean materials at the JMS facility would most likely be done by transporting the materials by truck from the WCP site processing area if hydraulic dredging is done, or by barge if mechanical dredging is done. In the latter case, some equipment may need to be set up at the JMS facility to offload the material from the barge and process it. Either way, this disposal option is also implementable.

Overall, the public is expected to be in general support of this alternative because it remediates the sediments to levels below those posing unacceptable risk and it includes dredging the navigational channel. Disposal of contaminated sediment in a new CDF in the harbor may be opposed because it removes a portion of the harbor from use and places contaminated sediment in close proximity to areas that may be eventually developed for residential land use.

5.7.4 Cost

A breakdown of costs for Alternative 6 is included in Appendix E. The total cost is estimated to be $31,000,000.

5.8 Alternative 7: Sediment Removal and JMS/YCL Disposal

5.8.1 Description

Alternative 7 is the same as Alternative 6 for sediment removal. Under Alternative 7, however, the sediments are disposed of at the YCL (contaminated sediment) and the JMS sites (uncontaminated sediment and till) rather than locations nearer the site.

5.8.1.1 Sediment and Glacial Till Disposal

All contaminated materials removed from the harbor under this alternative (256,000 cubic yards) will be handled and processed at a specially constructed facility on the WCP site adjacent to the harbor. After processing, all of the contaminated sediments will be disposed of at YCL.

Most of the uncontaminated sediments (sand) will be used for capping or clean layer placement on other portions of the harbor. About 87,000 cubic yards will be needed. Uncontaminated sand not used for capping or clean layer placement would be disposed of at the JMS facility. About 19,000 cubic yards will be disposed of in this manner.

The WCP site would be used to dispose of most of the uncontaminated glacial till. The total capacity for disposal of materials at the WCP site is 150,000 cubic yards. After disposal of 86,000 cubic yards of contaminated sediment, a total of 64,000 cubic yards of excess capacity exist for glacial till disposal. The remaining 67,000 cubic yards of glacial till will be disposed of at the JMS facility.

5.8.1.2 Capping and Clean Layer Placement

The capping and clean layer placement plan is identical to Alternative 2, which is shown in Table 5-2. The North Harbor will be capped with 2 feet of clean sand, and clean layer placement will be used in the Inner Harbor Extension, Inner Harbor, Marina, and Entrance Channel.

5.8.1.3 Post-Remedial Conditions Versus Current Conditions

After implementation of this remedial alternative, depths in the entire navigational channel will be 23 feet below LWD, with the exception of the Outer Harbor, where the depth will be 25 feet below LWD. Water depth in the North Harbor will be about 1 foot shallower than pre-dredge conditions, except in the shallowest portions, where the water depth will be about the same. In the Marina, the northeastern portion adjacent to the Inner Harbor will be several feet deeper than before. Figure 5-7 presents the post-remediation water depths (below the LWD) for this alternative.

The overall SWAC for the entire harbor should be near 0.25 ppm immediately following the completion of remedial activities.

5.8.2 Effectiveness

Immediately after the completion of remedial activities, the SWAC for the entire harbor will be near 0.25 mg/kg. Future monitoring of the capped areas will ensure that the SWAC remains at or below 0.25 mg/kg. Therefore, this alternative is protective of human health and the environment. Compliance with ARARs is not expected to be problematic for this alternative.

Allowances can be made during construction to minimize impacts on recreational and commercial shipping. The navigational channel is also deepened under this alternative. These project-specific RAOs are met. However, capping in the North Harbor and Marina may make the water depth over some portions of these segments shallower than 16 feet below LWD and 10 feet below LWD, respectively. This RAO may not be met with the implementation of this alternative.

Some long-term maintenance may be required for the cap in the North Harbor, which could involve placement of additional clean materials to supplement and/or replace the cap where erosion has occurred. Also, small sections of the cap may need to be armored with geotextile fabric and riprap if future monitoring indicates the need.

The effectiveness of disposal of excavated materials at YCL and the JMS facility was established under previous alternatives.

As mentioned previously under other alternatives, the risk of short-term human health impacts is minimal due to the use of devices and processes designed to reduce the spread of contamination. Chances for spreading contaminated sediment beyond the remedial area will be reduced through the use of sediment removal technologies that are designed to minimize sediment resuspension.

5.8.3 Implementability

This alternative is considered implementable. Implementability concerns for Alternative 7 are similar to those discussed for other dredging alternatives, including potential for disruption of harbor boat and cargo ship traffic, space adjacent to the site for dewatering of sediments, and noise and street damage impacts from truck traffic.

Similar to other alternatives, placement of clean material in segments of the harbor to reduce surface concentrations from settlement of contaminated material suspended during dredging should be easily implemented. Implementability of disposing excavated materials at YCL and the JMS facility has also been established previously.

Overall, the public is expected to be in general support of this alternative because it remediates the sediments to levels below those posing unacceptable risk and it includes dredging of the navigational channel. Disposal of uncontaminated till at the JMS site is expected to be supported by the public because it would be used to reduce risks at that site and reduce overall project costs for both sites.

5.8.4 Cost

A breakdown of costs for Alternative 7 is included in Appendix E. The total cost is estimated to be $33,000,000.

5.9 Alternative 8: Sediment Removal and YCL Disposal

5.9.1 Description

Alternative 8 is the same as Alternatives 6 and 7 for sediment removal. Under Alternative 8 however the sediments are disposed of at the YCL site.

5.9.1.1 Sediment and Glacial Till Disposal

All contaminated materials removed from the harbor under this alternative (256,000 cubic yards) will be handled and processed at a specially constructed facility on the WCP site adjacent to the harbor. After processing, all of the contaminated sediments will be disposed of at YCL.

Most of the uncontaminated sediments (sand) will be used for capping or clean layer placement on other portions of the harbor. About 87,000 cubic yards will be needed. Uncontaminated sand not used for capping or clean layer placement would be disposed of at YCL. About 19,000 cubic yards will be disposed of in this manner. YCL would also be used to dispose of the 131,000 cubic yards of uncontaminated glacial till.

5.9.1.2 Capping and Clean Layer Placement

The capping and clean layer placement plan is identical to Alternative 2, which is shown in Table 5-2. The North Harbor will be capped with 2 feet of clean sand, and clean layer placement will be used in the Inner Harbor Extension, Inner Harbor, Marina, and Entrance Channel.

5.9.1.3 Post-Remedial Conditions Versus Current Conditions

After implementation of this remedial alternative, depths in the entire navigational channel will be 23 feet below LWD, with the exception of the Outer Harbor, where the depth will be 25 feet below LWD. Water depth in the North Harbor will be about 1 foot shallower than pre-dredge conditions, except in the shallowest portions, where the water depth will be about the same. In the Marina, the northeastern portion adjacent to the Inner Harbor will be several feet deeper than before. Figure 5-7 presents the post-remediation water depths (below the LWD) for this alternative.

The overall SWAC for the entire harbor should be near 0.25 ppm immediately following the completion of remedial activities.

5.9.2 Effectiveness

Immediately after the completion of remedial activities, the SWAC for the entire harbor will be near 0.25 mg/kg. Future monitoring of the capped areas will ensure that the SWAC remains at or below 0.25 mg/kg. Therefore, this alternative is protective of human health and the environment. Compliance with ARARs is not expected to be problematic for this alternative.

Allowances can be made during construction to minimize impacts on recreational and commercial shipping. The navigational channel is also deepened under this alternative. These project-specific RAOs are met. However, capping in the North Harbor and Marina may make the water depth over some portions of these segments shallower than 16 feet

below LWD and 10 feet below LWD, respectively. This RAO may not be met with the implementation of this alternative.

Some long-term maintenance may be required for the cap in the North Harbor, which could involve placement of additional clean materials to supplement and/or replace the cap where erosion has occurred. Also, small sections of the cap may need to be armored with geotextile fabric and riprap if future monitoring indicates the need.

The effectiveness of disposal of excavated materials at YCL was established under previous alternatives.

As mentioned previously under other alternatives, the risk of short-term human health impacts is minimal due to the use of devices and processes designed to reduce the spread of contamination. Chances for spreading contaminated sediment beyond the remedial area will be reduced through the use of sediment removal technologies that are designed to minimize sediment resuspension.

5.9.3 Implementability

This alternative is considered implementable. Implementability concerns for Alternative 8 are similar to those discussed for other dredging alternatives, including potential for disruption of harbor boat and cargo ship traffic, space adjacent to the site for dewatering of sediments, and noise and street damage impacts from truck traffic.

Similar to other alternatives, placement of clean material in segments of the harbor to reduce surface concentrations from settlement of contaminated material suspended during dredging should be easily implemented. Implementability of disposing excavated materials at YCL has also been established previously.

Overall, the public is expected to be in general support of this alternative because it remediates the sediments to levels below those posing unacceptable risk and it includes dredging of the navigational channel.

5.9.4 Cost

A breakdown of costs for Alternative 8 is included in Appendix E. The total cost is estimated to be $34,000,000.

5.10 Alternative 9: Sediment Removal and YCL/Subtitle D Disposal

5.10.1 Description

Alternative 9 is the same as Alternatives 6, 7, and 8 for sediment removal. Under Alternative 9, however, the sediments are disposed of at the YCL site (uncontaminated sediment) and at a Subtitle D Landfill (contaminated sediment).

5.10.1.1 Sediment and Glacial Till Disposal

All contaminated materials removed from the harbor under this alternative (256,000 cubic yards) will be handled and processed at a specially constructed facility on the WCP site

adjacent to the harbor. After processing, all of the contaminated sediments will be disposed of at a nearby RCRA Subtitle D (i.e., solid waste) landfill.

Most of the uncontaminated sediments (sand) will be used for capping or clean layer placement on other portions of the harbor. About 87,000 cubic yards will be needed. Uncontaminated sand not used for capping or clean layer placement would be disposed of at YCL. About 19,000 cubic yards will be disposed of in this manner. YCL would also be used to dispose of the 131,000 cubic yards of uncontaminated glacial till.

5.10.1.2 Capping and Clean Layer Placement

The capping and clean layer placement plan is identical to Alternative 2, which is shown in Table 5-2. The North Harbor will be capped with 2 feet of clean sand, and clean layer placement will be used in the Inner Harbor Extension, Inner Harbor, Marina, and Entrance Channel.

5.10.1.3 Post-Remedial Conditions Versus Current Conditions

After implementation of this remedial alternative, depths in the entire navigational channel will be 23 feet below LWD, with the exception of the Outer Harbor, where the depth will be 25 feet below LWD. Water depth in the North Harbor will be about 1 foot shallower than pre-dredge conditions, except in the shallowest portions, where the water depth will be about the same. In the Marina, the northeastern portion adjacent to the Inner Harbor will be several feet deeper than before. Figure 5-7 presents the post-remediation water depths (below the LWD) for this alternative.

The overall SWAC for the entire harbor should be near 0.25 ppm immediately following the completion of remedial activities.

5.10.2 Effectiveness

Immediately after the completion of remedial activities, the SWAC for the entire harbor will be near 0.25 mg/kg. Future monitoring of the capped areas will ensure that the SWAC remains at or below 0.25 mg/kg. Therefore, this alternative is protective of human health and the environment. Compliance with ARARs is not expected to be problematic for this alternative.

Allowances can be made during construction to minimize impacts on recreational and commercial shipping. The navigational channel is also deepened under this alternative. These project-specific RAOs are met. However, capping in the North Harbor and Marina may make the water depth over some portions of these segments shallower than 16 feet below LWD and 10 feet below LWD, respectively. This RAO may not be met with the implementation of this alternative.

Some long-term maintenance may be required for the cap in the North Harbor, which could involve placing additional clean materials to supplement and/or replace the cap where erosion has occurred. Also, small sections of the cap may need to be armored with geotextile fabric and riprap if future monitoring indicates the need.

The effectiveness of disposal of excavated materials at YCL was established under previous alternatives. Disposal of contaminated materials at a RCRA Subtitle D landfill is also effective. Any RCRA Subtitle D landfill currently in operation will be constructed to have

adequate protection from seepage of contaminants into the environment if materials from Waukegan Harbor are disposed of there.

As mentioned previously under other alternatives, the risk of short-term human health impacts is minimal due to the use of devices and processes designed to reduce the spread of contamination. Chances for spreading contaminated sediment beyond the remedial area will be reduced through the use of sediment removal technologies that are designed to minimize sediment resuspension.

5.10.3 Implementability

This alternative is considered implementable. Implementability concerns for Alternative 9 are similar to those discussed for other dredging alternatives, including potential for disruption of harbor boat and cargo ship traffic, space adjacent to the site for dewatering of sediments, and noise and street damage impacts from truck traffic.

Similar to other alternatives, placement of clean material in segments of the harbor to reduce surface concentrations from settlement of contaminated material suspended during dredging should be easily implemented. Disposal at a RCRA Subtitle D landfill will also be implementable. Implementability of disposing excavated materials at YCL has also been established previously.

Overall, the public is expected to be in general support of this alternative because it remediates the sediments to levels below those posing unacceptable risk and it includes dredging of the navigational channel.

5.10.4 Cost

A breakdown of costs for Alternative 9 is included in Appendix E. The total cost is estimated to be $46,000,000.

5.11 Summary

The comparison of the nine assembled alternatives to the three alternative screening criteria of effectiveness, implementability and cost is summarized in Table 5-6.

TABLE 5-6
Comparison to Alternative Screening Criteria
Waukegan Harbor Area of Concern

Perfomance Criteria	Alternative 1 No Action	Alternative 2 Environmental Sediment Removal and YCL Disposal	Alternative 3 Monitored Natural Recovery, Navigational Channel Sediment Removal, and YCL Disposal	Alternative 4 Capping, Navigational Channel Sediment Removal, and YCL Disposal	Alternative 5 Capping and Limited Navigational Sediment Removal and YCL Disposal	Alternative 6 Sediment Removal and Near-Site Disposal	Alternative 7 Sediment Removal and JMS/YCL Disposal	Alternative 8 Sediment Removal and YCL Disposal	Alternative 9 Sediment Removal and YCL/Subtitle D Disposal
Effectiveness									
Meet RAO goal of 1 mg/kg at any single location and an overall SWAC of 0.25 mg/kg	All contaminated sediments left in place.	Contaminated sediment removed from all harbor segments except for Outer Harbor.	Contaminated sediments are removed from all harbor segments except for North Harbor and Marina.	Contaminated sediment will be removed or capped.	Contaminated sediment will be removed or capped.	Contaminated sediment removed from all harbor segments.	Contaminated sediment removed from all harbor segments.	Contaminated sediment removed from all harbor segments.	Contaminated sediment removed from all harbor segments.
	Will not meet overall SWAC goal in a reasonable time frame	Will achieve overall SWAC goal.	Will not meet SWAC goal until contaminated sediments in North Harbor and Marina attenuate.	Will achieve overall SWAC goal.	Will achieve overall SWAC goal.	Will achieve overall SWAC goal.	Will achieve overall SWAC goal.	Will achieve overall SWAC goal.	Will achieve overall SWAC goal.
Minimizes residual risk and affords long-term protection	Not effective	Clean layer placed on dredged residuals will minimize impacts of re-suspension, provide long-term protection, and help recovery of benthic community.	Prop wash and physical disturbances of North Harbor and Marina sediments could potentially cause recontamination of dredged segments.	Erosion of caps in North Harbor and Marina segments could potentially spread PCB-contaminated sediment throughout harbor. Clean layer placed on dredged residuals will minimize impacts of re-suspension, provide long-term protection, and help recovery of benthic community.	Erosion of caps in North Harbor and Marina segments could potentially spread PCB-contaminated sediment throughout harbor. Clean layer placed on dredged residuals will minimize impacts of re-suspension, provide long-term protection, and help recovery of benthic community.	Clean layer placed on dredged residuals will minimize impacts of re-suspension, provide long-term protection, and help recovery of benthic community.	Clean layer placed on dredged residuals will minimize impacts of re-suspension, provide long-term protection, and help recovery of benthic community.	Clean layer placed on dredged residuals will minimize impacts of re-suspension, provide long-term protection, and help recovery of benthic community.	Clean layer placed on dredged residuals will minimize impacts of re-suspension, provide long-term protection, and help recovery of benthic community.
Operation and Maintenance Considerations	None	Will require long-term maintenance of North Harbor cap.	None	Will require long-term maintenance of North Harbor cap.	Will require long-term maintenance of caps in North Harbor, Marina and navigational channel. Armored cap in navigational channel will make future dredging difficult.	Will require long-term maintenance of cap.	Will require long-term maintenance of cap.	Will require long-term maintenance of cap.	Will require long-term maintenance of cap.
Impacts to Harbor Users	Does not deepen navigational channel, therefore limiting cargo shipping in navigational channel.	Does not deepen navigational channel, therefore limiting cargo shipping in navigational channel. May slightly reduce depths in North Harbor and Marina.	Deepens the navigational channel.	Deepens the navigational channel. May slightly reduce depths in North Harbor and Marina.	Deepens a narrower channel through the Outer Harbor, Entrance Channel and Inner Harbor. Narrower channel will be more difficult to navigate. May slightly reduce depths in North Harbor and Marina.	Deepens the navigational channel and Marina.	Deepens the navigational channel and Marina.	Deepens the navigational channel and Marina.	Deepens the navigational channel and Marina.
Implementability									
Technical Implementability	Implementable	Implementable	Implementable	Implementable	Installation of geotextile and riprap in the Inner Harbor and Entrance Channel will be difficult.	Implementable	Implementable	Implementable	Implementable
Required Agreements and Coordination	None	Access to near harbor area (i.e., Waukegan Coke Plant site) needed for sediment dewatering, handling and stabilization and water	Access to near harbor area (i.e., Waukegan Coke Plant site) needed for sediment dewatering, handling and stabilization and water	Access to near harbor area (i.e., Waukegan Coke Plant site) needed for sediment dewatering, handling and stabilization and water	Access to near harbor area (i.e., Waukegan Coke Plant site) needed for sediment dewatering, handling and stabilization	Access to near harbor area (i.e., Waukegan Coke Plant site) needed for water treatment.	Access to near harbor area (i.e., Waukegan Coke Plant site) needed for sediment dewatering, handling and stabilization	Access to near harbor area (i.e., Waukegan Coke Plant site) needed for sediment dewatering, handling and stabilization	Access to near harbor area (i.e., Waukegan Coke Plant site) needed for sediment dewatering, handling and stabilization

TABLE 5-6
Comparison to Alternative Screening Criteria
Waukegan Harbor Area of Concern

Perfomance Criteria	Alternative 1 No Action	Alternative 2 Environmental Sediment Removal and YCL Disposal	Alternative 3 Monitored Natural Recovery, Navigational Channel Sediment Removal, and YCL Disposal	Alternative 4 Capping, Navigational Channel Sediment Removal, and YCL Disposal	Alternative 5 Capping and Limited Navigational Sediment Removal and YCL Disposal	Alternative 6 Sediment Removal and Near-Site Disposal	Alternative 7 Sediment Removal and JMS/YCL Disposal	Alternative 8 Sediment Removal and YCL Disposal	Alternative 9 Sediment Removal and YCL/Subtitle D Disposal
		treatment.	treatment.	treatment.	and water treatment.		and water treatment.	and water treatment.	and water treatment.
		Assumes disposal at Yeoman Creek Landfill site will be allowed.	Assumes disposal at Yeoman Creek Landfill site will be allowed.	Assumes disposal at Yeoman Creek Landfill site will be allowed.	Assumes disposal at Yeoman Creek Landfill site will be allowed.	Coordination with WCP and JMS sites needed to allow disposal of sediment	Assumes disposal at Yeoman Creek Landfill site will be allowed.	Assumes disposal at Yeoman Creek Landfill site will be allowed.	Assumes disposal at Yeoman Creek Landfill site will be allowed.
			Coordination with City to allow the disposal of sediment at the Waukegan Coke Plant site.	Coordination with City to allow the disposal of sediment at the Waukegan Coke Plant site.	Coordination with City to allow the disposal of sediment at the Waukegan Coke Plant site.		Coordination with JMS site needed to allow disposal of sediment.		
Construction Impacts to Community	Not Applicable	Noise and street damage from trucking 181,000 cy of sediment to YCL.	Noise and street damage from trucking 127,000 cy of sediment to YCL.	Noise and street damage from trucking 170,000 cy of sediment to YCL.	Noise and street damage from trucking 56,000 cy of sediment to YCL.		Noise and street damage from trucking 256,000 cy of sediment to YCL.	Noise and street damage from trucking 387,000 cy of sediment to YCL.	Noise and street damage from trucking 387,000 cy of sediment to YCL and Solid Waste Landfill.
Construction Impacts to Harbor Users	Not Applicable	Sequencing important to minimize impacts to shipping and recreational users.	Sequencing important to minimize impacts to shipping and recreational users.	Sequencing important to minimize impacts to shipping and recreational users.	Sequencing to minimize impact to shipping is the most difficult because of the narrower channel (100 ft wide) to be dredged. Dredging will need to be scheduled during non-shipping season.	Sequencing important to minimize impact to shipping and recreational users. Construction of CDF in North Harbor may cause more disruption to recreational boating than other alternatives.	Sequencing important to minimize impact to shipping and recreational users.	Sequencing important to minimize impact to shipping and recreational users.	Sequencing important to minimize impact to shipping and recreational users.
Public acceptance	Unacceptable	Lack of inclusion of dredging all harbor segments for navigation may make this unacceptable to some of the public.	May encounter resistance from a portion of the public because it does not actively remediate all PCB contaminated sediment in the North Harbor, Marina and Inner Harbor. Decades may be needed for MNR to eventually result in meeting PCB sediment goals.	Public expected to be in general support of this alternative because harbor sediments are remediated and harbor is dredged to allow navigation.	Public expected to be in general support of this alternative because harbor sediments are remediated and harbor is dredged to allow navigation.	Public expected to be in general support of this alternative because harbor sediments are remediated and harbor is dredged to allow navigation. However construction of CDF in North Harbor may be viewed negatively for long-term land use.	Public expected to be in general support of this alternative because harbor sediments are remediated and harbor is dredged to allow navigation	Public expected to be in general support of this alternative because harbor sediments are remediated and harbor is dredged to allow navigation.	Public expected to be in general support of this alternative because harbor sediments are remediated and harbor is dredged to allow navigation.
Cost	None	$18,000,000	$21,000,000	$25,000,000	$24,000,000	$31,000,000	$33,000,000	$34,000,000	$46,000,000

Navigational Channel includes the Outer Harbor, Entrance Channel, Inner Harbor and Inner Harbor Extension
YCL = Yeoman Creek Landfill. The identification of Yeoman Creek Landfill as the disposal location serves as a proxy for similar nearby disposal sites within Waukegan.
JMS = Johns Manville Site
WCP = Waukegan Coke Plant Site

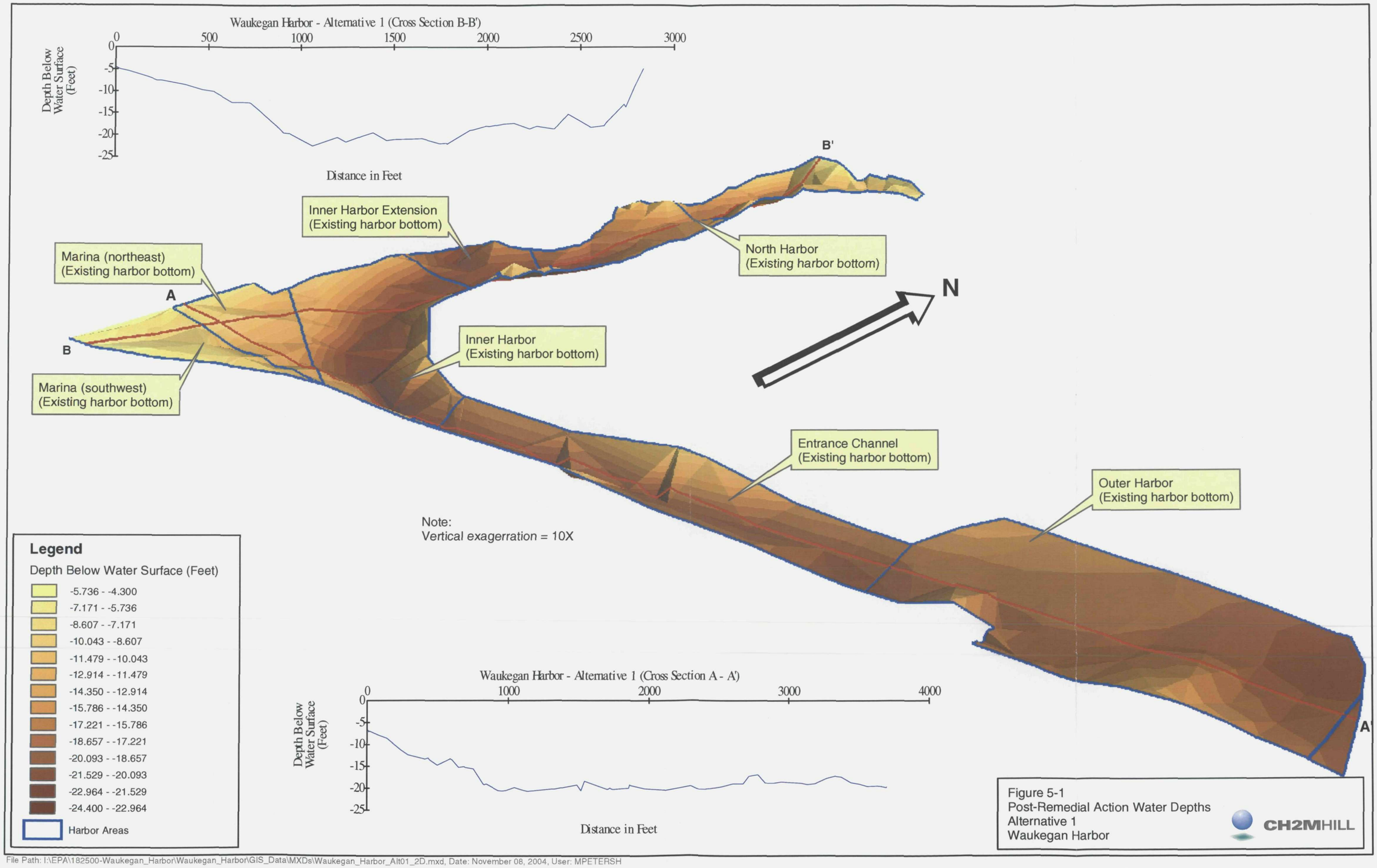

Figure 5-1
Post-Remedial Action Water Depths
Alternative 1
Waukegan Harbor

CH2MHILL

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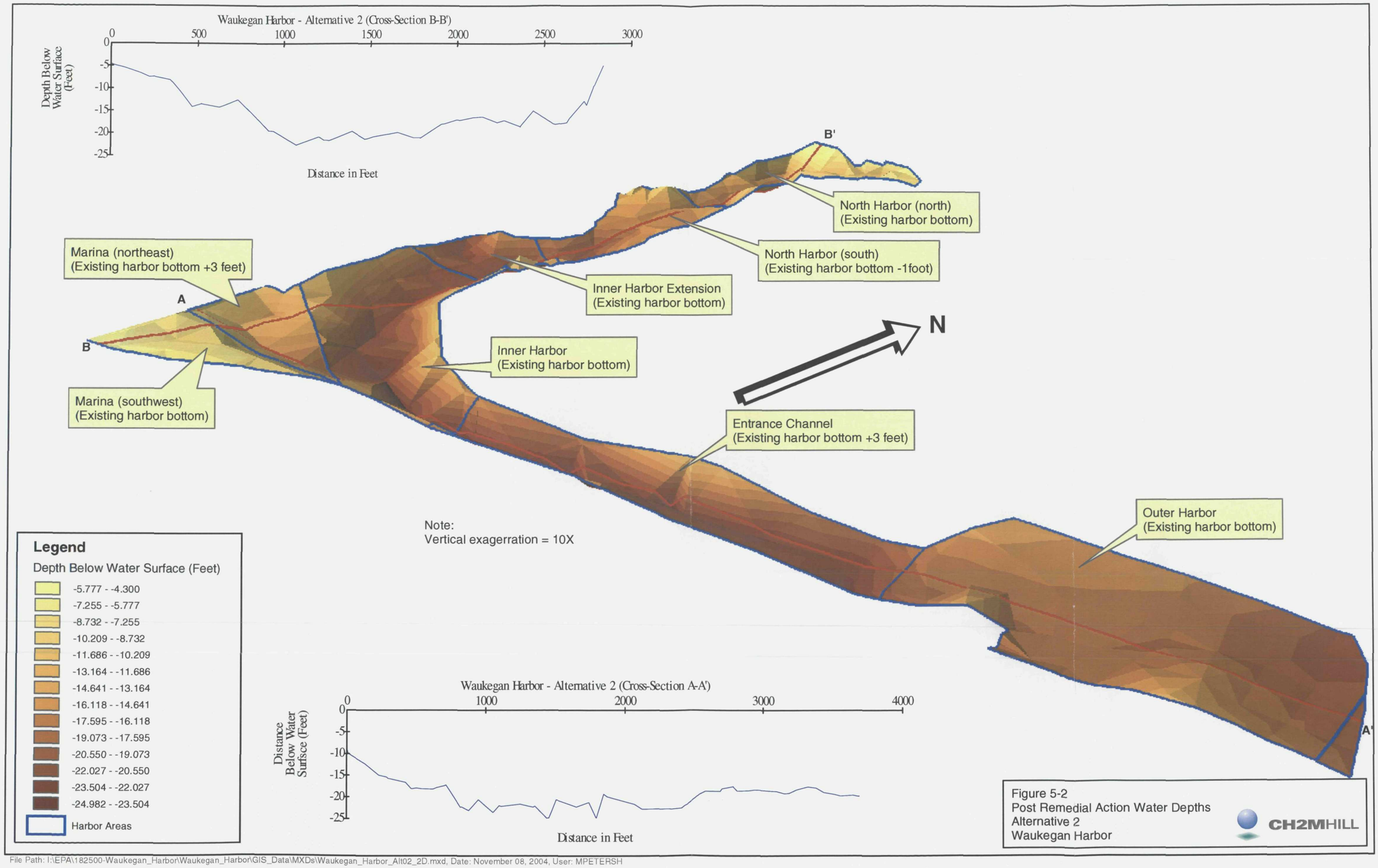

Figure 5-2
Post Remedial Action Water Depths
Alternative 2
Waukegan Harbor

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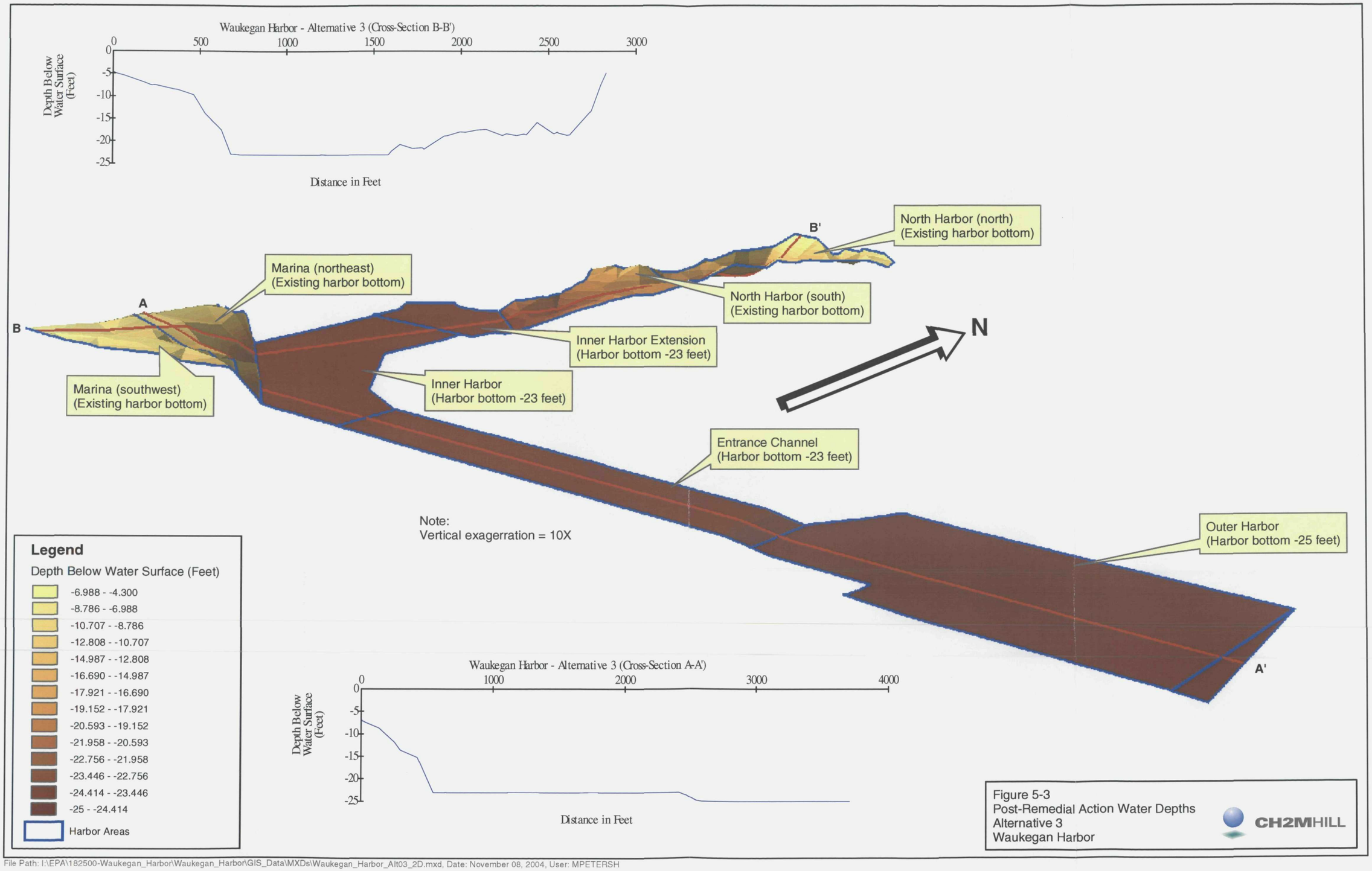

Figure 5-3
Post-Remedial Action Water Depths
Alternative 3
Waukegan Harbor

CH2MHILL

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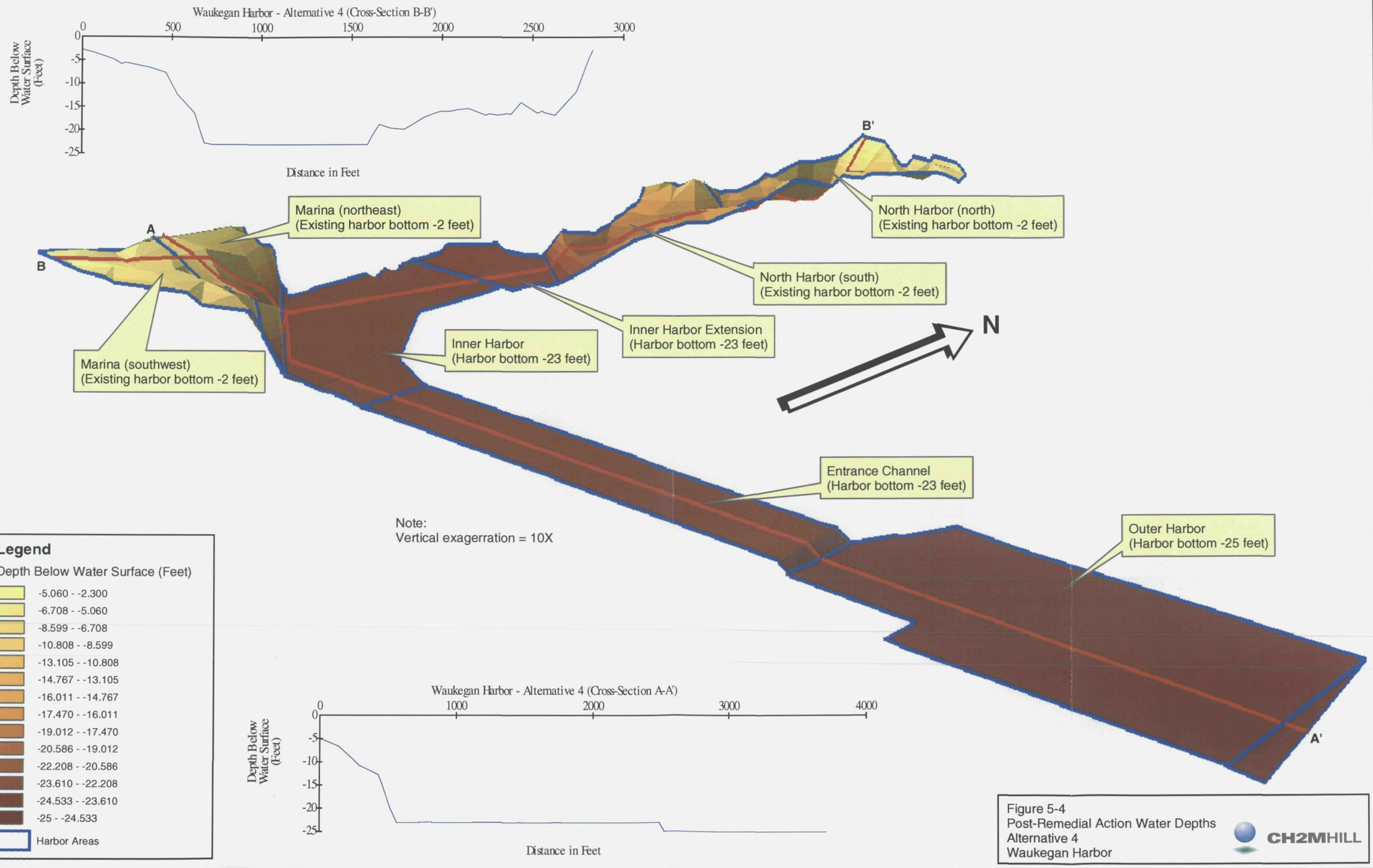

Figure 5-4
Post-Remedial Action Water Depths
Alternative 4
Waukegan Harbor

CH2MHILL

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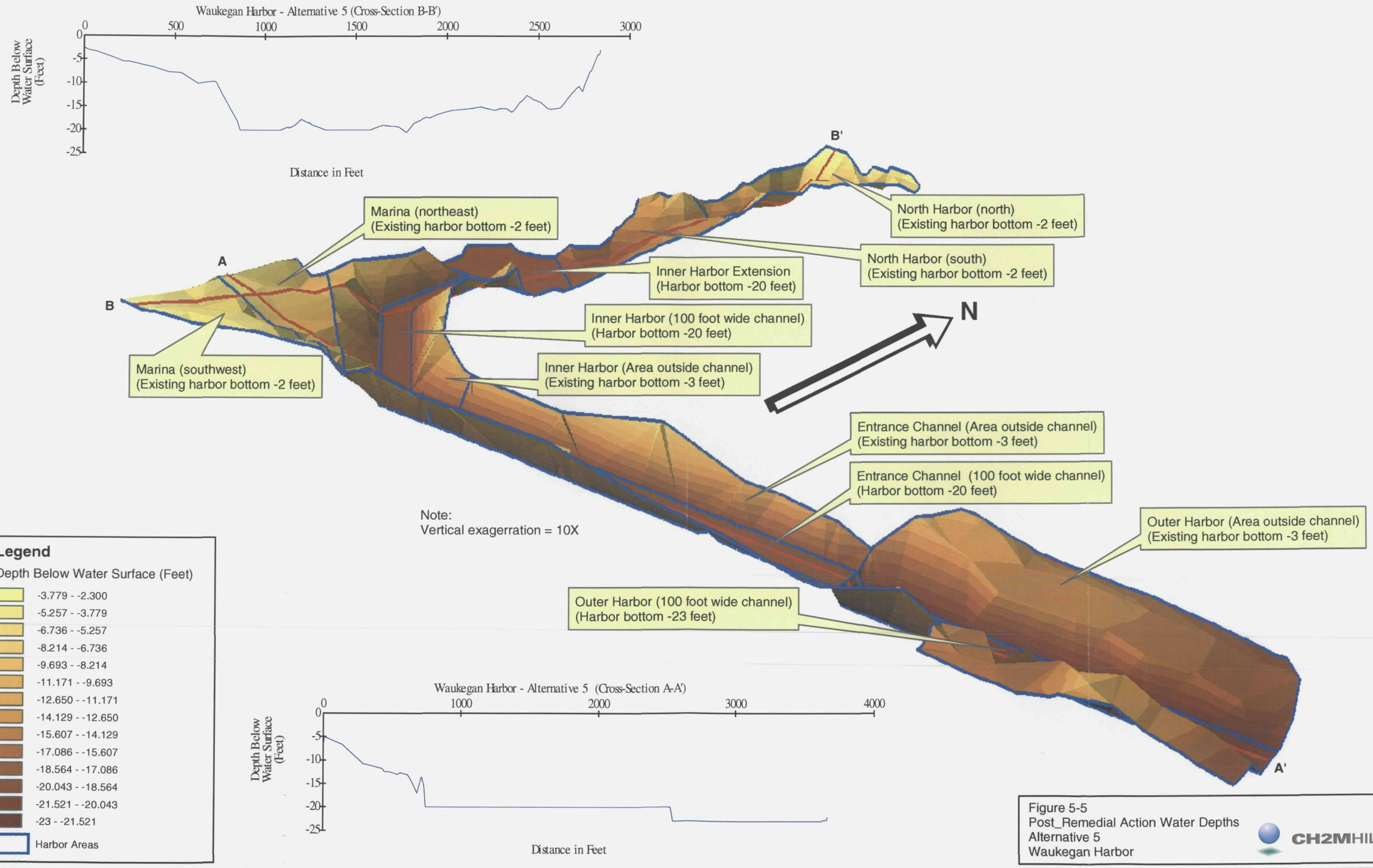

Figure 5-5
Post_Remedial Action Water Depths
Alternative 5
Waukegan Harbor

CH2MHILL

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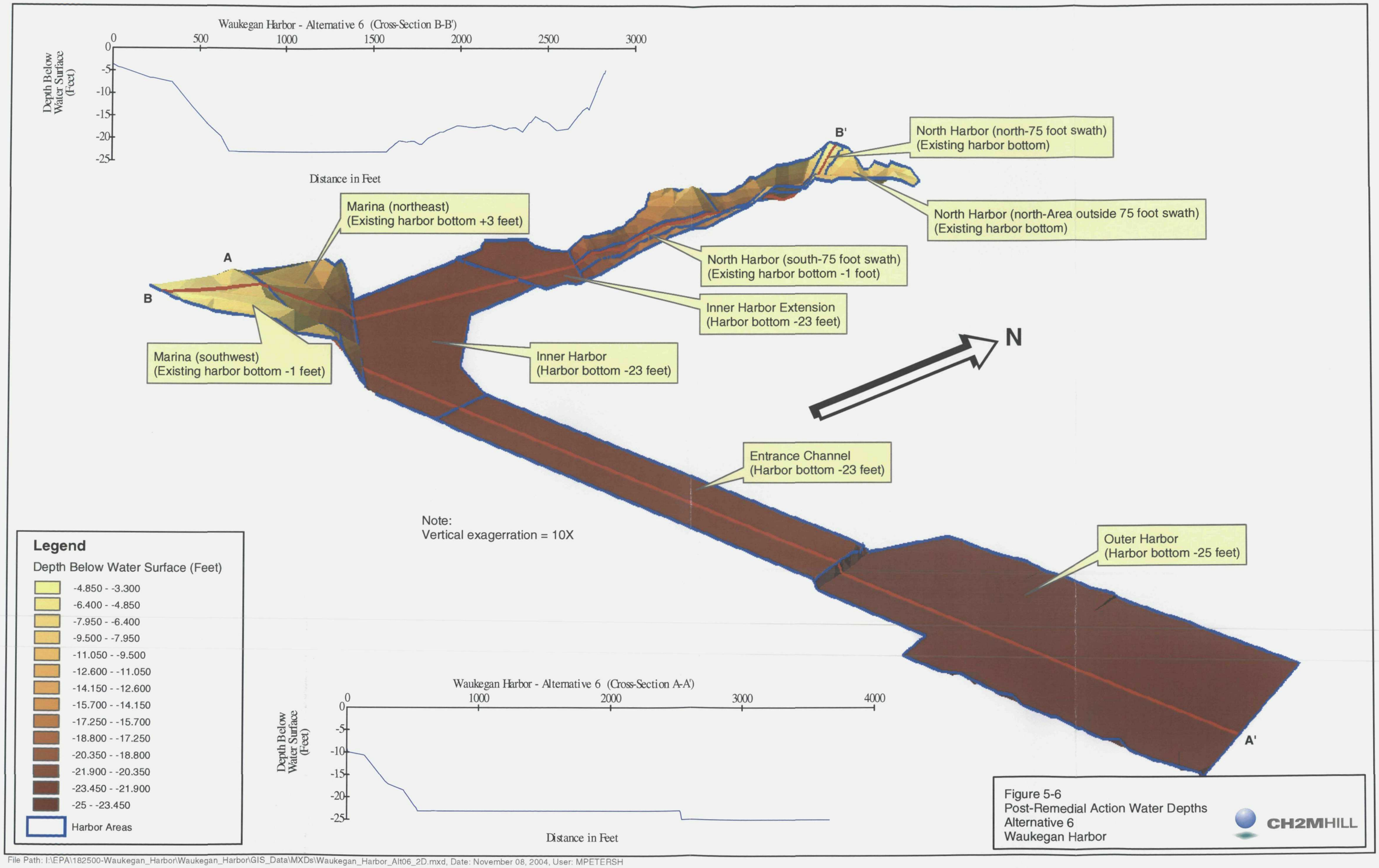

Figure 5-6
Post-Remedial Action Water Depths
Alternative 6
Waukegan Harbor

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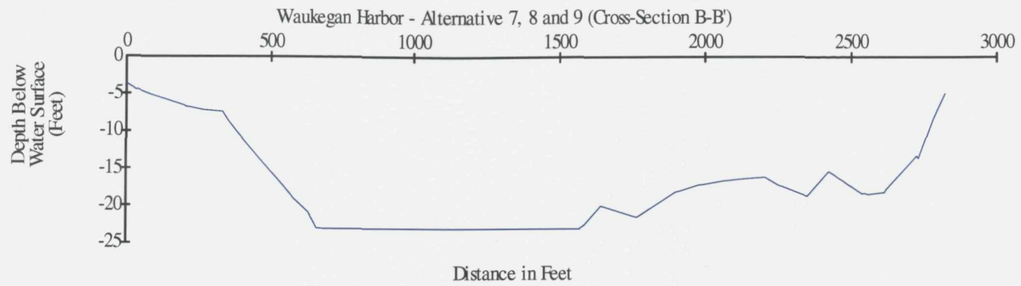

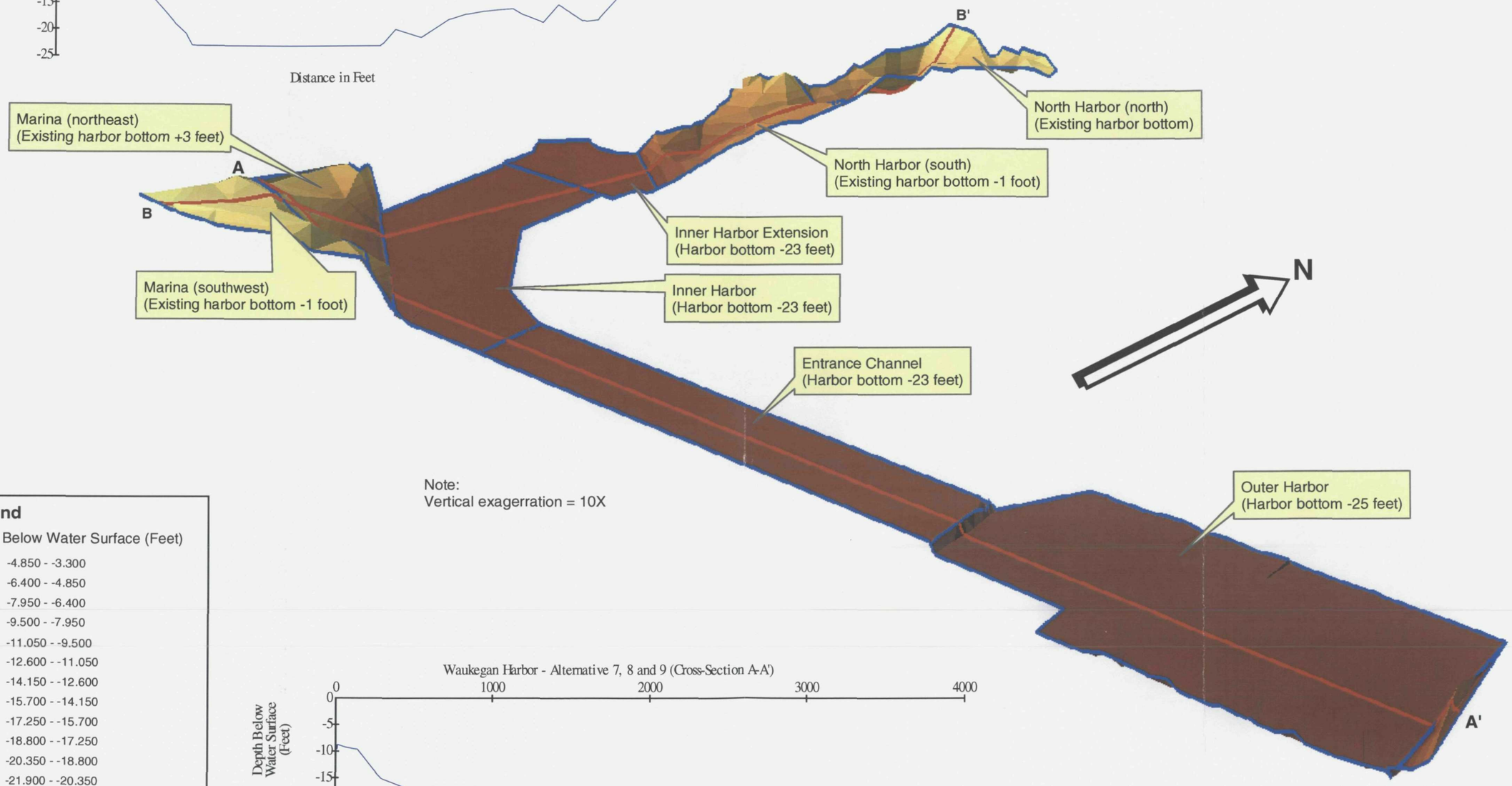

Note:
Vertical exagerration = 10X

Legend

Depth Below Water Surface (Feet)

- -4.850 - -3.300
- -6.400 - -4.850
- -7.950 - -6.400
- -9.500 - -7.950
- -11.050 - -9.500
- -12.600 - -11.050
- -14.150 - -12.600
- -15.700 - -14.150
- -17.250 - -15.700
- -18.800 - -17.250
- -20.350 - -18.800
- -21.900 - -20.350
- -23.450 - -21.900
- -25 - -23.450
- Harbor Areas

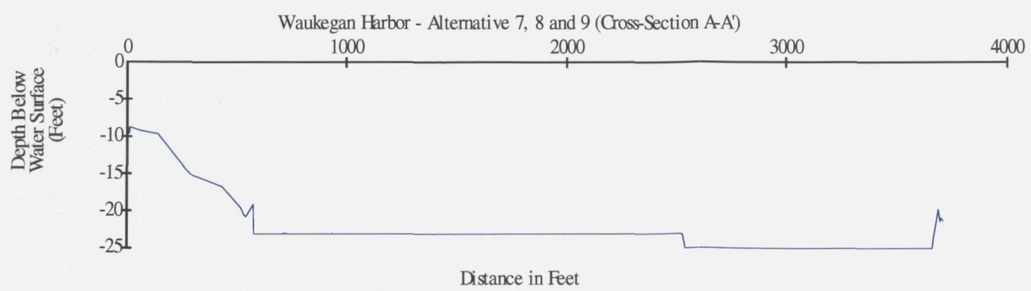

Figure 5-7
Post-Remedial Action Water Depths
Alternatives 7, 8 and 9
Waukegan Harbor

CH2MHILL

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SECTION 6

Data Gaps

6.1 Introduction

The existing sediment physical and chemical data were used in the development of the remedial alternatives array and the cost estimates in this document. However, the current data are not considered sufficient for a FS because of the data limitations in defining the lateral and vertical extent of PCB contamination. These data gaps resulted in making important assumptions relative to the volume of PCB contaminated sediment and the concentrations of PCBs in the sediments. As a result, the cost estimates, although sufficient for a screening level evaluation, are not considered to have the recommended +30 percent and –50 percent order of magnitude level of accuracy appropriate for FSs.

This section identifies data gaps needed to be filled prior to completion of an FS. Without this additional data, there is a substantial risk that assumptions related to the extent and severity of PCB contamination may be sufficiently different than actual conditions, such that a remedy selected would not otherwise have been selected had the data been available.

6.2 Data Gaps

The data gaps identified in Table 6-1 consider the data available from each harbor segment and the possible alternatives being considered. By far, the greatest data need is for determining the volume of PCB contaminated sediment. In general, the relatively thin sediment layer of the North Harbor, Inner Harbor Extension, and Inner Harbor will not require a large amount of additional characterization. More substantial sampling is anticipated for the Marina because the sediment in this segment is relatively thick and the cost of sediment removal is high given the presence of docks and piles throughout the area.

Additional sampling is also recommended for the Entrance Channel and Outer Harbor because of the limited sampling in the past and because of the very large volumes of sediment that would be dredged for navigational purposes. Much of the sediment in these two segments is sand that is much less contaminated than the siltier sediments of other harbor segments. Defining the depth of uncontaminated sand is important for disposal purposes since much less costly disposal options are available for uncontaminated sand. Also, it is likely that the PCB contamination is associated with the fine sediment fractions that could be separated from the sands. Testing should be conducted on the contaminated sand from these segments to determine whether particle segregation of the sands would reduce or eliminate the PCB contamination in the coarser fraction and allow less expensive disposal.

Limited sampling should also be conducted to confirm PCB levels previously detected in the till. Although the PCB concentrations detected in the till were at low levels (averaging 0.0754 ppm), these low concentrations could have implications for the beneficial reuse of the glacial till in areas outside the OMC Superfund site.

Other data needs identified in the table consist of determining sediment dewatering characteristics and water management processes. Dewatering is often a large percentage of a dredging project's cost, and data to allow more precise estimates of these costs is needed. The procedures to handle and treat the water resulting from dewatering processes will also have to be evaluated and included in the design of the dredging operation.

6.3 Other Important Issues

Though not specific data gaps, several other issues have been identified during the preparation of this document that are important to resolve prior to completion of the FS. These issues are:

- Future land use for areas surrounding the harbor. Specifically, the navigational dredging depths need to be decided. The depth of the navigational channel directly impacts the amount of uncontaminated materials (e.g., till and sand) that will need to be removed and disposed of. It should be noted that the financial impact of the navigational depths may be offset by the need to cover the dredged areas with clean sand.
- The required width of the North Harbor channel assuming a portion is used as a CDF. Specifically, what is a reasonable channel width to allow recreational boats access to Slip 4.
- The required width of the navigational channel for large cargo ships. The CAG-proposed alternative assumes this channel width can be 100 feet rather than the current 200-foot width. The acceptance of a narrower channel width needs to be verified because of potential additional costs relative to armoring the capped sediments along the channel sides to protect against resuspension of sediments from cargo ship prop wash.
- Determination by regulatory agencies regarding the use of YCL and other nearby potential disposal sites for the disposal of harbor sediments.
- The schedule of remedial actions on the WCP and the JMS sites. These sites are being considered as alternative locations to the YCL site for the disposal of the dredged material. The volume of sediment that can be accepted at these sites based on their remedial schedules will need to be determined.
- Depths of sheet pilings and marina piles are needed to determine whether dredging could affect stability of the piles.
- Schedule to minimize impacts to harbor users. Specifically, what are the schedule constraints that need to be considered to minimize impacts to the harbor users.
- Determination by regulatory agencies regarding which sediments and glacial till are suitable for offsite beneficial uses.

TABLE 6-1
Data Gap Evaluation

Data Gaps	Description of Existing Data	Additional Data Collection Needs	Assumptions Used in Alternatives Analysis
Volume of Contaminated Sediment and Till			
North Harbor	PCB results for 16 unconsolidated samples from 15 locations. Majority of the data collected in 1996 and 2003. PCB results for 2 sediment sample locations in till. 56 probe locations to determine volume of sediment. 4 core locations to determine depth to top of the till.	Limited sampling and analysis for PCBs in sediment to update the data and confirm the SWAC for the segment exceeds 0.25 mg/kg. Because of limited sediment thickness, vertical delineation of PCBs is not necessary. Sample till to determine if the SWAC for till samples in the segment exceed 0.25 mg/kg. Sample and analyze a subset of samples for additional parameters as dictated by the various disposal option requirements.	All sediment has PCB concentrations > SWAC of 0.25 mg/kg. All sediment has PCB concentrations < 50 mg/kg. Offsite disposal as a solid waste. Till has PCB concentrations < SWAC of 0.25 mg/kg and does not require removal to meet remedial goals.
Inner Harbor Extension	PCB results for 5 unconsolidated samples from 6 locations. Majority of the data collected in 2003. PCB results for 3 sample locations in till. 11 probe locations to determine volume of sediment. 6 core locations to determine depth to top of the till.	Limited sampling and analysis for PCBs in sediment to update the data and confirm the SWAC for the segment exceeds 0.25 mg/kg. Because of limited sediment thickness, vertical delineation of PCBs is not necessary. Sample till to determine if the SWAC for till samples in the segment exceed 0.25 mg/kg. Sample and analyze a subset of samples for additional parameters to evaluate disposal options.	All sediment has PCB concentrations > SWAC of 0.25 mg/kg. All sediment has PCB concentrations < 50 mg/kg. Offsite disposal as a solid waste. Till has PCB concentration < SWAC of 0.25 mg/kg and does not require removal to meet remedial goals.
Inner Harbor	PCB results for 19 unconsolidated samples from 14 locations. Majority of the data collected in 1995, 1996, and 1997. PCB results for 3 sample locations with PCB analysis in till. 35 probe locations to determine volume of sediment. 9 core locations to determine depth to top of the till.	Limited sampling and analysis for PCBs in sediment to update the data and confirm the SWAC for the segment exceeds 0.25 mg/kg. Because of limited sediment thickness, vertical delineation of PCBs is not necessary. Sample till to determine if the SWAC for till samples in the segment exceed 0.25 mg/kg. Sample and analyze a subset of samples for additional parameters to evaluate disposal options.	All sediment has PCB concentrations > SWAC of 0.25 mg/kg. All sediment has PCB concentrations < 50 mg/kg. Offsite disposal as a solid waste. Till has PCB concentration < SWAC of 0.25 mg/kg and does not require removal to meet remedial goals.

TABLE 6-1
Data Gap Evaluation

Data Gaps	Description of Existing Data	Additional Data Collection Needs	Assumptions Used in Alternatives Analysis
Marina	PCB results for 6 unconsolidated samples from 4 locations. Majority of the data collected in 1995 and 1996. PCB results for 1 sample location in till. 22 probe locations to determine volume of sediment. 2 core locations to determine depth to top of the till.	Sampling and analysis for PCBs in sediment to allow evaluation of horizontal and vertical distribution of PCBs. Additional detail on PCB distribution needed because of high cost of sediment removal around docks of Marina. Limited till sampling to confirm that SWAC for the till samples in the segment exceed 0.25 mg/kg. Sample and analyze a subset of samples for additional parameters to evaluate disposal options.	All sediment has PCB concentrations > SWAC of 0.25 mg/kg. All sediment has PCB concentrations < 50 mg/kg. Offsite disposal as a solid waste. Till has PCB concentration < SWAC of 0.25 mg/kg and does not require removal to meet remedial goals.
Entrance Channel	PCB results for 23 unconsolidated samples from 12 locations. Majority of the data collected in 2002 and 2003. PCB results for 3 sediment locations in till. 20 probe locations to determine volume of sediment. 6 core locations to determine depth to top of the till.	Sampling and analysis for PCBs in sediment to allow evaluation of horizontal and vertical distribution of PCBs. Perform grain size analysis and analyze sand and finer fractions to determine whether PCBs are present primarily in silt and clay fractions of sediment. Sample and analyze a subset of samples for additional parameters to evaluate disposal options. Analyze subset of samples for additional parameters to evaluate possibility for ULD.	50% of sediment (upper half) has PCBs > SWAC of 0.25 mg/kg but < 50 mg/kg. Offsite disposal as a solid waste. Lower sediment has PCBs < SWAC of 0.25 mg/kg. After particle segregation, the lower sediment will have undetectable PCBs and can be disposed of as uncontaminated sand. Till has PCBs < SWAC of 0.25 mg/kg PCBs and does not require removal to meet remedial goal for PCBs.
Outer Harbor	PCB results for 11 unconsolidated samples from 6 locations. Majority of the data collected in 2002 and 2003. PCB results for 2 sediment sample locations in till. 39 probe locations to determine volume of sediment. 4 core locations to determine depth to top of the till.	Sampling and analysis for PCBs in sediment to allow evaluation of horizontal and vertical distribution of PCBs. Perform grain size analysis and analyze sand and finer fractions to determine whether PCBs are present primarily in silt and clay fractions of sediment. Sample and analyze a subset of samples for additional parameters to evaluate disposal options. Analyze subset of samples for additional parameters to evaluate possibility for ULD.	Upper half of the sediment (i.e., 50% of sediment volume) contains PCB concentrations > SWAC of 0.25 mg/kg but < 50 mg/kg. After particle segregation, the sediment will have undetectable PCBs and can be disposed of as uncontaminated sand. Deeper sediment contains PCB concentrations < SWAC of 0.25 mg/kg. After particle segregation, the sediment will have undetectable PCBs and can be disposed of as uncontaminated sand. Till has PCB concentrations < SWAC of 0.25 mg/kg PCBs and does not require removal to meet remedial goal for PCBs.

TABLE 6-1
Data Gap Evaluation

Data Gaps	Description of Existing Data	Additional Data Collection Needs	Assumptions Used in Alternatives Analysis
Sediment Cap Material Borrow Areas			
Approach Channel	Limited grain-size and other geotechnical and chemical data exist for the samples from the Approach Channel.	Identification and testing of borrow area sediments. Limited samples should be collected for PCBs and analyzed for additional parameters to verify that materials can be used for capping.	Assume that sufficient sand from Approach Channel, Outer Harbor, Entrance Channel is shown to be uncontaminated and can be used as cap material.
Sediment Characteristics Needed for Capping Alternative			
All six harbor segments	Limited grain-size and other geotechnical data exist for the samples from the various harbor segments.	Sample collected for PCB delineation should also be tested for geotechnical characteristics (e.g., grain size and standard penetration tests) to determine if site conditions appropriate for capping.	Assume that sediment can be capped using conventional capping techniques.
Sediment Characteristics for Sediment Processing			
All six harbor segments	Limited grain-size and other geotechnical data exist for the samples from the various harbor segments.	Obtain sediment data to evaluate if the PCB contamination is associated with the finer-grained sediment fraction and the potential use of particle separation as a treatment/pretreatment process. Sample and analyze samples for geotechnical characteristics and/or perform treatability testing.	Potential cost-savings for disposal of a smaller volume of fine-grained sediment and beneficial reuse of the remaining lesser contaminated coarse-grained fraction is not included in the cost estimate
Sediment Dewatering Characteristics			
All six harbor segments	Specific data for sediment dewatering are unavailable	Obtain data on dewatering characteristics to determine most cost effective dewatering strategy and reagent mixes for solidification if needed. Sample and analyze samples for geotechnical characteristics and additional parameters to evaluate disposal options	Assume that sediment can be dewatered sufficient for truck transport using a combination of sedimentation basins and addition of solidification agents, or with geotubes.
Water Treatment Technologies			
All six harbor segments	Specific data to evaluate treatment technologies for the water generated from sediment removal and dewatering processes are unavailable	Obtain data on water treatment testing and analysis to determine cost and effectiveness of treatment trains. Sample and analyze water samples when evaluating different dewatering processes.	Assume that prior to discharge back into the harbor, the water generated will be treated using filtration and activated carbon.

TABLE 6-1
Data Gap Evaluation

Data Gaps	Description of Existing Data	Additional Data Collection Needs	Assumptions Used in Alternatives Analysis
Sediment Removal Methodology			
All six harbor segments	Specific data to determine the effectiveness of hydraulic versus mechanical dredging of the sediment are unavailable.	Obtain data to perform an in-depth evaluation of hydraulic versus mechanical dredging performance.	Assume that either dredging method will be effective and will not result in significant differences in cost for turbidity control measures, dewatering, and water treatment.

SECTION 7

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USEPA. *The Role of Cost in the Remedy Selection Process.* EPA/540/F-96/018. OSWER Publication 9200.3-23FS. September 1996.

Weston Solutions, Inc. (Weston). *Conceptual Design Summary Report—Waukegan Harbor Dredging. Waukegan, Illinois.* June 2003.

Appendix A
Source Data

APPENDIX A

Source Data

Summary tables of the geotechnical and chemical data from the information sources identified in Table 2-1 are provided in this appendix. These data were used to develop the conceptual model of the physical and chemical conditions existing in Waukegan Harbor.

The data tables from the following sources are attached:

- *Report of Findings, Waukegan Harbor Sampling and Analysis* (USACE November 1995)
- *Report on the Collection of Sediment Samples from Waukegan Inner Harbor* (QST Environmental Inc. January 1998)
- *Evaluation of Toxicity and Bioaccumulation of Contaminants in Sediments from Waukegan Harbor, Illinois* (USEPA October 1999)
- *Investigation Report for Waukegan CDF Geotechnical Boring and Laboratory Program, Waukegan Illinois* (Patrick Engineering Inc. 2003)
- USEPA 2002 Analytical Results (data provided electronically by USEPA)
- CAG 2002 Investigation (data provided electronically by USEPA)
- *Sediment Sampling Event, Waukegan Harbor Slip Number 4* (Letter report submitted to USEPA by Conestoga-Rovers & Associates August 21, 2003)
- USEPA 2003 Probe Data (data provided electronically by USEPA)

USACE 1995 Investigation (USACE 1995)

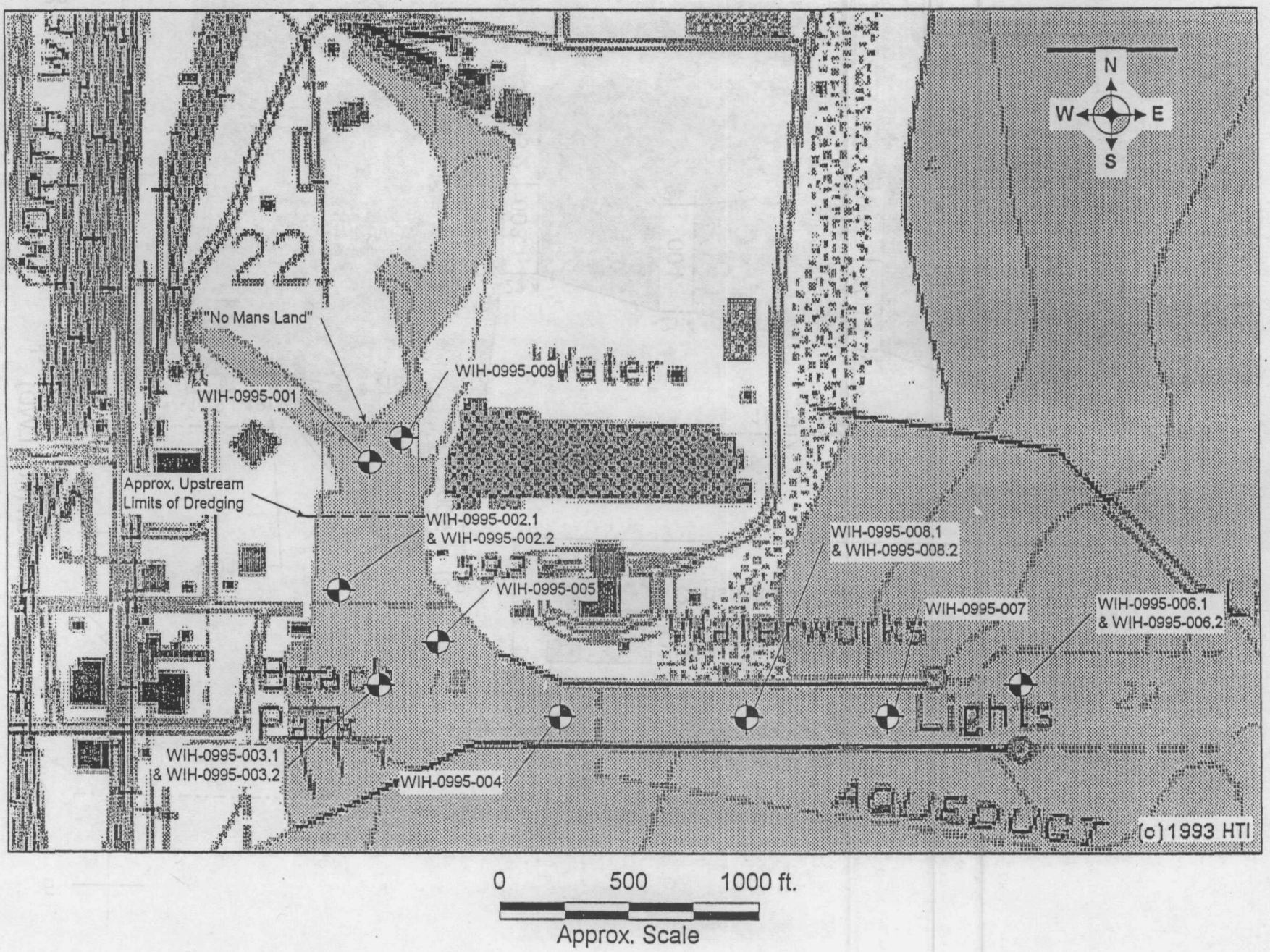


Figure 1. Sampling Locations

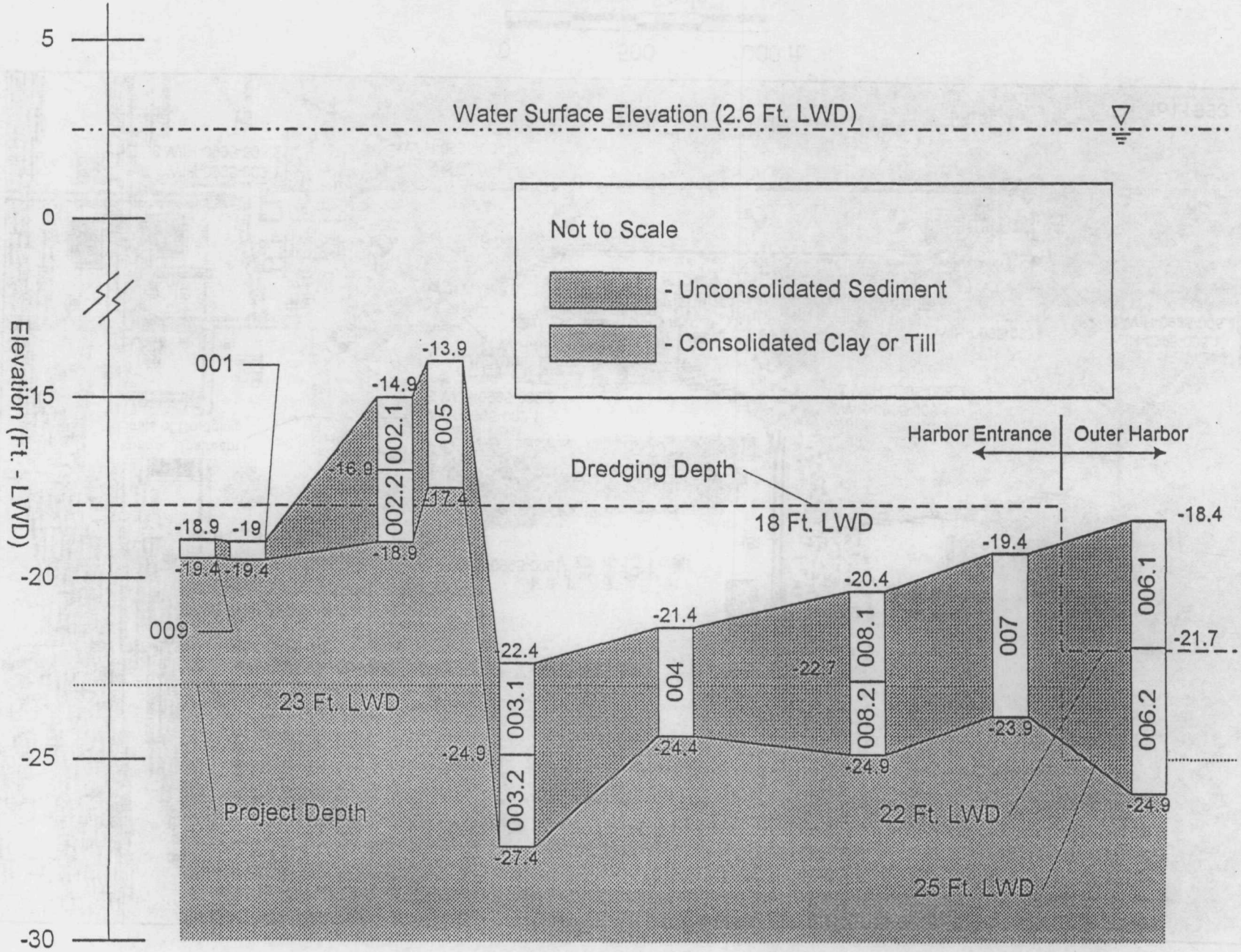


Figure 2. Sediment Sample Stratigraphy

Table 1. Sediment Stratigraphy

Sample	Sediment Surface (LWD)	Hammer Refusal (LWD)	Sample Length (ft)	Sample Description
WIH-0995-001	-19.0	-19.4	0.4	hard packed clay, little sand, light gray, no odor
WIH-0995-002.1	-14.9		2.0	loose silty sediment, gray in color, no sand, no odor
WIH-0995-002.2		-18.9	2.0	loose silty sediment, gray in color, no sand, no odor
WIH-0995-003.1	-22.4		2.5	loose silty sediment, gray in color, no sand, no odor
WIH-0995-003.2		-27.4	2.5	loose silty sediment, gray in color, no sand, no odor
WIH-0995-004	-21.4	-24.4	3.0	loose silty sediment, gray in color, some sand, no odor
WIH-0995-005	-13.9	-17.4	3.5	loose silty sediment, gray in color, no sand, no odor
WIH-0995-006.1	-18.4		3.3	lake sand, tan, brown, and black grains, no odor
WIH-0995-006.2		-24.9	3.3	lake sand, tan, brown, and black grains, no odor
WIH-0995-007	-19.4	-23.9	4.5	lake sand with some gray silt, no odor
WIH-0995-008.1	-20.4		2.3	sandy silt, gray in color, no odor
WIH-0995-008.2		-24.9	2.3	sandy silt, gray in color, no odor
WIH-0995-009	-18.9	-19.4	0.5	hard packed clay with some sand, light gray, no odor

SUMMARY OF WAUKEGAN INNER HARBOR SEDIMENT DATA

	Parameters	Landfill Acceptance Limits	Reporting Limits	WIH-0995-												
				001	002.1	002.2	003.1	003.2	004	005	006.1	006.2	007	008.1	008.2	009
	pH	2.5<pH<12.5	0.1	8.9	7.6	7.6	7.6	7.5	7.8	8.1	8.4	8.3	8	7.8	8.5	8.8
	Specific Gravity	g/ml	0.01	1.72	1.74	1.28	2.54	1.29	1.71	1.43	1.68	1.72	1.45	1.46	1.74	1.37
	Free Liquids	0% free liquids	1%													
	Total Solids	> 40%		84.5	41.8	48.4	48	53.1	63.1	71.6	79.6	71.8	69.4	66.1	86.2	85.8
	Flash Point	> 140 F (closed cup)	1F	>140	>140	>140	>140	>140	>140	>140	>140	>140	>140	>140	>140	>140
	Chlorine	<1.0%	%													
	Cyanide (as free CN)	<50 mg/L	1.0 mg/kg													
	Reactive Sulfide	<50 mg/L	matrix specific													
	PCB's	<50 mg/kg Total														
	PCB-1016		0.033 mg/kg													
	PCB-1221		0.033 mg/kg													
	PCB-1232		0.033 mg/kg													
	PCB-1242		0.033 mg/kg													
	PCB-1248		0.033 mg/kg		5.7	9.3	7.3	4.1	1	2.9	0.21	0.91	1.3	2.8	0.14	
	PCB-1254		0.033 mg/kg		1.3	1.6	1.6	0.82	0.17	0.67	0.037	0.35	0.33	0.91		
	PCB-1260		0.033 mg/kg													
TCLP	Arsenic	<5.0 mg/L	0.08 mg/L									0.12	0.093	0.17		0.086
TCLP	Barium	<100.0 mg/L	0.005 mg/L	0.48	0.36	0.45	0.39	0.45	0.27	0.24	0.15	0.28	0.27	0.27	0.33	0.33
TCLP	Cadmium	<1.0 mg/L	0.005 mg/L		0.24	0.42	0.47	0.53	0.018	0.14		0.018	0.05	0.065	0.012	
TCLP	Chromium	<5.0 mg/L	0.04 mg/L	0.005	0.027	0.038	0.025	0.024		0.005	0.008	0.009	0.005	0.006		
TCLP	Copper	<100.0 mg/L	0.005 mg/L		0.031	0.049	0.073	0.11	0.022	0.028	0.014	0.027	0.031	0.051	0.04	0.009
TCLP	Lead	<5.0 mg/L	0.04 mg/L		0.41	0.43	0.55	0.31	0.12	0.22	0.055	0.074	0.078	0.14	0.055	
TCLP	Mercury	<0.2 mg/L	0.2 ug/L													
TCLP	Nickel	<35.0 mg/L	0.02 mg/L		0.051	0.078	0.1	0.12	0.049	0.044	0.027	0.097	0.078	0.098	0.33	0.032
TCLP	Selenium	<1.0 mg/L	0.07 mg/L													
TCLP	Silver	<5.0 mg/L	0.005 mg/L													
TCLP	Zinc	<200.0 mg/L	0.020 mg/L	0.064	0.36	0.61	1.6	1.8	0.83	0.49	0.35	2.1	1.6	2.8	0.48	0.084
TCLP	Phenols	<2000 mg/L	200 mg/L													
TCLP	Benzene	<0.5 mg/L	27 ug/L													
TCLP	Carbon Tetrachloride	<0.5 mg/L	38 ug/L													
TCLP	Chlorobenzene	<100.0 mg/L	25 ug/L													
TCLP	Chloroform	<6.0 mg/L	45 ug/L													
TCLP	o-Cresol	<200.0 mg/L	50 ug/L													
TCLP	m-Cresol	<200.0 mg/L	200 ug/L													
TCLP	p-Cresol	<200.0 mg/L	200 ug/L													
TCLP	1,4-Dichlorobenzene	<7.5 mg/L	100 ug/L													
TCLP	1,2-Dichloroethane	<0.5 mg/L	39 ug/L													
TCLP	1,1-Dichloroethylene	<0.7 mg/L	65 ug/L													
TCLP	2,4-Dinitrotoluene	<0.13 mg/L	100 ug/L													
TCLP	Hexachlorobenzene	<0.13 mg/L	50 ug/L													
TCLP	Hexachloro-1,3-butadiene	<0.5 mg/L	150 ug/L													
TCLP	Hexachloroethane	<3.0 mg/L	100 ug/L													
TCLP	Methyl Ethyl Ketone	<200 mg/L	100 ug/L													
TCLP	Nitrobenzene	<2.0 mg/L	100 ug/l													
TCLP	Pentachlorophenol	<100.0 mg/L	100 ug/L													
TCLP	Pyridine	< 5.0 mg/L	100 ug/L													
TCLP	Tetrachloroethylene	<0.7 mg/L	71 ug/L													
TCLP	Trichloroethylene	<0.5 mg/L	35 ug/L													
TCLP	2,4,5-Trichlorophenol	<400.0 mg/L	50 ug/L													
TCLP	2,4,6-Trichlorophenol	<2.0 mg/L	50 ug/L													
TCLP	Vinyl Chloride	<0.2 mg/L	60 ug/L													

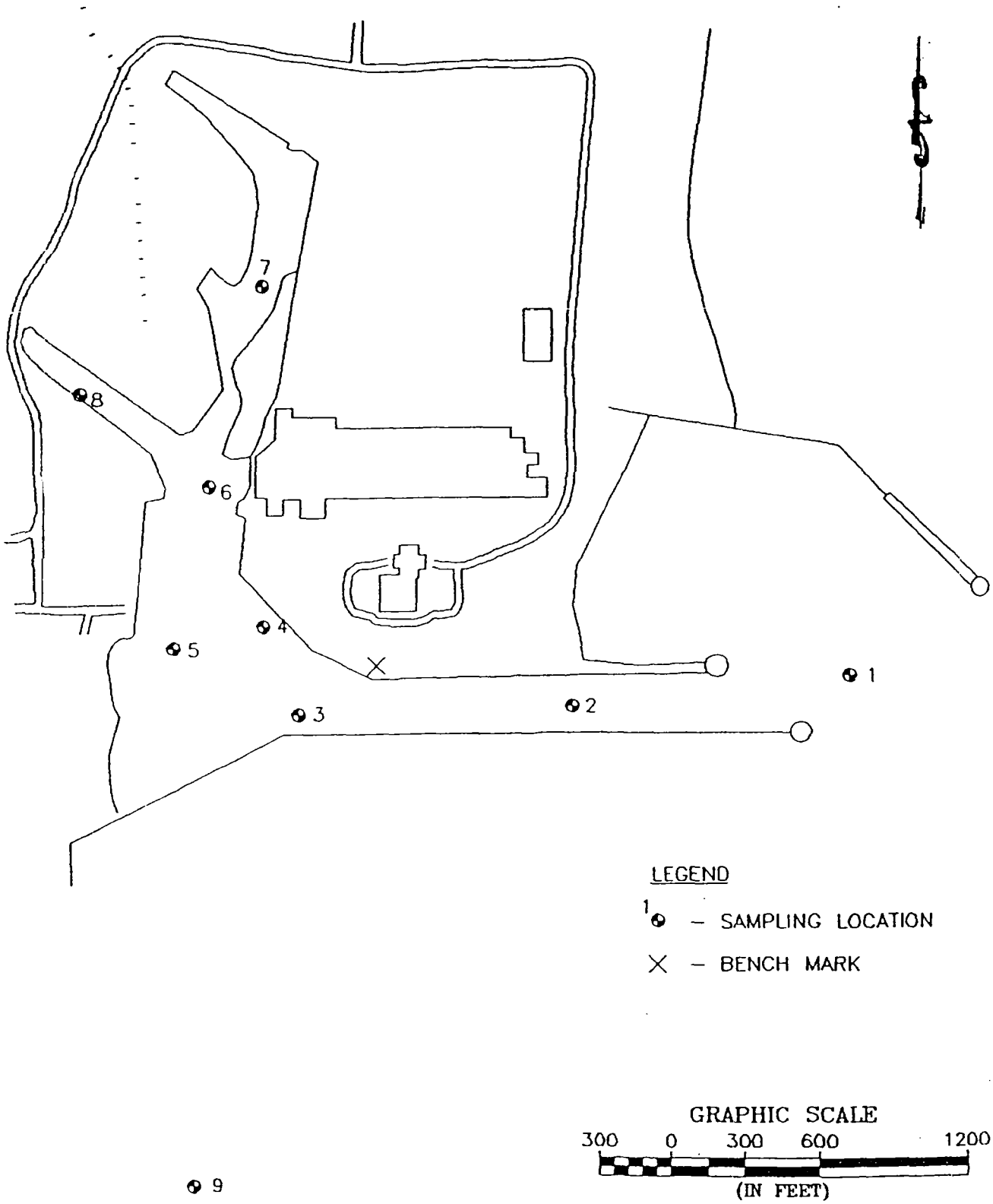
Notes:

1 - Blank cells denote that the parameter was analyzed for, but not detected.

2 - Shaded cells denote that total PCB was not analyzed for directly, but can be calculated from the sums of the individual Aroclors.

Table 3. Sediment Data Summary

QST 1997 Investigation (QST 1998)



QST ENVIRONMENTAL
5440 N. CUMBERLAND AVE.
SUITE 111
CHICAGO, ILLINOIS 60656

PROJECT NO.	559-7137.5100
DATE:	11/25/97
DRAWN BY:	RLK
CHECK BY:	DJS

SEDIMENT SAMPLING LOCATIONS
for
USACE – WAUKEGAN INNER HARBOR
WAUKEGAN, IL

FIGURE NO. 2

FILE NO. B970545

Table 1
Positioning and Depth Information
Sediment Sampling in Waukegan Inner Harbor
Waukegan, Illinois

Location Number	Latitude	Longitude	Sediment Depth BWS	Clay Depth BWS	Top of Sediment Elevation LWD	Top of Clay Elevation LWD
1	42.3613098	-87.8129321	21.0	30.0	-18.00	-27.00
2	42.3610389	-87.8170735	23.5	27.7	-20.50	-24.70
3	42.3610362	-87.8212223	18.5	29.0	-15.51	-26.00
4	42.3620582	-87.8217137	23.8	27.8	-20.80	-24.80
5	42.3618426	-87.8231009	16.3	18.8	-13.30	-15.80
6	42.3636621	-87.8225237	22.0	24.3	-19.00	-21.30
7	42.3659098	-87.8215925	17.8	19.1	-14.80	-16.05
8	42.3647055	-87.8244549	22.4	24.7	-19.40	-21.70
9	42.3558119	-87.8230226	9.4	NA	-6.40	NA

BWS = below water surface.
LWD = low water datum of Lake Michigan.

Lake Water Elevation
Referenced to LWD from Bench Mark # 79-7

	11-5-97	11-6-97	11-7-97
AM	3.00	NA	2.99
PM	NA	3.00	3.00

Bench Mark # 79-7

Latitude	42 21 41.27414
Longitude	087 49 08.48455
Elevation	+ 7.41 LWD

TABLE 2
SUMMARY OF GEOTECHNICAL RESULTS
SEDIMENT SAMPLING IN WAUKEGAN INNER HARBOR
WAUKEGAN, ILLINOIS

Parameter / Sample Number	WIH-1197-001S	WIH-1197-002S	WIH-1197-003S	WIH-1197-004S	WIH-1197-005S	WIH-1197-006S	WIH-1197-007S	WIH-1197-008S	WIH-1197-009S
Moisture Content (ASTM D2216)									
Moisture Content %	34.7	56.9	76.8	72.5	121.0	65.3	94.3	62.1	28.7
Atterberg Limits (ASTM D4318)									
Liquid Limit, %moisture	Not Plastic	24.5	35.3	24.9	49.8	28.5	44.0	28.2	Not Plastic
Plastic Limit, %moisture	Not Plastic	24.8	28.6	21.1	32.2	13.9	27.3	22.5	Not Plastic
Plastic Index, %moisture	Not Plastic	Not Plastic	6.7	3.8	17.6	14.6	16.7	5.7	Not Plastic
Soil Density (ASTM 2937) pounds cubic feet (pcf)									
Dry Density	80.1	61.4	52.5	54.1	45.2	58.4	--[1]	64.9	101.2
Specific Gravity (ASTM D584)									
Specific Gravity	2.4	2.5	2.5	2.4	2.3	2.5	2.4	2.5	2.71
Void Ratio (Calculated from Moisture Content, Specific Gravity and Soil Density)									
Void Ratio	0.84	1.54	1.92	1.78	2.24	1.69	--[1]	1.43	0.67
Grain Size Analysis (ASTM D422)									
Gravel %	0.0	0.0	0.0	0.0	0.0	3.0	0.0	1.0	0.0
Sand %	55.2	26.0	50.1	20	16.6	42.2	23.3	45.9	5.3
Silt %	35.9	60.8	35.9	60.8	62.5	47.0	67.1	42.6	72.6
Clay %	8.9	13.2	14.0	19.2	20.9	7.8	9.6	10.5	22.1
Soil Classification USCS	SM	ML	ML	SC-SM	MH	CL	ML	ML	ML

(1) Unable to obtain undisturbed sample for bulk density determination

Sample number ending in "S" indicates a sample of unconsolidated sediment.
Sample number ending in "C" indicates a sample of underlying clay or hardpan.

TABLE 3
SUMMARY OF DETECTED CONCENTRATIONS - ORGANIC COMPOUNDS IN SEDIMENT SAMPLES
SEDIMENT SAMPLING IN WAUKEGAN INNER HARBOR
WAUKEGAN, ILLINOIS

(All results are in µg/kg, except as noted)

Parameter / Sample Number	WIH-1197-001S	WIH-1197-002S	WIH-1197-003S	WIH-1197-004S	WIH-1197-005S	WIH-1197-006S	WIH-1197-007S	WIH-1197-008S	WIH-1197-009S
Volatile Organics (Method 8260)									
Acetone	<12	<13	<17	<18	<21	<17	39	<15	<13
Methylene Chloride	8.6	7.8	<8.6	<9.2	<10	<8.4	<11	<7.4	6.5
Semivolatiles (Method 8270)									
Acenaphthene	<86	93	<240	<260	<730	<590	<750	<210	<92
Acenaphthylene	<86	120	<240	<260	<730	<590	<750	<210	<92
Anthracene	<86	390	<240	<260	<730	<590	<750	<210	140
Benzo(a)anthracene	260	810	560	490	<1,000	<840	<1,100	340	520
Benzo(b)fluoranthene	260	650	560	450	<1,000	<840	1,100	440	770
Benzo(k)fluoranthene	210	570	450	430	<1,000	<840	<1,100	<300	240
Benzo(g,h,i)perylene	<200	<210	<550	<590	<1,700	<1,400	<1,700	<470	350
Benzo(a)pyrene	220	600	<480	<510	<1,500	<1200	<1500	<410	550
Bis(2-ethylhexyl)phthalate	300	280	1,100	670	1,500	940	1,600	830	340
Chrysene	330	1,000	740	<370	<1,000	970	1,300	560	760

TABLE 3
SUMMARY OF DETECTED CONCENTRATIONS - ORGANIC COMPOUNDS IN SEDIMENT SAMPLES
SEDIMENT SAMPLING IN WAUKEGAN INNER HARBOR
WAUKEGAN, ILLINOIS

(All results are in µg/kg, except as noted)

Parameter / Sample Number	WIH-1197-001S	WIH-1197-002S	WIH-1197-003S	WIH-1197-004S	WIH-1197-005S	WIH-1197-006S	WIH-1197-007S	WIH-1197-008S	WIH-1197-009S
Fluoranthene	520	1,200	1,100	1,000	860	2,000	2,300	930	1,400
Fluorene	<86	180	<240	<260	<730	<590	<750	<210	<92
Indeno(1,2,3-cd)pyrene	<200	210	<550	<590	<1,700	<1,400	<1,700	<470	310
2-Methylnaphthalene	<120	180	550	1,100	1,400	1,700	3,300	900	<130
Naphthalene	120	250	440	690	950	1,000	1,800	640	<92
Phenanthrene	410	1,100	830	730	<730	1,600	1,700	810	820
Pyrene	550	1,500	1,300	1,100	1,000	2,000	2,600	1,100	1,200
Organochlorine Pesticides (Method 8080)									
DDD	7.97	<0.870	<1.14	<1.23	<1.38	<1.13	<1.43	<0.986	12.1
DDE	4.05	<0.870	<1.14	<1.23	<1.38	<1.13	<1.43	<0.986	11.4
DDT	<0.817	<0.870	<1.14	<1.23	<1.38	<1.13	<1.43	<0.986	8.46
Polychlorinated Biphenyls (PCBs) (Method 8080)									
PCB-1242	613	524	3,530	3,050	4,320	21,000	7,810	6,190	87.9
PCB-1254	113	311	1,590	1,060	1,710	3,970	1,530	2,180	86.7

98012001.TB1

TABLE 3
SUMMARY OF DETECTED CONCENTRATIONS - ORGANIC COMPOUNDS IN SEDIMENT SAMPLES
SEDIMENT SAMPLING IN WAUKEGAN INNER HARBOR
WAUKEGAN, ILLINOIS

(All results are in µg/kg, except as noted)

Sample Number / Parameter	WIH-1197-001S	WIH-1197-002S	WIH-1197-003S	WIH-1197-004S	WIH-1197-005S	WIH-1197-006S	WIH-1197-007S	WIH-1197-008S	WIH-1197-009S
Total Organic Carbon (TOC) (mg/kg)	**55,900**	**70,400**	**97,900**	**80,000**	**76,300**	**75,800**	**72,200**	**63,200**	**61,700**
Total Recoverable Petroleum Hydrocarbons (TRPH) (mg/kg)	**143**	**331**	**841**	**2,610**	**1,080**	**3,200**	**3,470**	**1,980**	**180**
Phenol	<284	<279	<356	<400	<415	**495**	**604**	<342	<281

Values in bold are detected concentrations

TABLE 4
SUMMARY OF DETECTED CONCENTRATIONS - INORGANIC COMPOUNDS IN SEDIMENT SAMPLES
SEDIMENT SAMPLING IN WAUKEGAN INNER HARBOR
WAUKEGAN, ILLINOIS

(All results are in mg/kg, except as noted)

Sample Number / Parameter	WIH-1197-001S	WIH-1197-002S	WIH-1197-003S	WIH-1197-004S	WIH-1197-005S	WIH-1197-006S	WIH-1197-007S	WIH-1197-008S	WIH-1197-009S
Total Metals (6000 and 7000 Series Methods)									
Aluminum	1,920	2,300	6,640	8,520	11,500	11,500	9,480	5,110	2,020
Arsenic	3.32	7.73	20.6	18.5	24.8	28.1	44.0	15.0	4.76
Barium	18.2	18.7	38.3	37.7	43.8	39.7	49.3	26.7	15.8
Cadmium	< 0.533	0.991	6.71	10.1	9.3	13.5	27.4	7.2	<0.578
Calcium	84,400	74,300	76,100	74,000	68,100	63,400	54,100	55,200	82,700
Chromium	16.4	27.7	65.3	61.7	77.9	86.4	125	42.3	7.97
Cobalt	2.78	3.28	6.27	6.51	6.53	5.81	5.68	4.29	3.59
Copper	17.8	44.2	73.7	69.7	80.4	125	113	48.8	14.4
Iron	7,860	8,230	15,900	15,400	14,600	13,300	16,300	11,500	8,350
Lead	18.5	53.4	130	90.4	158	151	216	87	24.9
Magnesium	43,700	38,600	42,200	41,300	39,800	34,400	32,200	31,100	41,400
Manganese	407	348	464	490	454	352	346	318	414
Mercury	0.047	0.270	0.401	0.386	0.433	0.873	0.741	0.188	0.057
Nickel	7.2	9.55	19.3	18.9	19.6	18.4	22.2	13.1	7.84
Potassium	239	319	741	878	751	803	909	571	297
Selenium	<0.211	<0.272	<0.373	<0.371	<0.455	<0.341	0.535	<0.220	<0.272

TABLE 4

SUMMARY OF DETECTED CONCENTRATIONS - INORGANIC COMPOUNDS IN SEDIMENT SAMPLES
SEDIMENT SAMPLING IN WAUKEGAN INNER HARBOR
WAUKEGAN, ILLINOIS

(All results are in mg/kg, except as noted)

Sample Number / Parameter	WIH-1197-001S	WIH-1197-002S	WIH-1197-003S	WIH-1197-004S	WIH-1197-005S	WIH-1197-006S	WIH-1197-007S	WIH-1197-008S	WIH-1197-009S
Sodium	165	422	538	568	664	759	725	536	477
Vanadium	7.85	8.68	16.1	16.1	15.0	15.2	17.3	13.2	8.4
Zinc	70	94.9	204	162	234	195	262	137	76.7
Cyanide (in µg/g)	<0.547	<0.616	<0.794	<0.957	<0.979	1.41	<1.03	<0.755	<0.710
pH (in standard units)	8.13	8.04	7.71	7.64	7.76	7.89	7.45	7.93	7.64
Ammonia (N)	160	190	288	204	368	197	230	167	41.7
Total Kjeldahl Nitrogen (TKN)	300	650	1,280	1,340	1,410	980	1,100	842	427
Chemical Oxygen Demand (COD)	1,870	8,980	4,020	19,400	24,500	21,100	27,200	16,900	2,300
Total Phosphorus	165	473	734	577	505	684	1,320	535	186
Asbestos - none detected									
Moisture (%)	18.4	23.4	41.7	45.6	51.8	40.8	53.3	32.4	23.5

Values in bold are detected concentrations

TABLE 5
SUMMARY OF DETECTED CONCENTRATIONS - ORGANIC COMPOUNDS IN CLAY SAMPLES
SEDIMENT SAMPLING IN WAUKEGAN INNER HARBOR
WAUKEGAN, ILLINOIS

(All results are in µg/kg)

Parameter / Sample Number	WIH-1197-004C	WIH-1197-005C	WIH-1197-007C
Volatile Organics (Method 8260)			
Methylene Chloride	6.4	**10**	**14**
Semivolatiles (Method 8270)			
Bis(2-ethylhexyl)phthalate	**110**	**120**	<120
Organochlorine Pesticides (Method 8080) - none detected			
Polychlorinated Biphenyls (PCBs) (Method 8080)			
PCB-1242	<14.2	**154**	**2,170**
PCB-1254	<14.2	**63.6**	**220**
Total Organic Carbon (TOC) (mg/kg)	**42,900**	**46,700**	**85,000**
Total Recoverable Petroleum Hydrocarbons (TRPH) (mg/kg)	<29.6	**83.2**	**217**
Phenol - none detected			

Values in **bold** are detected concentrations

TABLE 6
SUMMARY OF DETECTED CONCENTRATIONS - INORGANIC COMPOUNDS IN CLAY SAMPLES
SEDIMENT SAMPLING IN WAUKEGAN INNER HARBOR
WAUKEGAN, ILLINOIS

(All results are in mg/kg, except as noted)

Sample Number / Parameter	WIH-1197-004C	WIH-1197-005C	WIH-1197-007C
Total Metals (6000 and 7000 Series Methods)			
Aluminum	2,280	7,990	5,900
Arsenic	6.24	3.72	4.41
Barium	13.9	44.5	35.1
Cadmium	<0.361	<0.564	0.664
Calcium	105,000	63,800	68,100
Chromium	4.37	14.7	12.8
Cobalt	4.01	9.09	8.19
Copper	14.0	20.3	19.3
Iron	9,490	15,700	14,700
Lead	6.24	6.7	6.57
Magnesium	56,400	32,100	37,100
Manganese	615	376	446
Mercury	0.010	0.022	0.035
Nickel	9.22	22.5	18.7
Potassium	394	1,490	1,000
Sodium	406	574	437

TABLE 6
SUMMARY OF DETECTED CONCENTRATIONS - INORGANIC COMPOUNDS IN CLAY SAMPLES
SEDIMENT SAMPLING IN WAUKEGAN INNER HARBOR
WAUKEGAN, ILLINOIS

(All results are in mg/kg, except as noted)

Sample Number / Parameter	WIH-1197-004C	WIH-1197-005C	WIH-1197-007C
Vanadium	**8.48**	**17.1**	**13.7**
Zinc	**28.5**	**42.6**	**38.9**
Cyanide (in µg/g) - none detected			
pH (in standard units)	**8.47**	**8.42**	**8.16**
Ammonia (N)	**61.5**	**75.0**	**67.9**
Total Kjeldahl Nitrogen (TKN)	**247**	**666**	**511**
Chemical Oxygen Demand (COD)	**2,760**	**2,720**	**1,520**
Total Phosphorus	**273**	**244**	**209**
Asbestos - none detected			
Moisture (%)	**6.3**	**13.9**	**13.6**

Values in **bold** are detected concentrations

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CHICAGO, ILLINOIS 60656

TEST BORING RECORD

CLIENT	▶ USACE	SITE	▶ WAUKEGAN INNER HARBOR
BORING NO.	▶ WIH-1197-001		
DATE	▶ 11-5-97		
LOGGED BY	▶ DJS	DRILLED BY	▶ MES
DRILLING METHOD	▶ HSA	SAMPLING METHOD	▶ PS/CONTINUOUS SAMPLER
		HOLE DIA.	4"
QST PROJECT NUMBER	▶ 559-7137.5100	QST DRAWING NUMBER	▶ B970552
		TOTAL DEPTH	9.5'

DEPTH	SAMPLE NUMBER	SAMPLE RECOVERY	PID READING	MOISTURE CONTENT	PENETRATION RESISTANCE	LITHOLOGY	REMARKS
0							
1	1	12"	0	SATUR.		SAND: Gray-Black, Fine Grained, Soft, Some Silt	
2							
3	2	18"	0	SATUR.		AS ABOVE: with (1) 0.25" Layer of Black Plant Matter and Shells	
4							
5	3	24"	0	SATUR.		AS ABOVE: with Little Shells, 1-2" Thick Silty Clay at 6'	
6							
7	4	24"	0	SATUR.		AS ABOVE: Becoming More Silt Rich with Depth	
8						AS ABOVE: Some Silty Clay at 8-8.5'	
9	5	18"	0	SATUR.		@ 9' CLAY: Dark Gray, Firm, Very Stiff, Trace Pebbles	
10						End of Boring at 9.5'	
11							
12							
13							
14							
15							
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25							

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TEST BORING RECORD

CLIENT	▶ USACE	SITE	▶ WAUKEGAN INNER HARBOR
BORING NO.	▶ WIH-1197-002		
DATE	▶ 11-5-97		
LOGGED BY	▶ DJS	DRILLED BY	▶ MES
DRILLING METHOD	▶ HSA	SAMPLING METHOD	▶ CONTINUOUS SAMPLER
		HOLE DIA.	4"
QST PROJECT NUMBER	▶ 559-7137.5100	QST DRAWING NUMBER	▶ B970553
		TOTAL DEPTH	4'

DEPTH	SAMPLE NUMBER	SAMPLE RECOVERY	PID READING	MOISTURE CONTENT	PENETRATION RESISTANCE	LITHOLOGY	REMARKS
0							
1	1	46"	0	SATUR.		SILTY SAND: Gray, Very Fine Grained, Soft, Becoming Fine Grained at 1'	
2						AS ABOVE: Grain Size Increasing with Depth	
3						@ 3' CLAY: Dark Gray, Firm, Very Stiff, Low Plasticity	
4						End of Boring at 4'	
5							
6							
7							
8							
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TEST BORING RECORD

CLIENT	▶ USACE	SITE	▶ WAUKEGAN INNER HARBOR
BORING NO.	▶ WIH-1197-003		
DATE	▶ 11-7-97		
LOGGED BY	▶ DJS	DRILLED BY	▶ MES
DRILLING METHOD	▶ HSA	SAMPLING METHOD	▶ CONTINUOUS SAMPLER
		HOLE DIA.	4"
QST PROJECT NUMBER	▶ 559-7137.5100	QST DRAWING NUMBER	▶ B970554
		TOTAL DEPTH	10.5'

DEPTH	SAMPLE NUMBER	SAMPLE RECOVERY	PID READING	MOISTURE CONTENT	PENETRATION RESISTANCE	LITHOLOGY	REMARKS
0							
1	1	48"	0	SATUR.		SILTY CLAY: Black-Gray, Soft, Sediment, Trace Sand Fine-Medium Grained, 1-2" Thick Sand Lense at 2'	
2						AS ABOVE: No Sand Lenses	
3							
4							
5	2	48"	0	SATUR.		AS ABOVE: Sand Content Increased	
6						SILTY SAND: Gray, Medium-Coarse Grained Sub-Rounded, Trace Shells	
7							
8							
9	3	30"	0	SATUR.		AS ABOVE	
10						Clay: Dark Gray, Firm, Very Stiff, Low Plasticity	
11						End of Boring at 10.5'	
12							
13							
14							
15							
16							
17							
18							
19							
20							
21							
22							
23							
24							
25							

QST ENVIRONMENTAL
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TEST BORING RECORD

CLIENT	▶ USACE	SITE	▶ WAUKEGAN INNER HARBOR
BORING NO.	▶ WIH-1197-004		
DATE	▶ 11-6-97		
LOGGED BY	▶ DJS	DRILLED BY	▶ MES
DRILLING METHOD	▶ HSA	SAMPLING METHOD	▶ CONTINUOUS SAMPLER
		HOLE DIA.	4"
QST PROJECT NUMBER	▶ 559-7137.5100	QST DRAWING NUMBER	▶ B970555
		TOTAL DEPTH	5'

DEPTH	SAMPLE NUMBER	SAMPLE RECOVERY	PID READING	MOISTURE CONTENT	PENETRATION RESISTANCE	LITHOLOGY	REMARKS
0							
1	1	58"	0	SATUR. TO MOIST		SILT: Black-Gray, Sediment, Some Clay, Trace Fine Sand, Very Soft, Alternating Layers of Fine Sand 2" Thick with Silt, Trace Shells Throughout	
2							
3							
4							
5						CLAY: Silty Sandy Clay, Gray, Firm, Low Plasticity	
6						End of Boring at 5'	
7							
8							
9							
10							
11							
12							
13							
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TEST BORING RECORD

CLIENT	▶ USACE	SITE	▶ WAUKEGAN INNER HARBOR
BORING NO.	▶ WIH-1197-005		
DATE	▶ 11-6-97		
LOGGED BY	▶ DJS	DRILLED BY	▶ MES
DRILLING METHOD	▶ HSA	SAMPLING METHOD	▶ CONTINUOUS SAMPLER
		HOLE DIA.	4"
QST PROJECT NUMBER	▶ 559-7137.5100	QST DRAWING NUMBER	▶ B970556
		TOTAL DEPTH	3.2'

DEPTH	SAMPLE NUMBER	SAMPLE RECOVERY	PID READING	MOISTURE CONTENT	PENETRATION RESISTANCE	LITHOLOGY	REMARKS
0							
1	1	38"	0	SATUR. TO MOIST		SILT: Black-Gray, Some Clay, Trace Fine Sand, Very Soft, Alternating Layers of Fine Sand 2" Thick with Little Silt, Trace Shells Throughout	
2							
3						CLAY: Gray, Little Silt and Sand, Firm, Low Plasticity	
4						End of Boring at 3.2'	
5							
6							
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TEST BORING RECORD

CLIENT	▶ USACE	SITE	▶ WAUKEGAN INNER HARBOR
BORING NO.	▶ WIH-1197-006		
DATE	▶ 11-6-97		
LOGGED BY	▶ DJS	DRILLED BY	▶ MES
DRILLING METHOD	▶ HSA	SAMPLING METHOD	▶ CONTINUOUS SAMPLER
		HOLE DIA.	4"
QST PROJECT NUMBER	▶ 559-7137.5100	QST DRAWING NUMBER	▶ B970557
		TOTAL DEPTH	2.5'

DEPTH	SAMPLE NUMBER	SAMPLE RECOVERY	PID READING	MOISTURE CONTENT	PENETRATION RESISTANCE	LITHOLOGY	REMARKS
0							
1	1	30"	0	SATUR. TO MOIST		SILT: Black-Gray, Some Clay, Trace Fine Grained Sand, Soft, Alternating Layers of Fine Sand 2" Thick with Little Silt, Trace Shells Throughout	
2							
3						2" CLAY: Gray, Little Silt and Sand, Firm, Low Plasticity	
4						End of Boring at 2.5'	
5							
6							
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9							
10							
11							
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TEST BORING RECORD

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CLIENT	▶ USACE	SITE	▶ WAUKEGAN INNER HARBOR
BORING NO.	▶ WIH-1197-007		
DATE	▶ 11-6-97		
LOGGED BY	▶ DJS	DRILLED BY	▶ MES
DRILLING METHOD	▶ HSA	SAMPLING METHOD	▶ CONTINUOUS SAMPLER
		HOLE DIA.	4"
QST PROJECT NUMBER	▶ 559-7137.5100	QST DRAWING NUMBER	▶ B970558
		TOTAL DEPTH	25"

DEPTH	SAMPLE NUMBER	SAMPLE RECOVERY	PID READING	MOISTURE CONTENT	PENETRATION RESISTANCE	LITHOLOGY	REMARKS
0							
1	1	25"	0	SATUR.		SILT: 15" Black-Gray, Soft, Little Sand, Trace Pebbles < .2" in Diameter	
2						CLAY: 10" Dark Gray, Firm, Very Stiff Low Plasticity	
3						End of Boring at 25"	
4							
5							
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TEST BORING RECORD

CLIENT	► USACE	SITE	► WAUKEGAN INNER HARBC
BORING NO.	► WIH-1197-008		
DATE	► 11-6-97		
LOGGED BY	► DJS	DRILLED BY	► MES
DRILLING METHOD	► HSA	SAMPLING METHOD	► CONTINUOUS SAMPLER
		HOLE DIA.	4"
QST PROJECT NUMBER	► 559-7137.5100	QST DRAWING NUMBER	► B970559
		TOTAL DEPTH	30"

DEPTH	SAMPLE NUMBER	SAMPLE RECOVERY	PID READING	MOISTURE CONTENT	PENETRATION RESISTANCE	LITHOLOGY	REMARKS
0							
1	1	30"	0	SATUR.		SILT: 28" Black-Gray, Some Clay, Trace Fine Sand, Very Soft, Alternating Layers Fine Sand, 2" Thick with Silt, Trace Shells Throughout	
2						CLAY: 2" Dark Gray, Firm, Very Stiff, Low Plasticity	
3						End of Boring at 30"	
4							
5							
6							
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TEST BORING RECORD

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CLIENT	▶ USACE	SITE	▶ WAUKEGAN INNER HA
BORING NO.	▶ WIH-1197-009		
DATE	▶ 11-12-97		
LOGGED BY	▶ DJS	DRILLED BY	▶ QST
DRILLING METHOD	▶ NA	SAMPLING METHOD	▶ CLAM SHELL – GRAB
		HOLE DIA.	NA
QST PROJECT NUMBER	▶ 559-7137.5100	QST DRAWING NUMBER	▶ B970560
		TOTAL DEPTH	NA

DEPTH	SAMPLE NUMBER	SAMPLE RECOVERY	PID READING	MOISTURE CONTENT	PENETRATION RESISTANCE	LITHOLOGY	REMARKS
0							
1	1	GRAB	0	SATUR.		SAND: Gray-Black, Fine to Coarse Grained, Some Silt, Loose	USED CLA SHELL BU TO GRAB SED. SAMP
2							
3							
4							
5							
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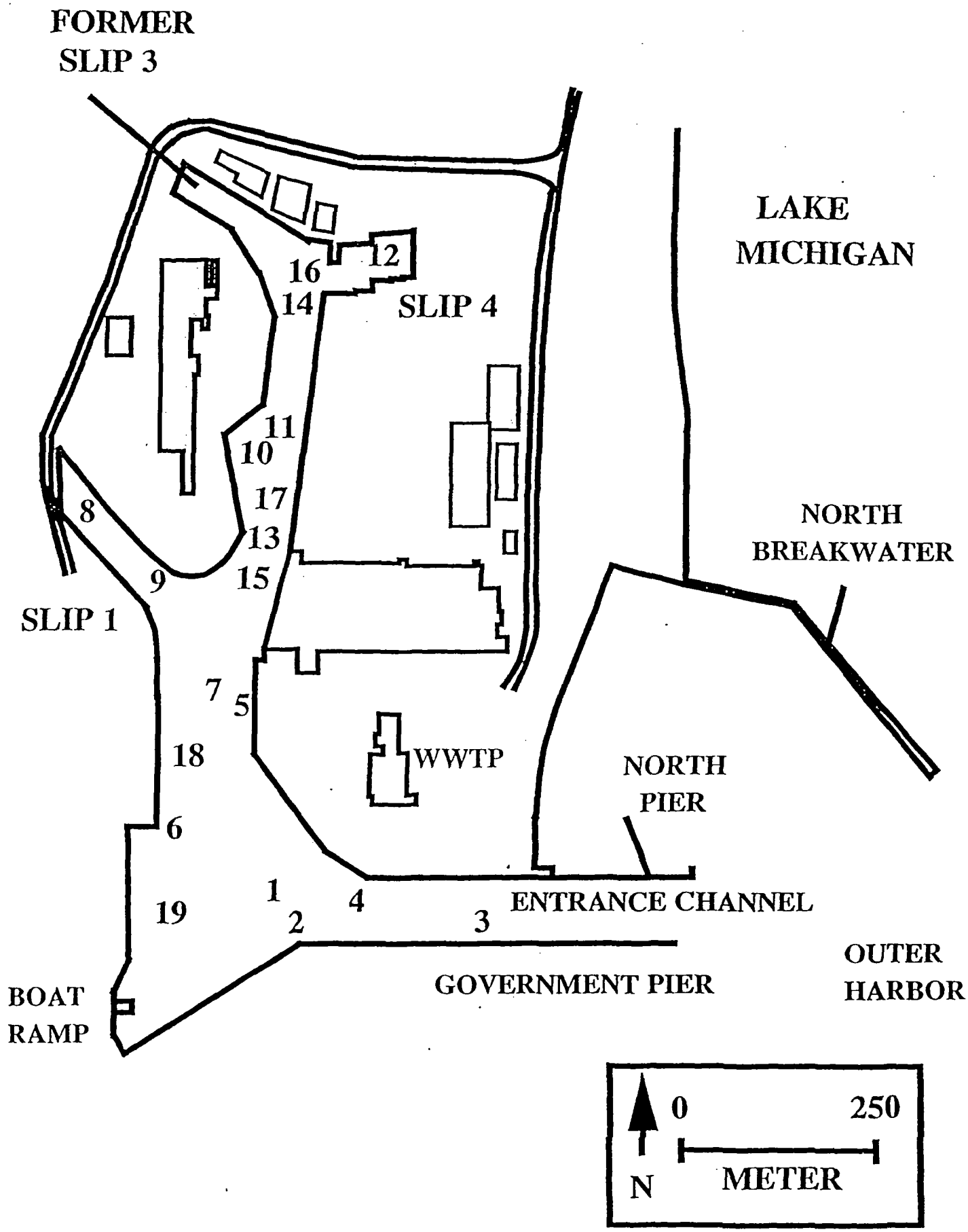
USEPA 1996 Investigation (USEPA 1999)


FORMER
SLIP 3
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SLIP 4
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Table 1. Physical characteristics of sediment samples from Waukegan Harbor at the start of whole-sediment tests.

Sample	Total Organic Carbon (%)	Water (%)	Particle Size (%) sand	clay	silt	Sediment Class
Control	1.6	31	73	17	10	Sandy Loam
WH-01	3.9	51	41	38	21	Clay Loam
WH-02 (rep 1)	3.0	55	2	38	60	Silty Clay Loam
WH-02 (rep 2)	2.7	55	3	38	56	Silty Clay
WH-03	2.2	45	23	27	50	Clay Loam
WH-04	2.8	46	51	28	21	Sandy Clay Loam
WH-05	3.0	52	38	33	29	Clay Loam
WH-06	3.5	57	9	36	55	Silty Clay Loam
WH-07	4.4	65	25	60	16	Clay
WH-08	7.8	47	37	28	35	Clay Loam
WH-09 (rep 1)	4.2	42	53	26	21	Sandy Clay Loam
WH-09 (rep 2)	2.7	43	34	34	32	Clay Loam
WH-10	3.1	44	45	21	34	Loam
WH-11	3.9	48	50	29	21	Sandy Clay Loam
WH-11R (rep 1)	2.4	50	35	35	29	Clay Loam
WH-11R (rep 2)	4.2	49	36	35	30	Clay Loam
WH-12	5.7	65	7	58	35	Clay
WH-13	4.1	51	32	37	31	Clay Loam
WH-14	4.9	63	9	50	41	Silty Clay
WH-15	3.3	44	48	27	26	Sandy Clay Loam
WH-16	3.8	55	34	36	30	Clay Loam
WH-17	3.8	20	15	46	39	Clay
WH-18 (rep 1)	4.4	58	4	43	52	Silty Clay
WH-18 (rep 2)	4.0	58	7	47	47	Silty Clay
WH-19	4.0	56	17	24	59	Silt Loam

Table 2. Concentrations of acid volatile sulfides (μmoles/g), simultaneously extracted metals (SEM in ug/g dry weight), the sum of the molar concentration of SEM, and the sum of the molar concentration of SEM subtracted from the molar concentration of AVS for the sediment samples from Waukegan Harbor.

Sample	AVS	Cd	Cu	Ni	Pb	Zn	∑SEM	∑SEM-AVS
Control	0.31	0.03	0.37	0.07	0.29	0.94	0.02	-0.29
WH-01	8.77	23.5	9.37	11.3	147	202	4.35	-4.42
WH-02	10.2	7.56	18.4	7.38	83.0	124	2.78	-7.42
WH-03	4.41	2.11	16.4	6.27	40.8	68.8	1.63	-2.78
WH-04	8.85	5.17	12.5	6.80	78.6	106	2.36	-6.49
WH-05	5.94	10.8	11.6	6.52	93.0	111	2.54	-3.40
WH-06	9.85	10.7	18.6	7.52	98.9	138	3.10	-6.75
WH-07	4.25	16.3	38.9	9.36	116	146	3.71	-0.54
WH-08	6.55	8.22	20.5	5.78	89.9	102	2.49	-4.06
WH-09	7.09	6.10	12.9	5.23	69.7	85.1	1.98	-5.11
WH-10	8.59	7.87	13.7	6.07	71.6	134	2.78	-5.81
WH-11	10.9	6.50	15.6	5.27	61.8	94.5	2.14	-8.76
WH-11R	10.6	6.77	17.0	5.73	64.4	96.8	2.22	-8.38
WH-12	39.4	6.92	6.68	7.83	77.1	167	3.23	-36.2
WH-13	8.89	7.86	21.3	6.32	83.4	113	2.64	-6.25
WH-14	20.4	8.45	16.0	7.68	84.0	170	3.46	-16.9
WH-15	8.26	6.33	10.5	5.64	82.6	98.3	2.22	-6.04
WH-16	18.5	8.07	19.3	6.92	98.6	144	3.17	-15.3
WH-17	13.8	9.55	17.5	7.74	103	133	3.02	-10.8
WH-18	9.81	12.5	26.8	7.98	111	151	3.51	-6.30
WH-19	16.2	11.6	18.1	8.22	105	150	3.33	-12.9

Table 3. Total metals (ug/g dry weight) concentrations measured in sediment samples from Waukegan Harbor.

Sample	Ag	As	Ba	Cd	Cr	Cu	Fe	Hg	K	Mn	Ni	Pb	Zn
WH-01	<1	43	54	30	145	133	22000	0.50	1400	465	27	188	298
WH-02	<1	20	38	8	56	74	17000	0.18	1600	480	18	80	169
WH-03	<1	11	32	2	28	46	14000	0.10	1300	505	14	45	106
WH-04	<1	22	39	7	57	72	16000	0.18	1800	456	19	98	170
WH-05	<1	22	36	8	59	64	14000	0.19	1300	414	16	84	151
WH-06	<1	25	41	12	72	85	16000	0.20	1200	497	20	112	189
WH-07	<1	33	54	16	96	92	21000	0.21	1700	550	26	119	198
WH-08	<1	20	31	8	51	66	17000	0.14	1000	372	15	93	147
WH-09	<1	14	32	6	40	51	12000	0.12	1000	309	12	64	119
WH-10	<1	31	38	12	70	93	16000	0.24	1200	384	18	117	213
WH-11	<1	20	22	5	32	46	10000	0.12	1000	261	100	49	98
WH-11R	<1	31	32	7	49	68	13000	0.16	1000	320	16	77	148
WH-12	<1	120	43	6	50	228	21000	0.17	1200	447	19	82	202
WH-13	<1	28	37	9	63	82	16000	0.26	1200	426	19	96	178
WH-14	<1	100	53	9	71	170	23000	0.23	1600	492	21	105	255
WH-15	<1	18	29	9	107	57	12000	0.15	1000	341	14	89	143
WH-16	<1	40	43	8	59	148	17000	0.23	1200	353	18	106	262
WH-17	<1	32	37	10	67	96	16000	0.22	1100	402	20	105	185
WH-18	<1	24	40	11	74	87	17000	0.16	1100	490	21	12	200
WH-19	<1	27	42	13	82	98	19000	0.39	1100	540	23	130	220

Table 4. Concentrations (μg/g dry weight) of organochlorine pesticides measured in sediment samples from Waukegan Harbor.

	Sample						
	WH-01	WH-02	WH-03	WH-04	WH-05	WH-06	WH-07
Total PCB's	5.1	NM	6.3	0.87	3.6	5.2	4.7
Aldrin	<0.001	NM	<0.001	<0.001	<0.24	<0.4	<0.36
Dieldrin	<0.019	NM	<0.022	<0.006	<0.019	<0.027	<0.02
Total DDT	<0.100	NM	<0.095	<0.035	<0.076	<0.092	<0.087
p,p'-DDE	<0.075	NM	<0.072	<0.02	<0.056	<0.060	<0.063
p,p'-DDD	<0.016	NM	<0.023	<0.011	<0.013	<0.020	<0.017
p,p'-DDT	<0.01	NM	<0.001	<0.005	<0.007	<0.012	<0.010
Total Chlordane	<0.014	NM	<0.02	<0.005	<0.012	<0.016	<0.014
Chlordane, Cis Isomer	<0.002	NM	<0.002	<0.002	<0.002	<0.002	<0.002
Chlordane, Trans Isomer	<0.014	NM	<0.02	<0.003	<0.012	<0.016	<0.014
Endrin	<0.001	NM	<0.001	<0.001	<0.001	<0.001	<0.001
Methoxychlor	<0.062	NM	<0.038	<0.025	<0.045	<0.050	<0.046
Alpha-BHC	<0.001	NM	<0.001	<0.001	<0.001	<0.001	<0.002
Gamma-BHC (Lindane)	<0.001	NM	<0.001	<0.001	<0.001	<0.001	<0.001
Hexachlorobenzene	<0.001	NM	<0.001	<0.001	<0.001	<0.001	<0.001
Heptachlor	<0.001	NM	<0.001	<0.001	<0.001	<0.001	<0.001
Heptachlor Epoxide	<0.001	NM	<0.001	<0.001	<0.001	<0.001	<0.001

NM=Not measured (sample jar was dropped during analysis)

Table 4. Concentrations (μg/g dry weight) of organochlorine pesticides measured in sediment samples from Waukegan Harbor (continued).

	Sample						
	WH-08	WH-09	WH-10	WH-11	WH-11R	WH-12	WH-13
Total PCB's	4.7	5	3	4.3	5.8	8.9	7.4
Aldrin	<0.34	<0.33	<0.21	<0.33	<0.45	<0.65	<0.52
Dieldrin	<0.021	<0.019	<0.011	<0.028	<0.03	<0.062	<0.078
Total DDT	<0.081	<0.101	<0.07	<0.08,	<0.11	<0.17	<0.17
p,p'-DDE	<0.061	<0.07	<0.04	<0.054	<0.069	<0.098	<0.13
p,p'-DDD	<0.02	<0.018	<0.019	<0.01	<0.015	<0.011	<0.022
p,p'-DDT	<0.01	<0.013	<0.01	<0.016	<0.024	<0.063	<0.014
Total Chlordane	<0.016	<0.015	<0.009	<0.016	<0.02	<0.032	<0.031
Chlordane, Cis Isomer	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Chlordane, Trans Isomer	<0.016	<0.015	<0.009	<0.016	<0.02	<0.032	<0.031
Endrin	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Methoxychlor	<0.044	<0.057	<0.034	<0.035	<0.04	<0.08	<0.064
Alpha-BHC	<0.003	<0.002	<0.001	<0.001	<0.001	<0.001	<0.001
Gamma-BHC (Lindane)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Hexachlorobenzene	<0.001	<0.001	0.0012	<0.001	<0.001	<0.001	<0.001
Heptachlor	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Heptachlor Epoxide	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

Table 4. Concentrations (μg/g dry weight) of organochlorine pesticides measured in sediment samples from Waukegan Harbor (continued).

	Sample					
	WH-14	WH-15	WH-16	WH-17	WH-18	WH-19
Total PCB's	7.7	4.9	7.3	7.3	4.4	5.2
Aldrin	<0.6	<0.37	<0.58	<0.52	<0.32	<0.33
Dieldrin	<0.053	<0.025	<0.045	<0.047	<0.026	<0.028
Total DDT	<0.14	<0.1	<0.13	<0.15	<0.1	<0.12
p,p'-DDE	<0.097	<0.074	<0.084	<0.11	<0.07	<0.084
p,p'-DDD	<0.013	<0.01	<0.012	<0.02	<0.011	<0.014
p,p'-DDT	<0.035	<0.014	<0.037	<0.017	<0.01	<0.023
Total Chlordane	<0.029	<0.02	<0.027	<0.03	<0.017	<0.02
Chlordane, Cis Isomer	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Chlordane, Trans Isomer	<0.029	<0.02	<0.027	<0.03	0.017	<0.02
Endrin	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Methoxychlor	<0.1	<0.054	<0.06	<0.057	<0.055	<0.04
Alpha-BHC	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Gamma-BHC (Lindane)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Hexachlorobenzene	<0.001	<0.001	<0.001	<0.001	<0.001	0.014
Heptachlor	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Heptachlor Epoxide	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

Table 1. Nutrient and metal compounds in surficial sediment from Waukegan Old North Harbor collected in April 1996. Results shown as mg/kg (ppm) unless otherwise noted.

Station / Parameter	QZO-04 C-1	QZO-05 P-02	QZO-06 P-03	QZO-07 P-04	QZO-08 P-05	QZO-09 P-06	QZO-10 P-07	QZO-11 P-08	QZO-12 P-09	QZO-13 P-10	QZO-01 P-11	QZO-01 P-11R	QZO-14 P-12	QZO-03 P-13	QZO-02 P-14	QZO-15 P-15	QZO-16 P-16	QZO-17 P-17	QZO-18 P-18	QZO-19 P-19
Phosphorus-P	914	575	571	668	766	818	796	443	515	715	392	592	521	633	890	532	696	825	905	837
% Volatile Solids	6.1	5.2	4.6	6.1	7.1	7.2	8.3	5.1	5.4	5.6	3.5	5.2	9.2	7.5	13.2	5.9	7.4	7.9	7.7	7.4
Mercury	0.50	0.18	<.10	0.18	0.19	0.20	0.21	0.14	0.12	0.24	0.12	0.16	0.17	0.26	0.23	0.15	0.23	0.22	0.16	0.39
Barium	54	38	32	39	36	41	54	31	32	38	22	32	43	37	53	29	43	37	40	42
Chromium	145	56	28	57	59	72	96	51	40	70	32	49	50	63	71	107	59	67	74	82
Iron	22,000	17,000	14,000	16000	14000	16000	21000	17000	12000	16000	10000	13000	21000	16000	23000	12000	17000	16000	17000	19000
Manganese	465	480	505	456	414	497	550	372	309	384	261	320	447	426	492	341	353	402	490	540
Silver	< 1	< 1	< 1	< 1	< 1	< 1	< 1	<1	<1	< 1	<1	<1	<1	<1	<1	<1	<1	<1	<0.3	<0.3
Kjeldahl-Nitrogen	5,000	4,973	109	4946	2919	1685	3370	939	966	1452	1105	1792	3333	2529	3232	1158	1988	224	4601	2892
Arsenic	43	20	11	22	22	25	33	20	14	31	20	31	120	28	100	18	40	32	24	27
Potassium	1400	1,600	1300	1800	1300	1200	1700	<1000	<1000	1200	<1000	<1000	1200	1200	1600	<1000	1200	1100	1100	1100
Cadmium	30	8	2	7	8	12	16	8	6	12	5	7	6	9	9	9	8	10	11	13
Copper	133	74	46	72	64	85	92	66	51	93	46	68	228	82	170	57	148	96	87	98
Lead	188	80	45	93	64	112	119	93	64	117	49	77	82	96	105	89	106	105	120	130
Nickel	27	18	14	19	16	20	26	15	12	18	10	16	19	19	21	14	18	20	21	23
Zinc	298	169	106	170	151	189	198	147	119	213	98	148	202	178	255	143	262	185	200	220

Source: IEPA, July 1999

Table 2. Organochlorine compounds in surficial sediment from Waukegan Old North Harbor collected in April 1996.
Results for PCBs shown as mg/kg (ppm), all others shown as ug/g (ppm) or ug/kg (ppb) dry weight.

Station / Parameter	QZO-04 C-1	QZO-06 P-03	QZO-07 P-04 (A)	QZO-08 P-05	QZO-09 P-06	QZO-10 P-07	QZO-11 P-08	QZO-12 P-09	QZO-13 P-10	QZO-01 P-11	QZO-01 P-11R	QZO-14 P-12	QZO-03 P-13	QZO-02 P-14	QZO-15 P-15	QZO-16 P-16	QZO-17 P-17	QZO-18 P-18	QZO-19 P-19
Total PCBs mg/kg	5.1	6.3	0.87	3.6	5.2	4.7	4.7	5.0	3.0	4.3	5.8	8.9	7.4	7.7	4.9	7.3	7.3	4.4	5.2
Aldrin ug/kg	<1.0	<1.0	<1.0	<240	<400	<360	<340	<330	<210	<330	<450	<650	<520	<600	<370	<580	<520	<320	<330
Dieldrin ug/kg	<19	<22	<8.0	<19	<27	<20	<21	<19	<11	<28	<30	<62	<78	<53	<25	<45	<47	<26	<28
Total DDT ug/kg	<100	<95	<35	<76	<92	<87	<81	<101	<70	<80	<110	<170	<170	<140	<100	<130	<150	<100	<120
P,P'-DDE ug/kg	<75	<72	<20	<56	<60	<63	<61	<70	<40	<54	<69	<98	<130	<97	<74	<84	<110	<70	<84
P,P'-DDD ug/kg	<16	<23	<11	<13	<20	<17	<20	<18	<19	<10	<15	<11	<22	<13	<10	<12	<20	<11	<14
P,P'-DDT ug/kg	<10	<1.0	<5.0	<7.0	<12	<10	<1.0	<13	<10	<16	<24	<63	<14	<35	<14	<37	<17	<10	<23
Total Chlordane ug/kg	<14	<20	<5.0	<12	<16	<14	<16	<15	<9.0	<16	<20	<32	<31	<29	<20	<27	<30	<17	<20
Chlordane, Cis Isomer ug/kg	< 2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Chlordane, Trans Isomer ug/kg	< 14	<20	<3.0	<12	<16	<14	<16	<15	<9.0	<16	<20	<32	<31	<29	<20	<27	<30	<17	<20
Endrin ug/kg	<1.0	<1.0	<1.0	<1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Methoxychlor ug/kg	<62	<38	<25	<45	<50	<46	<44	<57	<34	< 35	< 40	<80	<64	< 100	<54	< 60	<57	<55	<40
Alpha-BHC ug/kg	<1.0	<1.0	<1.0	<1.0	<1.3	<2.0	<3.0	<2.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Gamma-BHC (Lindane) ug/kg	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Hexachlorobenzene ug/kg	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	1.2	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	14
Heptachlor ug/kg	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Heptachlor Epoxide ug/kg	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Phenol ug/g	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.6	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Bis (2-Chloroethyl) Ether ug/g	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2-Chlorophenol ug/g	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,3-Dichlorobenzene ug/g	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,4-Dichlorobenzene ug/g	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Benzyl Alcohol ug/g	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,2-Dichlorobenzene ug/g	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2-Methylphenol ug/g	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Bis (2-Chloroisopropyl) Ether ug/g	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
4-Methylphenol ug/g	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
N-Nitroso-Di-N-Propylamine ug/g	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Hexachloroethane ug/g	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Nitrobenzene ug/g	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Isophorone ug/g	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2-Nitrophenol ug/g	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2,4-Dimethylphenol ug/g	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Benzoic Acid ug/g	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Bis (2-Chloroethoxy) Methane ug/g	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2,4-Dichlorophenol ug/g	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,2,4-Trichlorobenzene ug/g	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Naphthalene ug/g	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.66	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
4-Chloroaniline ug/g	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Hexachlorobutadiene ug/g	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
4-Chloro-3-Methylphenol ug/g	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2-Methylnapthalene ug/g	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Hexachlorocyclopentadiene ug/g	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2,4,6-Trichlorophenol ug/g	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2,4,5-Trichlorophenol ug/g	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2-Chloronaphthalene ug/g	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2-Nitroaniline ug/g	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Dimethylphthalate ug/g	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Acenaphthylene ug/g	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2,6-Dinitrotoluene ug/g	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
3-Nitroaniline ug/g	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Acenaphthene ug/g	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.69	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2,4-Dinitrophenol ug/g	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
4-Nitrophenol ug/g	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Dibenzofuran ug/g	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2,4-Dinitrotoluene ug/g	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Diethylphthalate ug/g	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
4-Chlorophenyl Phenyl Ether ug/g	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Fluorene ug/g	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.84	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
4-Nitroaniline ug/g	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
4,6-Dinitro-2-Methylphenol ug/g	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
4-Bromophenyl Phenyl Ether ug/g	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Hexachlorobenzene ug/g	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Pentachlorophenol ug/g	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Phenanthrene ug/g	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.2	<0.5	<0.5	2.6	0.56	<0.5	1.8	<0.5	<0.5	0.53	<0.5
Anthracene ug/g	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.75	<0.5	<0.5	0.83	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Di-N-Butylphthalate ug/g	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Fluoranthene ug/g	<0.5	0.60	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.3	<0.5	<0.5	3.1	0.97	<0.5	2.1	0.70	0.58	0.84	<0.5
Pyrene ug/g	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.71	<0.5	<0.5	1.8	0.56	<0.5	1.3	<0.5	<0.5	<0.5	<0.5
Butyl Benzyl Phthalate ug/g	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
3,3'-Dichlorobenzidine ug/g	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo (A) Anthracene ug/g	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.98	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Chrysene ug/g	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.68	<0.5	<0.5	1.7	<0.5	<0.5	0.86	<0.5	<0.5	<0.5	<0.5
Bis (2-Ethylhexyl) Phthalate ug/g	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.80	<0.5	0.58	<0.5	2.8	<0.5	<0.5	<0.5
Di-N-Octylphthalate ug/g	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo (B) Fluoranthene ug/g	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.53	<0.5	<0.5	1.7	0.60	<0.5	1.0	<0.5	<0.5	<0.5	<0.5
Benzo (K) Fluoranthene ug/g	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo (A) Pyrene ug/g	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.64	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Indeno (1,2,3-CD) Pyrene ug/g	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Dibenzo (AH) Anthracene ug/g	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo (GHI) Perylene ug/g	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5

(A) The sample bottle for station QZC-07 (P-07) was found broken at the lab, these results may be suspect.
The [illegible] bottle [illegible] PZO-0[illegible] was broke[illegible] it to the [illegible] fore no [illegible] nalysis ir[illegible].

USEPA 2000
Geotechnical Investigation
(Patrick Engineering, Inc. 2003)

TABLE 1
Summary of Investigation Program

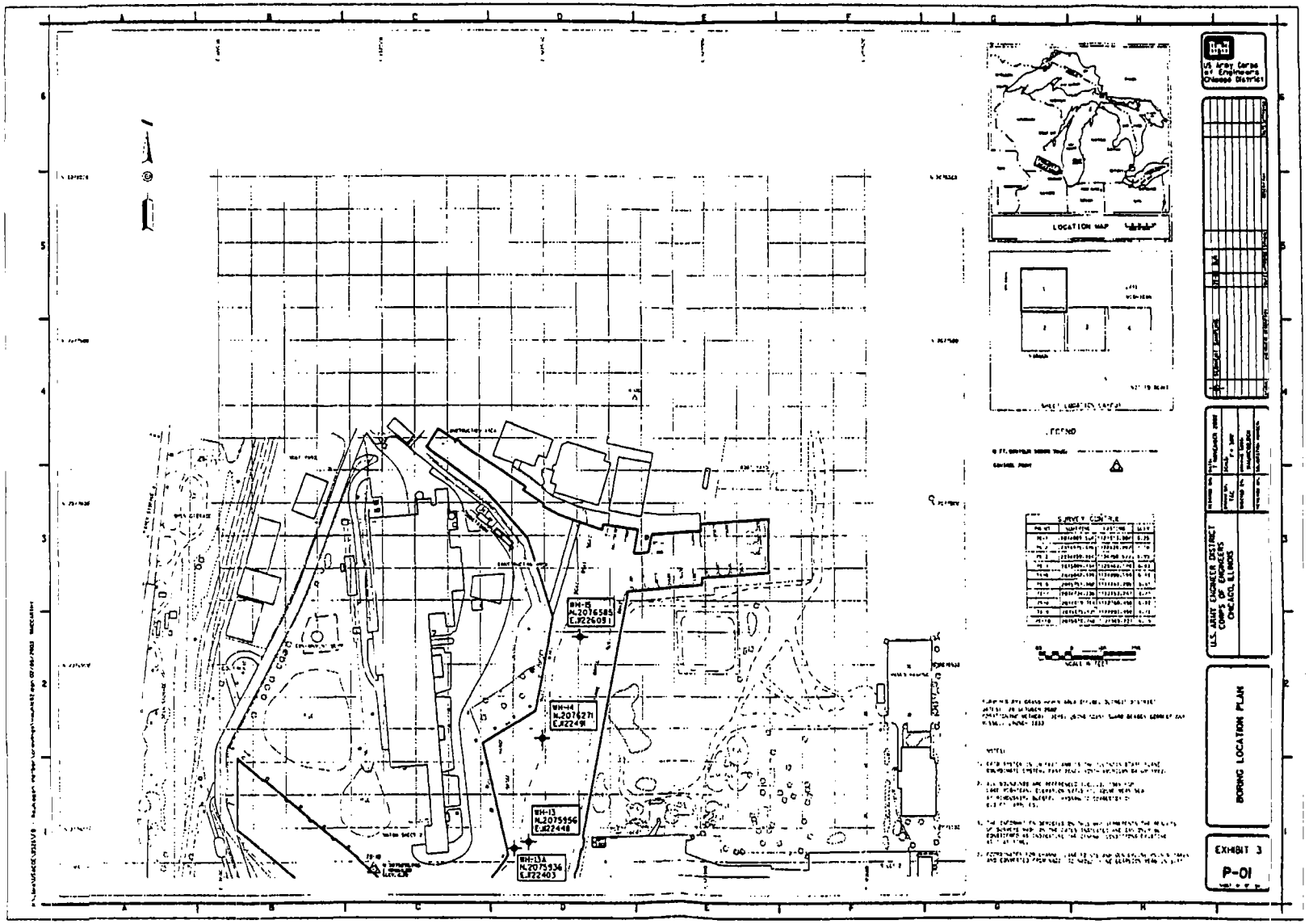
Boring Number	General Location	Investigation Type
WH-01	Approach Channel	Environmental
WH-02	Outer Harbor	Environmental
WH-03	Outer Harbor	Environmental
WH-04	Entrance Channel	Environmental
WH-05	Entrance Channel	Environmental
WH-06	Entrance Channel	Environmental
WH-07	Inner Harbor	Environmental
WH-08	Inner Harbor	Environmental
WH-09	Inner Harbor	Environmental
WH-10	Inner Harbor Extension	Environmental
WH-11	Inner Harbor Extension	Environmental
WH-12	Inner Harbor Extension	Environmental
WH-13	North Harbor	Environmental
WH-14	North Harbor	Environmental
WH-15	North Harbor	Environmental
WHSP-01	Near Inner Harbor	Structural
WHSP-02	West end of South Pier	Structural

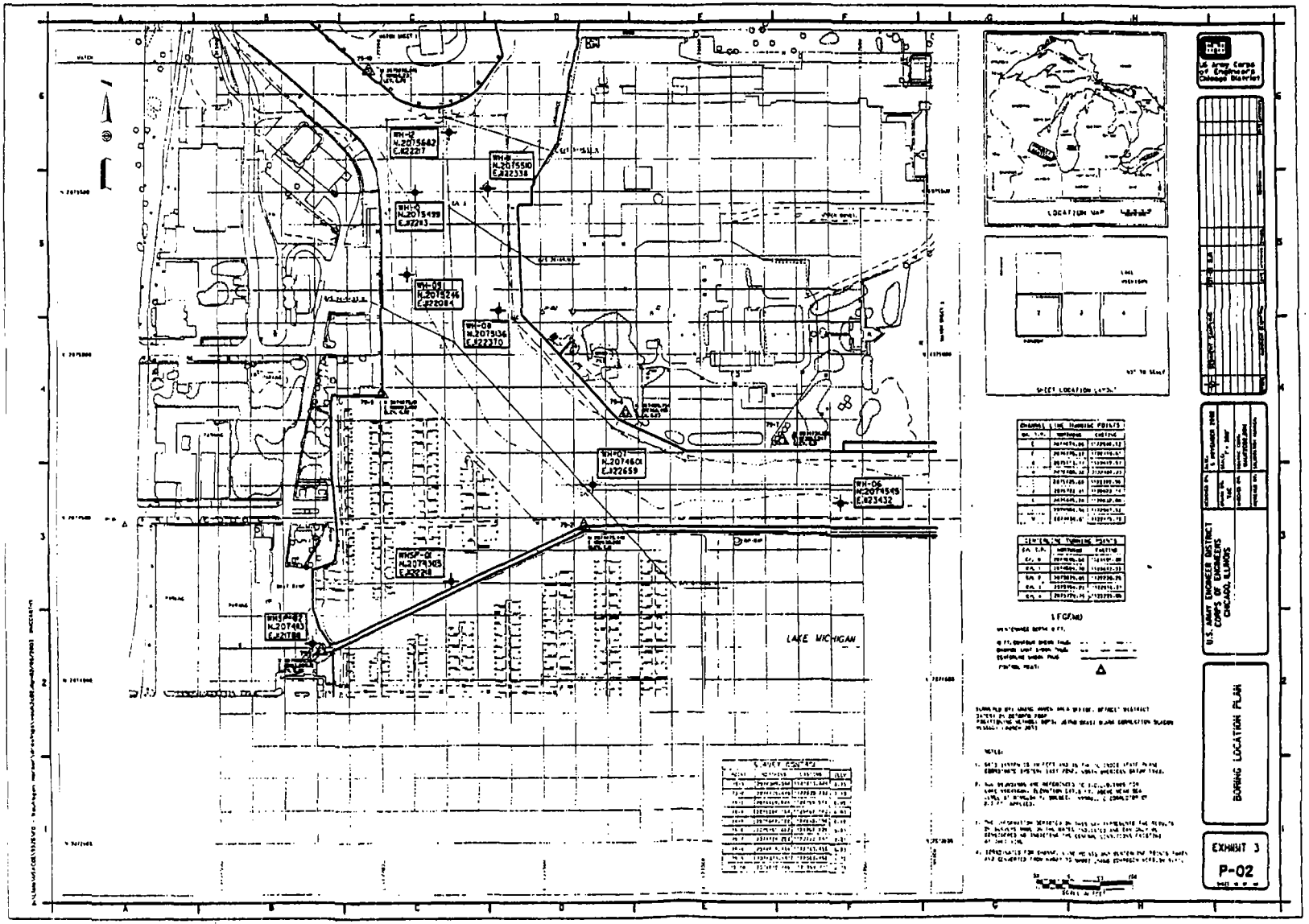
TABLE 2
Soil Boring Summary

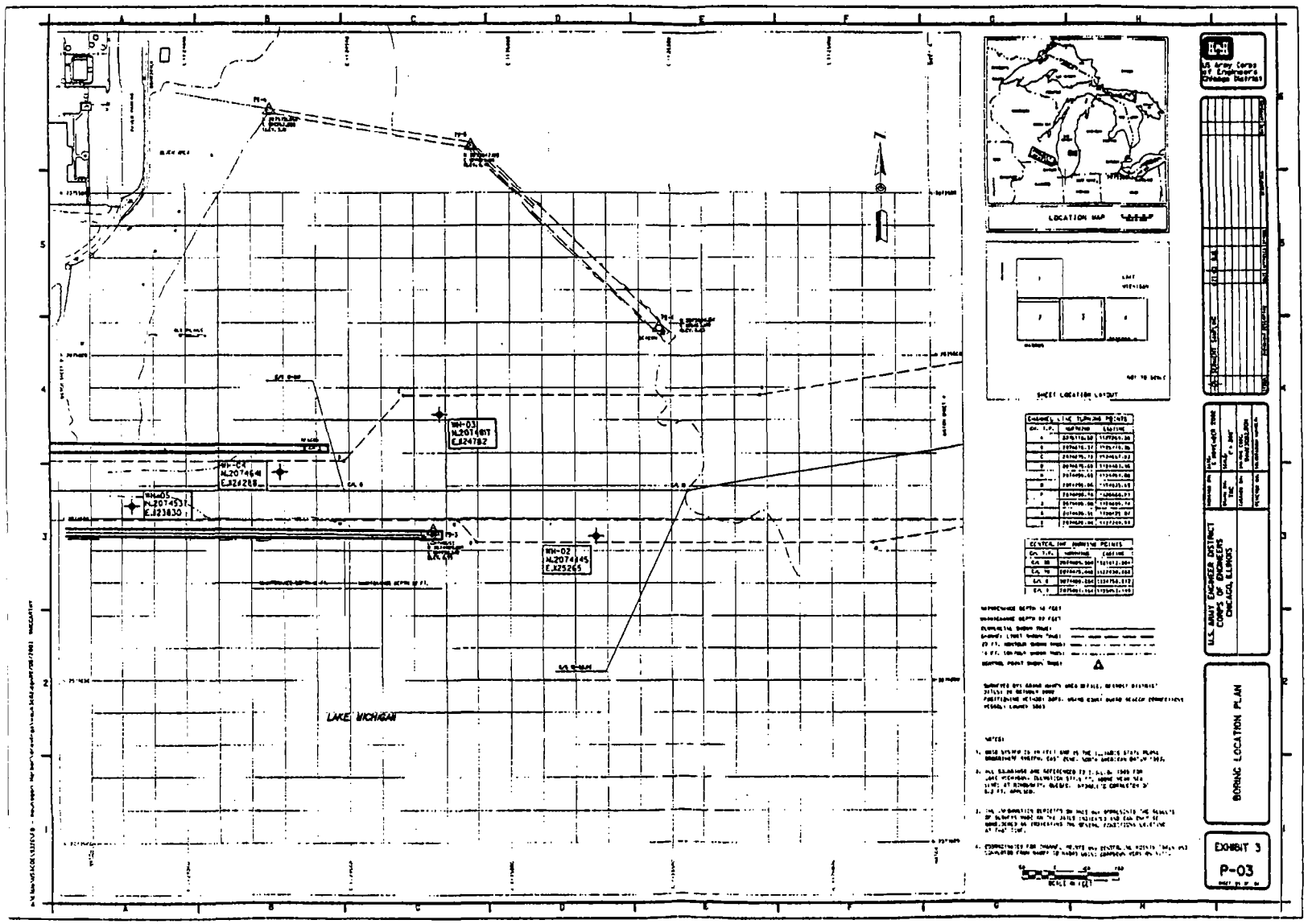
Boring #	NAD 83 As-Drilled Coordinates (state plane) North	East	Surface Elevation IGLD 1985	Surface Elevation LWD	Depth of Water (feet)	Top-of-Lake Bottom Soils (LWD)	Depth to Top-of-Hardpan (feet)	Top-of-Hardpan (LWD)
WH-01	207 4898	112 6546	576.6	-1.2	19	-20.2	35.0	-36.2
WH-02	207 4445	112 5265	576.6	-1.2	14	-15.2	24.0	-25.2
WH-03	207 4817	112 4782	576.8	-1.0	17	-18.0	23.5	-24.5
WH-04	207 4641	112 4288	576.8	-1.0	18.5	-19.5	29.0	-30.0
WH-05	207 4537	112 3830	576.8	-1.0	16.5	-17.5	26.0	-27.0
WH-06	207 4545	112 3432	576.7	-1.1	12	-13.1	21.0	-22.1
WH-07	207 4601	112 2659	576.5	-1.3	18	-19.3	22.0	-23.3
WH-08	207 5136	112 2370	576.7	-1.1	25	-26.1	25.5	-26.6
WH-09	207 5246	112 2084	576.7	-1.1	19	-20.1	25.0	-26.1
WH-10	207 5499	112 2113	576.6	-1.2	21	-22.2	21.1	-22.3
WH-11	207 5510	112 2338	576.7	-1.1	21	-22.1	21.3	-22.4
WH-12	207 5682	112 2217	576.6	-1.2	21	-22.2	21.1	-22.3
~~WH-13~~	207 5956	112 2448	576.8	-1.0	20	-21.0	22.0	-23.0
WH-13A	207 5936	112 2403	576.8	-1.0	22	-23.0	23.0	-24.0
WH-14	207 6271	112 2491	576.7	-1.1	21	-22.1	21.9	~~-23.0~~ -22.1
WH-15	207 6585	112 2609	576.7	-1.1	22	-23.1	22.3	-23.4
WHSP-01	207 4305	112 2218	577.2	-0.6	5	-5.6	14.5	-15.1
WHSP-02	2074122.9	112 1787.7	584.77	6.93	-	-	22.5	-15.6

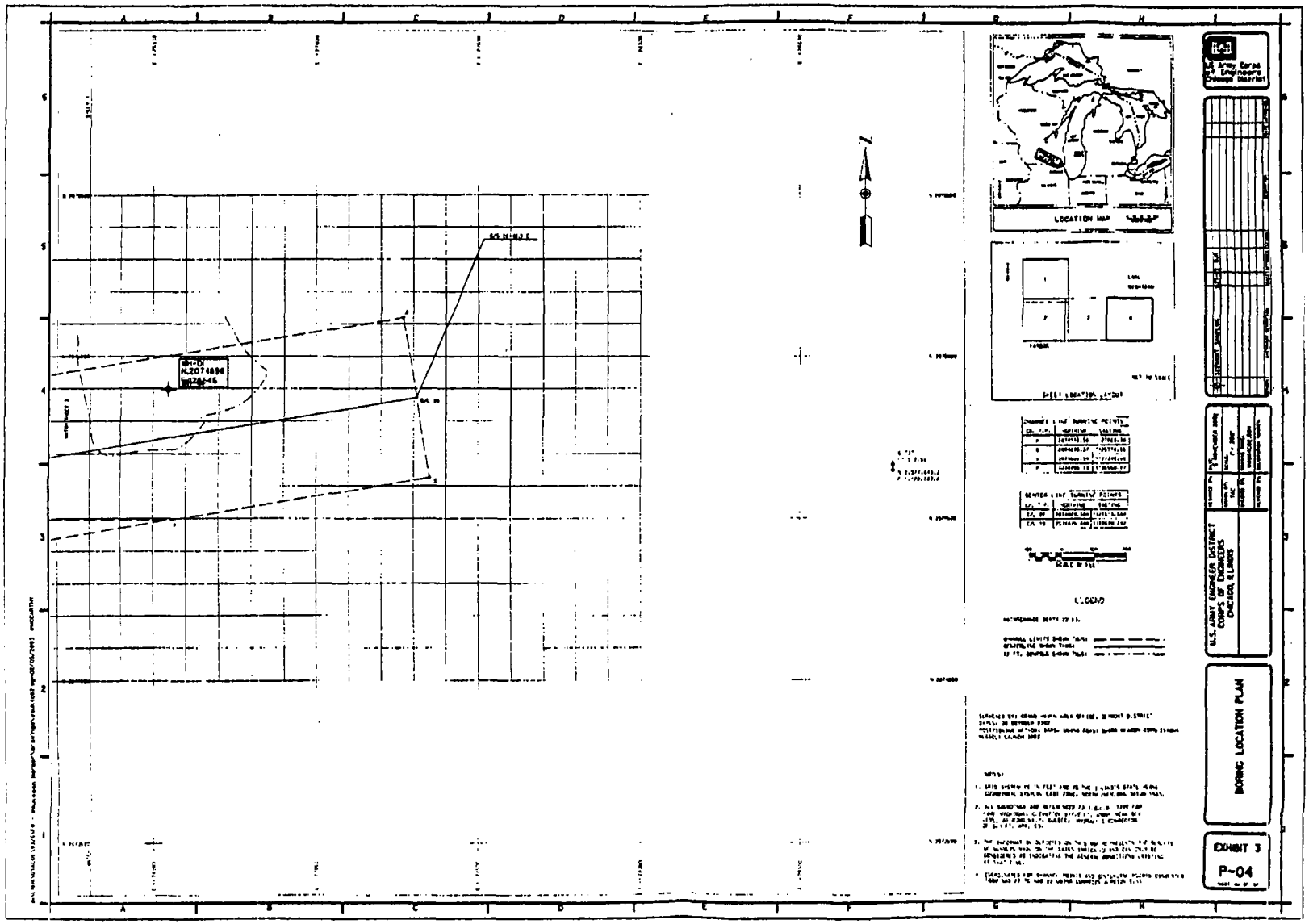
Notes: 1. For borings WH-01 through WH-15, and boring WHSP-01 (offshore borings), horizontal locations were surveyed using a hand-held GPS unit. Survey accuracy is estimated within plus or minus 15 feet. Boring WHSP-02 (onshore boring) was surveyed using industry standard Total Station equipment, and accuracy is estimated within plus or minus 0.1 feet.

2. Surface elevation is based on data obtained from National Ocean Service. Offshore water elevations are average of Lake Michigan elevations at Calumet Harbor and Milwaukee at date and hour of drilling.


BH-15
N.2076585
E.722609
BH-14
N.2076271
E.722498
BH-13
N.2075956
E.722448
BH-13A
N.2075936
E.722403
LOCATION MAP
LEGEND
SURVEY CONTROL
US Army Corps of Engineers Chicago District
U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
CHICAGO, ILLINOIS
BORING LOCATION PLAN
EXHIBIT 3
P-01


LAKE MICHIGAN
LOCATION MAP
SHEET LOCATION
U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
CHICAGO, ILLINOIS
BORING LOCATION PLAN
EXHIBIT 3
P-02


LAKE MICHIGAN
WH-03
N.2074181
E.324782
WH-04
N.2074644
E.324288
WH-05
N.2074531
E.323830
WH-02
N.2074445
E.325265
LOCATION MAP
SHEET LOCATION LAYOUT
U.S. Army Corps of Engineers
Chicago District
U.S. ARMY ENGINEER DISTRICT
CHICAGO, ILLINOIS
BORING LOCATION PLAN
EXHIBIT 3
P-03


LOCATION MAP
SHEET LOCATION LAYOUT
LEGEND
U.S. ARMY EngineerDistrict Chicago
U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
CHICAGO, ILLINOIS
BORING LOCATION PLAN
EXHIBIT 3
P-04

Hole No. WH-01

DRILLING LOG

DIVISION: Lakes and Rivers

INSTALLATION: Chicago District

SHEET 1 OF 2 SHEETS

1. PROJECT	Waukegan Harbor 9326.F0
2. LOCATION (Coordinates or Station)	N 2074898.0 ; E 1126546.0
3. DRILLING AGENCY	Patrick Drilling Inc.
4. HOLE NO. (As shown on drawing title and file number)	WH-01
5. NAME OF DRILLER	Jerry Copak
6. DIRECTION OF HOLE	[X] VERTICAL [ ] INCLINED ____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN	N/A
8. DEPTH DRILLED INTO ROCK	0
9. TOTAL DEPTH OF HOLE	37.0
10. SIZE AND TYPE OF BIT	3 1/4" I.D. HSA
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	LWD
12. MANUFACTURER'S DESIGNATION OF DRILL	CME-75
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED: 3; UNDISTURBED: 0
14. TOTAL NUMBER CORE BOXES	0
15. ELEVATION GROUND WATER	
16. DATE HOLE	STARTED: Jan 16, 03; COMPLETED: Jan 16, 03
17. ELEVATION TOP OF HOLE	-1.2
18. TOTAL CORE RECOVERY FOR BORING	%
19. SIGNATURE OF INSPECTOR	[signature]

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth weathering, etc., if significant) g
-1.2	0		Water			Elevation of Lake Michigan averaged from Calumet Harbor and Milwaukee at date and hour of drilling.
	5					
	10					
	15					Water depth determined using weighted tape measure.
-20.2	19.0		Very loose gray SAND, some silt, saturated SM	38"/60"	SS-1 19.0 24.0	Used 3" x 5' split spoon WOH from 19.0' - 22.0' 20/15/10/10
-21.2	20					

ENG FORM 1836 MAR 71. PREVIOUS EDITIONS ARE OBSOLETE. (modified by GCA 1/94)

PROJECT: Waukegan Harbor 9326.F0 HOLE NO. -WH-01

Hole No. WH-01

DRILLING LOG	DIVISION Lakes and Rivers	INSTALLATION Chicago District	SHEET 2 OF 2 SHEETS

1. PROJECT	Waukegan Harbor 9326.F0
2. LOCATION (Coordinates or Station)	N 2074898.0 ; E 1126546.0
3. DRILLING AGENCY	Patrick Drilling Inc.
4. HOLE NO. (As shown on drawing title and file number)	WH-01
5. NAME OF DRILLER	Jerry Copak
6. DIRECTION OF HOLE	[X] VERTICAL [ ] INCLINED ____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN	N/A
8. DEPTH DRILLED INTO ROCK	0
9. TOTAL DEPTH OF HOLE	37.0
10. SIZE AND TYPE OF BIT	3 1/4" I.D. HSA
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	LWD
12. MANUFACTURER'S DESIGNATION OF DRILL	CME-75
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED 3 / UNDISTURBED 0
14. TOTAL NUMBER CORE BOXES	0
15. ELEVATION GROUND WATER	
16. DATE HOLE	STARTED Jan 16, 03 / COMPLETED Jan 16, 03
17. ELEVATION TOP OF HOLE	-1.2
18. TOTAL CORE RECOVERY FOR BORING	%
19. SIGNATURE OF INSPECTOR	[signature]

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth weathering, etc., if significant) g
-1.2	10		Very loose gray SAND, some silt, saturated SM			
			Medium dense at 22.0'			
				24"/24"	SS-2 24.0 26.0	Used 2" x 24" split spoon 6/8/8/7 N=16
	15					
						Per instruction of COE representative, sampling ceased at 26.0'.
	30					
						Top of silt layer estimated by driller based on equipment response while drilling. Resumed sampling at 35.0'.
-36.2	35.0		Hard, gray SILT, trace coarse to fine sand, moist ML	20"/24"	SS-3 35.0 37.0	Used 2" x 24" split spoon 30/31/33/40 N=64 qu*=4.5 tsf Unconfined compressive strength estimated from visual observation while breaking sample with spade. Pocket penetrometer not used to avoid environmental contamination.
-38.2	37.0		End of Boring at 37.0'			

Hole No. WH-02

DRILLING LOG	DIVISION Lakes and Rivers	INSTALLATION Chicago District	SHEET 1 OF 2 SHEETS

1. PROJECT	Waukegan Harbor 9326.F0
2. LOCATION (Coordinates or Station)	N 2074445.0 ; E 1125265.0
3. DRILLING AGENCY	Patrick Drilling Inc.
4. HOLE NO. (As shown on drawing title and file number)	WH-02
5. NAME OF DRILLER	Jerry Copak
6. DIRECTION OF HOLE	[X] VERTICAL [ ] INCLINED ____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN	N/A
8. DEPTH DRILLED INTO ROCK	0
9. TOTAL DEPTH OF HOLE	25.0
10. SIZE AND TYPE OF BIT	3 1/4" I.D. HSA
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	LWD
12. MANUFACTURER'S DESIGNATION OF DRILL	CME-75
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED 2 / UNDISTURBED 0
14. TOTAL NUMBER CORE BOXES	0
15. ELEVATION GROUND WATER	
16. DATE HOLE	STARTED Jan 16, 03 / COMPLETED Jan 16, 03
17. ELEVATION TOP OF HOLE	-1.2
18. TOTAL CORE RECOVERY FOR BORING	%
19. SIGNATURE OF INSPECTOR	[signature]

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth weathering, etc., if significant) g
-1.2	0		Water			Elevation of Lake Michigan averaged from Calumet Harbor and Milwaukee at date and hour of drilling.
	5					
						Water depth determined using weighted tape measure.
	10					
-15.2	14.0		Loose to medium dense, tan and gray SAND, some silt, saturated SM	38"/60"	SS-1 14.0 19.0	Used 3" x 5' split spoon. WOH from 14.0' - 15.0' 3/3/3/4/5/6/18/50 for 5"
	15					
						Per instruction of COE representative, sampling ceased at 19.0'.
-21.2	20					

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE. (modified by GCA 1/94

PROJECT Waukegan Harbor 9326.F0 | HOLE NO. -WH-02

Hole No. WH-02

DRILLING LOG

DIVISION	Lakes and Rivers
INSTALLATION	Chicago District
SHEET	2 OF 2 SHEETS
1. PROJECT	Waukegan Harbor 9326.F0
2. LOCATION (Coordinates or Station)	N 2074445.0 ; E 1125265.0
3. DRILLING AGENCY	Patrick Drilling Inc.
4. HOLE NO. (As shown on drawing title and file number)	WH-02
5. NAME OF DRILLER	Jerry Copak
6. DIRECTION OF HOLE	[X] VERTICAL [ ] INCLINED ____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN	N/A
8. DEPTH DRILLED INTO ROCK	0
9. TOTAL DEPTH OF HOLE	25.0
10. SIZE AND TYPE OF BIT	3 1/4" I.D. HSA
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	LWD
12. MANUFACTURER'S DESIGNATION OF DRILL	CME-75
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED 2 / UNDISTURBED 0
14. TOTAL NUMBER CORE BOXES	0
15. ELEVATION GROUND WATER	
16. DATE HOLE	STARTED Jan 16, 03 / COMPLETED Jan 16, 03
17. ELEVATION TOP OF HOLE	-1.2
18. TOTAL CORE RECOVERY FOR BORING	%
19. SIGNATURE OF INSPECTOR	

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth weathering, etc., if significant) g
-21.2	20		Medium dense tan and gray SAND, some silt, saturated SM			
			Resumed sampling at 23.0'.	24"/24"	SS-2 23.0 25.0	Resumed sampling at 23.0' Used 2" x 24" split spoon 22/24/28/36 N=52 qu"=4.5+ tsf
-25.2	24.0		Hard gray clayey SILT, trace sand CL-ML			Unconfined compressive strength estimated. Penetrometer not used to avoid contamination.
-26.2	25.0		End of Boring at 25.0'			

Hole No. WH-03

DRILLING LOG

DIVISION	Lakes and Rivers
INSTALLATION	Chicago District
SHEET	1 OF 2 SHEETS
1. PROJECT	Waukegan Harbor 9326.F0
2. LOCATION (Coordinates or Station)	N 2074817.0 ; E 1124782.0
3. DRILLING AGENCY	Patrick Drilling Inc.
4. HOLE NO. (As shown on drawing title and file number)	WH-03
5. NAME OF DRILLER	Jerry Copak
6. DIRECTION OF HOLE	[X] VERTICAL [ ] INCLINED ____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN	N/A
8. DEPTH DRILLED INTO ROCK	0
9. TOTAL DEPTH OF HOLE	24.5
10. SIZE AND TYPE OF BIT	3 1/4" I.D. HSA
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	LWD
12. MANUFACTURER'S DESIGNATION OF DRILL	CME-75
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED 2 / UNDISTURBED 0
14. TOTAL NUMBER CORE BOXES	0
15. ELEVATION GROUND WATER	
16. DATE HOLE	STARTED Jan 16, 03 / COMPLETED Jan 16, 03
17. ELEVATION TOP OF HOLE	-1.0
18. TOTAL CORE RECOVERY FOR BORING	%
19. SIGNATURE OF INSPECTOR	[signature]

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth weathering, etc., if significant) g
-1.0	0		Water			Elevation of Lake Michigan averaged from Calumet Harbor and Milwaukee at date and hour of drilling.
	5					
						Water depth determined using weighted tape measure.
	10					
	15					
-18.0	17.0		Loose to medium dense olive SAND, some silt, saturated SM	23"/60"	SS-1 17.0 22.0	Used 3" x 5' split spoon WOH from 17.0' - 19.0' 4/8/10/10/12/15
-21.0	20					

Hole No. WH-03

DRILLING LOG

DIVISION: Lakes and Rivers

INSTALLATION: Chicago District

SHEET 2 OF 2 SHEETS

1. PROJECT: Waukegan Harbor 9326.F0
2. LOCATION (Coordinates or Station): N 2074817.0 ; E 1124782.0
3. DRILLING AGENCY: Patrick Drilling Inc.
4. HOLE NO. (As shown on drawing title and file number): WH-03
5. NAME OF DRILLER: Jerry Copak
6. DIRECTION OF HOLE: [X] VERTICAL [ ] INCLINED _____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN: N/A
8. DEPTH DRILLED INTO ROCK: 0
9. TOTAL DEPTH OF HOLE: 24.5
10. SIZE AND TYPE OF BIT: 3 1/4" I.D. HSA
11. DATUM FOR ELEVATION SHOWN (TBM or MSL): LWD
12. MANUFACTURER'S DESIGNATION OF DRILL: CME-75
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 2; UNDISTURBED 0
14. TOTAL NUMBER CORE BOXES: 0
15. ELEVATION GROUND WATER:
16. DATE HOLE: STARTED Jan 16, 03; COMPLETED Jan 16, 03
17. ELEVATION TOP OF HOLE: -1.0
18. TOTAL CORE RECOVERY FOR BORING: %
19. SIGNATURE OF INSPECTOR: [signature]

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth weathering, etc., if significant) g
-21.0	20		Loose to medium dense olive SAND, some silt, saturated SM			Per instruction of COE representative, sampling discontinued between 22.0' and 22.5'.
				24"/24"	SS-2 22.5 24.5	Used 2" x 24" split spoon 12/25/31/39 N=56 qu"=4.5+ tsf Unconfined compressive strength estimated. Penetrometer not used to avoid contamination.
-24.5	23.5		Hard gray clayey SILT, trace sand CL-ML			
-25.5	24.5		End of Boring at 24.5'			

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE. (modified by GCA 1/94)

PROJECT: Waukegan Harbor 9326.F0 HOLE NO. -WH-03

Hole No. WH-04

DRILLING LOG

DIVISION	Lakes and Rivers
INSTALLATION	Chicago District
SHEET	1 OF 2 SHEETS
1. PROJECT	Waukegan Harbor 9326.F0
2. LOCATION (Coordinates or Station)	N 2074641.0 ; E 1124288.0
3. DRILLING AGENCY	Patrick Drilling Inc.
4. HOLE NO. (As shown on drawing title and file number)	WH-04
5. NAME OF DRILLER	Jerry Copak
6. DIRECTION OF HOLE	[X] VERTICAL [ ] INCLINED ____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN	N/A
8. DEPTH DRILLED INTO ROCK	0
9. TOTAL DEPTH OF HOLE	30.0
10. SIZE AND TYPE OF BIT	3 1/4" I.D. HSA
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	LWD
12. MANUFACTURER'S DESIGNATION OF DRILL	CME-75
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED 2 / UNDISTURBED 0
14. TOTAL NUMBER CORE BOXES	0
15. ELEVATION GROUND WATER	
16. DATE HOLE	STARTED Jan 16, 03 / COMPLETED Jan 16, 03
17. ELEVATION TOP OF HOLE	-1.0
18. TOTAL CORE RECOVERY FOR BORING	%
19. SIGNATURE OF INSPECTOR	

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth weathering, etc., if significant) g
-1.0	0		Water			Elevation of Lake Michigan averaged from Calumet Harbor and Milwaukee at date and hour of drilling.
	5					
	10					Water depth determined using weighted tape measure.
	15					
-19.5	18.5		Very loose to medium dense gray SAND, some silt, saturated SM	41"/60"	SS-1 18.5 23.5	Used 3" x 5' split spoon WOH from 18.5' - 20.5' 2/2/6/18/17/20
-21.0	20					

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE. (modified by CCA 1/94)

PROJECT Waukegan Harbor 9326.FI | HOLE NO. -WH-04

Hole No. WH-04

DRILLING LOG

DIVISION	Lakes and Rivers
INSTALLATION	Chicago District
SHEET	2 OF 2 SHEETS
1. PROJECT	Waukegan Harbor 9326.F0
2. LOCATION (Coordinates or Station)	N 2074641.0 ; E 1124288.0
3. DRILLING AGENCY	Patrick Drilling Inc.
4. HOLE NO. (As shown on drawing title and file number)	WH-04
5. NAME OF DRILLER	Jerry Copak
6. DIRECTION OF HOLE	[X] VERTICAL [ ] INCLINED _____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN	N/A
8. DEPTH DRILLED INTO ROCK	0
9. TOTAL DEPTH OF HOLE	30.0
10. SIZE AND TYPE OF BIT	3 1/4" I.D. HSA
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	LWD
12. MANUFACTURER'S DESIGNATION OF DRILL	CME-75
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED 2 / UNDISTURBED 0
14. TOTAL NUMBER CORE BOXES	0
15. ELEVATION GROUND WATER	
16. DATE HOLE	STARTED Jan 16, 03 / COMPLETED Jan 16, 03
17. ELEVATION TOP OF HOLE	-1.0
18. TOTAL CORE RECOVERY FOR BORING	%
19. SIGNATURE OF INSPECTOR	[signature]

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth weathering, etc., if significant) g
-21.0	20		Very loose to medium dense gray SAND, some silt, saturated SM			
	25					Per instruction of COE representative, sampling discontinued between 23.5' and 28.0'.
				20"/24"	SS-2 28.0 30.0	Used 2" x 24" split spoon 6/18/40/35 N=58 qu"=4.5+ tsf Unconfined compressive strength estimated. Penetrometer not used to avoid contamination.
-30.0	29.0		Hard gray clayey SILT, trace sand, moist CL-ML			
-31.0	30.0		End of Boring at 30.0'			

Hole No. WH-05

DRILLING LOG

DIVISION	Lakes and Rivers
INSTALLATION	Chicago District
SHEET	1 OF 2 SHEETS
1. PROJECT	Waukegan Harbor 9326.F0
2. LOCATION (Coordinates or Station)	N 2074537.0 ; E 1123830.0
3. DRILLING AGENCY	Patrick Drilling Inc.
4. HOLE NO. (As shown on drawing title and file number)	WH-05
5. NAME OF DRILLER	Jerry Copak
6. DIRECTION OF HOLE	[X] VERTICAL [ ] INCLINED ____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN	N/A
8. DEPTH DRILLED INTO ROCK	0
9. TOTAL DEPTH OF HOLE	28.0
10. SIZE AND TYPE OF BIT	3 1/4" I.D. HSA
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	LWD
12. MANUFACTURER'S DESIGNATION OF DRILL	CME-75
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED 2 / UNDISTURBED 0
14. TOTAL NUMBER CORE BOXES	0
15. ELEVATION GROUND WATER	
16. DATE HOLE	STARTED Jan 16, 03 / COMPLETED Jan 16, 03
17. ELEVATION TOP OF HOLE	-1.0
18. TOTAL CORE RECOVERY FOR BORING	%
19. SIGNATURE OF INSPECTOR	

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth weathering, etc., if significant) g
-1.0	0		Water			Elevation of Lake Michigan averaged from Calumet Harbor and Milwaukee at date and hour of drilling.
	5					
	10					Water depth determined using weighted tape measure.
	15					
-17.5	16.5		Loose to dense gray SAND, some silt, saturated SM	39"/60"	SS-1 16.5 21.5	Used 3" x5' split spoon WOH from 16.5' - 18.0' 1/7/9/13/17/20/20
-21.0	20					

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE. (modified by GCA 1/94)

PROJECT Waukegan Harbor 9326.FI | HOLE NO. -WH-05

Hole No. WH-05

DRILLING LOG

DIVISION	Lakes and Rivers
INSTALLATION	Chicago District
SHEET	2 OF 2 SHEETS
1. PROJECT	Waukegan Harbor 9326.F0
2. LOCATION (Coordinates or Station)	N 2074537.0 ; E 1123830.0
3. DRILLING AGENCY	Patrick Drilling Inc.
4. HOLE NO. (As shown on drawing title and file number)	WH-05
5. NAME OF DRILLER	Jerry Copak
6. DIRECTION OF HOLE	[X] VERTICAL [ ] INCLINED ____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN	N/A
8. DEPTH DRILLED INTO ROCK	0
9. TOTAL DEPTH OF HOLE	28.0
10. SIZE AND TYPE OF BIT	3 1/4" I.D. HSA
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	LWD
12. MANUFACTURER'S DESIGNATION OF DRILL	CME-75
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED 2 / UNDISTURBED 0
14. TOTAL NUMBER CORE BOXES	0
15. ELEVATION GROUND WATER	
16. DATE HOLE	STARTED Jan 16, 03 / COMPLETED Jan 16, 03
17. ELEVATION TOP OF HOLE	-1.0
18. TOTAL CORE RECOVERY FOR BORING	%
19. SIGNATURE OF INSPECTOR	

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth weathering, etc., if significant) g
-21.0	20		Loose to dense gray SAND, some silt, saturated SM			
						Per instruction of COE representative, sampling discontinued between 21.5' and 26.0'.
	25					
-27.0	26.0		Hard gray clayey SILT, trace sand, moist CL-ML	18"/24"	SS-2 26.0 28.0	Used 2" x 24" split spoon 17/30/36/38 N=66 qu"=4.5+ tsf Unconfined compressive strength estimated. Penetrometer not used to avoid contamination.
-29.0	28.0		End of Boring at 28.0'			

Hole No. WH-06

DRILLING LOG

DIVISION	Lakes and Rivers
INSTALLATION	Chicago District
SHEET	1 OF 2 SHEETS
1. PROJECT	Waukegan Harbor 9326.F0
2. LOCATION (Coordinates or Station)	N 2074545.0 ; E 1123432.0
3. DRILLING AGENCY	Patrick Drilling Inc.
4. HOLE NO. (As shown on drawing title and file number)	WH-06
5. NAME OF DRILLER	Jerry Copak
6. DIRECTION OF HOLE	[X] VERTICAL [ ] INCLINED _____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN	N/A
8. DEPTH DRILLED INTO ROCK	0
9. TOTAL DEPTH OF HOLE	23.0
10. SIZE AND TYPE OF BIT	3 1/4" I.D. HSA
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	LWD
12. MANUFACTURER'S DESIGNATION OF DRILL	CME-75
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED 2 / UNDISTURBED 0
14. TOTAL NUMBER CORE BOXES	0
15. ELEVATION GROUND WATER	
16. DATE HOLE	STARTED Jan 16, 03 / COMPLETED Jan 16, 03
17. ELEVATION TOP OF HOLE	-1.1
18. TOTAL CORE RECOVERY FOR BORING	%
19. SIGNATURE OF INSPECTOR	[signature]

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth weathering, etc., if significant) g
-1.1	0		Water			Elevation of Lake Michigan averaged from Calumet Harbor and Milwaukee at date and hour of drilling.
	5					
						Water depth determined using weighted tape measure.
	10					
-13.1	12.0		Loose to dense gray SAND, some silt, saturated SM	30"/60"	SS-1 12.0 17.0	Used 3" x 5' split spoon WOH from 12.0' - 14.0' 4/4/11/15/16/15
	15					
						Per instruction of COE representative, sampling discontinued between 17.0' and 21.0'.
-21.1	20					

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE. (modified by GCA 1/94

PROJECT Waukegan Harbor 9326.F1 HOLE NO. -WH-06

Hole No. WH-06

DRILLING LOG

DIVISION	Lakes and Rivers
INSTALLATION	Chicago District
SHEET	2 OF 2 SHEETS
1. PROJECT	Waukegan Harbor 9326.F0
2. LOCATION (Coordinates or Station)	N 2074545.0 ; E 1123432.0
3. DRILLING AGENCY	Patrick Drilling Inc.
4. HOLE NO. (As shown on drawing title and file number)	WH-06
5. NAME OF DRILLER	Jerry Copak
6. DIRECTION OF HOLE	[X] VERTICAL [ ] INCLINED ____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN	N/A
8. DEPTH DRILLED INTO ROCK	0
9. TOTAL DEPTH OF HOLE	23.0
10. SIZE AND TYPE OF BIT	3 1/4" I.D. HSA
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	LWD
12. MANUFACTURER'S DESIGNATION OF DRILL	CME-75
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED 2 / UNDISTURBED 0
14. TOTAL NUMBER CORE BOXES	0
15. ELEVATION GROUND WATER	
16. DATE HOLE	STARTED Jan 16, 03 / COMPLETED Jan 16, 03
17. ELEVATION TOP OF HOLE	-1.1
18. TOTAL CORE RECOVERY FOR BORING	%
19. SIGNATURE OF INSPECTOR	

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth weathering, etc., if significant) g
-21.1	20					
-22.1	21.0					
			Hard gray clayey SILT, trace sand, wet ML-CL	12"/24"	SS-2 21.0 23.0	Used 2" x 24" split spoon 13/29/25/30 N=54 qu**=4.5+ tsf Unconfined compressive strength estimated. Penetrometer not used to avoid contamination.
-24.1	23.0					
			End of Boring at 23.0'			

Hole No. WH-07

DRILLING LOG	DIVISION Lakes and Rivers	INSTALLATION Chicago District	SHEET 1 OF 2 SHEETS

1. PROJECT	Waukegan Harbor 9326.F0
2. LOCATION (Coordinates or Station)	N 2074601.0 ; E 1122659.0
3. DRILLING AGENCY	Patrick Drilling Inc.
4. HOLE NO. (As shown on drawing title and file number)	WH-07
5. NAME OF DRILLER	Jerry Copak
6. DIRECTION OF HOLE	[X] VERTICAL [ ] INCLINED ____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN	N/A
8. DEPTH DRILLED INTO ROCK	0
9. TOTAL DEPTH OF HOLE	23.0
10. SIZE AND TYPE OF BIT	3 1/4" I.D. HSA
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	LWD
12. MANUFACTURER'S DESIGNATION OF DRILL	CME-75
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED 1 / UNDISTURBED 0
14. TOTAL NUMBER CORE BOXES	0
15. ELEVATION GROUND WATER	
16. DATE HOLE	STARTED Jan 16, 03 / COMPLETED Jan 16, 03
17. ELEVATION TOP OF HOLE	-1.3
18. TOTAL CORE RECOVERY FOR BORING	%
19. SIGNATURE OF INSPECTOR	[signature]

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth weathering, etc., if significant) g
-1.3	0		Water			Elevation of Lake Michigan averaged from Calumet Harbor and Milwaukee at date and hour of drilling.
	5					
						Water depth determined using weight tape measure.
	10					
	15					
-19.3	18.0		Very loose gray SILT, some sand, saturated ML	48"/60"	SS-1 18.0 23.0	Used 3" x 5' split spoon WOH for 4.0' 6/14
-21.3	20					

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE. (modified by GCA 1/94)

PROJECT Waukegan Harbor 9326.F1 | HOLE NO. -WH-07

Hole No. WH-07

DRILLING LOG

DIVISION	Lakes and Rivers
INSTALLATION	Chicago District
SHEET	2 OF 2 SHEETS
1. PROJECT	Waukegan Harbor 9326.F0
2. LOCATION (Coordinates or Station)	N 2074601.0 ; E 1122659.0
3. DRILLING AGENCY	Patrick Drilling Inc.
4. HOLE NO. (As shown on drawing title and file number)	WH-07
5. NAME OF DRILLER	Jerry Copak
6. DIRECTION OF HOLE	[X] VERTICAL [ ] INCLINED _____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN	N/A
8. DEPTH DRILLED INTO ROCK	0
9. TOTAL DEPTH OF HOLE	23.0
10. SIZE AND TYPE OF BIT	3 1/4" I.D. HSA
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	LWD
12. MANUFACTURER'S DESIGNATION OF DRILL	CME-75
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED 1 / UNDISTURBED 0
14. TOTAL NUMBER CORE BOXES	0
15. ELEVATION GROUND WATER	
16. DATE HOLE	STARTED Jan 16, 03 / COMPLETED Jan 16, 03
17. ELEVATION TOP OF HOLE	-1.3
18. TOTAL CORE RECOVERY FOR BORING	%
19. SIGNATURE OF INSPECTOR	[signature]

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth weathering, etc., if significant) g
-21.3	20		Very loose gray SILT, some sand, saturated ML			Unconfined compressive strength estimated. Penetrometer not used to avoid contamination. qu*=4.5+ tsf Sufficient sample 2" spoon not driven
-23.3	22.0		Hard gray clayey SILT, trace sand, moist CL-ML			
-24.3	23.0		End of Boring at 23.0'			

Hole No. WH-08

DRILLING LOG

DIVISION	Lakes and Rivers
INSTALLATION	Chicago District
SHEET	1 OF 2 SHEETS
1. PROJECT	Waukegan Harbor 9326.F0
2. LOCATION (Coordinates or Station)	N 2075136.0 ; E 1122370.0
3. DRILLING AGENCY	Patrick Drilling Inc.
4. HOLE NO. (As shown on drawing title and file number)	WH-08
5. NAME OF DRILLER	Jerry Copak
6. DIRECTION OF HOLE	[X] VERTICAL [ ] INCLINED ____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN	N/A
8. DEPTH DRILLED INTO ROCK	0
9. TOTAL DEPTH OF HOLE	26.5
10. SIZE AND TYPE OF BIT	3 1/4" I.D. HSA
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	LWD
12. MANUFACTURER'S DESIGNATION OF DRILL	CME-75
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED 1 / UNDISTURBED 0
14. TOTAL NUMBER CORE BOXES	0
15. ELEVATION GROUND WATER	
16. DATE HOLE	STARTED Jan 15, 03 / COMPLETED Jan 15, 03
17. ELEVATION TOP OF HOLE	-1.1
18. TOTAL CORE RECOVERY FOR BORING	%
19. SIGNATURE OF INSPECTOR	[signature]

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth weathering, etc., if significant) g
-1.1	0		Water			Boring offset approximately 130.0' north and 95.0' west due to water intake tunnel.
						Elevation of Lake Michigan averaged from Calumet Harbor and Milwaukee at date and hour of drilling.
	5					
						Water depth determined using weighted tape measure.
	10					
	15					
-21.1	20					

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE. (modified by GCA 1/94

PROJECT Waukegan Harbor 9326.F0 | HOLE NO. -WH-08

Hole No. WH-08

DRILLING LOG

DIVISION	Lakes and Rivers
INSTALLATION	Chicago District
SHEET	2 OF 2 SHEETS
1. PROJECT	Waukegan Harbor 9326.F0
2. LOCATION (Coordinates or Station)	N 2075136.0 ; E 1122370.0
3. DRILLING AGENCY	Patrick Drilling Inc.
4. HOLE NO. (As shown on drawing title and file number)	WH-08
5. NAME OF DRILLER	Jerry Copak
6. DIRECTION OF HOLE	[X] VERTICAL [ ] INCLINED ____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN	N/A
8. DEPTH DRILLED INTO ROCK	0
9. TOTAL DEPTH OF HOLE	26.5
10. SIZE AND TYPE OF BIT	3 1/4" I.D. HSA
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	LWD
12. MANUFACTURER'S DESIGNATION OF DRILL	CME-75
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED 1 / UNDISTURBED 0
14. TOTAL NUMBER CORE BOXES	0
15. ELEVATION GROUND WATER	
16. DATE HOLE	STARTED Jan 15, 03 / COMPLETED Jan 15, 03
17. ELEVATION TOP OF HOLE	-1.1
18. TOTAL CORE RECOVERY FOR BORING	%
19. SIGNATURE OF INSPECTOR	[signature]

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth weathering, etc., if significant) g
-21.1	20		Water			
-26.1	25.0					
-26.6	25.5		Very loose gray SILT, some sand, saturated ML	18"/24"	SS-1 25.0	Used 2" x 24" split spoon 0/20/25
			Hard grayey clayey SILT, trace sand, moist CL-ML		26.5	N=45 Unconfined compressive strength estimated. Penetrometer not used to avoid contamination. qu"=4.5+ tsf
-27.6	26.5		End of Boring at 26.5'			

Hole No. WH-09

DRILLING LOG

DIVISION	Lakes and Rivers
INSTALLATION	Chicago District
SHEET	1 OF 2 SHEETS
1. PROJECT	Waukegan Harbor 9326.F0
2. LOCATION (Coordinates or Station)	N 2075246.0 ; E 1122084.0
3. DRILLING AGENCY	Patrick Drilling Inc.
4. HOLE NO. (As shown on drawing title and file number)	WH-09
5. NAME OF DRILLER	Jerry Copak
6. DIRECTION OF HOLE	[X] VERTICAL [ ] INCLINED ____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN	N/A
8. DEPTH DRILLED INTO ROCK	0
9. TOTAL DEPTH OF HOLE	25.5
10. SIZE AND TYPE OF BIT	3 1/4" I.D. HSA
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	LWD
12. MANUFACTURER'S DESIGNATION OF DRILL	CME-75
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED 2 / UNDISTURBED 0
14. TOTAL NUMBER CORE BOXES	0
15. ELEVATION GROUND WATER	
16. DATE HOLE	STARTED Jan 15, 03 / COMPLETED Jan 15, 03
17. ELEVATION TOP OF HOLE	-1.1
18. TOTAL CORE RECOVERY FOR BORING	%
19. SIGNATURE OF INSPECTOR	

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth weathering, etc., if significant) g
-1.1	0		Water			Elevation of Lake Michigan averaged from Calumet Harbor and Milwaukee at date and hour of drilling.
	5					Water depth determined using weighted tape measure.
	10					
	15					
-20.1	19.0		Loose gray SILT, some sand, saturated ML	60"/60"	SS-1 19.0 24.0	Used 3" x 5' split spoon WOH from 19.0' - 24.0'
-21.1	20					

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE. (modified by GCA 1/94)

PROJECT Waukegan Harbor 9326.F1 HOLE NO. -WH-09

Hole No. WH-09

DRILLING LOG

DIVISION	Lakes and Rivers
INSTALLATION	Chicago District
SHEET	2 OF 2 SHEETS
1. PROJECT	Waukegan Harbor 9326.F0
2. LOCATION (Coordinates or Station)	N 2075246.0 ; E 1122084.0
3. DRILLING AGENCY	Patrick Drilling Inc.
4. HOLE NO. (As shown on drawing title and file number)	WH-09
5. NAME OF DRILLER	Jerry Copak
6. DIRECTION OF HOLE	[X] VERTICAL [ ] INCLINED ____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN	N/A
8. DEPTH DRILLED INTO ROCK	0
9. TOTAL DEPTH OF HOLE	25.5
10. SIZE AND TYPE OF BIT	3 1/4" I.D. HSA
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	LWD
12. MANUFACTURER'S DESIGNATION OF DRILL	CME-75
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED 2 / UNDISTURBED 0
14. TOTAL NUMBER CORE BOXES	0
15. ELEVATION GROUND WATER	
16. DATE HOLE	STARTED Jan 15, 03 / COMPLETED Jan 15, 03
17. ELEVATION TOP OF HOLE	-1.1
18. TOTAL CORE RECOVERY FOR BORING	%
19. SIGNATURE OF INSPECTOR	[signature]

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth weathering, etc., if significant) g
-21.1	20		Loose gray SILT, some sand, saturated ML			
				18"/18"	SS-2	Used 2" x 24" split spoon
					24.0	0/15/20
					25.5	N=35
-26.1	25.0					Unconfined compressive strength estimated. Penetrometer not used to avoid contamination.
			Hard gray clayey SILT, trace sand, moist CL-ML			
-26.6	25.5					qu*=4.5+ tsf
			End of Boring at 25.5'			

Hole No. WH-10

DRILLING LOG	DIVISION Lakes and Rivers	INSTALLATION Chicago District	SHEET 1 OF 2 SHEETS

1. PROJECT Waukegan Harbor 9326.F0	10. SIZE AND TYPE OF BIT 3 1/4" I.D. HSA
2. LOCATION (Coordinates or Station) N 2075499.0 ; E 1122113.0	11. DATUM FOR ELEVATION SHOWN (TBM or MSL) LWD
3. DRILLING AGENCY Patrick Drilling Inc.	12. MANUFACTURER'S DESIGNATION OF DRILL CME-75
4. HOLE NO. (As shown on drawing title and file number) WH-10	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 1; UNDISTURBED 0
5. NAME OF DRILLER Jerry Copak	14. TOTAL NUMBER CORE BOXES 0
6. DIRECTION OF HOLE [X] VERTICAL [ ] INCLINED ____ DEG. FROM VERT.	15. ELEVATION GROUND WATER
	16. DATE HOLE: STARTED Jan 15, 03; COMPLETED Jan 15, 03
7. THICKNESS OF OVERBURDEN N/A	17. ELEVATION TOP OF HOLE -1.2
8. DEPTH DRILLED INTO ROCK 0	18. TOTAL CORE RECOVERY FOR BORING %
9. TOTAL DEPTH OF HOLE 22.0	19. SIGNATURE OF INSPECTOR [signature]

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth weathering, etc., if significant) g
-1.2	0		Water			Elevation of Lake Michigan averaged from Calumet Harbor and Milwaukee at date and hour of drilling.
	5					
						Water depth determined using weighted tape measure.
	10					
	15					
-21.2	20					

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE. (modified by GCA 1/94)

PROJECT Waukegan Harbor 9326.F1 | HOLE NO. -WH-10

Hole No. WH-10

DRILLING LOG

DIVISION	Lakes and Rivers
INSTALLATION	Chicago District
SHEET	2 OF 2 SHEETS
1. PROJECT	Waukegan Harbor 9326.F0
2. LOCATION (Coordinates or Station)	N 2075499.0 ; E 1122113.0
3. DRILLING AGENCY	Patrick Drilling Inc.
4. HOLE NO. (As shown on drawing title and file number)	WH-10
5. NAME OF DRILLER	Jerry Copak
6. DIRECTION OF HOLE	[X] VERTICAL [ ] INCLINED _____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN	N/A
8. DEPTH DRILLED INTO ROCK	0
9. TOTAL DEPTH OF HOLE	22.0
10. SIZE AND TYPE OF BIT	3 1/4" I.D. HSA
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	LWD
12. MANUFACTURER'S DESIGNATION OF DRILL	CME-75
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED 1 / UNDISTURBED 0
14. TOTAL NUMBER CORE BOXES	0
15. ELEVATION GROUND WATER	
16. DATE HOLE	STARTED Jan 15, 03 / COMPLETED Jan 15, 03
17. ELEVATION TOP OF HOLE	-1.2
18. TOTAL CORE RECOVERY FOR BORING	%
19. SIGNATURE OF INSPECTOR	[signature]

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth weathering, etc., if significant) g
-21.2	20					
-22.2	21.0					
-22.3	21.1		Gray SAND and gravel, trace silt SW	12/18"	SS-1 21.0	Used 2" x 24" split spoon 10/ 50 for 6"
-23.2	22.0		Hard gray clayey SILT, trace sand and gravel, moist CL-ML		22.0	Unconfined compressive strength estimated. Penetrometer not used to avoid contamination. qu'=4.5+ tsf
			End of Boring at 22.0'			

Hole No. WH-11

DRILLING LOG	DIVISION Lakes and Rivers	INSTALLATION Chicago District	SHEET 1 OF 2 SHEETS

1. PROJECT Waukegan Harbor 9326.F0	10. SIZE AND TYPE OF BIT 3 1/4" I.D. HSA
2. LOCATION (Coordinates or Station) N 2075510.0 ; E 1122338.0	11. DATUM FOR ELEVATION SHOWN (TBM or MSL) LWD
3. DRILLING AGENCY Patrick Drilling Inc.	12. MANUFACTURER'S DESIGNATION OF DRILL CME-75
4. HOLE NO. (As shown on drawing title and file number) WH-11	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 1; UNDISTURBED 0
5. NAME OF DRILLER Jerry Copak	14. TOTAL NUMBER CORE BOXES 0
6. DIRECTION OF HOLE [X] VERTICAL [ ] INCLINED ____ DEG. FROM VERT.	15. ELEVATION GROUND WATER
	16. DATE HOLE: STARTED Jan 15, 03; COMPLETED Jan 15, 03
7. THICKNESS OF OVERBURDEN N/A	17. ELEVATION TOP OF HOLE -1.1
8. DEPTH DRILLED INTO ROCK 0	18. TOTAL CORE RECOVERY FOR BORING %
9. TOTAL DEPTH OF HOLE 22.5	19. SIGNATURE OF INSPECTOR

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth weathering, etc., if significant) g
-1.1	0		Water			Elevation of Lake Michigan averaged from Calumet Harbor and Milwaukee at date and hour of drilling.
	5					Water depth determined using weighted tape measure.
	10					
	15					
-21.1	20					

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE. (modified by GCA 1/94)

PROJECT Waukegan Harbor 9326.FI | HOLE NO. -WH-11

Hole No. WH-11

DRILLING LOG

DIVISION	Lakes and Rivers
INSTALLATION	Chicago District
SHEET	2 OF 2 SHEETS
1. PROJECT	Waukegan Harbor 9326.F0
2. LOCATION (Coordinates or Station)	N 2075510.0 ; E 1122338.0
3. DRILLING AGENCY	Patrick Drilling Inc.
4. HOLE NO. (As shown on drawing title and file number)	WH-11
5. NAME OF DRILLER	Jerry Copak
6. DIRECTION OF HOLE	[X] VERTICAL [ ] INCLINED ____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN	N/A
8. DEPTH DRILLED INTO ROCK	0
9. TOTAL DEPTH OF HOLE	22.5
10. SIZE AND TYPE OF BIT	3 1/4" I.D. HSA
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	LWD
12. MANUFACTURER'S DESIGNATION OF DRILL	CME-75
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED 1 / UNDISTURBED 0
14. TOTAL NUMBER CORE BOXES	0
15. ELEVATION GROUND WATER	
16. DATE HOLE	STARTED Jan 15, 03 / COMPLETED Jan 15, 03
17. ELEVATION TOP OF HOLE	-1.1
18. TOTAL CORE RECOVERY FOR BORING	%
19. SIGNATURE OF INSPECTOR	[signature]

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth weathering, etc., if significant) g
-21.1	20		Water			
-22.1	21.0					
-22.4	21.3		Medium dense gray SAND, some silt, trace gravel, saturated SW	16"/18"	SS-1 21.0 22.5	Used 2" x 24" split spoon 12/38/50 for 5" N=88+ Unconfined compressive strength estimated. Penetrometer not used to avoid contamination. qu*=4.5+ tsf
			Hard gray clayey SILT, trace sand, moist CL-ML			
-23.6	22.5		End of Boring at 22.5'			

Hole No. WH-12

DRILLING LOG

DIVISION	Lakes and Rivers
INSTALLATION	Chicago District
SHEET	1 OF 2 SHEETS
1. PROJECT	Waukegan Harbor 9326.F0
2. LOCATION (Coordinates or Station)	N 2075682.0 ; E 1122217.0
3. DRILLING AGENCY	Patrick Drilling Inc.
4. HOLE NO. (As shown on drawing title and file number)	WH-12
5. NAME OF DRILLER	Jerry Copak
6. DIRECTION OF HOLE	[X] VERTICAL [ ] INCLINED _____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN	N/A
8. DEPTH DRILLED INTO ROCK	0
9. TOTAL DEPTH OF HOLE	22.0
10. SIZE AND TYPE OF BIT	3 1/4" I.D. HSA
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	LWD
12. MANUFACTURER'S DESIGNATION OF DRILL	CME-75
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED: 1; UNDISTURBED: 0
14. TOTAL NUMBER CORE BOXES	0
15. ELEVATION GROUND WATER	
16. DATE HOLE	STARTED: Jan 15, 03; COMPLETED: Jan 15, 03
17. ELEVATION TOP OF HOLE	-1.2
18. TOTAL CORE RECOVERY FOR BORING	%
19. SIGNATURE OF INSPECTOR	

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth weathering, etc., if significant) g
-1.2	0		Water			Elevation of Lake Michigan averaged from Calumet Harbor and Milwaukee at date and hour of drilling.
	5					
						Water depth determined using weighted tape measure.
	10					
	15					
-21.2	20					

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE. Modified by GCA 1/94

PROJECT: Waukegan Harbor 9326.F0 HOLE NO. WH-12

Hole No. WH-12

DRILLING LOG

DIVISION	Lakes and Rivers
INSTALLATION	Chicago District
SHEET	2 OF 2 SHEETS
1. PROJECT	Waukegan Harbor 9326.F0
2. LOCATION (Coordinates or Station)	N 2075682.0 ; E 1122217.0
3. DRILLING AGENCY	Patrick Drilling Inc.
4. HOLE NO. (As shown on drawing title and file number)	WH-12
5. NAME OF DRILLER	Jerry Copak
6. DIRECTION OF HOLE	[X] VERTICAL [ ] INCLINED ____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN	N/A
8. DEPTH DRILLED INTO ROCK	0
9. TOTAL DEPTH OF HOLE	22.0
10. SIZE AND TYPE OF BIT	3 1/4" I.D. HSA
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	LWD
12. MANUFACTURER'S DESIGNATION OF DRILL	CME-75
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED: 1 ; UNDISTURBED: 0
14. TOTAL NUMBER CORE BOXES	0
15. ELEVATION GROUND WATER	
16. DATE HOLE	STARTED: Jan 15, 03 ; COMPLETED: Jan 15, 03
17. ELEVATION TOP OF HOLE	-1.2
18. TOTAL CORE RECOVERY FOR BORING	%
19. SIGNATURE OF INSPECTOR	

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth weathering, etc., if significant) g
-21.2	20		Water			
-22.2	21.0					
-22.3	21.1		Very dense dark gray SAND and gravel, trace organic silt, well graded, saturated SW	12"/12"	SS-1 21.0 22.0	Used 2" x 24" split spoon 42/40 Unconfined compressive strength estimated. Penetrometer not used to avoid contamination. qu*=4.5+ tsf
-23.2	22.0		Hard gray clayey SILT, trace sand and gravel CL-ML			
			End of Boring at 22.0'			

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE. (modified by GCA 1/94

PROJECT: Waukegan Harbor 9326.F0 | HOLE NO. -WH-12

Hole No. WH-13

DRILLING LOG

DIVISION	Lakes and Rivers
INSTALLATION	Chicago District
SHEET	1 OF 2 SHEETS
1. PROJECT	Waukegan Harbor 9326.F0
2. LOCATION (Coordinates or Station)	N 2075956.0 ; E 1122448.0
3. DRILLING AGENCY	Patrick Drilling Inc.
4. HOLE NO. (As shown on drawing title and file number)	WH-13
5. NAME OF DRILLER	Jerry Copak
6. DIRECTION OF HOLE	[X] VERTICAL [ ] INCLINED ____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN	N/A
8. DEPTH DRILLED INTO ROCK	0
9. TOTAL DEPTH OF HOLE	22.6
10. SIZE AND TYPE OF BIT	3 1/4" I.D. HSA
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	LWD
12. MANUFACTURER'S DESIGNATION OF DRILL	CME-75
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED 1 / UNDISTURBED 0
14. TOTAL NUMBER CORE BOXES	0
15. ELEVATION GROUND WATER	
16. DATE HOLE	STARTED Jan 15, 03 / COMPLETED Jan 15, 03
17. ELEVATION TOP OF HOLE	-1.0
18. TOTAL CORE RECOVERY FOR BORING	%
19. SIGNATURE OF INSPECTOR	David Randall

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth weathering, etc., if significant) g
-1.0	0		Water			Elevation of Lake Michigan averaged from Calumet Harbor and Milwaukee at date and hour of drilling.
	5					Water depth determined using weighted tape measure.
	10					
	15					
-21.0	20.0					

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE. (modified by GCA 1/94)

PROJECT Waukegan Harbor 9326.F0 | HOLE NO. WH-13

Hole No. WH-13

DRILLING LOG

DIVISION	Lakes and Rivers
INSTALLATION	Chicago District
SHEET	2 OF 2 SHEETS
1. PROJECT	Waukegan Harbor 9326.F0
2. LOCATION (Coordinates or Station)	N 2075956.0 ; E 1122448.0
3. DRILLING AGENCY	Patrick Drilling Inc.
4. HOLE NO. (As shown on drawing title and file number)	WH-13
5. NAME OF DRILLER	Jerry Copak
6. DIRECTION OF HOLE	[X] VERTICAL [ ] INCLINED ____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN	N/A
8. DEPTH DRILLED INTO ROCK	0
9. TOTAL DEPTH OF HOLE	22.6
10. SIZE AND TYPE OF BIT	3 1/4" I.D. HSA
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	LWD
12. MANUFACTURER'S DESIGNATION OF DRILL	CME-75
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED: 1 ; UNDISTURBED: 0
14. TOTAL NUMBER CORE BOXES	0
15. ELEVATION GROUND WATER	
16. DATE HOLE	STARTED: Jan 15, 03 ; COMPLETED: Jan 15, 03
17. ELEVATION TOP OF HOLE	-1.0
18. TOTAL CORE RECOVERY FOR BORING	%
19. SIGNATURE OF INSPECTOR	D. J. Randall

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth weathering, etc., if significant) g
-21.0	20		Very soft black organic SILT, low plasticity, saturated ML/OL	1"/24"	SS-1 20.0 22.0	Used 3" x 5' split spoon WOH from 20.0' - 22.0'
-23.0	22.0					
-23.6	22.6		Very stiff to hard gray silty CLAY, trace sand and gravel CL	7"/7"	SS-2 22.0 22.6	Used 2" x 24" split spoon 47/50.1" N=50+ Unconfined compressive strength estimated. Penetrometer not used to avoid contamination. qu'=3.5 tsf
			End of Boring at 22.6'			

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE. (modified by GCA 1/94)

PROJECT Waukegan Harbor 9326.F0 | HOLE NO. -WH-13

Hole No. WH-13A

DRILLING LOG

DIVISION	Lakes and Rivers
INSTALLATION	Chicago District
SHEET	1 OF 2 SHEETS
1. PROJECT	Waukegan Harbor 9326.F0
2. LOCATION (Coordinates or Station)	N 2075936.0 ; E 1122403.0
3. DRILLING AGENCY	Patrick Drilling Inc.
4. HOLE NO. (As shown on drawing title and file number)	WH-13A
5. NAME OF DRILLER	Jerry Copak
6. DIRECTION OF HOLE	[X] VERTICAL [ ] INCLINED ____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN	N/A
8. DEPTH DRILLED INTO ROCK	0
9. TOTAL DEPTH OF HOLE	23.0
10. SIZE AND TYPE OF BIT	3 1/4" I.D. HSA
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	LWD
12. MANUFACTURER'S DESIGNATION OF DRILL	CME-75
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED 1 / UNDISTURBED 0
14. TOTAL NUMBER CORE BOXES	0
15. ELEVATION GROUND WATER	
16. DATE HOLE	STARTED Jan 15, 03 / COMPLETED Jan 15, 03
17. ELEVATION TOP OF HOLE	-1.0
18. TOTAL CORE RECOVERY FOR BORING	%
19. SIGNATURE OF INSPECTOR	[signature]

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth weathering, etc., if significant) g
-1.0	0		Water			Boring offset and redrilled at the request of ACOE personnel due to small amount of sediment in Boring WH-13 Boring WH-13A offset 20'S, 45'W Elevation of Lake Michigan averaged from Calumet Harbor and Milwaukee at date and hour of drilling.
	5					Water depth determined using weighted tape measure.
	10					
	15					
-21.0	20					

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE. (modified by GCA 1/94)

PROJECT Waukegan Harbor 9326.F0 | HOLE NO. -WH-13A

Hole No. WH-13A

DRILLING LOG

DIVISION	Lakes and Rivers
INSTALLATION	Chicago District
SHEET	2 OF 2 SHEETS
1. PROJECT	Waukegan Harbor 9326.F0
2. LOCATION (Coordinates or Station)	N 2075936.0 ; E 1122403.0
3. DRILLING AGENCY	Patrick Drilling Inc.
4. HOLE NO. (As shown on drawing title and file number)	WH-13A
5. NAME OF DRILLER	Jerry Copak
6. DIRECTION OF HOLE	[X] VERTICAL [ ] INCLINED ____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN	N/A
8. DEPTH DRILLED INTO ROCK	0
9. TOTAL DEPTH OF HOLE	23.0
10. SIZE AND TYPE OF BIT	3 1/4" I.D. HSA
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	LWD
12. MANUFACTURER'S DESIGNATION OF DRILL	CME-75
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED 1 / UNDISTURBED 0
14. TOTAL NUMBER CORE BOXES	0
15. ELEVATION GROUND WATER	
16. DATE HOLE	STARTED Jan 15, 03 / COMPLETED Jan 15, 03
17. ELEVATION TOP OF HOLE	-1.0
18. TOTAL CORE RECOVERY FOR BORING	%
19. SIGNATURE OF INSPECTOR	Daniel H. Randall

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth weathering, etc., if significant) g
-21.0	20		Water			
-23.0	22.0		Loose to medium dense gray SAND and gravel, saturated SW	12"/12"	SS-1 22.0 23.0	Used 3" x 5' split spoon 7/49 N=49+
-23.9	22.9					
-24.0	23.0		Hard gray clayey SILT, trace sand, moist CL-ML			
			End of Boring at 23.0'			

Hole No. WH-14

DRILLING LOG

DIVISION	Lakes and Rivers
INSTALLATION	Chicago District
SHEET	1 OF 2 SHEETS
1. PROJECT	Waukegan Harbor 9326.F0
2. LOCATION (Coordinates or Station)	N 2076271.0 ; E 1122491.0
3. DRILLING AGENCY	Patrick Drilling Inc.
4. HOLE NO. (As shown on drawing title and file number)	WH-14
5. NAME OF DRILLER	Jerry Copak
6. DIRECTION OF HOLE	[X] VERTICAL [ ] INCLINED ____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN	N/A
8. DEPTH DRILLED INTO ROCK	0
9. TOTAL DEPTH OF HOLE	21.9
10. SIZE AND TYPE OF BIT	3 1/4" I.D. HSA
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	LWD
12. MANUFACTURER'S DESIGNATION OF DRILL	CME-75
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED 1 / UNDISTURBED 0
14. TOTAL NUMBER CORE BOXES	0
15. ELEVATION GROUND WATER	
16. DATE HOLE	STARTED Jan 15, 03 / COMPLETED Jan 15, 03
17. ELEVATION TOP OF HOLE	-1.1
18. TOTAL CORE RECOVERY FOR BORING	%
19. SIGNATURE OF INSPECTOR	D. Randall

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth weathering, etc., if significant) g
-1.1	0		Water			Elevation of Lake Michigan averaged from Calumet Harbor and Milwaukee at date and hour of drilling.
	5					Water depth determined using weighted tape measure.
	10					
	15					
-21.1	20					

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE. (modified by GCA 1/94)

PROJECT Waukegan Harbor 9326.F0 | HOLE NO. -WH-14

Hole No. WH-14

DRILLING LOG

DIVISION	Lakes and Rivers
INSTALLATION	Chicago District
SHEET	2 OF 2 SHEETS
1. PROJECT	Waukegan Harbor 9326.F0
2. LOCATION (Coordinates or Station)	N 2076271.0 ; E 1122491.0
3. DRILLING AGENCY	Patrick Drilling Inc.
4. HOLE NO. (As shown on drawing title and file number)	WH-14
5. NAME OF DRILLER	Jerry Copak
6. DIRECTION OF HOLE	[X] VERTICAL [ ] INCLINED _____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN	N/A
8. DEPTH DRILLED INTO ROCK	0
9. TOTAL DEPTH OF HOLE	21.9
10. SIZE AND TYPE OF BIT	3 1/4" I.D. HSA
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	LWD
12. MANUFACTURER'S DESIGNATION OF DRILL	CME-75
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED 1 / UNDISTURBED 0
14. TOTAL NUMBER CORE BOXES	0
15. ELEVATION GROUND WATER	
16. DATE HOLE	STARTED Jan 15, 03 / COMPLETED Jan 15, 03
17. ELEVATION TOP OF HOLE	-1.1
18. TOTAL CORE RECOVERY FOR BORING	%
19. SIGNATURE OF INSPECTOR	David Rudolph

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth weathering, etc., if significant) g
-21.1	20		Water			
-22.1	21.0		Hard gray clayey SILT, trace sand and gravel CL-ML	11"/11"	SS-1 21.0 21.9	Used 2" x 24" split spoon 24/50 for 5" qu"=4.5+tsf
-23.0	21.9		End of Boring at 21.9'			

Hole No. WH-15

DRILLING LOG

DIVISION	Lakes and Rivers
INSTALLATION	Chicago District
SHEET	1 OF 2 SHEETS
1. PROJECT	Waukegan Harbor 9326.F0
2. LOCATION (Coordinates or Station)	N 2076585.0 ; E 1122609.0
3. DRILLING AGENCY	Patrick Drilling Inc.
4. HOLE NO. (As shown on drawing title and file number)	WH-15
5. NAME OF DRILLER	Jerry Copak
6. DIRECTION OF HOLE	[X] VERTICAL [ ] INCLINED _____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN	N/A
8. DEPTH DRILLED INTO ROCK	0
9. TOTAL DEPTH OF HOLE	24.0
10. SIZE AND TYPE OF BIT	3 1/4" I.D. HSA
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	LWD
12. MANUFACTURER'S DESIGNATION OF DRILL	CME-75
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED: 1 ; UNDISTURBED: 0
14. TOTAL NUMBER CORE BOXES	0
15. ELEVATION GROUND WATER	
16. DATE HOLE	STARTED: Jan 15, 03 ; COMPLETED: Jan 15, 03
17. ELEVATION TOP OF HOLE	-1.1
18. TOTAL CORE RECOVERY FOR BORING	%
19. SIGNATURE OF INSPECTOR	[signature]

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth weathering, etc., if significant) g
-1.1	0		Water			Elevation of Lake Michigan averaged from Calumet Harbor and Milwaukee at date and hour of drilling.
	5					Water depth determined using weighted tape measure.
	10					
	15					
-21.1	20					

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE. (modified by GCA 1/94)

PROJECT Waukegan Harbor 9326.F1 | HOLE NO. -WH-15

Hole No. WH-15

DRILLING LOG

DIVISION	Lakes and Rivers
INSTALLATION	Chicago District
SHEET	2 OF 2 SHEETS
1. PROJECT	Waukegan Harbor 9326.F0
2. LOCATION (Coordinates or Station)	N 2076585.0 ; E 1122609.0
3. DRILLING AGENCY	Patrick Drilling Inc.
4. HOLE NO. (As shown on drawing title and file number)	WH-15
5. NAME OF DRILLER	Jerry Copak
6. DIRECTION OF HOLE	[X] VERTICAL [ ] INCLINED _____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN	N/A
8. DEPTH DRILLED INTO ROCK	0
9. TOTAL DEPTH OF HOLE	24.0
10. SIZE AND TYPE OF BIT	3 1/4" I.D. HSA
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	LWD
12. MANUFACTURER'S DESIGNATION OF DRILL	CME-75
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED: 1 / UNDISTURBED: 0
14. TOTAL NUMBER CORE BOXES	0
15. ELEVATION GROUND WATER	
16. DATE HOLE	STARTED: Jan 15, 03 / COMPLETED: Jan 15, 03
17. ELEVATION TOP OF HOLE	-1.1
18. TOTAL CORE RECOVERY FOR BORING	%
19. SIGNATURE OF INSPECTOR	[signature]

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth weathering, etc., if significant) g
-21.1	20		Water			
-23.1	22.0					
-23.4	22.3		Medium dense gray SAND, some silt, saturated SM	12"/24"	SS-1 22.0 24.0	Used 2" x 24" split spoon 7/8/8/9 N=16
			Very stiff to hard gray clayey SILT, trace sand and gravel CL-ML			Unconfined compressive strength estimated. Penetrometer not used to avoid contamination.
-25.1	24.0					qu"=4.5+ tsf
			End of Boring at 24.0'			

Hole No. WHSP-01

DRILLING LOG

DIVISION	Lakes and Rivers
INSTALLATION	Chicago District
SHEET	1 OF 2 SHEETS
1. PROJECT	Waukegan Harbor 9326.F0
2. LOCATION (Coordinates or Station)	N 2074305.0 ; E 1122218.0
3. DRILLING AGENCY	Patrick Drilling Inc.
4. HOLE NO. (As shown on drawing title and file number)	WHSP-01
5. NAME OF DRILLER	Jerry Copak
6. DIRECTION OF HOLE	[X] VERTICAL [ ] INCLINED _____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN	N/A
8. DEPTH DRILLED INTO ROCK	0
9. TOTAL DEPTH OF HOLE	35.0
10. SIZE AND TYPE OF BIT	3 1/4" I.D. HSA
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	LWD
12. MANUFACTURER'S DESIGNATION OF DRILL	CME-75
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED 11; UNDISTURBED 0
14. TOTAL NUMBER CORE BOXES	0
15. ELEVATION GROUND WATER	
16. DATE HOLE	STARTED Jan 17, 03; COMPLETED Jan 17, 03
17. ELEVATION TOP OF HOLE	-0.6
18. TOTAL CORE RECOVERY FOR BORING	%
19. SIGNATURE OF INSPECTOR	

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth weathering, etc., if significant) g
-0.6	0		Water			Elevation of Lake Michigan averaged from Calumet Harbor and Milwaukee at date and hour of drilling. Water depth determined using weighted tape measure
-5.6	5.0		Loose to dense grayish brown fine to coarse SAND, trace silt, saturated SP	36"/60"	SS-1 5.0 10.0	Used 3" x 5' split spoon WOH from 5.0' - 8.5' 3/7/7 Vane Shear: 10ft-lb with large vane (9" by 3.625"). Shear strength=108 psf Depth = 5.6-6.3'
	10			24"/24"	SS-2 10.0 12.0	Used 2" x 24" split spoon 8/16/17 N=33 WC%=24.5
				16"/18"	SS-3A/B 13.5 15.0	9/14/21 N=35 WC%=16.5 WC%=16.2 qu*=4.5 tsf
-15.1	14.5		Hard gray silty CLAY, trace medium to fine sand, moist CL			
	15			10"/18"	SS-4 16.0 17.5	17/25/29 N=54 qu*=4.5 tsf WC%=14.8
-18.6	18.0		Hard gray clayey SILT, trace fine sand, moist CL-ML			
				4"/18"	SS-5 18.5 18.8	60/4" qu*=4.5 tsf WC%=11.6
-20.6	20					

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE. (modified by GCA 1/94)

PROJECT: Waukegan Harbor 9326.F0 HOLE NO. -WHSP-01

Hole No. WHSP-01

DRILLING LOG

DIVISION	Lakes and Rivers
INSTALLATION	Chicago District
SHEET	2 OF 2 SHEETS
1. PROJECT	Waukegan Harbor 9326.F0
2. LOCATION (Coordinates or Station)	N 2074305.0 ; E 1122218.0
3. DRILLING AGENCY	Patrick Drilling Inc.
4. HOLE NO. (As shown on drawing title and file number)	WHSP-01
5. NAME OF DRILLER	Jerry Copak
6. DIRECTION OF HOLE	[X] VERTICAL [ ] INCLINED ____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN	N/A
8. DEPTH DRILLED INTO ROCK	0
9. TOTAL DEPTH OF HOLE	35.0
10. SIZE AND TYPE OF BIT	3 1/4" I.D. HSA
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	LWD
12. MANUFACTURER'S DESIGNATION OF DRILL	CME-75
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED 11 / UNDISTURBED 0
14. TOTAL NUMBER CORE BOXES	0
15. ELEVATION GROUND WATER	
16. DATE HOLE	STARTED Jan 17, 03 / COMPLETED Jan 17, 03
17. ELEVATION TOP OF HOLE	-0.6
18. TOTAL CORE RECOVERY FOR BORING	%
19. SIGNATURE OF INSPECTOR	

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth weathering, etc., if significant) g
-20.7	20.1		Hard gray silty CLAY, trace sand and gravel, moist CL			
				12"/18"	SS-6 21.0 22.5	10/20/26 N=46 qu**=8.7 tsf qu*=4.5+ tsf WC%=15.1
				15"/18"	SS-7 23.5 25.0	12/16/24 N=40 qu**=5.5 tsf qu*=4.5+ tsf WC%=13.4
	25					
-27.1	26.5		Extremely dense gray SILT, trace coarse to fine sand, moist ML	14"/18"	SS-8 26.0 27.5	22/35/59 N=94 WC%=20.0
				18"/18"	SS-9 28.5 30.0	28/50 for 5"
	30					
			Clay seam	18"/18"	SS-10 31.0 32.5	21/43/40 N=83 WC%=16.9
				18"/18"	SS-11 33.5 35.0	8/34/40 N=74 WC%=20.5
-35.6	35.0		End of Boring at 35.0'			

Hole No. WHSP-02

DRILLING LOG

DIVISION: Lakes and Rivers

INSTALLATION: Chicago District

SHEET 1 OF 2 SHEETS

1. PROJECT: Waukegan Harbor 9326.F0
2. LOCATION (Coordinates or Station): N 2074112.9 ; E 1121787.7
3. DRILLING AGENCY: Patrick Drilling Inc.
4. HOLE NO. (As shown on drawing title and file number): WHSP-02
5. NAME OF DRILLER: Jerry Copak
6. DIRECTION OF HOLE: [X] VERTICAL [ ] INCLINED _____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN: N/A
8. DEPTH DRILLED INTO ROCK: 0
9. TOTAL DEPTH OF HOLE: 40.0
10. SIZE AND TYPE OF BIT: 3 1/4" I.D. HSA
11. DATUM FOR ELEVATION SHOWN (TBM or MSL): LWD
12. MANUFACTURER'S DESIGNATION OF DRILL: CME-75
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 16; UNDISTURBED 0
14. TOTAL NUMBER CORE BOXES: 0
15. ELEVATION GROUND WATER: 1.9
16. DATE HOLE: STARTED Jan 21, 03; COMPLETED Jan 21, 03
17. ELEVATION TOP OF HOLE: 6.9
18. TOTAL CORE RECOVERY FOR BORING: %
19. SIGNATURE OF INSPECTOR: [signature]

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth weathering, etc., if significant) g
6.9	0		Gravel and sand fill, poorly graded, dry GP			
6.1	0.8		Medium dense brown fine to coarse SAND, trace silt, poorly graded, moist SP	8"/18"	SS-1 1.0 2.5	13/6/5 N=11 WC%=5.2
				10"/18"	SS-2 3.5 5.0	8/6/8 N=14 WC%=5.1
1.9	5.0		Loose brown fine to medium SAND, trace silt, poorly graded, saturated SP			
				10"/18"	SS-3 6.0 7.5	2/2/3 N=5 WC%=23.2
-1.6	8.5		Dense to medium dense brown to gray fine to coarse SAND, trace gravel, well graded, saturated SW	16"/18"	SS-4 8.5 10.0	8/19/19 N=38 WC%=18.0
	10			18"/18"	SS-5 11.0 12.5	4/6/9 N=15 WC%=22.9
				16"/18"	SS-6 13.5 15.0	3/3/8 N=11 WC%=22.5
	15			13"/18"	SS-7 16.0 17.5	4/7/16 N=23 WC%=20.4
				16"/18"	SS-8 18.5 20.0	11/21/27 N=48 WC%=18.1
-13.1	20.0					

Hole No. WHSP-02

DRILLING LOG	DIVISION Lakes and Rivers	INSTALLATION Chicago District	SHEET 2 OF 2 SHEETS

1. PROJECT Waukegan Harbor 9326.F0	10. SIZE AND TYPE OF BIT 3 1/4" I.D. HSA
2. LOCATION (Coordinates or Station) N 2074112.9 ; E 1121787.7	11. DATUM FOR ELEVATION SHOWN (TBM or MSL) LWD
3. DRILLING AGENCY Patrick Drilling Inc.	12. MANUFACTURER'S DESIGNATION OF DRILL CME-75
4. HOLE NO. (As shown on drawing title and file number) WHSP-02	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 16; UNDISTURBED 0
5. NAME OF DRILLER Jerry Copak	14. TOTAL NUMBER CORE BOXES 0
6. DIRECTION OF HOLE [X] VERTICAL [ ] INCLINED ____ DEG. FROM VERT.	15. ELEVATION GROUND WATER 1.9
7. THICKNESS OF OVERBURDEN N/A	16. DATE HOLE: STARTED Jan 21, 03; COMPLETED Jan 21, 03
8. DEPTH DRILLED INTO ROCK 0	17. ELEVATION TOP OF HOLE 6.9
9. TOTAL DEPTH OF HOLE 40.0	18. TOTAL CORE RECOVERY FOR BORING %
	19. SIGNATURE OF INSPECTOR

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth weathering, etc., if significant) g
-13.1	20		Dense to medium dense brown to gray fine to coarse SAND, trace silt, trace gravel, well graded, saturated SW			
				17"/18"	SS-9 21.0 22.5	10/19/20 N=39
-15.6	22.5		Hard gray SILTY CLAY, trace sand and gravel, moist CL			
				18"/18"	SS-10 23.0 24.5	14/50 for 2" qu*=4.5+ tsf WC%=9.7
	25					
				18"/18"	SS-11 26.0 27.5	8/24/32 N=56 qu**=7.5 tsf qu*=4.5+ tsf WC%=16.8
				16"/16"	SS-12 28.5 30.0	9/16/23 N=39 qu**=8.7 tsf qu*=4.5+ tsf WC%=15.0
	30					
				18"/18"	SS-13 31.0 32.5	10/10/17 N=27 qu**=3.6 tsf qu*=3.0 tsf WC%=17.1
				18"/18"	SS-14 33.5 35.0	7/9/15 N=24 qu**=6.1 tsf qu*=4.5+ tsf WC%=16.4
	35					
				18"/18"	SS-15 36.0 37.5	8/11/17 N=28 qu**=4.7 tsf qu*=4.5+ tsf WC%=15.6
				18"/18"	SS-16 38.5 40.0	9/13/15 N=28 qu**=4.2 tsf qu*=4.5 tsf WC%=16.6
-33.1	40.0		End of Boring at 40.0'			

USEPA 2000
Analytical Results

Sample Name	Sample Interval (inches)	Sediment Depth (inches) for each location	Water Depth (feet)
WH-2002-01.1	0-18	204	18
WH-2002-01.2	18-36		18
WH-2002-01.3	204-224		18
WH-2002-02.1	0-19	112	14
WH-2002-02.2	19-38		14
WH-2002-02.3	112-124		14
WH-2002-03.1	0-12	66	17
WH-2002-03.2	12-24		17
WH-2002-03.3	66-79		17
WH2002-04.1	0-20	125	18.5
WH-2002-04.2	20-40		18.5
WH-2002-04.3	125-138		18.5
WH-2002-05.1	0-18	126	16.5
WH-2002-05.2	18-36		16.5
WH-2002-05.3	126-144		16.5
WH-2002-06.1	0-18	116	12
WH-2002-06.2	18-34		12
WH-2002-06.3	116-132		12
WH-2002-07.1	0-21	40	18
WH-2002-07.2	27-40		18
WH-2002-07.3	40-49		18
WH-2002-08.1	0-9	13	25
WH-2002-08.2	NONE		
WH-2002-08.3	13-25		25
WH-2002-09.1	0-42	58	19
WH-2002-09.2	48-58		19
WH-2002-09.3	58-64		19
WH-2002-10.1	0-4	6	21
WH-2002-10.2	NONE		
WH-2002-10.3	6-18		21
WH-2002-11.1	0-2	2	21
WH-2002-11.2	NONE		
WH-2002-11.3	2-16		21
WH-2002-12.1	NONE	0	
WH-2002-12.2	NONE		
WH-2002-12.3	0-12		21
WH-2002-13.1	NONE	4	
WH-2002-13.2	NONE		
WH-2002-13.3	4-6		22
WH-2002-14.1	0-1	6	21
WH-2002-14.2	NONE		
WH-2002-14.3	6-12		21
WH-2002-15.1	0-4	6	22
WH-2002-15.2	NONE		
WH-2002-15.3	6-10		22
WH-2002-16.1	0-6	22	5
WH-2002-16.2	6-22		5
WH-2002-16.3	22-30		5

iment samples, samples that are numbered WH-2002-XX.3 are located in the clay layer of the sample

ONE" indicate that no soft sediment was present to collect

USEPA 2002 Investigation Analytical Results[a]
PCBs
Waukegan Harbor AOC

PROJECT	SAMPLENAME	SAMPDATE	ANALYTE	RESULT	DL	RL	UNITS	BASIS	PSOLIDS
Waukegan Harbor	WH-2002 - 1.1	01/16/2003	PCB-1016	U	0.0195	0.0977	ug/g	Dry	79.7
Waukegan Harbor	WH-2002 - 1.1	01/16/2003	PCB-1221	U	0.0195	0.0977	ug/g	Dry	79.7
Waukegan Harbor	WH-2002 - 1.1	01/16/2003	PCB-1232	U	0.0195	0.0977	ug/g	Dry	79.7
Waukegan Harbor	WH-2002 - 1.1	01/16/2003	PCB-1242	0.0459	0.0195	0.0977	ug/g	Dry	79.7
Waukegan Harbor	WH-2002 - 1.1	01/16/2003	PCB-1248	U	0.0195	0.0977	ug/g	Dry	79.7
Waukegan Harbor	WH-2002 - 1.1	01/16/2003	PCB-1254	U	0.0195	0.0977	ug/g	Dry	79.7
Waukegan Harbor	WH-2002 - 1.1	01/16/2003	PCB-1260	U	0.0195	0.0977	ug/g	Dry	79.7
Waukegan Harbor	WH-2002 - 1.1	01/16/2003	PCB-1262	U	0.0195	0.0977	ug/g	Dry	79.7
Waukegan Harbor	WH-2002 - 1.1	01/16/2003	PCB-1268	U	0.0195	0.0977	ug/g	Dry	79.7
Waukegan Harbor	WH-2002 - 1.2	01/16/2003	PCB-1016	U	0.0202	0.101	ug/g	Dry	78.4
Waukegan Harbor	WH-2002 - 1.2	01/16/2003	PCB-1221	U	0.0202	0.101	ug/g	Dry	78.4
Waukegan Harbor	WH-2002 - 1.2	01/16/2003	PCB-1232	U	0.0202	0.101	ug/g	Dry	78.4
Waukegan Harbor	WH-2002 - 1.2	01/16/2003	PCB-1242	U	0.0202	0.101	ug/g	Dry	78.4
Waukegan Harbor	WH-2002 - 1.2	01/16/2003	PCB-1248	0.100	0.0202	0.101	ug/g	Dry	78.4
Waukegan Harbor	WH-2002 - 1.2	01/16/2003	PCB-1254	U	0.0202	0.101	ug/g	Dry	78.4
Waukegan Harbor	WH-2002 - 1.2	01/16/2003	PCB-1260	U	0.0202	0.101	ug/g	Dry	78.4
Waukegan Harbor	WH-2002 - 1.2	01/16/2003	PCB-1262	U	0.0202	0.101	ug/g	Dry	78.4
Waukegan Harbor	WH-2002 - 1.2	01/16/2003	PCB-1268	U	0.0202	0.101	ug/g	Dry	78.4
Waukegan Harbor	WH-2002 - 1.3	01/16/2003	PCB-1016	U	0.0182	0.0912	ug/g	Dry	90.3
Waukegan Harbor	WH-2002 - 1.3	01/16/2003	PCB-1221	U	0.0182	0.0912	ug/g	Dry	90.3
Waukegan Harbor	WH-2002 - 1.3	01/16/2003	PCB-1232	U	0.0182	0.0912	ug/g	Dry	90.3
Waukegan Harbor	WH-2002 - 1.3	01/16/2003	PCB-1242	U	0.0182	0.0912	ug/g	Dry	90.3
Waukegan Harbor	WH-2002 - 1.3	01/16/2003	PCB-1248	U	0.0182	0.0912	ug/g	Dry	90.3
Waukegan Harbor	WH-2002 - 1.3	01/16/2003	PCB-1254	U	0.0182	0.0912	ug/g	Dry	90.3
Waukegan Harbor	WH-2002 - 1.3	01/16/2003	PCB-1260	U	0.0182	0.0912	ug/g	Dry	90.3
Waukegan Harbor	WH-2002 - 1.3	01/16/2003	PCB-1262	U	0.0182	0.0912	ug/g	Dry	90.3
Waukegan Harbor	WH-2002 - 1.3	01/16/2003	PCB-1268	U	0.0182	0.0912	ug/g	Dry	90.3
Waukegan Harbor	WH-2002 - 16.1	01/16/2003	PCB-1016	U	0.0210	0.105	ug/g	Dry	77.1
Waukegan Harbor	WH-2002 - 16.1	01/16/2003	PCB-1221	U	0.0210	0.105	ug/g	Dry	77.1
Waukegan Harbor	WH-2002 - 16.1	01/16/2003	PCB-1232	U	0.0210	0.105	ug/g	Dry	77.1

USEPA 2002 Investigation Analytical Results[a]
PCBs
Waukegan Harbor AOC

PROJECT	SAMPLENAME	SAMPDATE	ANALYTE	RESULT	DL	RL	UNITS	BASIS	PSOLIDS
Waukegan Harbor	WH-2002 - 16.1	01/16/2003	PCB-1242	U	0.0210	0.105	ug/g	Dry	77.1
Waukegan Harbor	WH-2002 - 16.1	01/16/2003	PCB-1248	0.761	0.0210	0.105	ug/g	Dry	77.1
Waukegan Harbor	WH-2002 - 16.1	01/16/2003	PCB-1254	U	0.0210	0.105	ug/g	Dry	77.1
Waukegan Harbor	WH-2002 - 16.1	01/16/2003	PCB-1260	U	0.0210	0.105	ug/g	Dry	77.1
Waukegan Harbor	WH-2002 - 16.1	01/16/2003	PCB-1262	U	0.0210	0.105	ug/g	Dry	77.1
Waukegan Harbor	WH-2002 - 16.1	01/16/2003	PCB-1268	U	0.0210	0.105	ug/g	Dry	77.1
Waukegan Harbor	WH-2002 - 16.2	01/16/2003	PCB-1016	U	0.0174	0.0872	ug/g	Dry	80.4
Waukegan Harbor	WH-2002 - 16.2	01/16/2003	PCB-1221	U	0.0174	0.0872	ug/g	Dry	80.4
Waukegan Harbor	WH-2002 - 16.2	01/16/2003	PCB-1232	U	0.0174	0.0872	ug/g	Dry	80.4
Waukegan Harbor	WH-2002 - 16.2	01/16/2003	PCB-1242	U	0.0174	0.0872	ug/g	Dry	80.4
Waukegan Harbor	WH-2002 - 16.2	01/16/2003	PCB-1248	0.0488	0.0174	0.0872	ug/g	Dry	80.4
Waukegan Harbor	WH-2002 - 16.2	01/16/2003	PCB-1254	U	0.0174	0.0872	ug/g	Dry	80.4
Waukegan Harbor	WH-2002 - 16.2	01/16/2003	PCB-1260	U	0.0174	0.0872	ug/g	Dry	80.4
Waukegan Harbor	WH-2002 - 16.2	01/16/2003	PCB-1262	U	0.0174	0.0872	ug/g	Dry	80.4
Waukegan Harbor	WH-2002 - 16.2	01/16/2003	PCB-1268	U	0.0174	0.0872	ug/g	Dry	80.4
Waukegan Harbor	WH-2002 - 16.3	01/16/2003	PCB-1016	U	0.0199	0.0997	ug/g	Dry	87.1
Waukegan Harbor	WH-2002 - 16.3	01/16/2003	PCB-1221	U	0.0199	0.0997	ug/g	Dry	87.1
Waukegan Harbor	WH-2002 - 16.3	01/16/2003	PCB-1232	U	0.0199	0.0997	ug/g	Dry	87.1
Waukegan Harbor	WH-2002 - 16.3	01/16/2003	PCB-1242	U	0.0199	0.0997	ug/g	Dry	87.1
Waukegan Harbor	WH-2002 - 16.3	01/16/2003	PCB-1248	U	0.0199	0.0997	ug/g	Dry	87.1
Waukegan Harbor	WH-2002 - 16.3	01/16/2003	PCB-1254	U	0.0199	0.0997	ug/g	Dry	87.1
Waukegan Harbor	WH-2002 - 16.3	01/16/2003	PCB-1260	U	0.0199	0.0997	ug/g	Dry	87.1
Waukegan Harbor	WH-2002 - 16.3	01/16/2003	PCB-1262	U	0.0199	0.0997	ug/g	Dry	87.1
Waukegan Harbor	WH-2002 - 16.3	01/16/2003	PCB-1268	U	0.0199	0.0997	ug/g	Dry	87.1
Waukegan Harbor	WH-2002 - 2.1	01/16/2003	PCB-1016	U	0.0217	0.109	ug/g	Dry	78.9
Waukegan Harbor	WH-2002 - 2.1	01/16/2003	PCB-1221	U	0.0217	0.109	ug/g	Dry	78.9
Waukegan Harbor	WH-2002 - 2.1	01/16/2003	PCB-1232	U	0.0217	0.109	ug/g	Dry	78.9
Waukegan Harbor	WH-2002 - 2.1	01/16/2003	PCB-1242	U	0.0217	0.109	ug/g	Dry	78.9
Waukegan Harbor	WH-2002 - 2.1	01/16/2003	PCB-1248	U	0.0217	0.109	ug/g	Dry	78.9
Waukegan Harbor	WH-2002 - 2.1	01/16/2003	PCB-1254	U	0.0217	0.109	ug/g	Dry	78.9

USEPA 2002 Investigation Analytical Results[a]
PCBs
Waukegan Harbor AOC

PROJECT	SAMPLENAME	SAMPDATE	ANALYTE	RESULT	DL	RL	UNITS	BASIS	PSOLIDS
Waukegan Harbor	WH-2002 - 2.1	01/16/2003	PCB-1260	U	0.0217	0.109	ug/g	Dry	78.9
Waukegan Harbor	WH-2002 - 2.1	01/16/2003	PCB-1262	U	0.0217	0.109	ug/g	Dry	78.9
Waukegan Harbor	WH-2002 - 2.1	01/16/2003	PCB-1268	U	0.0217	0.109	ug/g	Dry	78.9
Waukegan Harbor	WH-2002 - 2.2	01/16/2003	PCB-1016	U	0.0251	0.125	ug/g	Dry	79.8
Waukegan Harbor	WH-2002 - 2.2	01/16/2003	PCB-1221	U	0.0251	0.125	ug/g	Dry	79.8
Waukegan Harbor	WH-2002 - 2.2	01/16/2003	PCB-1232	U	0.0251	0.125	ug/g	Dry	79.8
Waukegan Harbor	WH-2002 - 2.2	01/16/2003	PCB-1242	U	0.0251	0.125	ug/g	Dry	79.8
Waukegan Harbor	WH-2002 - 2.2	01/16/2003	PCB-1248	0.0481	0.0251	0.125	ug/g	Dry	79.8
Waukegan Harbor	WH-2002 - 2.2	01/16/2003	PCB-1254	U	0.0251	0.125	ug/g	Dry	79.8
Waukegan Harbor	WH-2002 - 2.2	01/16/2003	PCB-1260	U	0.0251	0.125	ug/g	Dry	79.8
Waukegan Harbor	WH-2002 - 2.2	01/16/2003	PCB-1262	U	0.0251	0.125	ug/g	Dry	79.8
Waukegan Harbor	WH-2002 - 2.2	01/16/2003	PCB-1268	U	0.0251	0.125	ug/g	Dry	79.8
Waukegan Harbor	WH-2002 - 2.3	01/16/2003	PCB-1016	U	0.0184	0.0919	ug/g	Dry	89.5
Waukegan Harbor	WH-2002 - 2.3	01/16/2003	PCB-1221	U	0.0184	0.0919	ug/g	Dry	89.5
Waukegan Harbor	WH-2002 - 2.3	01/16/2003	PCB-1232	U	0.0184	0.0919	ug/g	Dry	89.5
Waukegan Harbor	WH-2002 - 2.3	01/16/2003	PCB-1242	U	0.0184	0.0919	ug/g	Dry	89.5
Waukegan Harbor	WH-2002 - 2.3	01/16/2003	PCB-1248	U	0.0184	0.0919	ug/g	Dry	89.5
Waukegan Harbor	WH-2002 - 2.3	01/16/2003	PCB-1254	U	0.0184	0.0919	ug/g	Dry	89.5
Waukegan Harbor	WH-2002 - 2.3	01/16/2003	PCB-1260	U	0.0184	0.0919	ug/g	Dry	89.5
Waukegan Harbor	WH-2002 - 2.3	01/16/2003	PCB-1262	U	0.0184	0.0919	ug/g	Dry	89.5
Waukegan Harbor	WH-2002 - 2.3	01/16/2003	PCB-1268	U	0.0184	0.0919	ug/g	Dry	89.5
Waukegan Harbor	WH-2002 - 3.1	01/16/2003	PCB-1016	U	0.0192	0.0958	ug/g	Dry	79.8
Waukegan Harbor	WH-2002 - 3.1	01/16/2003	PCB-1221	U	0.0192	0.0958	ug/g	Dry	79.8
Waukegan Harbor	WH-2002 - 3.1	01/16/2003	PCB-1232	U	0.0192	0.0958	ug/g	Dry	79.8
Waukegan Harbor	WH-2002 - 3.1	01/16/2003	PCB-1242	U	0.0192	0.0958	ug/g	Dry	79.8
Waukegan Harbor	WH-2002 - 3.1	01/16/2003	PCB-1248	0.152	0.0192	0.0958	ug/g	Dry	79.8
Waukegan Harbor	WH-2002 - 3.1	01/16/2003	PCB-1254	U	0.0192	0.0958	ug/g	Dry	79.8
Waukegan Harbor	WH-2002 - 3.1	01/16/2003	PCB-1260	U	0.0192	0.0958	ug/g	Dry	79.8
Waukegan Harbor	WH-2002 - 3.1	01/16/2003	PCB-1262	U	0.0192	0.0958	ug/g	Dry	79.8
Waukegan Harbor	WH-2002 - 3.1	01/16/2003	PCB-1268	U	0.0192	0.0958	ug/g	Dry	79.8

USEPA 2002 Investigation Analytical Results[a]
PCBs
Waukegan Harbor AOC

PROJECT	SAMPLENAME	SAMPDATE	ANALYTE	RESULT	DL	RL	UNITS	BASIS	PSOLIDS
Waukegan Harbor	WH-2002 - 3.2	01/16/2003	PCB-1016	U	0.0189	0.0944	ug/g	Dry	80.5
Waukegan Harbor	WH-2002 - 3.2	01/16/2003	PCB-1221	U	0.0189	0.0944	ug/g	Dry	80.5
Waukegan Harbor	WH-2002 - 3.2	01/16/2003	PCB-1232	U	0.0189	0.0944	ug/g	Dry	80.5
Waukegan Harbor	WH-2002 - 3.2	01/16/2003	PCB-1242	U	0.0189	0.0944	ug/g	Dry	80.5
Waukegan Harbor	WH-2002 - 3.2	01/16/2003	PCB-1248	0.165	0.0189	0.0944	ug/g	Dry	80.5
Waukegan Harbor	WH-2002 - 3.2	01/16/2003	PCB-1254	U	0.0189	0.0944	ug/g	Dry	80.5
Waukegan Harbor	WH-2002 - 3.2	01/16/2003	PCB-1260	U	0.0189	0.0944	ug/g	Dry	80.5
Waukegan Harbor	WH-2002 - 3.2	01/16/2003	PCB-1262	U	0.0189	0.0944	ug/g	Dry	80.5
Waukegan Harbor	WH-2002 - 3.2	01/16/2003	PCB-1268	U	0.0189	0.0944	ug/g	Dry	80.5
Waukegan Harbor	WH-2002 - 3.3	01/16/2003	PCB-1016	U	0.0172	0.0862	ug/g	Dry	84.1
Waukegan Harbor	WH-2002 - 3.3	01/16/2003	PCB-1221	U	0.0172	0.0862	ug/g	Dry	84.1
Waukegan Harbor	WH-2002 - 3.3	01/16/2003	PCB-1232	U	0.0172	0.0862	ug/g	Dry	84.1
Waukegan Harbor	WH-2002 - 3.3	01/16/2003	PCB-1242	U	0.0172	0.0862	ug/g	Dry	84.1
Waukegan Harbor	WH-2002 - 3.3	01/16/2003	PCB-1248	U	0.0172	0.0862	ug/g	Dry	84.1
Waukegan Harbor	WH-2002 - 3.3	01/16/2003	PCB-1254	U	0.0172	0.0862	ug/g	Dry	84.1
Waukegan Harbor	WH-2002 - 3.3	01/16/2003	PCB-1260	U	0.0172	0.0862	ug/g	Dry	84.1
Waukegan Harbor	WH-2002 - 3.3	01/16/2003	PCB-1262	U	0.0172	0.0862	ug/g	Dry	84.1
Waukegan Harbor	WH-2002 - 3.3	01/16/2003	PCB-1268	U	0.0172	0.0862	ug/g	Dry	84.1
Waukegan Harbor	WH-2002 - 4.1	01/16/2003	PCB-1016	U	0.0216	0.108	ug/g	Dry	74.3
Waukegan Harbor	WH-2002 - 4.1	01/16/2003	PCB-1221	U	0.0216	0.108	ug/g	Dry	74.3
Waukegan Harbor	WH-2002 - 4.1	01/16/2003	PCB-1232	U	0.0216	0.108	ug/g	Dry	74.3
Waukegan Harbor	WH-2002 - 4.1	01/16/2003	PCB-1242	U	0.0216	0.108	ug/g	Dry	74.3
Waukegan Harbor	WH-2002 - 4.1	01/16/2003	PCB-1248	0.385	0.0216	0.108	ug/g	Dry	74.3
Waukegan Harbor	WH-2002 - 4.1	01/16/2003	PCB-1254	U	0.0216	0.108	ug/g	Dry	74.3
Waukegan Harbor	WH-2002 - 4.1	01/16/2003	PCB-1260	U	0.0216	0.108	ug/g	Dry	74.3
Waukegan Harbor	WH-2002 - 4.1	01/16/2003	PCB-1262	U	0.0216	0.108	ug/g	Dry	74.3
Waukegan Harbor	WH-2002 - 4.1	01/16/2003	PCB-1268	U	0.0216	0.108	ug/g	Dry	74.3
Waukegan Harbor	WH-2002 - 4.2	01/16/2003	PCB-1016	U	0.0176	0.0882	ug/g	Dry	77.7
Waukegan Harbor	WH-2002 - 4.2	01/16/2003	PCB-1221	U	0.0176	0.0882	ug/g	Dry	77.7
Waukegan Harbor	WH-2002 - 4.2	01/16/2003	PCB-1232	U	0.0176	0.0882	ug/g	Dry	77.7

USEPA 2002 Investigation Analytical Results[a]
PCBs
Waukegan Harbor AOC

PROJECT	SAMPLENAME	SAMPDATE	ANALYTE	RESULT	DL	RL	UNITS	BASIS	PSOLIDS
Waukegan Harbor	WH-2002 - 4.2	01/16/2003	PCB-1242	U	0.0176	0.0882	ug/g	Dry	77.7
Waukegan Harbor	WH-2002 - 4.2	01/16/2003	PCB-1248	0.0538	0.0176	0.0882	ug/g	Dry	77.7
Waukegan Harbor	WH-2002 - 4.2	01/16/2003	PCB-1254	U	0.0176	0.0882	ug/g	Dry	77.7
Waukegan Harbor	WH-2002 - 4.2	01/16/2003	PCB-1260	U	0.0176	0.0882	ug/g	Dry	77.7
Waukegan Harbor	WH-2002 - 4.2	01/16/2003	PCB-1262	U	0.0176	0.0882	ug/g	Dry	77.7
Waukegan Harbor	WH-2002 - 4.2	01/16/2003	PCB-1268	U	0.0176	0.0882	ug/g	Dry	77.7
Waukegan Harbor	WH-2002 - 4.3	01/16/2003	PCB-1016	U	0.0186	0.0929	ug/g	Dry	89.7
Waukegan Harbor	WH-2002 - 4.3	01/16/2003	PCB-1221	U	0.0186	0.0929	ug/g	Dry	89.7
Waukegan Harbor	WH-2002 - 4.3	01/16/2003	PCB-1232	U	0.0186	0.0929	ug/g	Dry	89.7
Waukegan Harbor	WH-2002 - 4.3	01/16/2003	PCB-1242	U	0.0186	0.0929	ug/g	Dry	89.7
Waukegan Harbor	WH-2002 - 4.3	01/16/2003	PCB-1248	U	0.0186	0.0929	ug/g	Dry	89.7
Waukegan Harbor	WH-2002 - 4.3	01/16/2003	PCB-1254	U	0.0186	0.0929	ug/g	Dry	89.7
Waukegan Harbor	WH-2002 - 4.3	01/16/2003	PCB-1260	U	0.0186	0.0929	ug/g	Dry	89.7
Waukegan Harbor	WH-2002 - 4.3	01/16/2003	PCB-1262	U	0.0186	0.0929	ug/g	Dry	89.7
Waukegan Harbor	WH-2002 - 4.3	01/16/2003	PCB-1268	U	0.0186	0.0929	ug/g	Dry	89.7
Waukegan Harbor	WH-2002 - 5.1	01/16/2003	PCB-1016	U	0.0224	0.112	ug/g	Dry	70.5
Waukegan Harbor	WH-2002 - 5.1	01/16/2003	PCB-1221	U	0.0224	0.112	ug/g	Dry	70.5
Waukegan Harbor	WH-2002 - 5.1	01/16/2003	PCB-1232	U	0.0224	0.112	ug/g	Dry	70.5
Waukegan Harbor	WH-2002 - 5.1	01/16/2003	PCB-1242	U	0.0224	0.112	ug/g	Dry	70.5
Waukegan Harbor	WH-2002 - 5.1	01/16/2003	PCB-1248	0.878	0.0224	0.112	ug/g	Dry	70.5
Waukegan Harbor	WH-2002 - 5.1	01/16/2003	PCB-1254	U	0.0224	0.112	ug/g	Dry	70.5
Waukegan Harbor	WH-2002 - 5.1	01/16/2003	PCB-1260	U	0.0224	0.112	ug/g	Dry	70.5
Waukegan Harbor	WH-2002 - 5.1	01/16/2003	PCB-1262	U	0.0224	0.112	ug/g	Dry	70.5
Waukegan Harbor	WH-2002 - 5.1	01/16/2003	PCB-1268	U	0.0224	0.112	ug/g	Dry	70.5
Waukegan Harbor	WH-2002 - 5.2	01/16/2003	PCB-1016	U	0.252	1.26	ug/g	Dry	70.3
Waukegan Harbor	WH-2002 - 5.2	01/16/2003	PCB-1221	U	0.252	1.26	ug/g	Dry	70.3
Waukegan Harbor	WH-2002 - 5.2	01/16/2003	PCB-1232	U	0.252	1.26	ug/g	Dry	70.3
Waukegan Harbor	WH-2002 - 5.2	01/16/2003	PCB-1242	U	0.252	1.26	ug/g	Dry	70.3
Waukegan Harbor	WH-2002 - 5.2	01/16/2003	PCB-1248	9.34	0.252	1.26	ug/g	Dry	70.3
Waukegan Harbor	WH-2002 - 5.2	01/16/2003	PCB-1254	U	0.252	1.26	ug/g	Dry	70.3

USEPA 2002 Investigation Analytical Results[a]
PCBs
Waukegan Harbor AOC

PROJECT	SAMPLENAME	SAMPDATE	ANALYTE	RESULT	DL	RL	UNITS	BASIS	PSOLIDS
Waukegan Harbor	WH-2002 - 5.2	01/16/2003	PCB-1260	U	0.252	1.26	ug/g	Dry	70.3
Waukegan Harbor	WH-2002 - 5.2	01/16/2003	PCB-1262	U	0.252	1.26	ug/g	Dry	70.3
Waukegan Harbor	WH-2002 - 5.2	01/16/2003	PCB-1268	U	0.252	1.26	ug/g	Dry	70.3
Waukegan Harbor	WH-2002 - 5.3	01/16/2003	PCB-1016	U	0.0165	0.0827	ug/g	Dry	88.4
Waukegan Harbor	WH-2002 - 5.3	01/16/2003	PCB-1221	U	0.0165	0.0827	ug/g	Dry	88.4
Waukegan Harbor	WH-2002 - 5.3	01/16/2003	PCB-1232	U	0.0165	0.0827	ug/g	Dry	88.4
Waukegan Harbor	WH-2002 - 5.3	01/16/2003	PCB-1242	U	0.0165	0.0827	ug/g	Dry	88.4
Waukegan Harbor	WH-2002 - 5.3	01/16/2003	PCB-1248	U	0.0165	0.0827	ug/g	Dry	88.4
Waukegan Harbor	WH-2002 - 5.3	01/16/2003	PCB-1254	U	0.0165	0.0827	ug/g	Dry	88.4
Waukegan Harbor	WH-2002 - 5.3	01/16/2003	PCB-1260	U	0.0165	0.0827	ug/g	Dry	88.4
Waukegan Harbor	WH-2002 - 5.3	01/16/2003	PCB-1262	U	0.0165	0.0827	ug/g	Dry	88.4
Waukegan Harbor	WH-2002 - 5.3	01/16/2003	PCB-1268	U	0.0165	0.0827	ug/g	Dry	88.4
Waukegan Harbor	WH-2002 - 6.1	01/16/2003	PCB-1016	U	0.0266	0.133	ug/g	Dry	68.4
Waukegan Harbor	WH-2002 - 6.1	01/16/2003	PCB-1221	U	0.0266	0.133	ug/g	Dry	68.4
Waukegan Harbor	WH-2002 - 6.1	01/16/2003	PCB-1232	U	0.0266	0.133	ug/g	Dry	68.4
Waukegan Harbor	WH-2002 - 6.1	01/16/2003	PCB-1242	U	0.0266	0.133	ug/g	Dry	68.4
Waukegan Harbor	WH-2002 - 6.1	01/16/2003	PCB-1248	1.69	0.0266	0.133	ug/g	Dry	68.4
Waukegan Harbor	WH-2002 - 6.1	01/16/2003	PCB-1254	U	0.0266	0.133	ug/g	Dry	68.4
Waukegan Harbor	WH-2002 - 6.1	01/16/2003	PCB-1260	U	0.0266	0.133	ug/g	Dry	68.4
Waukegan Harbor	WH-2002 - 6.1	01/16/2003	PCB-1262	U	0.0266	0.133	ug/g	Dry	68.4
Waukegan Harbor	WH-2002 - 6.1	01/16/2003	PCB-1268	U	0.0266	0.133	ug/g	Dry	68.4
Waukegan Harbor	WH-2002 - 6.2	01/16/2003	PCB-1016	U	0.0403	0.201	ug/g	Dry	74.6
Waukegan Harbor	WH-2002 - 6.2	01/16/2003	PCB-1221	U	0.0403	0.201	ug/g	Dry	74.6
Waukegan Harbor	WH-2002 - 6.2	01/16/2003	PCB-1232	U	0.0403	0.201	ug/g	Dry	74.6
Waukegan Harbor	WH-2002 - 6.2	01/16/2003	PCB-1242	U	0.0403	0.201	ug/g	Dry	74.6
Waukegan Harbor	WH-2002 - 6.2	01/16/2003	PCB-1248	2.70	0.0403	0.201	ug/g	Dry	74.6
Waukegan Harbor	WH-2002 - 6.2	01/16/2003	PCB-1254	U	0.0403	0.201	ug/g	Dry	74.6
Waukegan Harbor	WH-2002 - 6.2	01/16/2003	PCB-1260	U	0.0403	0.201	ug/g	Dry	74.6
Waukegan Harbor	WH-2002 - 6.2	01/16/2003	PCB-1262	U	0.0403	0.201	ug/g	Dry	74.6
Waukegan Harbor	WH-2002 - 6.2	01/16/2003	PCB-1268	U	0.0403	0.201	ug/g	Dry	74.6

USEPA 2002 Investigation Analytical Results[a]
PCBs
Waukegan Harbor AOC

PROJECT	SAMPLENAME	SAMPDATE	ANALYTE	RESULT	DL	RL	UNITS	BASIS	PSOLIDS
Waukegan Harbor	WH-2002 - 6.3	01/16/2003	PCB-1016	U	0.0166	0.0831	ug/g	Dry	90.5
Waukegan Harbor	WH-2002 - 6.3	01/16/2003	PCB-1221	U	0.0166	0.0831	ug/g	Dry	90.5
Waukegan Harbor	WH-2002 - 6.3	01/16/2003	PCB-1232	U	0.0166	0.0831	ug/g	Dry	90.5
Waukegan Harbor	WH-2002 - 6.3	01/16/2003	PCB-1242	U	0.0166	0.0831	ug/g	Dry	90.5
Waukegan Harbor	WH-2002 - 6.3	01/16/2003	PCB-1248	U	0.0166	0.0831	ug/g	Dry	90.5
Waukegan Harbor	WH-2002 - 6.3	01/16/2003	PCB-1254	U	0.0166	0.0831	ug/g	Dry	90.5
Waukegan Harbor	WH-2002 - 6.3	01/16/2003	PCB-1260	U	0.0166	0.0831	ug/g	Dry	90.5
Waukegan Harbor	WH-2002 - 6.3	01/16/2003	PCB-1262	U	0.0166	0.0831	ug/g	Dry	90.5
Waukegan Harbor	WH-2002 - 6.3	01/16/2003	PCB-1268	U	0.0166	0.0831	ug/g	Dry	90.5
Waukegan Harbor	WH-2002 - 7.1	01/16/2003	PCB-1016	U	0.270	1.35	ug/g	Dry	57.4
Waukegan Harbor	WH-2002 - 7.1	01/16/2003	PCB-1221	U	0.270	1.35	ug/g	Dry	57.4
Waukegan Harbor	WH-2002 - 7.1	01/16/2003	PCB-1232	U	0.270	1.35	ug/g	Dry	57.4
Waukegan Harbor	WH-2002 - 7.1	01/16/2003	PCB-1242	U	0.270	1.35	ug/g	Dry	57.4
Waukegan Harbor	WH-2002 - 7.1	01/16/2003	PCB-1248	13.9	0.270	1.35	ug/g	Dry	57.4
Waukegan Harbor	WH-2002 - 7.1	01/16/2003	PCB-1254	U	0.270	1.35	ug/g	Dry	57.4
Waukegan Harbor	WH-2002 - 7.1	01/16/2003	PCB-1260	U	0.270	1.35	ug/g	Dry	57.4
Waukegan Harbor	WH-2002 - 7.1	01/16/2003	PCB-1262	U	0.270	1.35	ug/g	Dry	57.4
Waukegan Harbor	WH-2002 - 7.1	01/16/2003	PCB-1268	U	0.270	1.35	ug/g	Dry	57.4
Waukegan Harbor	WH-2002 - 7.2	01/16/2003	PCB-1016	U	0.120	0.600	ug/g	Dry	61.1
Waukegan Harbor	WH-2002 - 7.2	01/16/2003	PCB-1221	U	0.120	0.600	ug/g	Dry	61.1
Waukegan Harbor	WH-2002 - 7.2	01/16/2003	PCB-1232	U	0.120	0.600	ug/g	Dry	61.1
Waukegan Harbor	WH-2002 - 7.2	01/16/2003	PCB-1242	U	0.120	0.600	ug/g	Dry	61.1
Waukegan Harbor	WH-2002 - 7.2	01/16/2003	PCB-1248	5.45	0.120	0.600	ug/g	Dry	61.1
Waukegan Harbor	WH-2002 - 7.2	01/16/2003	PCB-1254	U	0.120	0.600	ug/g	Dry	61.1
Waukegan Harbor	WH-2002 - 7.2	01/16/2003	PCB-1260	U	0.120	0.600	ug/g	Dry	61.1
Waukegan Harbor	WH-2002 - 7.2	01/16/2003	PCB-1262	U	0.120	0.600	ug/g	Dry	61.1
Waukegan Harbor	WH-2002 - 7.2	01/16/2003	PCB-1268	U	0.120	0.600	ug/g	Dry	61.1
Waukegan Harbor	WH-2002 - 7.3	01/16/2003	PCB-1016	U	0.0205	0.102	ug/g	Dry	88.0
Waukegan Harbor	WH-2002 - 7.3	01/16/2003	PCB-1221	U	0.0205	0.102	ug/g	Dry	88.0
Waukegan Harbor	WH-2002 - 7.3	01/16/2003	PCB-1232	U	0.0205	0.102	ug/g	Dry	88.0

USEPA 2002 Investigation Analytical Results[a]
PCBs
Waukegan Harbor AOC

PROJECT	SAMPLENAME	SAMPDATE	ANALYTE	RESULT	DL	RL	UNITS	BASIS	PSOLIDS
Waukegan Harbor	WH-2002 - 7.3	01/16/2003	PCB-1242	U	0.0205	0.102	ug/g	Dry	88.0
Waukegan Harbor	WH-2002 - 7.3	01/16/2003	PCB-1248	0.0277	0.0205	0.102	ug/g	Dry	88.0
Waukegan Harbor	WH-2002 - 7.3	01/16/2003	PCB-1254	U	0.0205	0.102	ug/g	Dry	88.0
Waukegan Harbor	WH-2002 - 7.3	01/16/2003	PCB-1260	U	0.0205	0.102	ug/g	Dry	88.0
Waukegan Harbor	WH-2002 - 7.3	01/16/2003	PCB-1262	U	0.0205	0.102	ug/g	Dry	88.0
Waukegan Harbor	WH-2002 - 7.3	01/16/2003	PCB-1268	U	0.0205	0.102	ug/g	Dry	88.0
Waukegan Harbor	WH-2002-10.1	01/15/2003	PCB-1016	U	0.0451	0.225	ug/g	Dry	72.5
Waukegan Harbor	WH-2002-10.1	01/15/2003	PCB-1221	U	0.0451	0.225	ug/g	Dry	72.5
Waukegan Harbor	WH-2002-10.1	01/15/2003	PCB-1232	U	0.0451	0.225	ug/g	Dry	72.5
Waukegan Harbor	WH-2002-10.1	01/15/2003	PCB-1242	U	0.0451	0.225	ug/g	Dry	72.5
Waukegan Harbor	WH-2002-10.1	01/15/2003	PCB-1248	1.53	0.0451	0.225	ug/g	Dry	72.5
Waukegan Harbor	WH-2002-10.1	01/15/2003	PCB-1254	U	0.0451	0.225	ug/g	Dry	72.5
Waukegan Harbor	WH-2002-10.1	01/15/2003	PCB-1260	U	0.0451	0.225	ug/g	Dry	72.5
Waukegan Harbor	WH-2002-10.1	01/15/2003	PCB-1262	U	0.0451	0.225	ug/g	Dry	72.5
Waukegan Harbor	WH-2002-10.1	01/15/2003	PCB-1268	U	0.0451	0.225	ug/g	Dry	72.5
Waukegan Harbor	WH-2002-10.3	01/15/2003	PCB-1016	U	0.0233	0.116	ug/g	Dry	86.0
Waukegan Harbor	WH-2002-10.3	01/15/2003	PCB-1221	U	0.0233	0.116	ug/g	Dry	86.0
Waukegan Harbor	WH-2002-10.3	01/15/2003	PCB-1232	U	0.0233	0.116	ug/g	Dry	86.0
Waukegan Harbor	WH-2002-10.3	01/15/2003	PCB-1242	U	0.0233	0.116	ug/g	Dry	86.0
Waukegan Harbor	WH-2002-10.3	01/15/2003	PCB-1248	0.0923	0.0233	0.116	ug/g	Dry	86.0
Waukegan Harbor	WH-2002-10.3	01/15/2003	PCB-1254	U	0.0233	0.116	ug/g	Dry	86.0
Waukegan Harbor	WH-2002-10.3	01/15/2003	PCB-1260	U	0.0233	0.116	ug/g	Dry	86.0
Waukegan Harbor	WH-2002-10.3	01/15/2003	PCB-1262	U	0.0233	0.116	ug/g	Dry	86.0
Waukegan Harbor	WH-2002-10.3	01/15/2003	PCB-1268	U	0.0233	0.116	ug/g	Dry	86.0
Waukegan Harbor	WH-2002-11.1	01/15/2003	PCB-1016	U	0.0189	0.0944	ug/g	Dry	84.1
Waukegan Harbor	WH-2002-11.1	01/15/2003	PCB-1221	U	0.0189	0.0944	ug/g	Dry	84.1
Waukegan Harbor	WH-2002-11.1	01/15/2003	PCB-1232	U	0.0189	0.0944	ug/g	Dry	84.1
Waukegan Harbor	WH-2002-11.1	01/15/2003	PCB-1242	U	0.0189	0.0944	ug/g	Dry	84.1
Waukegan Harbor	WH-2002-11.1	01/15/2003	PCB-1248	0.946	0.0189	0.0944	ug/g	Dry	84.1
Waukegan Harbor	WH-2002-11.1	01/15/2003	PCB-1254	U	0.0189	0.0944	ug/g	Dry	84.1

USEPA 2002 Investigation Analytical Results[a]
PCBs
Waukegan Harbor AOC

PROJECT	SAMPLENAME	SAMPDATE	ANALYTE	RESULT	DL	RL	UNITS	BASIS	PSOLIDS
Waukegan Harbor	WH-2002-11.1	01/15/2003	PCB-1260	U	0.0189	0.0944	ug/g	Dry	84.1
Waukegan Harbor	WH-2002-11.1	01/15/2003	PCB-1262	U	0.0189	0.0944	ug/g	Dry	84.1
Waukegan Harbor	WH-2002-11.1	01/15/2003	PCB-1268	U	0.0189	0.0944	ug/g	Dry	84.1
Waukegan Harbor	WH-2002-11.3	01/15/2003	PCB-1016	U	0.0226	0.113	ug/g	Dry	88.5
Waukegan Harbor	WH-2002-11.3	01/15/2003	PCB-1221	U	0.0226	0.113	ug/g	Dry	88.5
Waukegan Harbor	WH-2002-11.3	01/15/2003	PCB-1232	U	0.0226	0.113	ug/g	Dry	88.5
Waukegan Harbor	WH-2002-11.3	01/15/2003	PCB-1242	0.0520	0.0226	0.113	ug/g	Dry	88.5
Waukegan Harbor	WH-2002-11.3	01/15/2003	PCB-1248	U	0.0226	0.113	ug/g	Dry	88.5
Waukegan Harbor	WH-2002-11.3	01/15/2003	PCB-1254	U	0.0226	0.113	ug/g	Dry	88.5
Waukegan Harbor	WH-2002-11.3	01/15/2003	PCB-1260	U	0.0226	0.113	ug/g	Dry	88.5
Waukegan Harbor	WH-2002-11.3	01/15/2003	PCB-1262	U	0.0226	0.113	ug/g	Dry	88.5
Waukegan Harbor	WH-2002-11.3	01/15/2003	PCB-1268	U	0.0226	0.113	ug/g	Dry	88.5
Waukegan Harbor	WH-2002-12.3	01/15/2003	PCB-1016	U	0.0229	0.114	ug/g	Dry	87.4
Waukegan Harbor	WH-2002-12.3	01/15/2003	PCB-1221	U	0.0229	0.114	ug/g	Dry	87.4
Waukegan Harbor	WH-2002-12.3	01/15/2003	PCB-1232	U	0.0229	0.114	ug/g	Dry	87.4
Waukegan Harbor	WH-2002-12.3	01/15/2003	PCB-1242	U	0.0229	0.114	ug/g	Dry	87.4
Waukegan Harbor	WH-2002-12.3	01/15/2003	PCB-1248	0.0384	0.0229	0.114	ug/g	Dry	87.4
Waukegan Harbor	WH-2002-12.3	01/15/2003	PCB-1254	U	0.0229	0.114	ug/g	Dry	87.4
Waukegan Harbor	WH-2002-12.3	01/15/2003	PCB-1260	U	0.0229	0.114	ug/g	Dry	87.4
Waukegan Harbor	WH-2002-12.3	01/15/2003	PCB-1262	U	0.0229	0.114	ug/g	Dry	87.4
Waukegan Harbor	WH-2002-12.3	01/15/2003	PCB-1268	U	0.0229	0.114	ug/g	Dry	87.4
Waukegan Harbor	WH-2002-13.3	01/15/2003	PCB-1016	U	0.0222	0.111	ug/g	Dry	90.1
Waukegan Harbor	WH-2002-13.3	01/15/2003	PCB-1221	U	0.0222	0.111	ug/g	Dry	90.1
Waukegan Harbor	WH-2002-13.3	01/15/2003	PCB-1232	U	0.0222	0.111	ug/g	Dry	90.1
Waukegan Harbor	WH-2002-13.3	01/15/2003	PCB-1242	U	0.0222	0.111	ug/g	Dry	90.1
Waukegan Harbor	WH-2002-13.3	01/15/2003	PCB-1248	0.169	0.0222	0.111	ug/g	Dry	90.1
Waukegan Harbor	WH-2002-13.3	01/15/2003	PCB-1254	U	0.0222	0.111	ug/g	Dry	90.1
Waukegan Harbor	WH-2002-13.3	01/15/2003	PCB-1260	U	0.0222	0.111	ug/g	Dry	90.1
Waukegan Harbor	WH-2002-13.3	01/15/2003	PCB-1262	U	0.0222	0.111	ug/g	Dry	90.1
Waukegan Harbor	WH-2002-13.3	01/15/2003	PCB-1268	U	0.0222	0.111	ug/g	Dry	90.1

USEPA 2002 Investigation Analytical Results[a]
PCBs
Waukegan Harbor AOC

PROJECT	SAMPLENAME	SAMPDATE	ANALYTE	RESULT	DL	RL	UNITS	BASIS	PSOLIDS
Waukegan Harbor	WH-2002-14.1	01/15/2003	PCB-1016	U	0.123	0.613	ug/g	Dry	81.6
Waukegan Harbor	WH-2002-14.1	01/15/2003	PCB-1221	U	0.123	0.613	ug/g	Dry	81.6
Waukegan Harbor	WH-2002-14.1	01/15/2003	PCB-1232	U	0.123	0.613	ug/g	Dry	81.6
Waukegan Harbor	WH-2002-14.1	01/15/2003	PCB-1242	U	0.123	0.613	ug/g	Dry	81.6
Waukegan Harbor	WH-2002-14.1	01/15/2003	PCB-1248	6.56	0.123	0.613	ug/g	Dry	81.6
Waukegan Harbor	WH-2002-14.1	01/15/2003	PCB-1254	U	0.123	0.613	ug/g	Dry	81.6
Waukegan Harbor	WH-2002-14.1	01/15/2003	PCB-1260	U	0.123	0.613	ug/g	Dry	81.6
Waukegan Harbor	WH-2002-14.1	01/15/2003	PCB-1262	U	0.123	0.613	ug/g	Dry	81.6
Waukegan Harbor	WH-2002-14.1	01/15/2003	PCB-1268	U	0.123	0.613	ug/g	Dry	81.6
Waukegan Harbor	WH-2002-14.3	01/15/2003	PCB-1016	U	0.0218	0.109	ug/g	Dry	91.5
Waukegan Harbor	WH-2002-14.3	01/15/2003	PCB-1221	U	0.0218	0.109	ug/g	Dry	91.5
Waukegan Harbor	WH-2002-14.3	01/15/2003	PCB-1232	U	0.0218	0.109	ug/g	Dry	91.5
Waukegan Harbor	WH-2002-14.3	01/15/2003	PCB-1242	0.0673	0.0218	0.109	ug/g	Dry	91.5
Waukegan Harbor	WH-2002-14.3	01/15/2003	PCB-1248	U	0.0218	0.109	ug/g	Dry	91.5
Waukegan Harbor	WH-2002-14.3	01/15/2003	PCB-1254	U	0.0218	0.109	ug/g	Dry	91.5
Waukegan Harbor	WH-2002-14.3	01/15/2003	PCB-1260	U	0.0218	0.109	ug/g	Dry	91.5
Waukegan Harbor	WH-2002-14.3	01/15/2003	PCB-1262	U	0.0218	0.109	ug/g	Dry	91.5
Waukegan Harbor	WH-2002-14.3	01/15/2003	PCB-1268	U	0.0218	0.109	ug/g	Dry	91.5
Waukegan Harbor	WH-2002-15.1	01/15/2003	PCB-1016	U	0.0724	0.362	ug/g	Dry	82.8
Waukegan Harbor	WH-2002-15.1	01/15/2003	PCB-1221	U	0.0724	0.362	ug/g	Dry	82.8
Waukegan Harbor	WH-2002-15.1	01/15/2003	PCB-1232	U	0.0724	0.362	ug/g	Dry	82.8
Waukegan Harbor	WH-2002-15.1	01/15/2003	PCB-1242	U	0.0724	0.362	ug/g	Dry	82.8
Waukegan Harbor	WH-2002-15.1	01/15/2003	PCB-1248	2.16	0.0724	0.362	ug/g	Dry	82.8
Waukegan Harbor	WH-2002-15.1	01/15/2003	PCB-1254	U	0.0724	0.362	ug/g	Dry	82.8
Waukegan Harbor	WH-2002-15.1	01/15/2003	PCB-1260	U	0.0724	0.362	ug/g	Dry	82.8
Waukegan Harbor	WH-2002-15.1	01/15/2003	PCB-1262	U	0.0724	0.362	ug/g	Dry	82.8
Waukegan Harbor	WH-2002-15.1	01/15/2003	PCB-1268	U	0.0724	0.362	ug/g	Dry	82.8
Waukegan Harbor	WH-2002-15.3	01/15/2003	PCB-1016	U	0.0239	0.119	ug/g	Dry	83.8
Waukegan Harbor	WH-2002-15.3	01/15/2003	PCB-1221	U	0.0239	0.119	ug/g	Dry	83.8
Waukegan Harbor	WH-2002-15.3	01/15/2003	PCB-1232	U	0.0239	0.119	ug/g	Dry	83.8

USEPA 2002 Investigation Analytical Results[a]
PCBs
Waukegan Harbor AOC

PROJECT	SAMPLENAME	SAMPDATE	ANALYTE	RESULT	DL	RL	UNITS	BASIS	PSOLIDS
Waukegan Harbor	WH-2002-15.3	01/15/2003	PCB-1242	U	0.0239	0.119	ug/g	Dry	83.8
Waukegan Harbor	WH-2002-15.3	01/15/2003	PCB-1248	U	0.0239	0.119	ug/g	Dry	83.8
Waukegan Harbor	WH-2002-15.3	01/15/2003	PCB-1254	U	0.0239	0.119	ug/g	Dry	83.8
Waukegan Harbor	WH-2002-15.3	01/15/2003	PCB-1260	U	0.0239	0.119	ug/g	Dry	83.8
Waukegan Harbor	WH-2002-15.3	01/15/2003	PCB-1262	U	0.0239	0.119	ug/g	Dry	83.8
Waukegan Harbor	WH-2002-15.3	01/15/2003	PCB-1268	U	0.0239	0.119	ug/g	Dry	83.8
Waukegan Harbor	WH-2002-8.1	01/15/2003	PCB-1016	U	0.167	0.835	ug/g	Dry	49.6
Waukegan Harbor	WH-2002-8.1	01/15/2003	PCB-1221	U	0.167	0.835	ug/g	Dry	49.6
Waukegan Harbor	WH-2002-8.1	01/15/2003	PCB-1232	U	0.167	0.835	ug/g	Dry	49.6
Waukegan Harbor	WH-2002-8.1	01/15/2003	PCB-1242	U	0.167	0.835	ug/g	Dry	49.6
Waukegan Harbor	WH-2002-8.1	01/15/2003	PCB-1248	7.25	0.167	0.835	ug/g	Dry	49.6
Waukegan Harbor	WH-2002-8.1	01/15/2003	PCB-1254	U	0.167	0.835	ug/g	Dry	49.6
Waukegan Harbor	WH-2002-8.1	01/15/2003	PCB-1260	U	0.167	0.835	ug/g	Dry	49.6
Waukegan Harbor	WH-2002-8.1	01/15/2003	PCB-1262	U	0.167	0.835	ug/g	Dry	49.6
Waukegan Harbor	WH-2002-8.1	01/15/2003	PCB-1268	U	0.167	0.835	ug/g	Dry	49.6
Waukegan Harbor	WH-2002-8.3	01/15/2003	PCB-1016	U	0.0239	0.120	ug/g	Dry	83.6
Waukegan Harbor	WH-2002-8.3	01/15/2003	PCB-1221	U	0.0239	0.120	ug/g	Dry	83.6
Waukegan Harbor	WH-2002-8.3	01/15/2003	PCB-1232	U	0.0239	0.120	ug/g	Dry	83.6
Waukegan Harbor	WH-2002-8.3	01/15/2003	PCB-1242	0.0528	0.0239	0.120	ug/g	Dry	83.6
Waukegan Harbor	WH-2002-8.3	01/15/2003	PCB-1248	U	0.0239	0.120	ug/g	Dry	83.6
Waukegan Harbor	WH-2002-8.3	01/15/2003	PCB-1254	U	0.0239	0.120	ug/g	Dry	83.6
Waukegan Harbor	WH-2002-8.3	01/15/2003	PCB-1260	U	0.0239	0.120	ug/g	Dry	83.6
Waukegan Harbor	WH-2002-8.3	01/15/2003	PCB-1262	U	0.0239	0.120	ug/g	Dry	83.6
Waukegan Harbor	WH-2002-8.3	01/15/2003	PCB-1268	U	0.0239	0.120	ug/g	Dry	83.6
Waukegan Harbor	WH-2002-9.1	01/15/2003	PCB-1016	U	0.614	3.07	ug/g	Dry	52.6
Waukegan Harbor	WH-2002-9.1	01/15/2003	PCB-1221	U	0.614	3.07	ug/g	Dry	52.6
Waukegan Harbor	WH-2002-9.1	01/15/2003	PCB-1232	U	0.614	3.07	ug/g	Dry	52.6
Waukegan Harbor	WH-2002-9.1	01/15/2003	PCB-1242	U	0.614	3.07	ug/g	Dry	52.6
Waukegan Harbor	WH-2002-9.1	01/15/2003	PCB-1248	29.8	0.614	3.07	ug/g	Dry	52.6
Waukegan Harbor	WH-2002-9.1	01/15/2003	PCB-1254	U	0.614	3.07	ug/g	Dry	52.6

USEPA 2002 Investigation Analytical Results[a]
PCBs
Waukegan Harbor AOC

PROJECT	SAMPLENAME	SAMPDATE	ANALYTE	RESULT	DL	RL	UNITS	BASIS	PSOLIDS
Waukegan Harbor	WH-2002-9.1	01/15/2003	PCB-1260	U	0.614	3.07	ug/g	Dry	52.6
Waukegan Harbor	WH-2002-9.1	01/15/2003	PCB-1262	U	0.614	3.07	ug/g	Dry	52.6
Waukegan Harbor	WH-2002-9.1	01/15/2003	PCB-1268	U	0.614	3.07	ug/g	Dry	52.6
Waukegan Harbor	WH-2002-9.2	01/15/2003	PCB-1016	U	0.548	2.74	ug/g	Dry	63.7
Waukegan Harbor	WH-2002-9.2	01/15/2003	PCB-1221	U	0.548	2.74	ug/g	Dry	63.7
Waukegan Harbor	WH-2002-9.2	01/15/2003	PCB-1232	U	0.548	2.74	ug/g	Dry	63.7
Waukegan Harbor	WH-2002-9.2	01/15/2003	PCB-1242	U	0.548	2.74	ug/g	Dry	63.7
Waukegan Harbor	WH-2002-9.2	01/15/2003	PCB-1248	23.1	0.548	2.74	ug/g	Dry	63.7
Waukegan Harbor	WH-2002-9.2	01/15/2003	PCB-1254	U	0.548	2.74	ug/g	Dry	63.7
Waukegan Harbor	WH-2002-9.2	01/15/2003	PCB-1260	U	0.548	2.74	ug/g	Dry	63.7
Waukegan Harbor	WH-2002-9.2	01/15/2003	PCB-1262	U	0.548	2.74	ug/g	Dry	63.7
Waukegan Harbor	WH-2002-9.2	01/15/2003	PCB-1268	U	0.548	2.74	ug/g	Dry	63.7
Waukegan Harbor	WH-2002-9.3	01/15/2003	PCB-1016	U	0.0231	0.115	ug/g	Dry	86.7
Waukegan Harbor	WH-2002-9.3	01/15/2003	PCB-1221	U	0.0231	0.115	ug/g	Dry	86.7
Waukegan Harbor	WH-2002-9.3	01/15/2003	PCB-1232	U	0.0231	0.115	ug/g	Dry	86.7
Waukegan Harbor	WH-2002-9.3	01/15/2003	PCB-1242	U	0.0231	0.115	ug/g	Dry	86.7
Waukegan Harbor	WH-2002-9.3	01/15/2003	PCB-1248	0.197	0.0231	0.115	ug/g	Dry	86.7
Waukegan Harbor	WH-2002-9.3	01/15/2003	PCB-1254	U	0.0231	0.115	ug/g	Dry	86.7
Waukegan Harbor	WH-2002-9.3	01/15/2003	PCB-1260	U	0.0231	0.115	ug/g	Dry	86.7
Waukegan Harbor	WH-2002-9.3	01/15/2003	PCB-1262	U	0.0231	0.115	ug/g	Dry	86.7
Waukegan Harbor	WH-2002-9.3	01/15/2003	PCB-1268	U	0.0231	0.115	ug/g	Dry	86.7

[a]Data provided electronically by USEPA

USEPA 2002 Investigation Analytical Results[a]
Metals
Waukegan Harbor AOC

PROJECT	SAMPLENAME	ANALYTE	RESULT	DL	RL	UNITS	BASIS	PSOLIDS
Waukegan Harbor	WH-2002 - 1.1	Arsenic	2.1	0.17	0.64	mg/kg	Dry	79.7
Waukegan Harbor	WH-2002 - 1.2	Arsenic	2.5	0.20	0.75	mg/kg	Dry	78.4
Waukegan Harbor	WH-2002 - 1.3	Arsenic	7.6	0.18	0.66	mg/kg	Dry	90.3
Waukegan Harbor	WH-2002 - 16.1	Arsenic	4.7	0.20	0.75	mg/kg	Dry	77.1
Waukegan Harbor	WH-2002 - 16.2	Arsenic	3.7	0.20	0.75	mg/kg	Dry	80.4
Waukegan Harbor	WH-2002 - 16.3	Arsenic	6.1	0.20	0.75	mg/kg	Dry	87.1
Waukegan Harbor	WH-2002 - 2.1	Arsenic	1.7	0.16	0.60	mg/kg	Dry	78.9
Waukegan Harbor	WH-2002 - 2.2	Arsenic	1.8	0.16	0.62	mg/kg	Dry	79.8
Waukegan Harbor	WH-2002 - 2.3	Arsenic	6.6	0.20	0.75	mg/kg	Dry	89.5
Waukegan Harbor	WH-2002 - 3.1	Arsenic	3.7	0.20	0.75	mg/kg	Dry	79.8
Waukegan Harbor	WH-2002 - 3.2	Arsenic	4.1	0.20	0.75	mg/kg	Dry	80.5
Waukegan Harbor	WH-2002 - 3.3	Arsenic	7.4	0.20	0.75	mg/kg	Dry	84.1
Waukegan Harbor	WH-2002 - 4.2	Arsenic	1.5	0.20	0.75	mg/kg	Dry	77.7
Waukegan Harbor	WH-2002 - 6.1	Arsenic	11	0.40	1.5	mg/kg	Dry	68.4
Waukegan Harbor	WH-2002 - 5.2	Arsenic	13	0.40	1.5	mg/kg	Dry	70.3
Waukegan Harbor	WH-2002 - 6.2	Arsenic	21	0.40	1.5	mg/kg	Dry	74.6
Waukegan Harbor	WH-2002 - 5.1	Arsenic	5.3	0.18	0.68	mg/kg	Dry	70.5
Waukegan Harbor	WH-2002 - 4.1	Arsenic	5.8	0.20	0.75	mg/kg	Dry	74.3
Waukegan Harbor	WH-2002 - 6.3	Arsenic	7.0	0.20	0.75	mg/kg	Dry	90.5
Waukegan Harbor	WH-2002 - 5.3	Arsenic	7.2	0.20	0.75	mg/kg	Dry	88.4
Waukegan Harbor	WH-2002 - 4.3	Arsenic	7.5	0.20	0.75	mg/kg	Dry	89.7
Waukegan Harbor	WH-2002-8.1	Arsenic	30	0.80	3.0	mg/kg	Dry	49.6
Waukegan Harbor	WH-2002-9.1	Arsenic	32	0.71	2.7	mg/kg	Dry	52.6
Waukegan Harbor	WH-2002-9.2	Arsenic	37	0.80	3.0	mg/kg	Dry	63.7
Waukegan Harbor	WH-2002-10.3	Arsenic	10	0.20	0.75	mg/kg	Dry	86.0
Waukegan Harbor	WH-2002-10.1	Arsenic	11	0.20	0.75	mg/kg	Dry	72.5
Waukegan Harbor	WH-2002-11.1	Arsenic	4.7	0.20	0.75	mg/kg	Dry	87.4
Waukegan Harbor	WH-2002-11.3	Arsenic	6.2	0.20	0.75	mg/kg	Dry	88.5
Waukegan Harbor	WH-2002-11.1	Arsenic	8.7	0.18	0.68	mg/kg	Dry	84.1
Waukegan Harbor	WH-2002-14.1	Arsenic	16	0.40	1.5	mg/kg	Dry	81.6
Waukegan Harbor	WH-2002-15.1	Arsenic	5.5	0.20	0.75	mg/kg	Dry	82.8

USEPA 2002 Investigation Analytical Results[a]
Metals
Waukegan Harbor AOC

PROJECT	SAMPLENAME	ANALYTE	RESULT	DL	RL	UNITS	BASIS	PSOLIDS
Waukegan Harbor	WH-2002-13.3	Arsenic	5.9	0.18	0.66	mg/kg	Dry	90.1
Waukegan Harbor	WH-2002-15.3	Arsenic	6.4	0.20	0.75	mg/kg	Dry	83.8
Waukegan Harbor	WH-2002-14.3	Arsenic	8.1	0.20	0.75	mg/kg	Dry	91.5
Waukegan Harbor	WH-2002 - 7.1	Arsenic	44	1.8	6.7	mg/kg	Dry	57.4
Waukegan Harbor	WH-2002-8.3	Arsenic	6.4	0.20	0.75	mg/kg	Dry	83.6
Waukegan Harbor	WH-2002-9.3	Arsenic	6.6	0.20	0.75	mg/kg	Dry	86.7
Waukegan Harbor	WH-2002 - 7.3	Arsenic	6.8	0.20	0.75	mg/kg	Dry	88.0
Waukegan Harbor	WH-2002 - 7.2	Arsenic	63	2.0	7.5	mg/kg	Dry	61.1
Waukegan Harbor	WH-2002 - 1.1	Barium	6.0	0.034	0.17	mg/kg	Dry	79.7
Waukegan Harbor	WH-2002 - 1.2	Barium	9.5	0.040	0.20	mg/kg	Dry	78.4
Waukegan Harbor	WH-2002 - 1.3	Barium	28	0.035	0.18	mg/kg	Dry	90.3
Waukegan Harbor	WH-2002 - 16.1	Barium	12	0.040	0.20	mg/kg	Dry	77.1
Waukegan Harbor	WH-2002 - 16.2	Barium	8.6	0.040	0.20	mg/kg	Dry	80.4
Waukegan Harbor	WH-2002 - 16.3	Barium	43	0.040	0.20	mg/kg	Dry	87.1
Waukegan Harbor	WH-2002 - 2.1	Barium	4.6	0.032	0.16	mg/kg	Dry	78.9
Waukegan Harbor	WH-2002 - 2.2	Barium	4.8	0.033	0.16	mg/kg	Dry	79.8
Waukegan Harbor	WH-2002 - 2.3	Barium	34	0.040	0.20	mg/kg	Dry	89.5
Waukegan Harbor	WH-2002 - 3.1	Barium	15	0.040	0.20	mg/kg	Dry	79.8
Waukegan Harbor	WH-2002 - 3.2	Barium	18	0.040	0.20	mg/kg	Dry	80.5
Waukegan Harbor	WH-2002 - 3.3	Barium	29	0.040	0.20	mg/kg	Dry	84.1
Waukegan Harbor	WH-2002 - 4.1	Barium	20	0.040	0.20	mg/kg	Dry	74.3
Waukegan Harbor	WH-2002 - 5.1	Barium	20	0.036	0.18	mg/kg	Dry	70.5
Waukegan Harbor	WH-2002 - 6.1	Barium	31	0.040	0.20	mg/kg	Dry	68.4
Waukegan Harbor	WH-2002 - 4.3	Barium	35	0.040	0.20	mg/kg	Dry	89.7
Waukegan Harbor	WH-2002 - 5.2	Barium	35	0.040	0.20	mg/kg	Dry	70.3
Waukegan Harbor	WH-2002 - 5.3	Barium	36	0.040	0.20	mg/kg	Dry	88.4
Waukegan Harbor	WH-2002 - 6.3	Barium	36	0.040	0.20	mg/kg	Dry	90.5
Waukegan Harbor	WH-2002 - 6.2	Barium	42	0.040	0.20	mg/kg	Dry	74.6
Waukegan Harbor	WH-2002 - 4.2	Barium	7.0	0.040	0.20	mg/kg	Dry	77.7
Waukegan Harbor	WH-2002 - 7.3	Barium	19	0.040	0.20	mg/kg	Dry	88.0
Waukegan Harbor	WH-2002-8.1	Barium	42	0.040	0.20	mg/kg	Dry	49.6

USEPA 2002 Investigation Analytical Results[a]
Metals
Waukegan Harbor AOC

PROJECT	SAMPLENAME	ANALYTE	RESULT	DL	RL	UNITS	BASIS	PSOLIDS
Waukegan Harbor	WH-2002-9.1	Barium	45	0.036	0.18	mg/kg	Dry	52.6
Waukegan Harbor	WH-2002-11.1	Barium	13	0.036	0.18	mg/kg	Dry	84.1
Waukegan Harbor	WH-2002-10.3	Barium	16	0.040	0.20	mg/kg	Dry	86.0
Waukegan Harbor	WH-2002-10.1	Barium	36	0.040	0.20	mg/kg	Dry	72.5
Waukegan Harbor	WH-2002-12.3	Barium	39	0.040	0.20	mg/kg	Dry	88.5
Waukegan Harbor	WH-2002-12.3	Barium	57	0.040	0.20	mg/kg	Dry	87.4
Waukegan Harbor	WH-2002-15.1	Barium	13	0.040	0.20	mg/kg	Dry	82.8
Waukegan Harbor	WH-2002-13.3	Barium	21	0.035	0.18	mg/kg	Dry	90.1
Waukegan Harbor	WH-2002-14.1	Barium	21	0.040	0.20	mg/kg	Dry	81.6
Waukegan Harbor	WH-2002-14.3	Barium	27	0.040	0.20	mg/kg	Dry	91.5
Waukegan Harbor	WH-2002-15.3	Barium	37	0.040	0.20	mg/kg	Dry	83.8
Waukegan Harbor	WH-2002 - 7.1	Barium	47	0.036	0.18	mg/kg	Dry	57.4
Waukegan Harbor	WH-2002-9.2	Barium	49	0.040	0.20	mg/kg	Dry	63.7
Waukegan Harbor	WH-2002-9.3	Barium	49	0.040	0.20	mg/kg	Dry	86.7
Waukegan Harbor	WH-2002-8.3	Barium	56	0.040	0.20	mg/kg	Dry	83.6
Waukegan Harbor	WH-2002 - 7.2	Barium	71	0.040	0.20	mg/kg	Dry	61.1
Waukegan Harbor	WH-2002 - 1.1	Cadmium	U	0.51	1.7	mg/kg	Dry	79.7
Waukegan Harbor	WH-2002 - 1.2	Cadmium	U	0.60	2.0	mg/kg	Dry	78.4
Waukegan Harbor	WH-2002 - 1.3	Cadmium	U	0.53	1.8	mg/kg	Dry	90.3
Waukegan Harbor	WH-2002 - 16.1	Cadmium	U	0.60	2.0	mg/kg	Dry	77.1
Waukegan Harbor	WH-2002 - 16.2	Cadmium	U	0.60	2.0	mg/kg	Dry	80.4
Waukegan Harbor	WH-2002 - 16.3	Cadmium	U	0.60	2.0	mg/kg	Dry	87.1
Waukegan Harbor	WH-2002 - 2.1	Cadmium	U	0.48	1.6	mg/kg	Dry	78.9
Waukegan Harbor	WH-2002 - 2.2	Cadmium	U	0.49	1.6	mg/kg	Dry	79.8
Waukegan Harbor	WH-2002 - 2.3	Cadmium	U	0.60	2.0	mg/kg	Dry	89.5
Waukegan Harbor	WH-2002 - 3.1	Cadmium	U	0.60	2.0	mg/kg	Dry	79.8
Waukegan Harbor	WH-2002 - 3.2	Cadmium	U	0.60	2.0	mg/kg	Dry	80.5
Waukegan Harbor	WH-2002 - 3.3	Cadmium	U	0.60	2.0	mg/kg	Dry	84.1
Waukegan Harbor	WH-2002 - 4.1	Cadmium	U	0.60	2.0	mg/kg	Dry	74.3
Waukegan Harbor	WH-2002 - 4.2	Cadmium	U	0.60	2.0	mg/kg	Dry	77.7
Waukegan Harbor	WH-2002 - 4.3	Cadmium	U	0.60	2.0	mg/kg	Dry	89.7

USEPA 2002 Investigation Analytical Results[a]
Metals
Waukegan Harbor AOC

PROJECT	SAMPLENAME	ANALYTE	RESULT	DL	RL	UNITS	BASIS	PSOLIDS
Waukegan Harbor	WH-2002 - 5.1	Cadmium	U	0.54	1.8	mg/kg	Dry	70.5
Waukegan Harbor	WH-2002 - 5.2	Cadmium	2.4	0.60	2.0	mg/kg	Dry	70.3
Waukegan Harbor	WH-2002 - 5.3	Cadmium	U	0.60	2.0	mg/kg	Dry	88.4
Waukegan Harbor	WH-2002 - 6.1	Cadmium	U	0.60	2.0	mg/kg	Dry	68.4
Waukegan Harbor	WH-2002 - 6.2	Cadmium	6.2	0.60	2.0	mg/kg	Dry	74.6
Waukegan Harbor	WH-2002 - 6.3	Cadmium	U	0.60	2.0	mg/kg	Dry	90.5
Waukegan Harbor	WH-2002 - 7.2	Cadmium	15	0.60	2.0	mg/kg	Dry	61.1
Waukegan Harbor	WH-2002-9.1	Cadmium	15	0.54	1.8	mg/kg	Dry	52.6
Waukegan Harbor	WH-2002 - 7.3	Cadmium	U	0.60	2.0	mg/kg	Dry	88.0
Waukegan Harbor	WH-2002-10.1	Cadmium	3.9	0.60	2.0	mg/kg	Dry	72.5
Waukegan Harbor	WH-2002-10.3	Cadmium	U	0.60	2.0	mg/kg	Dry	86.0
Waukegan Harbor	WH-2002-11.1	Cadmium	U	0.54	1.8	mg/kg	Dry	84.1
Waukegan Harbor	WH-2002-12.3	Cadmium	U	0.60	2.0	mg/kg	Dry	87.4
Waukegan Harbor	WH-2002-12.3	Cadmium	U	0.60	2.0	mg/kg	Dry	88.5
Waukegan Harbor	WH-2002-13.3	Cadmium	U	0.53	1.8	mg/kg	Dry	90.1
Waukegan Harbor	WH-2002-15.1	Cadmium	2.0	0.60	2.0	mg/kg	Dry	82.8
Waukegan Harbor	WH-2002-14.3	Cadmium	U	0.60	2.0	mg/kg	Dry	91.5
Waukegan Harbor	WH-2002-14.1	Cadmium	6.4	0.60	2.0	mg/kg	Dry	81.6
Waukegan Harbor	WH-2002-15.3	Cadmium	U	0.60	2.0	mg/kg	Dry	83.8
Waukegan Harbor	WH-2002-8.1	Cadmium	19	0.60	2.0	mg/kg	Dry	49.6
Waukegan Harbor	WH-2002-8.3	Cadmium	U	0.60	2.0	mg/kg	Dry	83.6
Waukegan Harbor	WH-2002 - 7.1	Cadmium	31	0.54	1.8	mg/kg	Dry	57.4
Waukegan Harbor	WH-2002-9.2	Cadmium	39	0.60	2.0	mg/kg	Dry	63.7
Waukegan Harbor	WH-2002-9.3	Cadmium	U	0.60	2.0	mg/kg	Dry	86.7
Waukegan Harbor	WH-2002 - 1.1	Chromium	2.7	0.51	1.7	mg/kg	Dry	79.7
Waukegan Harbor	WH-2002 - 1.2	Chromium	2.5	0.60	2.0	mg/kg	Dry	78.4
Waukegan Harbor	WH-2002 - 1.3	Chromium	7.7	0.53	1.8	mg/kg	Dry	90.3
Waukegan Harbor	WH-2002 - 16.1	Chromium	10	0.60	2.0	mg/kg	Dry	77.1
Waukegan Harbor	WH-2002 - 16.2	Chromium	2.7	0.60	2.0	mg/kg	Dry	80.4
Waukegan Harbor	WH-2002 - 16.3	Chromium	10	0.60	2.0	mg/kg	Dry	87.1
Waukegan Harbor	WH-2002 - 2.1	Chromium	U	0.48	1.6	mg/kg	Dry	78.9

USEPA 2002 Investigation Analytical Results[a]
Metals
Waukegan Harbor AOC

PROJECT	SAMPLENAME	ANALYTE	RESULT	DL	RL	UNITS	BASIS	PSOLIDS
Waukegan Harbor	WH-2002 - 2.2	Chromium	1.9	0.49	1.6	mg/kg	Dry	79.8
Waukegan Harbor	WH-2002 - 2.3	Chromium	9.7	0.60	2.0	mg/kg	Dry	89.5
Waukegan Harbor	WH-2002 - 3.1	Chromium	4.5	0.60	2.0	mg/kg	Dry	79.8
Waukegan Harbor	WH-2002 - 3.2	Chromium	6.5	0.60	2.0	mg/kg	Dry	80.5
Waukegan Harbor	WH-2002 - 3.3	Chromium	7.0	0.60	2.0	mg/kg	Dry	84.1
Waukegan Harbor	WH-2002 - 5.3	Chromium	10	0.60	2.0	mg/kg	Dry	88.4
Waukegan Harbor	WH-2002 - 4.2	Chromium	U	0.60	2.0	mg/kg	Dry	77.7
Waukegan Harbor	WH-2002 - 5.1	Chromium	11	0.54	1.8	mg/kg	Dry	70.5
Waukegan Harbor	WH-2002 - 6.1	Chromium	34	0.60	2.0	mg/kg	Dry	68.4
Waukegan Harbor	WH-2002 - 5.2	Chromium	49	0.60	2.0	mg/kg	Dry	70.3
Waukegan Harbor	WH-2002 - 6.2	Chromium	76	0.60	2.0	mg/kg	Dry	74.6
Waukegan Harbor	WH-2002 - 4.1	Chromium	8.9	0.60	2.0	mg/kg	Dry	74.3
Waukegan Harbor	WH-2002 - 6.3	Chromium	9.4	0.60	2.0	mg/kg	Dry	90.5
Waukegan Harbor	WH-2002 - 4.3	Chromium	9.5	0.60	2.0	mg/kg	Dry	89.7
Waukegan Harbor	WH-2002-9.3	Chromium	13	0.60	2.0	mg/kg	Dry	86.7
Waukegan Harbor	WH-2002 - 7.1	Chromium	140	0.54	1.8	mg/kg	Dry	57.4
Waukegan Harbor	WH-2002-9.2	Chromium	140	0.60	2.0	mg/kg	Dry	63.7
Waukegan Harbor	WH-2002-12.3	Chromium	10	0.60	2.0	mg/kg	Dry	88.5
Waukegan Harbor	WH-2002-10.3	Chromium	U	0.60	2.0	mg/kg	Dry	86.0
Waukegan Harbor	WH-2002-12.3	Chromium	16	0.60	2.0	mg/kg	Dry	87.4
Waukegan Harbor	WH-2002-10.1	Chromium	30	0.60	2.0	mg/kg	Dry	72.5
Waukegan Harbor	WH-2002-11.1	Chromium	9.5	0.54	1.8	mg/kg	Dry	84.1
Waukegan Harbor	WH-2002-15.1	Chromium	11	0.60	2.0	mg/kg	Dry	82.8
Waukegan Harbor	WH-2002-15.3	Chromium	11	0.60	2.0	mg/kg	Dry	83.8
Waukegan Harbor	WH-2002-14.1	Chromium	25	0.60	2.0	mg/kg	Dry	81.6
Waukegan Harbor	WH-2002-13.3	Chromium	4.6	0.53	1.8	mg/kg	Dry	90.1
Waukegan Harbor	WH-2002-14.3	Chromium	6.9	0.60	2.0	mg/kg	Dry	91.5
Waukegan Harbor	WH-2002-8.3	Chromium	16	0.60	2.0	mg/kg	Dry	83.6
Waukegan Harbor	WH-2002 - 7.2	Chromium	160	0.60	2.0	mg/kg	Dry	61.1
Waukegan Harbor	WH-2002 - 7.3	Chromium	3.5	0.60	2.0	mg/kg	Dry	88.0
Waukegan Harbor	WH-2002-9.1	Chromium	90	0.54	1.8	mg/kg	Dry	52.6

USEPA 2002 Investigation Analytical Results[a]
Metals
Waukegan Harbor AOC

PROJECT	SAMPLENAME	ANALYTE	RESULT	DL	RL	UNITS	BASIS	PSOLIDS
Waukegan Harbor	WH-2002-8.1	Chromium	93	0.60	2.0	mg/kg	Dry	49.6
Waukegan Harbor	WH-2002 - 1.1	Copper	1.6	0.26	0.85	mg/kg	Dry	79.7
Waukegan Harbor	WH-2002 - 1.2	Copper	U	0.30	1.0	mg/kg	Dry	78.4
Waukegan Harbor	WH-2002 - 1.3	Copper	14	0.27	0.89	mg/kg	Dry	90.3
Waukegan Harbor	WH-2002 - 16.1	Copper	13	0.30	1.0	mg/kg	Dry	77.1
Waukegan Harbor	WH-2002 - 16.2	Copper	3.6	0.30	1.0	mg/kg	Dry	80.4
Waukegan Harbor	WH-2002 - 16.3	Copper	15	0.30	1.0	mg/kg	Dry	87.1
Waukegan Harbor	WH-2002 - 2.1	Copper	U	0.24	0.81	mg/kg	Dry	78.9
Waukegan Harbor	WH-2002 - 2.2	Copper	U	0.25	0.82	mg/kg	Dry	79.8
Waukegan Harbor	WH-2002 - 2.3	Copper	17	0.30	1.0	mg/kg	Dry	89.5
Waukegan Harbor	WH-2002 - 3.1	Copper	8.1	0.30	1.0	mg/kg	Dry	79.8
Waukegan Harbor	WH-2002 - 3.2	Copper	12	0.30	1.0	mg/kg	Dry	80.5
Waukegan Harbor	WH-2002 - 3.3	Copper	15	0.30	1.0	mg/kg	Dry	84.1
Waukegan Harbor	WH-2002 - 5.1	Copper	16	0.27	0.91	mg/kg	Dry	70.5
Waukegan Harbor	WH-2002 - 4.2	Copper	U	0.30	1.0	mg/kg	Dry	77.7
Waukegan Harbor	WH-2002 - 4.3	Copper	19	0.30	1.0	mg/kg	Dry	89.7
Waukegan Harbor	WH-2002 - 6.3	Copper	19	0.30	1.0	mg/kg	Dry	90.5
Waukegan Harbor	WH-2002 - 5.3	Copper	21	0.30	1.0	mg/kg	Dry	88.4
Waukegan Harbor	WH-2002 - 4.1	Copper	35	0.30	1.0	mg/kg	Dry	74.3
Waukegan Harbor	WH-2002 - 6.1	Copper	50	0.30	1.0	mg/kg	Dry	68.4
Waukegan Harbor	WH-2002 - 5.2	Copper	54	0.30	1.0	mg/kg	Dry	70.3
Waukegan Harbor	WH-2002 - 6.2	Copper	93	0.30	1.0	mg/kg	Dry	74.6
Waukegan Harbor	WH-2002 - 7.1	Copper	110	0.27	0.89	mg/kg	Dry	57.4
Waukegan Harbor	WH-2002 - 7.2	Copper	140	0.30	1.0	mg/kg	Dry	61.1
Waukegan Harbor	WH-2002 - 7.3	Copper	19	0.30	1.0	mg/kg	Dry	88.0
Waukegan Harbor	WH-2002-10.3	Copper	16	0.30	1.0	mg/kg	Dry	86.0
Waukegan Harbor	WH-2002-12.3	Copper	18	0.30	1.0	mg/kg	Dry	88.5
Waukegan Harbor	WH-2002-12.3	Copper	19	0.30	1.0	mg/kg	Dry	87.4
Waukegan Harbor	WH-2002-11.1	Copper	41	0.27	0.90	mg/kg	Dry	84.1
Waukegan Harbor	WH-2002-10.1	Copper	55	0.30	1.0	mg/kg	Dry	72.5
Waukegan Harbor	WH-2002-13.3	Copper	13	0.27	0.89	mg/kg	Dry	90.1

USEPA 2002 Investigation Analytical Results[a]
Metals
Waukegan Harbor AOC

PROJECT	SAMPLENAME	ANALYTE	RESULT	DL	RL	UNITS	BASIS	PSOLIDS
Waukegan Harbor	WH-2002-15.1	Copper	13	0.30	1.0	mg/kg	Dry	82.8
Waukegan Harbor	WH-2002-14.3	Copper	16	0.30	1.0	mg/kg	Dry	91.5
Waukegan Harbor	WH-2002-15.3	Copper	17	0.30	1.0	mg/kg	Dry	83.8
Waukegan Harbor	WH-2002-14.1	Copper	33	0.30	1.0	mg/kg	Dry	81.6
Waukegan Harbor	WH-2002-9.3	Copper	19	0.30	1.0	mg/kg	Dry	86.7
Waukegan Harbor	WH-2002-8.3	Copper	21	0.30	1.0	mg/kg	Dry	83.6
Waukegan Harbor	WH-2002-9.1	Copper	88	0.27	0.89	mg/kg	Dry	52.6
Waukegan Harbor	WH-2002-9.2	Copper	90	0.30	1.0	mg/kg	Dry	63.7
Waukegan Harbor	WH-2002-8.1	Copper	91	0.30	1.0	mg/kg	Dry	49.6
Waukegan Harbor	WH-2002 - 1.1	Iron	5700	1.7	850	mg/kg	Dry	79.7
Waukegan Harbor	WH-2002 - 1.2	Iron	5000	2.0	1000	mg/kg	Dry	78.4
Waukegan Harbor	WH-2002 - 1.3	Iron	16000	1.8	890	mg/kg	Dry	90.3
Waukegan Harbor	WH-2002 - 16.1	Iron	6500	2.0	1000	mg/kg	Dry	77.1
Waukegan Harbor	WH-2002 - 16.2	Iron	5200	2.0	1000	mg/kg	Dry	80.4
Waukegan Harbor	WH-2002 - 16.3	Iron	18000	2.0	1000	mg/kg	Dry	87.1
Waukegan Harbor	WH-2002 - 2.1	Iron	3500	1.6	810	mg/kg	Dry	78.9
Waukegan Harbor	WH-2002 - 2.2	Iron	3500	1.6	820	mg/kg	Dry	79.8
Waukegan Harbor	WH-2002 - 2.3	Iron	19000	2.0	1000	mg/kg	Dry	89.5
Waukegan Harbor	WH-2002 - 3.1	Iron	9000	2.0	1000	mg/kg	Dry	79.8
Waukegan Harbor	WH-2002 - 3.2	Iron	10000	2.0	1000	mg/kg	Dry	80.5
Waukegan Harbor	WH-2002 - 3.3	Iron	19000	2.0	1000	mg/kg	Dry	84.1
Waukegan Harbor	WH-2002 - 4.1	Iron	10000	2.0	1000	mg/kg	Dry	74.3
Waukegan Harbor	WH-2002 - 5.2	Iron	15000	2.0	1000	mg/kg	Dry	70.3
Waukegan Harbor	WH-2002 - 6.1	Iron	15000	2.0	1000	mg/kg	Dry	68.4
Waukegan Harbor	WH-2002 - 6.2	Iron	18000	2.0	1000	mg/kg	Dry	74.6
Waukegan Harbor	WH-2002 - 6.3	Iron	20000	2.0	1000	mg/kg	Dry	90.5
Waukegan Harbor	WH-2002 - 4.3	Iron	21000	2.0	1000	mg/kg	Dry	89.7
Waukegan Harbor	WH-2002 - 5.3	Iron	22000	2.0	1000	mg/kg	Dry	88.4
Waukegan Harbor	WH-2002 - 4.2	Iron	5400	2.0	1000	mg/kg	Dry	77.7
Waukegan Harbor	WH-2002 - 5.1	Iron	8400	1.8	910	mg/kg	Dry	70.5
Waukegan Harbor	WH-2002 - 7.3	Iron	14000	2.0	1000	mg/kg	Dry	88.0

USEPA 2002 Investigation Analytical Results[a]
Metals
Waukegan Harbor AOC

PROJECT	SAMPLENAME	ANALYTE	RESULT	DL	RL	UNITS	BASIS	PSOLIDS
Waukegan Harbor	WH-2002-8.1	Iron	16000	2.0	1000	mg/kg	Dry	49.6
Waukegan Harbor	WH-2002-9.2	Iron	18000	2.0	1000	mg/kg	Dry	63.7
Waukegan Harbor	WH-2002-11.1	Iron	12000	1.8	900	mg/kg	Dry	84.1
Waukegan Harbor	WH-2002-10.1	Iron	14000	2.0	1000	mg/kg	Dry	72.5
Waukegan Harbor	WH-2002-10.3	Iron	17000	2.0	1000	mg/kg	Dry	86.0
Waukegan Harbor	WH-2002-12.3	Iron	18000	2.0	1000	mg/kg	Dry	88.5
Waukegan Harbor	WH-2002-12.3	Iron	21000	2.0	1000	mg/kg	Dry	87.4
Waukegan Harbor	WH-2002-14.1	Iron	14000	2.0	1000	mg/kg	Dry	81.6
Waukegan Harbor	WH-2002-13.3	Iron	15000	1.8	890	mg/kg	Dry	90.1
Waukegan Harbor	WH-2002-14.3	Iron	19000	2.0	1000	mg/kg	Dry	91.5
Waukegan Harbor	WH-2002-15.3	Iron	19000	2.0	1000	mg/kg	Dry	83.8
Waukegan Harbor	WH-2002-15.1	Iron	7600	2.0	1000	mg/kg	Dry	82.8
Waukegan Harbor	WH-2002-9.1	Iron	19000	1.8	890	mg/kg	Dry	52.6
Waukegan Harbor	WH-2002-9.3	Iron	21000	2.0	1000	mg/kg	Dry	86.7
Waukegan Harbor	WH-2002-8.3	Iron	22000	2.0	1000	mg/kg	Dry	83.6
Waukegan Harbor	WH-2002 - 7.1	Iron	24000	1.8	890	mg/kg	Dry	57.4
Waukegan Harbor	WH-2002 - 7.2	Iron	28000	2.0	1000	mg/kg	Dry	61.1
Waukegan Harbor	WH-2002 - 1.1	Lead	5.3	0.38	1.3	mg/kg	Dry	79.7
Waukegan Harbor	WH-2002 - 1.2	Lead	6.2	0.45	1.5	mg/kg	Dry	78.4
Waukegan Harbor	WH-2002 - 1.3	Lead	9.7	0.40	1.3	mg/kg	Dry	90.3
Waukegan Harbor	WH-2002 - 16.1	Lead	23	3.2	10	mg/kg	Dry	77.1
Waukegan Harbor	WH-2002 - 16.2	Lead	4.1	0.45	1.5	mg/kg	Dry	80.4
Waukegan Harbor	WH-2002 - 16.3	Lead	9.7	0.45	1.5	mg/kg	Dry	87.1
Waukegan Harbor	WH-2002 - 2.1	Lead	3.4	0.36	1.2	mg/kg	Dry	78.9
Waukegan Harbor	WH-2002 - 2.2	Lead	4.1	0.37	1.2	mg/kg	Dry	79.8
Waukegan Harbor	WH-2002 - 2.3	Lead	11	0.45	1.5	mg/kg	Dry	89.5
Waukegan Harbor	WH-2002 - 3.1	Lead	13	0.45	1.5	mg/kg	Dry	79.8
Waukegan Harbor	WH-2002 - 3.2	Lead	19	0.45	1.5	mg/kg	Dry	80.5
Waukegan Harbor	WH-2002 - 3.3	Lead	10	0.45	1.5	mg/kg	Dry	84.1
Waukegan Harbor	WH-2002 - 4.3	Lead	11	0.45	1.5	mg/kg	Dry	89.7
Waukegan Harbor	WH-2002 - 6.2	Lead	110	3.2	10	mg/kg	Dry	74.6

USEPA 2002 Investigation Analytical Results[a]
Metals
Waukegan Harbor AOC

PROJECT	SAMPLENAME	ANALYTE	RESULT	DL	RL	UNITS	BASIS	PSOLIDS
Waukegan Harbor	WH-2002 - 5.3	Lead	12	0.45	1.5	mg/kg	Dry	88.4
Waukegan Harbor	WH-2002 - 6.3	Lead	12	0.45	1.5	mg/kg	Dry	90.5
Waukegan Harbor	WH-2002 - 4.1	Lead	13	3.2	10	mg/kg	Dry	74.3
Waukegan Harbor	WH-2002 - 5.1	Lead	27	2.9	9.1	mg/kg	Dry	70.5
Waukegan Harbor	WH-2002 - 4.2	Lead	4.0	0.45	1.5	mg/kg	Dry	77.7
Waukegan Harbor	WH-2002 - 6.1	Lead	63	3.2	10	mg/kg	Dry	68.4
Waukegan Harbor	WH-2002 - 5.2	Lead	93	3.2	10	mg/kg	Dry	70.3
Waukegan Harbor	WH-2002 - 7.3	Lead	10	0.45	1.5	mg/kg	Dry	88.0
Waukegan Harbor	WH-2002-9.3	Lead	12	0.45	1.5	mg/kg	Dry	86.7
Waukegan Harbor	WH-2002-8.1	Lead	120	3.2	10	mg/kg	Dry	49.6
Waukegan Harbor	WH-2002-10.3	Lead	10	0.45	1.5	mg/kg	Dry	86.0
Waukegan Harbor	WH-2002-11.1	Lead	10	0.45	1.5	mg/kg	Dry	87.4
Waukegan Harbor	WH-2002-11.3	Lead	11	0.45	1.5	mg/kg	Dry	88.5
Waukegan Harbor	WH-2002-11.1	Lead	19	2.9	9.0	mg/kg	Dry	84.1
Waukegan Harbor	WH-2002-10.1	Lead	55	3.2	10	mg/kg	Dry	72.5
Waukegan Harbor	WH-2002-14.3	Lead	10	0.45	1.5	mg/kg	Dry	91.5
Waukegan Harbor	WH-2002-15.3	Lead	11	0.45	1.5	mg/kg	Dry	83.8
Waukegan Harbor	WH-2002-15.1	Lead	14	0.45	1.5	mg/kg	Dry	82.8
Waukegan Harbor	WH-2002-14.1	Lead	24	3.2	10	mg/kg	Dry	81.6
Waukegan Harbor	WH-2002-13.3	Lead	7.9	0.40	1.3	mg/kg	Dry	90.1
Waukegan Harbor	WH-2002-8.3	Lead	13	0.45	1.5	mg/kg	Dry	83.6
Waukegan Harbor	WH-2002-9.1	Lead	150	2.9	8.9	mg/kg	Dry	52.6
Waukegan Harbor	WH-2002 - 7.1	Lead	180	2.9	8.9	mg/kg	Dry	57.4
Waukegan Harbor	WH-2002-9.2	Lead	180	3.2	10	mg/kg	Dry	63.7
Waukegan Harbor	WH-2002 - 7.2	Lead	230	3.2	10	mg/kg	Dry	61.1
Waukegan Harbor	WH-2002 - 1.1	Mercury	U	0.04	0.10	mg/kg	Dry	79.7
Waukegan Harbor	WH-2002 - 1.2	Mercury	U	0.04	0.10	mg/kg	Dry	78.4
Waukegan Harbor	WH-2002 - 1.3	Mercury	U	0.04	0.10	mg/kg	Dry	90.3
Waukegan Harbor	WH-2002 - 16.1	Mercury	0.09	0.04	0.10	mg/kg	Dry	77.1
Waukegan Harbor	WH-2002 - 16.2	Mercury	U	0.04	0.10	mg/kg	Dry	80.4
Waukegan Harbor	WH-2002 - 16.3	Mercury	U	0.04	0.10	mg/kg	Dry	87.1

USEPA 2002 Investigation Analytical Results[a]
Metals
Waukegan Harbor AOC

PROJECT	SAMPLENAME	ANALYTE	RESULT	DL	RL	UNITS	BASIS	PSOLIDS
Waukegan Harbor	WH-2002 - 2.1	Mercury	U	0.04	0.10	mg/kg	Dry	78.9
Waukegan Harbor	WH-2002 - 2.2	Mercury	U	0.04	0.10	mg/kg	Dry	79.8
Waukegan Harbor	WH-2002 - 2.3	Mercury	U	0.04	0.10	mg/kg	Dry	89.5
Waukegan Harbor	WH-2002 - 3.1	Mercury	U	0.04	0.10	mg/kg	Dry	79.8
Waukegan Harbor	WH-2002 - 3.2	Mercury	0.04	0.04	0.10	mg/kg	Dry	80.5
Waukegan Harbor	WH-2002 - 3.3	Mercury	U	0.04	0.10	mg/kg	Dry	84.1
Waukegan Harbor	WH-2002 - 4.1	Mercury	0.04	0.04	0.10	mg/kg	Dry	74.3
Waukegan Harbor	WH-2002 - 4.2	Mercury	U	0.04	0.10	mg/kg	Dry	77.7
Waukegan Harbor	WH-2002 - 4.3	Mercury	U	0.04	0.10	mg/kg	Dry	89.7
Waukegan Harbor	WH-2002 - 5.1	Mercury	0.06	0.04	0.10	mg/kg	Dry	70.5
Waukegan Harbor	WH-2002 - 6.1	Mercury	0.19	0.04	0.10	mg/kg	Dry	68.4
Waukegan Harbor	WH-2002 - 5.3	Mercury	U	0.04	0.10	mg/kg	Dry	88.4
Waukegan Harbor	WH-2002 - 6.2	Mercury	0.20	0.04	0.10	mg/kg	Dry	74.6
Waukegan Harbor	WH-2002 - 5.2	Mercury	0.22	0.04	0.10	mg/kg	Dry	70.3
Waukegan Harbor	WH-2002 - 6.3	Mercury	U	0.04	0.10	mg/kg	Dry	90.5
Waukegan Harbor	WH-2002 - 7.3	Mercury	0.04	0.04	0.10	mg/kg	Dry	88.0
Waukegan Harbor	WH-2002-8.3	Mercury	0.04	0.04	0.10	mg/kg	Dry	83.6
Waukegan Harbor	WH-2002-9.1	Mercury	0.34	0.04	0.10	mg/kg	Dry	52.6
Waukegan Harbor	WH-2002-10.3	Mercury	U	0.04	0.10	mg/kg	Dry	86.0
Waukegan Harbor	WH-2002-11.1	Mercury	U	0.04	0.10	mg/kg	Dry	87.4
Waukegan Harbor	WH-2002-11.3	Mercury	U	0.04	0.10	mg/kg	Dry	88.5
Waukegan Harbor	WH-2002-9.2	Mercury	0.46	0.04	0.10	mg/kg	Dry	63.7
Waukegan Harbor	WH-2002 - 7.1	Mercury	0.60	0.04	0.10	mg/kg	Dry	57.4
Waukegan Harbor	WH-2002 - 7.2	Mercury	0.89	0.04	0.10	mg/kg	Dry	61.1
Waukegan Harbor	WH-2002-9.3	Mercury	U	0.04	0.10	mg/kg	Dry	86.7
Waukegan Harbor	WH-2002 - 1.1	Nickel	4.2	0.26	0.85	mg/kg	Dry	79.7
Waukegan Harbor	WH-2002 - 1.2	Nickel	3.6	0.30	1.0	mg/kg	Dry	78.4
Waukegan Harbor	WH-2002 - 1.3	Nickel	18	0.27	0.89	mg/kg	Dry	90.3
Waukegan Harbor	WH-2002 - 16.1	Nickel	8.8	0.30	1.0	mg/kg	Dry	77.1
Waukegan Harbor	WH-2002 - 16.2	Nickel	5.0	0.30	1.0	mg/kg	Dry	80.4
Waukegan Harbor	WH-2002 - 16.3	Nickel	23	0.30	1.0	mg/kg	Dry	87.1

USEPA 2002 Investigation Analytical Results[a]
Metals
Waukegan Harbor AOC

PROJECT	SAMPLENAME	ANALYTE	RESULT	DL	RL	UNITS	BASIS	PSOLIDS
Waukegan Harbor	WH-2002 - 2.1	Nickel	3.0	0.24	0.81	mg/kg	Dry	78.9
Waukegan Harbor	WH-2002 - 2.2	Nickel	3.1	0.25	0.82	mg/kg	Dry	79.8
Waukegan Harbor	WH-2002 - 2.3	Nickel	21	0.30	1.0	mg/kg	Dry	89.5
Waukegan Harbor	WH-2002 - 3.1	Nickel	8.3	0.30	1.0	mg/kg	Dry	79.8
Waukegan Harbor	WH-2002 - 3.2	Nickel	9.8	0.30	1.0	mg/kg	Dry	80.5
Waukegan Harbor	WH-2002 - 3.3	Nickel	21	0.30	1.0	mg/kg	Dry	84.1
Waukegan Harbor	WH-2002 - 4.1	Nickel	11	0.30	1.0	mg/kg	Dry	74.3
Waukegan Harbor	WH-2002 - 5.2	Nickel	16	0.30	1.0	mg/kg	Dry	70.3
Waukegan Harbor	WH-2002 - 6.1	Nickel	16	0.30	1.0	mg/kg	Dry	68.4
Waukegan Harbor	WH-2002 - 6.2	Nickel	20	0.30	1.0	mg/kg	Dry	74.6
Waukegan Harbor	WH-2002 - 6.3	Nickel	22	0.30	1.0	mg/kg	Dry	90.5
Waukegan Harbor	WH-2002 - 4.3	Nickel	25	0.30	1.0	mg/kg	Dry	89.7
Waukegan Harbor	WH-2002 - 5.3	Nickel	25	0.30	1.0	mg/kg	Dry	88.4
Waukegan Harbor	WH-2002 - 4.2	Nickel	5.4	0.30	1.0	mg/kg	Dry	77.7
Waukegan Harbor	WH-2002 - 5.1	Nickel	8.8	0.27	0.91	mg/kg	Dry	70.5
Waukegan Harbor	WH-2002 - 7.3	Nickel	14	0.30	1.0	mg/kg	Dry	88.0
Waukegan Harbor	WH-2002-8.1	Nickel	20	0.30	1.0	mg/kg	Dry	49.6
Waukegan Harbor	WH-2002-9.1	Nickel	25	0.27	0.89	mg/kg	Dry	52.6
Waukegan Harbor	WH-2002-11.1	Nickel	10	0.27	0.90	mg/kg	Dry	84.1
Waukegan Harbor	WH-2002-10.1	Nickel	14	0.30	1.0	mg/kg	Dry	72.5
Waukegan Harbor	WH-2002-10.3	Nickel	15	0.30	1.0	mg/kg	Dry	86.0
Waukegan Harbor	WH-2002-12.3	Nickel	18	0.30	1.0	mg/kg	Dry	88.5
Waukegan Harbor	WH-2002-12.3	Nickel	24	0.30	1.0	mg/kg	Dry	87.4
Waukegan Harbor	WH-2002-14.1	Nickel	12	0.30	1.0	mg/kg	Dry	81.6
Waukegan Harbor	WH-2002-13.3	Nickel	13	0.27	0.89	mg/kg	Dry	90.1
Waukegan Harbor	WH-2002-14.3	Nickel	20	0.30	1.0	mg/kg	Dry	91.5
Waukegan Harbor	WH-2002-15.3	Nickel	20	0.30	1.0	mg/kg	Dry	83.8
Waukegan Harbor	WH-2002-15.1	Nickel	7.6	0.30	1.0	mg/kg	Dry	82.8
Waukegan Harbor	WH-2002-9.3	Nickel	26	0.30	1.0	mg/kg	Dry	86.7
Waukegan Harbor	WH-2002-9.2	Nickel	27	0.30	1.0	mg/kg	Dry	63.7
Waukegan Harbor	WH-2002-8.3	Nickel	28	0.30	1.0	mg/kg	Dry	83.6

USEPA 2002 Investigation Analytical Results[a]
Metals
Waukegan Harbor AOC

PROJECT	SAMPLENAME	ANALYTE	RESULT	DL	RL	UNITS	BASIS	PSOLIDS
Waukegan Harbor	WH-2002 - 7.1	Nickel	32	0.27	0.89	mg/kg	Dry	57.4
Waukegan Harbor	WH-2002 - 7.2	Nickel	32	0.30	1.0	mg/kg	Dry	61.1
Waukegan Harbor	WH-2002 - 1.1	Zinc	46	0.85	4.3	mg/kg	Dry	79.7
Waukegan Harbor	WH-2002 - 1.2	Zinc	49	1.0	5.0	mg/kg	Dry	78.4
Waukegan Harbor	WH-2002 - 1.3	Zinc	59	0.89	4.4	mg/kg	Dry	90.3
Waukegan Harbor	WH-2002 - 16.1	Zinc	77	1.0	5.0	mg/kg	Dry	77.1
Waukegan Harbor	WH-2002 - 16.2	Zinc	22	1.0	5.0	mg/kg	Dry	80.4
Waukegan Harbor	WH-2002 - 16.3	Zinc	78	1.0	5.0	mg/kg	Dry	87.1
Waukegan Harbor	WH-2002 - 2.1	Zinc	29	0.81	4.0	mg/kg	Dry	78.9
Waukegan Harbor	WH-2002 - 2.2	Zinc	28	0.82	4.1	mg/kg	Dry	79.8
Waukegan Harbor	WH-2002 - 2.3	Zinc	57	1.0	5.0	mg/kg	Dry	89.5
Waukegan Harbor	WH-2002 - 3.1	Zinc	71	1.0	5.0	mg/kg	Dry	79.8
Waukegan Harbor	WH-2002 - 3.2	Zinc	85	1.0	5.0	mg/kg	Dry	80.5
Waukegan Harbor	WH-2002 - 3.3	Zinc	95	1.0	5.0	mg/kg	Dry	84.1
Waukegan Harbor	WH-2002 - 6.1	Zinc	150	1.0	5.0	mg/kg	Dry	68.4
Waukegan Harbor	WH-2002 - 5.2	Zinc	190	1.0	5.0	mg/kg	Dry	70.3
Waukegan Harbor	WH-2002 - 6.2	Zinc	230	1.0	5.0	mg/kg	Dry	74.6
Waukegan Harbor	WH-2002 - 4.2	Zinc	46	1.0	5.0	mg/kg	Dry	77.7
Waukegan Harbor	WH-2002 - 5.3	Zinc	69	1.0	5.0	mg/kg	Dry	88.4
Waukegan Harbor	WH-2002 - 6.3	Zinc	71	1.0	5.0	mg/kg	Dry	90.5
Waukegan Harbor	WH-2002 - 4.3	Zinc	76	1.0	5.0	mg/kg	Dry	89.7
Waukegan Harbor	WH-2002 - 4.1	Zinc	78	1.0	5.0	mg/kg	Dry	74.3
Waukegan Harbor	WH-2002 - 5.1	Zinc	81	0.91	4.5	mg/kg	Dry	70.5
Waukegan Harbor	WH-2002-8.1	Zinc	200	1.0	5.0	mg/kg	Dry	49.6
Waukegan Harbor	WH-2002-9.1	Zinc	230	0.89	4.5	mg/kg	Dry	52.6
Waukegan Harbor	WH-2002-9.2	Zinc	250	1.0	5.0	mg/kg	Dry	63.7
Waukegan Harbor	WH-2002-10.1	Zinc	110	1.0	5.0	mg/kg	Dry	72.5
Waukegan Harbor	WH-2002-10.3	Zinc	59	1.0	5.0	mg/kg	Dry	86.0
Waukegan Harbor	WH-2002-11.1	Zinc	61	0.90	4.5	mg/kg	Dry	84.1
Waukegan Harbor	WH-2002-12.3	Zinc	66	1.0	5.0	mg/kg	Dry	87.4
Waukegan Harbor	WH-2002-12.3	Zinc	66	1.0	5.0	mg/kg	Dry	88.5

USEPA 2002 Investigation Analytical Results[a]
Metals
Waukegan Harbor AOC

PROJECT	SAMPLENAME	ANALYTE	RESULT	DL	RL	UNITS	BASIS	PSOLIDS
Waukegan Harbor	WH-2002-14.1	Zinc	290	1.0	5.0	mg/kg	Dry	81.6
Waukegan Harbor	WH-2002-15.1	Zinc	53	1.0	5.0	mg/kg	Dry	82.8
Waukegan Harbor	WH-2002-15.3	Zinc	57	1.0	5.0	mg/kg	Dry	83.8
Waukegan Harbor	WH-2002-13.3	Zinc	61	0.89	4.4	mg/kg	Dry	90.1
Waukegan Harbor	WH-2002-14.3	Zinc	80	1.0	5.0	mg/kg	Dry	91.5
Waukegan Harbor	WH-2002 - 7.1	Zinc	330	0.89	4.5	mg/kg	Dry	57.4
Waukegan Harbor	WH-2002 - 7.2	Zinc	460	1.0	5.0	mg/kg	Dry	61.1
Waukegan Harbor	WH-2002 - 7.3	Zinc	64	1.0	5.0	mg/kg	Dry	88.0
Waukegan Harbor	WH-2002-8.3	Zinc	68	1.0	5.0	mg/kg	Dry	83.6
Waukegan Harbor	WH-2002-9.3	Zinc	70	1.0	5.0	mg/kg	Dry	86.7

[a]Data provided electronically by USEPA

USEPA 2002 Investigation Analytical Results[a]
Other
Waukegan Harbor AOC

PROJECT	SAMPLENAME	ANALYTE	RESULT	DL	RL	UNITS	BASIS	PSOLIDS
Waukegan Harbor	WH-2002 - 1.1	Ammonia as N	U	0.06	0.25	mg/kg	Dry	79.7
Waukegan Harbor	WH-2002 - 1.2	Ammonia as N	U	0.06	0.26	mg/kg	Dry	78.4
Waukegan Harbor	WH-2002 - 1.3	Ammonia as N	U	0.06	0.22	mg/kg	Dry	90.3
Waukegan Harbor	WH-2002 - 16.1	Ammonia as N	U	0.06	0.26	mg/kg	Dry	77.1
Waukegan Harbor	WH-2002 - 16.2	Ammonia as N	U	0.06	0.25	mg/kg	Dry	80.4
Waukegan Harbor	WH-2002 - 16.3	Ammonia as N	U	0.06	0.23	mg/kg	Dry	87.1
Waukegan Harbor	WH-2002 - 2.1	Ammonia as N	26.4	0.06	0.25	mg/kg	Dry	78.9
Waukegan Harbor	WH-2002 - 2.2	Ammonia as N	U	0.06	0.25	mg/kg	Dry	79.8
Waukegan Harbor	WH-2002 - 2.3	Ammonia as N	8.92	0.06	0.22	mg/kg	Dry	89.5
Waukegan Harbor	WH-2002 - 3.1	Ammonia as N	U	0.06	0.25	mg/kg	Dry	79.8
Waukegan Harbor	WH-2002 - 3.2	Ammonia as N	63.0	0.06	0.25	mg/kg	Dry	80.5
Waukegan Harbor	WH-2002 - 3.3	Ammonia as N	35.1	0.06	0.24	mg/kg	Dry	84.1
Waukegan Harbor	WH-2002 - 4.1	Ammonia as N	26.6	0.07	0.27	mg/kg	Dry	74.3
Waukegan Harbor	WH-2002 - 4.2	Ammonia as N	35.1	0.06	0.26	mg/kg	Dry	77.7
Waukegan Harbor	WH-2002 - 4.3	Ammonia as N	U	0.06	0.22	mg/kg	Dry	89.7
Waukegan Harbor	WH-2002 - 5.1	Ammonia as N	49.0	0.07	0.28	mg/kg	Dry	70.5
Waukegan Harbor	WH-2002 - 5.2	Ammonia as N	147	0.07	0.28	mg/kg	Dry	70.3
Waukegan Harbor	WH-2002 - 5.3	Ammonia as N	24.1	0.06	0.23	mg/kg	Dry	88.4
Waukegan Harbor	WH-2002 - 6.1	Ammonia as N	157	0.07	0.29	mg/kg	Dry	68.4
Waukegan Harbor	WH-2002 - 6.2	Ammonia as N	197	0.07	0.27	mg/kg	Dry	74.6
Waukegan Harbor	WH-2002 - 6.3	Ammonia as N	72.2	0.06	0.22	mg/kg	Dry	90.5
Waukegan Harbor	WH-2002 - 7.1	Ammonia as N	185	0.09	0.35	mg/kg	Dry	57.4
Waukegan Harbor	WH-2002 - 7.2	Ammonia as N	237	0.08	0.33	mg/kg	Dry	61.1
Waukegan Harbor	WH-2002 - 7.3	Ammonia as N	U	0.06	0.23	mg/kg	Dry	88.0
Waukegan Harbor	WH-2002-10.3	Ammonia as N	14.2	0.06	0.23	mg/kg	Dry	86.0
Waukegan Harbor	WH-2002-11.1	Ammonia as N	U	0.06	0.23	mg/kg	Dry	87.4
Waukegan Harbor	WH-2002-11.3	Ammonia as N	U	0.06	0.23	mg/kg	Dry	88.5
Waukegan Harbor	WH-2002-8.3	Ammonia as N	17.3	0.06	0.24	mg/kg	Dry	83.6
Waukegan Harbor	WH-2002-9.1	Ammonia as N	128	0.10	0.38	mg/kg	Dry	52.6
Waukegan Harbor	WH-2002-9.2	Ammonia as N	114	0.08	0.31	mg/kg	Dry	63.7
Waukegan Harbor	WH-2002-9.3	Ammonia as N	U	0.06	0.23	mg/kg	Dry	86.7

USEPA 2002 Investigation Analytical Results[a]
Other
Waukegan Harbor AOC

PROJECT	SAMPLENAME	ANALYTE	RESULT	DL	RL	UNITS	BASIS	PSOLIDS
Waukegan Harbor	WH-2002 - 1.1	Benzo (a) pyrene	U	7.11	41.8	ug/kg	Dry	79.7
Waukegan Harbor	WH-2002 - 1.2	Benzo (a) pyrene	93.4	7.23	42.5	ug/kg	Dry	78.4
Waukegan Harbor	WH-2002 - 1.3	Benzo (a) pyrene	U	7.08	41.6	ug/kg	Dry	90.3
Waukegan Harbor	WH-2002 - 16.1	Benzo (a) pyrene	281	14.7	86.4	ug/kg	Dry	77.1
Waukegan Harbor	WH-2002 - 16.2	Benzo (a) pyrene	55.2	7.05	41.4	ug/kg	Dry	80.4
Waukegan Harbor	WH-2002 - 16.3	Benzo (a) pyrene	U	6.51	38.2	ug/kg	Dry	87.1
Waukegan Harbor	WH-2002 - 2.1	Benzo (a) pyrene	U	7.18	42.2	ug/kg	Dry	78.9
Waukegan Harbor	WH-2002 - 2.2	Benzo (a) pyrene	119	8.16	47.9	ug/kg	Dry	79.8
Waukegan Harbor	WH-2002 - 2.3	Benzo (a) pyrene	U	7.35	43.2	ug/kg	Dry	89.5
Waukegan Harbor	WH-2002 - 3.1	Benzo (a) pyrene	209	9.89	58.1	ug/kg	Dry	79.8
Waukegan Harbor	WH-2002 - 3.2	Benzo (a) pyrene	128	9.30	54.6	ug/kg	Dry	80.5
Waukegan Harbor	WH-2002 - 3.3	Benzo (a) pyrene	U	9.88	58.0	ug/kg	Dry	84.1
Waukegan Harbor	WH-2002 - 4.1	Benzo (a) pyrene	420	18.6	109	ug/kg	Dry	74.3
Waukegan Harbor	WH-2002 - 4.2	Benzo (a) pyrene	517	7.30	42.9	ug/kg	Dry	77.7
Waukegan Harbor	WH-2002 - 4.3	Benzo (a) pyrene	U	6.32	37.1	ug/kg	Dry	89.7
Waukegan Harbor	WH-2002 - 5.1	Benzo (a) pyrene	399	16.1	94.5	ug/kg	Dry	70.5
Waukegan Harbor	WH-2002 - 5.2	Benzo (a) pyrene	288	32.3	190	ug/kg	Dry	70.3
Waukegan Harbor	WH-2002 - 5.3	Benzo (a) pyrene	U	6.42	37.7	ug/kg	Dry	88.4
Waukegan Harbor	WH-2002 - 6.1	Benzo (a) pyrene	254	16.6	97.4	ug/kg	Dry	68.4
Waukegan Harbor	WH-2002 - 6.2	Benzo (a) pyrene	126	7.61	44.7	ug/kg	Dry	74.6
Waukegan Harbor	WH-2002 - 6.3	Benzo (a) pyrene	U	6.27	36.8	ug/kg	Dry	90.5
Waukegan Harbor	WH-2002 - 7.1	Benzo (a) pyrene	128	9.88	58.0	ug/kg	Dry	57.4
Waukegan Harbor	WH-2002 - 7.2	Benzo (a) pyrene	385	37.1	218	ug/kg	Dry	61.1
Waukegan Harbor	WH-2002 - 7.3	Benzo (a) pyrene	68.4	6.44	37.8	ug/kg	Dry	88.0
Waukegan Harbor	WH-2002-10.3	Benzo (a) pyrene	44.3	6.60	38.7	ug/kg	Dry	86.0
Waukegan Harbor	WH-2002-11.1	Benzo (a) pyrene	U	15.0	87.9	ug/kg	Dry	87.4
Waukegan Harbor	WH-2002-11.3	Benzo (a) pyrene	U	6.41	37.6	ug/kg	Dry	88.5
Waukegan Harbor	WH-2002-15.1	Benzo (a) pyrene	327	13.7	80.4	ug/kg	Dry	82.8
Waukegan Harbor	WH-2002-15.3	Benzo (a) pyrene	U	6.76	39.7	ug/kg	Dry	83.8
Waukegan Harbor	WH-2002-8.3	Benzo (a) pyrene	50.8	6.78	39.8	ug/kg	Dry	83.6
Waukegan Harbor	WH-2002-9.1	Benzo (a) pyrene	201	16.2	95.1	ug/kg	Dry	52.6

USEPA 2002 Investigation Analytical Results[a]
Other
Waukegan Harbor AOC

PROJECT	SAMPLENAME	ANALYTE	RESULT	DL	RL	UNITS	BASIS	PSOLIDS
Waukegan Harbor	WH-2002-9.2	Benzo (a) pyrene	130	13.4	78.5	ug/kg	Dry	63.7
Waukegan Harbor	WH-2002-9.3	Benzo (a) pyrene	U	6.54	38.4	ug/kg	Dry	86.7
Waukegan Harbor	WH-2002 - 1.1	Phenol	U	0.05	0.5	mg/kg	Dry	79.7
Waukegan Harbor	WH-2002 - 1.2	Phenol	1.1	0.05	0.5	mg/kg	Dry	78.4
Waukegan Harbor	WH-2002 - 1.3	Phenol	U	0.04	0.4	mg/kg	Dry	90.3
Waukegan Harbor	WH-2002 - 16.1	Phenol	0.4	0.05	0.5	mg/kg	Dry	77.1
Waukegan Harbor	WH-2002 - 16.2	Phenol	U	0.05	0.5	mg/kg	Dry	80.4
Waukegan Harbor	WH-2002 - 16.3	Phenol	1.2	0.05	0.5	mg/kg	Dry	87.1
Waukegan Harbor	WH-2002 - 2.1	Phenol	U	0.05	0.5	mg/kg	Dry	78.9
Waukegan Harbor	WH-2002 - 2.2	Phenol	U	0.05	0.5	mg/kg	Dry	79.8
Waukegan Harbor	WH-2002 - 2.3	Phenol	U	0.04	0.4	mg/kg	Dry	89.5
Waukegan Harbor	WH-2002 - 3.1	Phenol	U	0.05	0.5	mg/kg	Dry	79.8
Waukegan Harbor	WH-2002 - 3.2	Phenol	U	0.05	0.5	mg/kg	Dry	80.5
Waukegan Harbor	WH-2002 - 3.3	Phenol	0.7	0.05	0.5	mg/kg	Dry	84.1
Waukegan Harbor	WH-2002 - 4.1	Phenol	0.9	0.05	0.5	mg/kg	Dry	74.3
Waukegan Harbor	WH-2002 - 4.2	Phenol	U	0.05	0.5	mg/kg	Dry	77.7
Waukegan Harbor	WH-2002 - 4.3	Phenol	0.3	0.04	0.4	mg/kg	Dry	89.7
Waukegan Harbor	WH-2002 - 5.1	Phenol	0.4	0.06	0.6	mg/kg	Dry	70.5
Waukegan Harbor	WH-2002 - 5.2	Phenol	0.4	0.06	0.6	mg/kg	Dry	70.3
Waukegan Harbor	WH-2002 - 5.3	Phenol	0.2	0.05	0.5	mg/kg	Dry	88.4
Waukegan Harbor	WH-2002 - 6.1	Phenol	0.2	0.06	0.6	mg/kg	Dry	68.4
Waukegan Harbor	WH-2002 - 6.2	Phenol	0.6	0.05	0.5	mg/kg	Dry	74.6
Waukegan Harbor	WH-2002 - 6.3	Phenol	0.7	0.04	0.4	mg/kg	Dry	90.5
Waukegan Harbor	WH-2002 - 7.1	Phenol	1.1	0.07	0.7	mg/kg	Dry	57.4
Waukegan Harbor	WH-2002 - 7.2	Phenol	2.7	0.07	0.7	mg/kg	Dry	61.1
Waukegan Harbor	WH-2002 - 7.3	Phenol	U	0.05	0.5	mg/kg	Dry	88.0
Waukegan Harbor	WH-2002-10.3	Phenol	U	0.05	0.5	mg/kg	Dry	86.0
Waukegan Harbor	WH-2002-11.1	Phenol	U	0.05	0.5	mg/kg	Dry	87.4
Waukegan Harbor	WH-2002-11.3	Phenol	U	0.05	0.5	mg/kg	Dry	88.5
Waukegan Harbor	WH-2002-8.3	Phenol	U	0.05	0.5	mg/kg	Dry	83.6
Waukegan Harbor	WH-2002-9.1	Phenol	0.4	0.08	0.8	mg/kg	Dry	52.6

USEPA 2002 Investigation Analytical Results[a]
Other
Waukegan Harbor AOC

PROJECT	SAMPLENAME	ANALYTE	RESULT	DL	RL	UNITS	BASIS	PSOLIDS
Waukegan Harbor	WH-2002-9.2	Phenol	0.6	0.06	0.6	mg/kg	Dry	63.7
Waukegan Harbor	WH-2002-9.3	Phenol	0.5	0.05	0.5	mg/kg	Dry	86.7
Waukegan Harbor	WH-2002 - 1.1	Total Solids	79.7	1.00	1.00	%	Wet	79.7
Waukegan Harbor	WH-2002 - 1.2	Total Solids	78.4	1.00	1.00	%	Wet	78.4
Waukegan Harbor	WH-2002 - 1.3	Total Solids	90.2	1.00	1.00	%	Wet	90.3
Waukegan Harbor	WH-2002 - 16.1	Total Solids	77.1	1.00	1.00	%	Wet	77.1
Waukegan Harbor	WH-2002 - 16.2	Total Solids	80.4	1.00	1.00	%	Wet	80.4
Waukegan Harbor	WH-2002 - 16.3	Total Solids	87.1	1.00	1.00	%	Wet	87.1
Waukegan Harbor	WH-2002 - 2.1	Total Solids	78.9	1.00	1.00	%	Wet	78.9
Waukegan Harbor	WH-2002 - 2.2	Total Solids	79.8	1.00	1.00	%	Wet	79.8
Waukegan Harbor	WH-2002 - 2.3	Total Solids	89.5	1.00	1.00	%	Wet	89.5
Waukegan Harbor	WH-2002 - 3.1	Total Solids	79.8	1.00	1.00	%	Wet	79.8
Waukegan Harbor	WH-2002 - 3.2	Total Solids	80.5	1.00	1.00	%	Wet	80.5
Waukegan Harbor	WH-2002 - 3.3	Total Solids	84.1	1.00	1.00	%	Wet	84.1
Waukegan Harbor	WH-2002 - 4.1	Total Solids	74.3	1.00	1.00	%	Wet	74.3
Waukegan Harbor	WH-2002 - 4.2	Total Solids	77.7	1.00	1.00	%	Wet	77.7
Waukegan Harbor	WH-2002 - 4.3	Total Solids	89.7	1.00	1.00	%	Wet	89.7
Waukegan Harbor	WH-2002 - 5.1	Total Solids	70.5	1.00	1.00	%	Wet	70.5
Waukegan Harbor	WH-2002 - 5.2	Total Solids	70.3	1.00	1.00	%	Wet	70.3
Waukegan Harbor	WH-2002 - 5.3	Total Solids	88.4	1.00	1.00	%	Wet	88.4
Waukegan Harbor	WH-2002 - 6.1	Total Solids	68.4	1.00	1.00	%	Wet	68.4
Waukegan Harbor	WH-2002 - 6.2	Total Solids	74.6	1.00	1.00	%	Wet	74.6
Waukegan Harbor	WH-2002 - 6.3	Total Solids	90.5	1.00	1.00	%	Wet	90.5
Waukegan Harbor	WH-2002 - 7.1	Total Solids	57.4	1.00	1.00	%	Wet	57.4
Waukegan Harbor	WH-2002 - 7.2	Total Solids	61.1	1.00	1.00	%	Wet	61.1
Waukegan Harbor	WH-2002 - 7.3	Total Solids	88.0	1.00	1.00	%	Wet	88.0
Waukegan Harbor	WH-2002-10.1	Total Solids	72.5	1.00	1.00	%	Wet	72.5
Waukegan Harbor	WH-2002-10.3	Total Solids	86.0	1.00	1.00	%	Wet	86.0
Waukegan Harbor	WH-2002-11.1	Total Solids	87.4	1.00	1.00	%	Wet	87.4
Waukegan Harbor	WH-2002-11.1	Total Solids	84.0	1.00	1.00	%	Wet	84.1
Waukegan Harbor	WH-2002-11.3	Total Solids	88.5	1.00	1.00	%	Wet	88.5

USEPA 2002 Investigation Analytical Results[a]
Other
Waukegan Harbor AOC

PROJECT	SAMPLENAME	ANALYTE	RESULT	DL	RL	UNITS	BASIS	PSOLIDS
Waukegan Harbor	WH-2002-13.3	Total Solids	90.1	1.00	1.00	%	Wet	90.1
Waukegan Harbor	WH-2002-14.1	Total Solids	81.6	1.00	1.00	%	Wet	81.6
Waukegan Harbor	WH-2002-14.3	Total Solids	91.5	1.00	1.00	%	Wet	91.5
Waukegan Harbor	WH-2002-15.1	Total Solids	82.8	1.00	1.00	%	Wet	82.8
Waukegan Harbor	WH-2002-15.3	Total Solids	83.8	1.00	1.00	%	Wet	83.8
Waukegan Harbor	WH-2002-8.1	Total Solids	49.6	1.00	1.00	%	Wet	49.6
Waukegan Harbor	WH-2002-8.3	Total Solids	83.6	1.00	1.00	%	Wet	83.6
Waukegan Harbor	WH-2002-9.1	Total Solids	52.6	1.00	1.00	%	Wet	52.6
Waukegan Harbor	WH-2002-9.2	Total Solids	63.7	1.00	1.00	%	Wet	63.7
Waukegan Harbor	WH-2002-9.3	Total Solids	86.7	1.00	1.00	%	Wet	86.7
Waukegan Harbor	WH-2002 - 1.1	Total Volatile Solids	U	1.00	1.00	%	Wet	79.7
Waukegan Harbor	WH-2002 - 1.2	Total Volatile Solids	U	1.00	1.00	%	Wet	78.4
Waukegan Harbor	WH-2002 - 1.3	Total Volatile Solids	1.44	1.00	1.00	%	Wet	90.3
Waukegan Harbor	WH-2002 - 16.1	Total Volatile Solids	1.55	1.00	1.00	%	Wet	77.1
Waukegan Harbor	WH-2002 - 16.2	Total Volatile Solids	U	1.00	1.00	%	Wet	80.4
Waukegan Harbor	WH-2002 - 16.3	Total Volatile Solids	2.47	1.00	1.00	%	Wet	87.1
Waukegan Harbor	WH-2002 - 2.1	Total Volatile Solids	U	1.00	1.00	%	Wet	78.9
Waukegan Harbor	WH-2002 - 2.2	Total Volatile Solids	U	1.00	1.00	%	Wet	79.8
Waukegan Harbor	WH-2002 - 2.3	Total Volatile Solids	1.74	1.00	1.00	%	Wet	89.5
Waukegan Harbor	WH-2002 - 3.1	Total Volatile Solids	1.18	1.00	1.00	%	Wet	79.8
Waukegan Harbor	WH-2002 - 3.2	Total Volatile Solids	1.26	1.00	1.00	%	Wet	80.5
Waukegan Harbor	WH-2002 - 3.3	Total Volatile Solids	1.06	1.00	1.00	%	Wet	84.1
Waukegan Harbor	WH-2002 - 4.1	Total Volatile Solids	2.38	1.00	1.00	%	Wet	74.3
Waukegan Harbor	WH-2002 - 4.2	Total Volatile Solids	U	1.00	1.00	%	Wet	77.7
Waukegan Harbor	WH-2002 - 4.3	Total Volatile Solids	3.15	1.00	1.00	%	Wet	89.7
Waukegan Harbor	WH-2002 - 5.1	Total Volatile Solids	3.05	1.00	1.00	%	Wet	70.5
Waukegan Harbor	WH-2002 - 5.2	Total Volatile Solids	5.24	1.00	1.00	%	Wet	70.3
Waukegan Harbor	WH-2002 - 5.3	Total Volatile Solids	2.44	1.00	1.00	%	Wet	88.4
Waukegan Harbor	WH-2002 - 6.1	Total Volatile Solids	3.93	1.00	1.00	%	Wet	68.4
Waukegan Harbor	WH-2002 - 6.2	Total Volatile Solids	2.67	1.00	1.00	%	Wet	74.6
Waukegan Harbor	WH-2002 - 6.3	Total Volatile Solids	2.21	1.00	1.00	%	Wet	90.5

USEPA 2002 Investigation Analytical Results[a]
Other
Waukegan Harbor AOC

PROJECT	SAMPLENAME	ANALYTE	RESULT	DL	RL	UNITS	BASIS	PSOLIDS
Waukegan Harbor	WH-2002 - 7.1	Total Volatile Solids	5.84	1.00	1.00	%	Wet	57.4
Waukegan Harbor	WH-2002 - 7.2	Total Volatile Solids	5.64	1.00	1.00	%	Wet	61.1
Waukegan Harbor	WH-2002 - 7.3	Total Volatile Solids	1.23	1.00	1.00	%	Wet	88.0
Waukegan Harbor	WH-2002-10.1	Total Volatile Solids	4.51	1.00	1.00	%	Wet	72.5
Waukegan Harbor	WH-2002-10.3	Total Volatile Solids	1.76	1.00	1.00	%	Wet	86.0
Waukegan Harbor	WH-2002-11.1	Total Volatile Solids	2.54	1.00	1.00	%	Wet	87.4
Waukegan Harbor	WH-2002-11.1	Total Volatile Solids	3.04	1.00	1.00	%	Wet	84.1
Waukegan Harbor	WH-2002-11.3	Total Volatile Solids	2.15	1.00	1.00	%	Wet	88.5
Waukegan Harbor	WH-2002-13.3	Total Volatile Solids	1.65	1.00	1.00	%	Wet	90.1
Waukegan Harbor	WH-2002-14.1	Total Volatile Solids	2.17	1.00	1.00	%	Wet	81.6
Waukegan Harbor	WH-2002-14.3	Total Volatile Solids	1.76	1.00	1.00	%	Wet	91.5
Waukegan Harbor	WH-2002-15.1	Total Volatile Solids	2.08	1.00	1.00	%	Wet	82.8
Waukegan Harbor	WH-2002-15.3	Total Volatile Solids	2.04	1.00	1.00	%	Wet	83.8
Waukegan Harbor	WH-2002-8.1	Total Volatile Solids	7.00	1.00	1.00	%	Wet	49.6
Waukegan Harbor	WH-2002-8.3	Total Volatile Solids	11.8	1.00	1.00	%	Wet	83.6
Waukegan Harbor	WH-2002-9.1	Total Volatile Solids	7.63	1.00	1.00	%	Wet	52.6
Waukegan Harbor	WH-2002-9.2	Total Volatile Solids	6.39	1.00	1.00	%	Wet	63.7
Waukegan Harbor	WH-2002-9.3	Total Volatile Solids	1.24	1.00	1.00	%	Wet	86.7

[a]Data provided electronically by USEPA

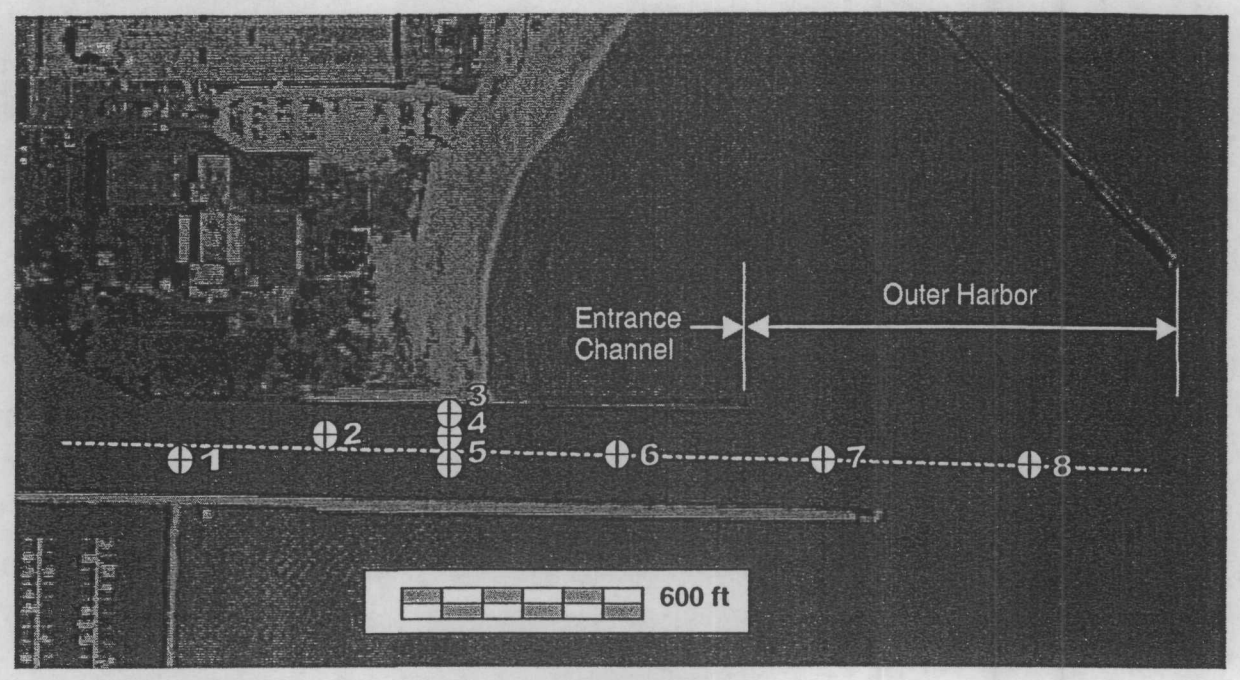
USEPA 2002 Investigation Analytical Results[a]
Total Organic Carbon
Waukegan Harbor AOC

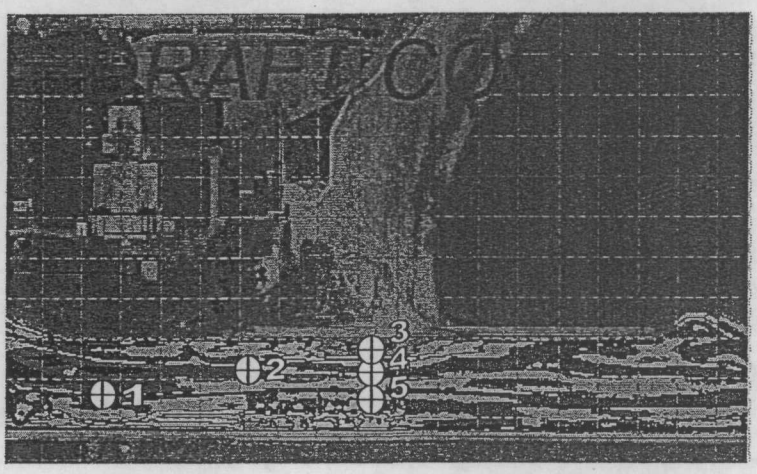
PROJECT	SAMPLENAME	SAMPDATE	ANALYTE	RESULT	DL	RL	UNITS	BASIS	PSOLIDS	% dry weight
Waukegan Harbor	WH-2002 - 1.1	01/16/2003	Total Organic Carbon	1.3	1.0	1.0	%	Wet	79.7	1.63
Waukegan Harbor	WH-2002 - 1.2	01/16/2003	Total Organic Carbon	U	1.0	1.0	%	Wet	78.4	
Waukegan Harbor	WH-2002 - 1.3	01/16/2003	Total Organic Carbon	1.4	1.0	1.0	%	Wet	90.3	1.55
Waukegan Harbor	WH-2002 - 2.1	01/16/2003	Total Organic Carbon	U	1.0	1.0	%	Wet	78.9	
Waukegan Harbor	WH-2002 - 2.2	01/16/2003	Total Organic Carbon	U	1.0	1.0	%	Wet	79.8	
Waukegan Harbor	WH-2002 - 2.3	01/16/2003	Total Organic Carbon	2.1	1.0	1.0	%	Wet	89.5	2.35
Waukegan Harbor	WH-2002 - 3.1	01/16/2003	Total Organic Carbon	1.2	1.0	1.0	%	Wet	79.8	1.50
Waukegan Harbor	WH-2002 - 3.2	01/16/2003	Total Organic Carbon	U	1.0	1.0	%	Wet	80.5	
Waukegan Harbor	WH-2002 - 3.3	01/16/2003	Total Organic Carbon	1.6	1.0	1.0	%	Wet	84.1	1.90
Waukegan Harbor	WH-2002 - 4.1	01/16/2003	Total Organic Carbon	1.6	1.0	1.0	%	Wet	74.3	2.15
Waukegan Harbor	WH-2002 - 4.2	01/16/2003	Total Organic Carbon	U	1.0	1.0	%	Wet	77.7	
Waukegan Harbor	WH-2002 - 4.3	01/16/2003	Total Organic Carbon	2.6	1.0	1.0	%	Wet	89.7	2.90
Waukegan Harbor	WH-2002 - 5.1	01/16/2003	Total Organic Carbon	1.8	1.0	1.0	%	Wet	70.5	2.55
Waukegan Harbor	WH-2002 - 5.2	01/16/2003	Total Organic Carbon	3.8	1.0	1.0	%	Wet	70.3	5.41
Waukegan Harbor	WH-2002 - 5.3	01/16/2003	Total Organic Carbon	1.6	1.0	1.0	%	Wet	88.4	1.81
Waukegan Harbor	WH-2002 - 6.1	01/16/2003	Total Organic Carbon	2.7	1.0	1.0	%	Wet	68.4	3.95
Waukegan Harbor	WH-2002 - 6.2	01/16/2003	Total Organic Carbon	3.2	1.0	1.0	%	Wet	74.6	4.29
Waukegan Harbor	WH-2002 - 6.3	01/16/2003	Total Organic Carbon	2.0	1.0	1.0	%	Wet	90.5	2.21
Waukegan Harbor	WH-2002 - 7.1	01/16/2003	Total Organic Carbon	4.1	1.0	1.0	%	Wet	57.4	7.14
Waukegan Harbor	WH-2002 - 7.2	01/16/2003	Total Organic Carbon	4.5	1.0	1.0	%	Wet	61.1	7.36
Waukegan Harbor	WH-2002 - 7.3	01/16/2003	Total Organic Carbon	2.9	1.0	1.0	%	Wet	88.0	3.30
Waukegan Harbor	WH-2002 - 16.1	01/16/2003	Total Organic Carbon	U	1.0	1.0	%	Wet	77.1	
Waukegan Harbor	WH-2002 - 16.2	01/16/2003	Total Organic Carbon	U	1.0	1.0	%	Wet	80.4	
Waukegan Harbor	WH-2002 - 16.3	01/16/2003	Total Organic Carbon	1.4	1.0	1.0	%	Wet	87.1	1.61
Waukegan Harbor	WH-2002-11.1	01/15/2003	Total Organic Carbon	1.5	1.0	1.0	%	Wet	87.4	1.72
Waukegan Harbor	WH-2002-11.3	01/15/2003	Total Organic Carbon	1.3	1.0	1.0	%	Wet	88.5	1.47
Waukegan Harbor	WH-2002-10.3	01/15/2003	Total Organic Carbon	1.0	1.0	1.0	%	Wet	86.0	1.16
Waukegan Harbor	WH-2002-9.2	01/15/2003	Total Organic Carbon	3.9	1.0	1.0	%	Wet	63.7	6.12
Waukegan Harbor	WH-2002-9.3	01/15/2003	Total Organic Carbon	1.9	1.0	1.0	%	Wet	86.7	2.19
Waukegan Harbor	WH-2002-8.3	01/15/2003	Total Organic Carbon	1.7	1.0	1.0	%	Wet	83.6	2.03
Waukegan Harbor	WH-2002-9.1	01/15/2003	Total Organic Carbon	5.7	1.0	1.0	%	Wet	52.6	10.84

[a]Data provided electronically by USEPA

CAG 2002 Investigation

5/16/02 Sediment Samples





Sample locations are shown on a 1998 USGS aerial photo (top) and a 2000 Lake County aerial photo with June 2002 bathymetric results superimposed. Samples were collected with 4 in. dia. x 5 ft. split spoon by a CME drill rig on 30 x 80 ft. spud barge. Samples are representative of material that is planned to be removed for a 100 ft. wide channel cleared to LWD-23 ft. with 1:2 side slopes. Samples at Location 3 are representative of a 2000-3000 cu. yd. sand bar which will also be removed. Driller's notes follow:

1. LWD-21/26 ft., black organic silt, trace fine sand (OL)
2. LWD-17/22 ft., gray fine sand, little silt with occasional shells, poorly graded (SM-SP)
3. LWD-10/15 ft., brown fine sand, trace silt, poorly graded (SP)
4. LWD-18/23 ft., gray fine sand, trace silt, with occasional shells, poorly graded (SP)
5. LWD-18/23 ft., gray and black organic silt, some fine sand (OL)
6. No boring attempted
7. LWD-22/27 ft., gray find sand, some silt, poorly graded (SM-SP)
8. LWD-24/29 ft., gray fine sand, little silt, poorly graded (SM-SP)

Location 6 was not sampled because of budget constraints. Samples were generally collected at two depths. Samples were collected at three depths at Location 3 in search of subtle stratification, and at Location 4 because of observed stratification.

Analytical Summary -- 5/16/02 Sediment Samples

Sample ID is depth below sediment surface.			Entrance Channel									Sand Bar			Outer Harbor				USEPA PEC*
Blank is non-detect.			Location 1		Location 2		Location 4			Location 5		Location 3			Location 7		Location 8		
Detection limits, QA/QC flags not shown.			1.7 ft	3.4 ft	1.7 ft	3.4 ft	1.3 ft	2.5 ft	3.8 ft	1.7 ft	3.4 ft	1.3 ft	2.5 ft	3.8 ft	1.7 ft	3.4 ft	1.7 ft	3.4 ft	
Metals	Antimony	mg/kg																	
	Arsenic	mg/kg		24.7						9.21	19.5								33
	Barium	mg/kg		40.6															
	Cadmium	mg/kg		***5.09***						4.33									4.98
	Chromium	mg/kg	12.6	71.3	12.7	3.49	3.20	13.3	4.05	53.4	64.1	1.80	2.09	2.01	5.97	8.61	3.83	4.99	111
	Copper	mg/kg	19.6	118	19.1		3.15	23.0	3.17	54.0	138				10.1	12.2	4.63	6.87	2900
	Lead	mg/kg	23.8	***129***	21.8	4.08	4.74	24.8	5.20	81.5	67.3	2.48	2.37	2.24	11.9	15.7	5.18	7.10	128
	Nickel	mg/kg	6.78	15.6	6.84			8.23		14.0	12.6				5.38	5.56	3.83	4.37	48.6
	Zinc	mg/kg	53.8	233	52.8			60.1		146	186				39.8	42.5		31.9	459
Nutrients	Ammonia as N	mg/kg	185	231	128	9.45	36.3	161	12.4	191	253	6.98	9.94	10.2	63.7	115	27.2	88.5	
	Phosphorus	mg/kg	14.3	1.65		0.508	3.12	0.240	0.797					2.01	1.44	1.05			
	Total Kjeldahl Nitrogen	mg/kg	607	996	408	32.9	122	692	81.1	109	529	47.3	21.6	15.9	271	184	171	149	
BTEX	Benzene	mg/kg		0.031						0.038									
	Ethylbenzene	mg/kg																	
	Toluene	mg/kg																	
	Total Xylenes	mg/kg																	
PCB	PCB-1016	mg/kg																	(0.676
	PCB-1221	mg/kg																	total PCBs)
	PCB-1232	mg/kg																	
	PCB-1242	mg/kg																	
	PCB-1248	mg/kg	0.070	0.093	0.101	0.052	0.059	0.125	0.119	0.405	0.044				0.101	0.077	0.058	0.087	
	PCB-1254	mg/kg																	
	PCB-1260	mg/kg																	
PNA	Acenaphthene	mg/kg																	(22.8
	Acenaphthylene	mg/kg																	total PNAs)
	Anthracene	mg/kg																	
	Benz (a) anthracene	mg/kg																	
	Benzo (a) pyrene	mg/kg	0.025	0.098			0.045	0.137		0.129	0.056				0.053	0.019			1.45
	Benzo (b) fluoranthene	mg/kg																	
	Benzo (ghi) perylene	mg/kg																	
	Benzo (k) fluoranthene	mg/kg																	
	Chrysene	mg/kg																	1.29
	Dibenz (a,h) anthracene	mg/kg	0.011				0.045	0.097											
	Fluoranthene	mg/kg	0.202																
	Fluorene	mg/kg																	
	Indeno (1,2,3-cd) pyrene	mg/kg																	
	Naphthalene	mg/kg	0.155																0.561
	Phenanthrene	mg/kg	0.222																1.17
	Pyrene	mg/kg														0.132			1.52
Misc	Total Organic Carbon	mg/kg	9240	18500	3450	1660	1390	7110	1280	14200	18700	337	625	373	10100	2150	1100	10100	
	Phenol	mg/kg	2.13	2.26	1.02	1.23	2.92	0.822	0.91		1.67	1.16	1.42	1.78	2.14				
	Total Solids	% by Wt	67.7	65.7	72.7	76.3	82.0	76.7	77.1	71.9	72.4	77.8	76.3	76.6	79.1	76.3	79.8	78.3	
	Asbestos fiber		yes	yes	yes		yes	yes		yes	yes	yes							

** Probable Effect Concentration (PEC) is a sediment quality guideline. Concentrations above the PEC are expected to impact benthic organisms.*

Draft

CRA 2003 Sampling Event (CRA 2003)

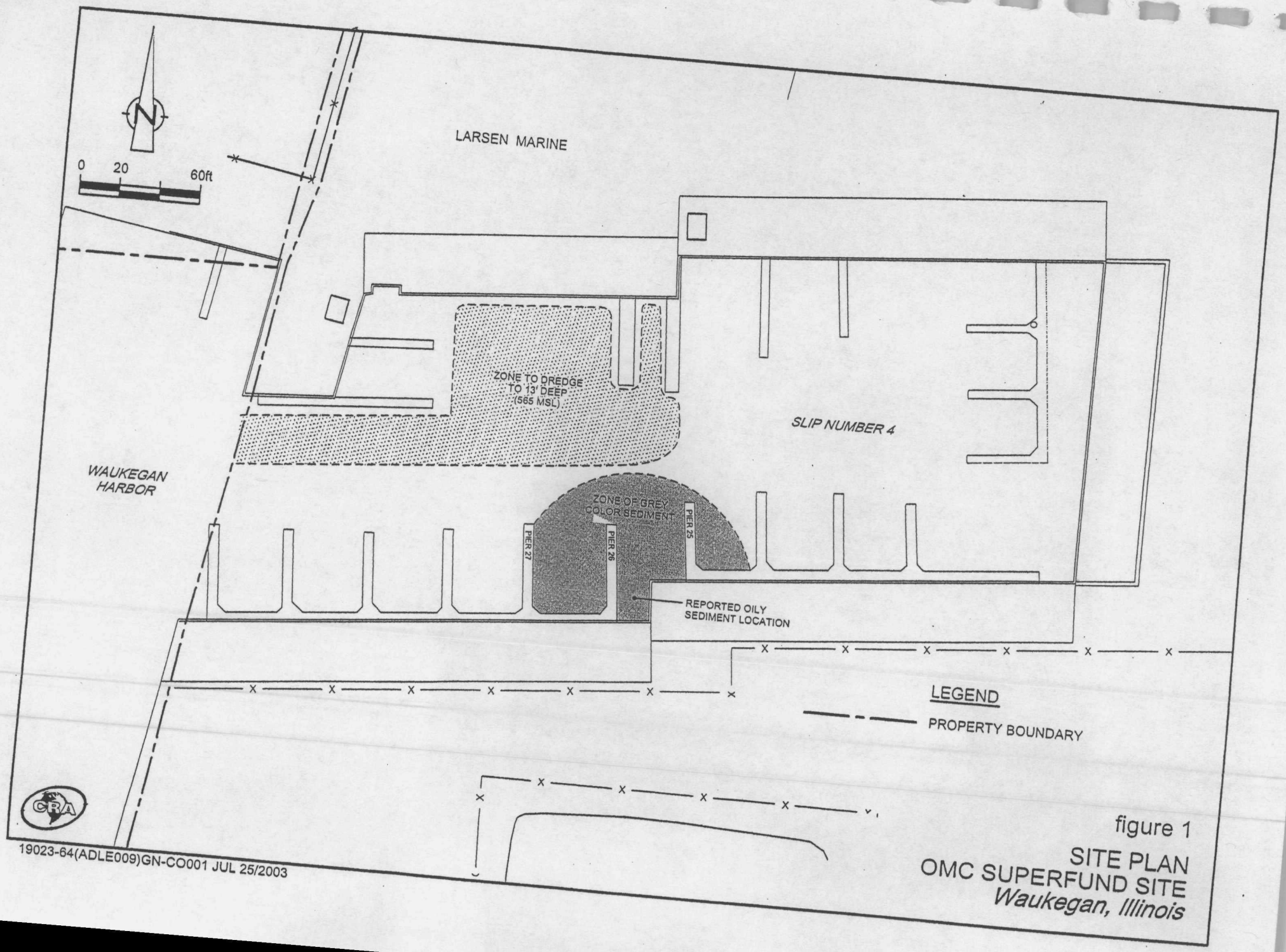


figure 1

SITE PLAN
OMC SUPERFUND SITE
Waukegan, Illinois

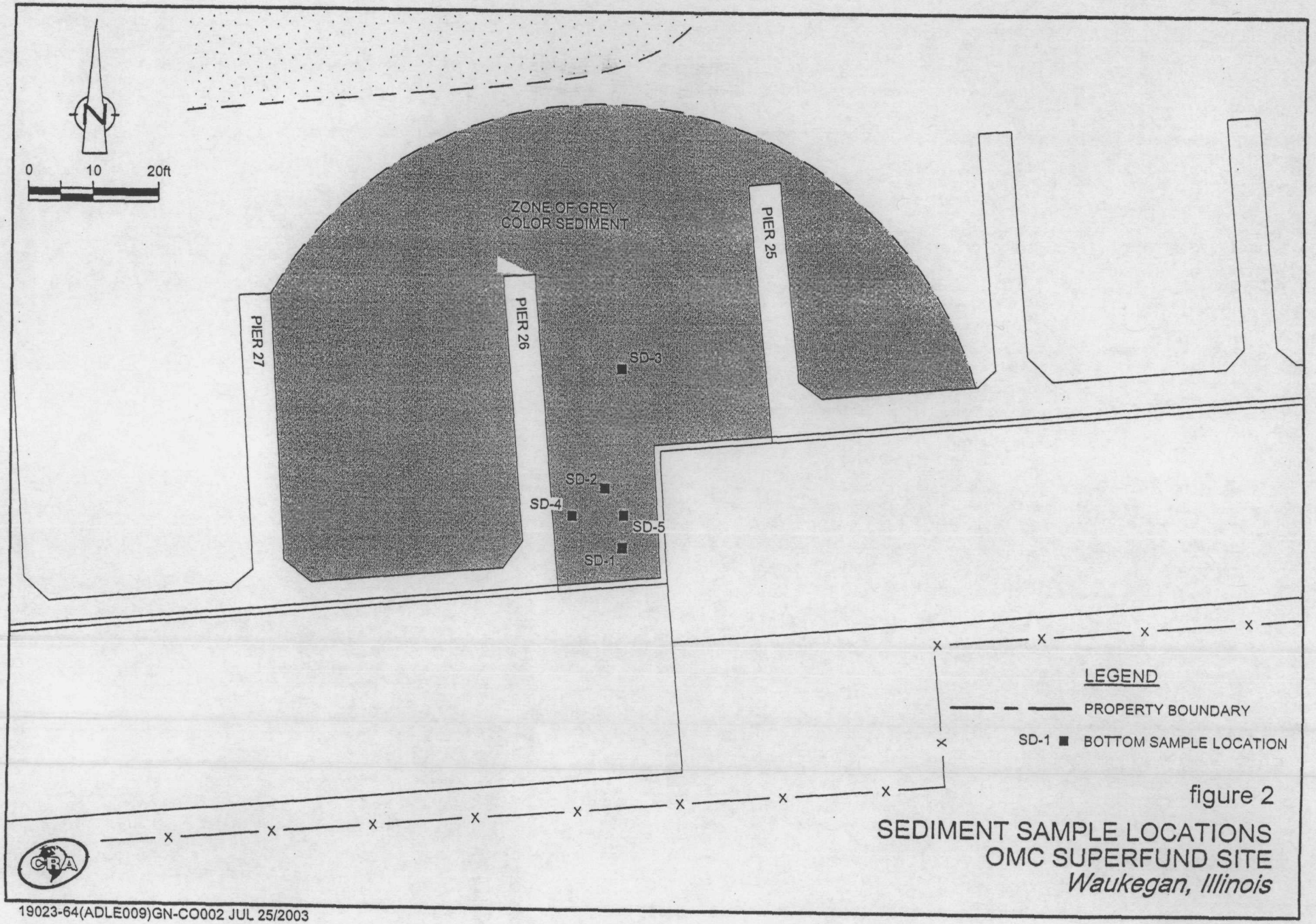


figure 2

SEDIMENT SAMPLE LOCATIONS
OMC SUPERFUND SITE
Waukegan, Illinois

19023-64(ADLE009)GN-CO002 JUL 25/2003

TABLE 1

SUMMARY OF SEDIMENT SAMPLES
APRIL 23, 2003
WAUKEGAN HARBOR SLIP #4
WAUKEGAN, ILLINOIS

Sample Identification	*Sample Date*	*Sample Location*	*Sample Time*	*Quality Assurance/ Quality Control*	*Interval (feet)* [1]	*Description (feet)*	*Requested Analyses*
S-042303-WP-001	4/23/2003	SD-1	9:13	--	0.0 - 1.1'	0.0-0.4' -wet mud, silt-like material, marine-type odor 0.4' -1.1' - fine grained sand, gray	PAH[2], PCBs[3], TPH-DRO[4], Arsenic
S-042303-WP-002	4/23/2003	SD-1	9:15	Duplicate	0.0 - 1.1'	0.0-0.4' -wet mud, silt-like material, marine-type odor 0.4' -1.1' - fine grained sand, gray	PAH, PCBs, TPH-DRO, Arsenic
S-042303-WP-003	4/23/2003	SD-2	9:45	MS/MSD[2]	0.0 - 1.8'	0.0 - 0.4' - mud/silt 0.4' - 1.8' - fine sand, gray, moderate odor	PAH, PCBs, TPH-DRO, Arsenic
W-042303-WP-004	4/23/2003	--	9:00	Rinsate	--	--	PAH, PCBs, TPH-DRO, Arsenic
S-042303-WP-005	4/23/2003	SD-3	10:40	--	0.0 -2.0'	0.0 - 0.3' -wet mud, silt-like material 0.3 - 2.0' - fine sand, gray, moderate odor	PAH, PCBs, TPH-DRO, Arsenic
--	4/23/2003	SD-4	11:05	--	0.0 - 1.3'	0.0-0.2' - brown sand 0.2' -0.6' -wet mud, silt-like material, marine-type odor 0.6' - 1.3' - fine gray sand, slight odor	No Analysis
--	4/23/2003	SD-5	11:30	--	0.0 - 1.8'	0.0 - 0.5' - mud, silt, slight odor 0.5' - 1.8' - sand, fine-grained, gray, moderate odor	No Analysis

Notes:

1 feet - Feet Below the Water/Sediment Interface
2 PAH - Polynuclear Aromatic Hydrocarbons
3 PCB - Polychlorinated Biphenyl
4 TPH - DRO - Diesel Fraction of Total Petroleum Hydrocarbons
5 MS/MSD - Matrix Spike/Matrix Spike Duplicate

TABLE 2

SUMMARY OF DETECTED ANALYTES IN SEDIMENT
WAUKEGAN HARBOR SLIP #4
WAUKEGAN, ILLINOIS

Location:	*SD-1*	*SD-1 (Duplicate)*	*SD-2*	*SD-3*
Sample Media:	*Soil*	*Soil*	*Soil*	*Soil*
ANALYTES				
Polynuclear Aromatic Hydrocarbons (mg/kg) [2]				
Acenaphthene	0.92	0.85	2.0 [3]	2.0 [3]
Acenaphthylene	0.066	0.061	0.089	0.17
Anthracene	0.57	0.48	2.5 [3]	1.6 [3]
Benzo(a)anthracene	0.72	0.65	1.2 [3]	1.4 [3]
Benzo(a)pyrene	0.42	0.35	0.67	0.81
Benzo(b)fluoranthene	0.54	0.49	0.84	0.96
Benzo(g,h,i)perylene	0.19	0.15	0.23	0.28
Benzo(k)fluoranthene	0.36	0.28	0.53	0.66
Chrysene	0.72	0.66	1.5 [3]	1.8 [3]
Dibenzo(a,h)anthracene	0.065	0.056	0.1	0.13
Fluoranthene	1.9 [3]	1.6 [3]	5.1 [3]	5.7 [3]
Fluorene	0.76	0.69	0.25	2.33
Indeno(1,2,3-cd)pyrene	0.17	0.14	2.1 [3]	0.3
Naphthalene	3.8 [3]	3.2 [3]	11 [3]	1.3 [3]
Phenanthrene	1.9 [3]	1.6 [3]	3.7 [3]	8.9 [3]
Pyrene	1.6 [3]	1.3 [3]	0.13	4.4 [3]
TPH (as Diesel)	87	120	100	98
PCBs (mg/kg)				
Aroclor 1248	0.76	0.69	0.64	0.22
Metals (mg/kg)				
Arsenic	1.4	1.4	1.3	1.3

Notes:

[1] ft bgs - feet below ground surface.
[2] mg/kg - milligrams per kilogram
[3] - Result is from a dilution

USEPA 2003 Probe Data

USEPA Probe Investigation Results[a]

DATE	X_COORD	Y_COORD	ID	WATER_DEPT	SED_BOT_DE	THICKNESS	SURF_ELEV	SEDBOTELEV	Harbor Segment
20030429	1123111.795	2076919.676	p1	7.00	9.00	2.00	569.50	567.50	North Harbor
20030429	1123116.128	2076886.225	p2	8.00	9.60	1.60	568.50	566.90	North Harbor
20030429	1123125.733	2076818.371	p3	7.40	8.50	1.10	569.10	568.00	North Harbor
20030429	1123056.227	2076902.659	p4	9.50	12.00	2.50	567.00	564.50	North Harbor
20030429	1123072.858	2076858.795	p5	7.20	9.40	2.20	569.30	567.10	North Harbor
20030429	1123090.324	2076801.184	p6	8.00	9.30	1.30	568.50	567.20	North Harbor
20030429	1123016.048	2076800.105	p7	9.10	11.80	2.70	567.40	564.70	North Harbor
20030429	1123029.668	2076844.811	p8	11.50	12.80	1.30	565.00	563.70	North Harbor
20030429	1123012.689	2076891.873	p9	11.70	13.50	1.80	564.80	563.00	North Harbor
20030429	1122956.876	2076873.545	p10	11.50	11.60	0.10	565.00	564.90	North Harbor
20030429	1122936.194	2076781.951	p11	9.70	11.60	1.90	566.80	564.90	North Harbor
20030429	1122943.352	2076827.462	p12	11.10	11.50	0.40	565.40	565.00	North Harbor
20030429	1122896.541	2076774.942	p13	10.50	12.50	2.00	566.00	564.00	North Harbor
20030429	1122900.071	2076823.928	p14	11.90	12.50	0.60	564.60	564.00	North Harbor
20030429	1122891.71	2076865.236	p15	9.50	11.80	2.30	567.00	564.70	North Harbor
20030429	1122817.443	2076771.181	p16	11.00	12.50	1.50	565.50	564.00	North Harbor
20030429	1122811.495	2076802.66	p17	11.20	13.50	2.30	565.30	563.00	North Harbor
20030429	1122759.454	2076757.756	p18	11.30	13.00	1.70	565.20	563.50	North Harbor
20030429	1122759.791	2076809.963	p19	14.10	14.80	0.70	562.40	561.70	North Harbor
20030429	1122735.72	2076864.296	p20	9.50	12.00	2.50	567.00	564.50	North Harbor
20030429	1122713.31	2076914.493	p21	4.70	7.40	2.70	571.80	569.10	North Harbor
20030429	1122637.322	2076887.732	p22	10.50	11.50	1.00	566.00	565.00	North Harbor
20030429	1122641.353	2076853.334	p23	14.00	15.80	1.80	562.50	560.70	North Harbor
20030429	1122708.574	2076829.501	p24	13.50	16.30	2.80	563.00	560.20	North Harbor
20030429	1122650.26	2076823.049	p25	16.90	17.50	0.60	559.60	559.00	North Harbor
20030429	1122620.41	2076761.976	p26	17.10	18.80	1.70	559.40	557.70	North Harbor
20030429	1122675.381	2076715.578	p27	18.70	22.50	3.80	557.80	554.00	North Harbor
20030429	1122741.412	2076681.342	p28	14.70	16.80	2.10	561.80	559.70	North Harbor
20030429	1122670.294	2076647.006	p29	18.30	21.30	3.00	558.20	555.20	North Harbor
20030429	1122603.678	2076687.66	p30	17.00	20.10	3.10	559.50	556.40	North Harbor
20030429	1122526.113	2076589.453	p31	14.90	17.00	2.10	561.60	559.50	North Harbor
20030429	1122588.104	2076545.556	p32	18.20	21.50	3.30	558.30	555.00	North Harbor
20030429	1122702.629	2076508.817	p33	11.20	13.50	2.30	565.30	563.00	North Harbor
20030429	1122617.298	2076456.628	p34	18.60	22.30	3.70	557.90	554.20	North Harbor
20030429	1122502.736	2076466.382	p35	16.40	17.60	1.20	560.10	558.90	North Harbor
20030429	1122680.99	2076377.613	p36	14.90	16.20	1.30	561.60	560.30	North Harbor
20030429	1122562.744	2076361.966	p37	18.90	22.80	3.90	557.60	553.70	North Harbor

USEPA Probe Investigation Results[a]

DATE	X_COORD	Y_COORD	ID	WATER_DEPT	SED_BOT_DE	THICKNESS	SURF_ELEV	SEDBOTELEV	Harbor Segment
20030429	1122455.682	2076335.062	p38	11.30	12.80	1.50	565.20	563.70	North Harbor
20030429	1122356.684	2076276.472	p40	12.60	16.10	3.50	563.90	560.40	North Harbor
20030429	1122438.885	2076237.674	p41	15.50	16.10	0.60	561.00	560.40	North Harbor
20030429	1122366.664	2076243.349	p42	14.50	16.80	2.30	562.00	559.70	North Harbor
20030429	1122507.879	2076197.254	p43	17.60	20.80	3.20	558.90	555.70	North Harbor
20030430	1122444.157	2075112.51	p69	13.70	16.30	2.60	562.90	560.30	Inner Harbor
20030430	1122294.147	2075116.496	p70	21.10	21.80	0.70	555.50	554.80	Inner Harbor
20030430	1122130.043	2075115.235	p71	16.30	27.50	1.12	560.30	549.10	Inner Harbor
20030430	1122017.919	2075063.191	p72	9.50	11.50	2.00	567.10	565.10	Outside In_Harbor
20030430	1122018.348	2074919.03	p73	10.30	14.00	3.70	566.30	562.60	Outside Marina
20030430	1122165.593	2074890.853	p74	12.60	25.80	1.32	564.00	550.80	Inner Harbor
20030430	1122369.098	2074827.058	p75	21.40	26.00	4.60	555.20	550.60	Inner Harbor
20030430	1122534.733	2074818.709	p76	23.70	25.80	2.10	552.90	550.80	Inner Harbor
20030430	1122660.1	2074869.917	p77	11.30	16.50	5.20	565.30	560.10	Inner Harbor
20030430	1122758.137	2074779.433	p78	10.30	14.30	4.00	566.30	562.30	Inner Harbor
20030430	1122547.285	2074745.975	p79	24.30	25.80	1.50	552.30	550.80	Inner Harbor
20030430	1122328.796	2074745.552	p80	16.00	26.50	1.05	560.60	550.10	Inner Harbor
20030430	1122229.229	2075639.669	p81	20.40	20.60	0.20	556.20	556.00	Inner Harbor Extension
20030430	1122022.574	2075748.301	p82	21.80	22.30	0.50	554.80	554.30	Outside In_Harb_Ext
20030430	1122128.716	2074977.158	p84	13.40	25.00	1.16	563.20	551.60	Inner Harbor
20030430	1122334.223	2074950.259	P84	22.30	25.80	3.50	554.30	550.80	Inner Harbor
20030430	1122532.685	2074928.357	P85	19.20	24.60	5.40	557.40	552.00	Inner Harbor
20030430	1122221.995	2074796.615	P86	12.80	24.30	1.15	563.80	552.30	Inner Harbor
20030430	1122219.238	2074594.507	P87	12.70	23.30	1.06	563.90	553.30	Marina
20030430	1122222.68	2074496.783	P88	11.60	15.30	3.70	565.00	561.30	Marina
20030430	1122066.08	2074785.534	P89	12.30	23.30	1.10	564.30	553.30	Marina
20030430	1122057.575	2074647.374	P90	8.70	10.50	1.80	567.90	566.10	Marina
20030430	1122075.94	2074517.077	P91	8.50	9.30	0.80	568.10	567.30	Marina
20030430	1121933.962	2074829.746	P92	8.10	9.00	0.90	568.50	567.60	Marina
20030430	1121938.146	2074621.117	P93	7.20	9.80	2.60	569.40	566.80	Marina
20030430	1121947.807	2074496.933	P94	6.50	7.00	0.50	570.10	569.60	Marina
20030430	1124347.41	2074485.436	P95	21.00	21.30	0.30	555.60	555.30	Entrance Channel
20030430	1124313.463	2074684.398	P96	17.50	18.40	0.90	559.10	558.20	Entrance Channel
20030430	1124334.689	2074582.371	P97	20.10	22.00	1.90	556.50	554.60	Entrance Channel
20030430	1124042.228	2074672.517	P98	16.10	16.50	0.40	560.50	560.10	Entrance Channel
20030430	1124039.166	2074578.111	P99	20.70	22.80	2.10	555.90	553.80	Entrance Channel
20030430	1124034.493	2074490.635	P100	18.00	20.00	2.00	558.60	556.60	Entrance Channel

USEPA Probe Investigation Results[a]

DATE	X_COORD	Y_COORD	ID	WATER_DEPT	SED_BOT_DE	THICKNESS	SURF_ELEV	SEDBOTELEV	Harbor Segment
20030430	1123869.688	2074486.728	P101	17.30	18.00	0.70	559.30	558.60	Entrance Channel
20030430	1123795.499	2074564.147	P102	19.70	25.00	5.30	556.90	551.60	Entrance Channel
20030430	1123745.44	2074681.488	P103	9.60	9.80	0.20	567.00	566.80	Entrance Channel
20030430	1123659.637	2074576.942	P104	20.50	24.00	3.50	556.10	552.60	Entrance Channel
20030430	1123577.589	2074493.977	P105	13.50	20.00	6.50	563.10	556.60	Entrance Channel
20030430	1123504.347	2074532.295	P106	19.20	22.00	2.80	557.40	554.60	Entrance Channel
20030430	1123367.04	2074683.005	P107	15.90	18.30	2.40	560.70	558.30	Entrance Channel
20030430	1123247.545	2074573.565	P108	20.50	22.80	2.30	556.10	553.80	Entrance Channel
20030430	1123141.582	2074510.529	P109	15.90	27.00	1.11	560.70	549.60	Entrance Channel
20030430	1122991.791	2074594.569	P110	21.70	24.00	2.30	554.90	552.60	Entrance Channel
20030430	1122916.578	2074708.495	P111	15.50	16.00	0.50	561.10	560.60	Inner Harbor
20030430	1122865.747	2074583.192	P112	21.90	23.50	1.60	554.70	553.10	Inner Harbor
20030430	1122800.804	2074497.377	P113	13.50	21.30	7.80	563.10	555.30	Inner Harbor
20030430	1122745.715	2074637.283	P114	24.40	24.50	0.10	552.20	552.10	Inner Harbor
20030430	1122641.088	2074870.8	P115	16.70	17.50	0.80	559.90	559.10	Inner Harbor
20030430	1122587.504	2074722.057	P116	22.70	24.30	1.60	553.90	552.30	Inner Harbor
20030430	1122519.972	2074569.842	P117	13.30	22.80	9.50	563.30	553.80	Marina
20030430	1122498.923	2074437.588	P118	8.80	10.50	1.70	567.80	566.10	Marina
20030430	1122416.347	2074508.613	P119	12.60	24.00	1.14	564.00	552.60	Marina
20030430	1122361.577	2074583.432	p120	13.70	24.50	1.08	562.90	552.10	Marina
20030430	1122372.003	2074427.854	P121	7.50	9.50	2.00	569.10	567.10	Marina
20030430	1122258.047	2074339.922	P122	6.10	7.80	1.70	570.50	568.80	Marina
20030430	1122216.167	2074435.425	P123	7.50	9.00	1.50	569.10	567.60	Marina
20030430	1122134.475	2074288.017	P124	5.60	6.40	0.80	571.00	570.20	Marina
20030430	1122072.862	2074386.595	P125	7.90	10.00	2.10	568.70	566.60	Marina
20030430	1122009.476	2074224.417	P126	5.40	6.00	0.60	571.20	570.60	Marina
20030430	1121942.955	2074316.698	P127	5.40	9.00	3.60	571.20	567.60	Marina
20030430	1121940.916	2074418.803	P128	6.80	9.30	2.50	569.80	567.30	Marina
20030430	1121918.153	2074185.78	P129	4.30	4.90	0.60	572.30	571.70	Marina
20030430	1122643.506	2076153.146	p44	17.60	18.70	1.10	559.00	557.90	North Harbor
20030430	1122459.084	2076139.189	p45	16.90	19.80	2.90	559.70	556.80	North Harbor
20030430	1122524.613	2076100.159	p46	18.20	22.50	4.30	558.40	554.10	North Harbor
20030430	1122626.455	2076072.339	p47	16.50	18.60	2.10	560.10	558.00	North Harbor
20030430	1122416.231	2076046.837	p48	17.80	19.30	1.50	558.80	557.30	North Harbor
20030430	1122394.012	2075911.069	p49	17.40	17.60	0.20	559.20	559.00	Outside North Harbor
20030430	1122465.719	2075896.494	p50	22.50	22.60	0.10	554.10	554.00	North Harbor
20030430	1122599.205	2075909.494	p51	17.50	18.00	0.50	559.10	558.60	North Harbor

USEPA Probe Investigation Results[a]

DATE	X_COORD	Y_COORD	ID	WATER_DEPT	SED_BOT_DE	THICKNESS	SURF_ELEV	SEDBOTELEV	Harbor Segment
20030430	1122334.571	2075826.121	p52	18.50	18.60	0.10	558.10	558.00	North Harbor
20030430	1122398.451	2075785.152	p53	20.50	20.80	0.30	556.10	555.80	North Harbor
20030430	1122535.927	2075821.559	p54	21.00	21.30	0.30	555.60	555.30	North Harbor
20030430	1122512.166	2075629.887	p55	13.70	17.00	3.30	562.90	559.60	Inner Harbor Extension
20030430	1122378.191	2075600.743	p56	21.20	22.00	0.80	555.40	554.60	Inner Harbor Extension
20030430	1122169.33	2075749.398	p57	16.00	18.80	2.80	560.60	557.80	Inner Harbor Extension
20030430	1122089.527	2075638.808	p58	23.60	23.70	0.10	553.00	552.90	Inner Harbor Extension
20030430	1122223.622	2075556.669	p59	20.90	21.00	0.10	555.70	555.60	Inner Harbor Extension
20030430	1122444.937	2075531.698	p60	10.50	17.50	7.00	566.10	559.10	Inner Harbor Extension
20030430	1122429.62	2075429.672	p61	13.70	16.80	3.10	562.90	559.80	Inner Harbor
20030430	1122310.161	2075380.09	p62	21.60	22.30	0.70	555.00	554.30	Inner Harbor
20030430	1122153.631	2075395.78	p63	21.00	25.50	4.50	555.60	551.10	Inner Harbor
20030430	1122017.988	2075389.514	p64	13.30	15.50	2.20	563.30	561.10	Outside In_Harbor
20030430	1122018.181	2075304.957	p65	13.40	16.00	2.60	563.20	560.60	Outside In_Harbor
20030430	1122125.791	2075268.517	p66	18.50	25.00	6.50	558.10	551.60	Inner Harbor
20030430	1122257.224	2075221.727	p67	22.70	22.80	0.10	553.90	553.80	Inner Harbor
20030430	1122434.204	2075223.202	p68	12.70	16.50	3.80	563.90	560.10	Inner Harbor
20030821	1124258.167	2074593.442	56	20.01	21.75	1.74	556.49	554.75	Entrance Channel
20030821	1123726.042	2074604.82	57	21.82	22.00	0.18	554.68	554.50	Entrance Channel
20030821	1123380.674	2074609.225	58	21.98	22.75	0.77	554.52	553.75	Entrance Channel
20030821	1123061.813	2074575.289	59	21.16	24.25	3.09	555.34	552.25	Entrance Channel
20030821	1122652.49	2074600.076	60	16.73	26.00	9.27	559.77	550.50	Inner Harbor
20030821	1122282.587	2074893.263	61	17.39	25.50	8.11	559.11	551.00	Inner Harbor
20030821	1122194.647	2075083.517	62	19.03	23.75	4.72	557.47	552.75	Inner Harbor
20030821	1122439.003	2075051.365	63	18.04	23.00	4.96	558.46	553.50	Inner Harbor
20030821	1122284.379	2075346.013	64	21.33	23.75	2.42	555.17	552.75	Inner Harbor
20030821	1122314.976	2075564.758	65	21.98	22.75	0.77	554.52	553.75	Inner Harbor Extension
20030821	1122108.617	2075495.634	66	18.86	19.50	0.64	557.64	557.00	Inner Harbor Extension
20030821	1122317.339	2075679.937	67	21.65	21.75	0.10	554.85	554.75	Inner Harbor Extension
20030821	1122485.614	2075761.366	68	21.65	21.75	0.10	554.85	554.75	North Harbor
20030821	1122530.076	2076034.861	69	19.36	21.50	2.14	557.14	555.00	North Harbor
20030821	1122518.434	2076269.863	70	17.39	20.00	2.61	559.11	556.50	North Harbor
20030821	1122578.293	2074645.016	71	19.68	24.75	5.07	556.82	551.76	Inner Harbor
20030821	1125543.698	2074840.912	2	21.00	22.25	1.25	555.50	554.25	Outer Harbor
20030821	1125605.529	2074636.229	3	19.85	20.50	0.65	556.65	556.00	Outside_Out_Harbor
20030821	1125641.486	2074473.449	4	19.68	20.25	0.56	556.82	556.26	Outside_Out_Harbor
20030821	1125669.44	2074362.494	5	19.03	19.13	0.10	557.47	557.37	Outside_Out_Harbor

USEPA Probe Investigation Results[a]

DATE	X_COORD	Y_COORD	ID	WATER_DEPT	SED_BOT_DE	THICKNESS	SURF_ELEV	SEDBOTELEV	Harbor Segment
20030821	1125469.012	2074345.144	6	16.40	16.50	0.10	560.10	560.00	Outside_Out_Harbor
20030821	1125484.552	2074482.608	7	18.86	19.25	0.39	557.64	557.25	Outer Harbor
20030821	1125479.83	2074663.134	8	20.34	21.25	0.91	556.16	555.25	Outer Harbor
20030821	1125444.698	2074850.263	9	21.33	22.25	0.92	555.17	554.25	Outer Harbor
20030821	1125437.209	2074994.195	10	20.67	20.77	0.10	555.83	555.73	Outside_Out_Harbor
20030821	1125275.426	2074974.329	11	18.70	18.80	0.10	557.80	557.70	Outside_Out_Harbor
20030821	1125320.631	2074861.384	12	20.01	20.11	0.10	556.49	556.39	Outer Harbor
20030821	1125352.234	2074690.413	13	20.01	20.11	0.10	556.49	556.39	Outer Harbor
20030821	1125376.257	2074478.148	14	17.72	17.82	0.10	558.78	558.68	Outer Harbor
20030821	1125391.88	2074363.194	15	15.09	15.19	0.10	561.41	561.31	Outside_Out_Harbor
20030821	1125243.372	2074380.26	16	13.78	13.88	0.10	562.72	562.62	Outer Harbor
20030821	1125267.379	2074509.11	17	16.08	16.50	0.42	560.42	560.00	Outer Harbor
20030821	1125235.464	2074672.818	18	19.03	19.58	0.55	557.47	556.92	Outer Harbor
20030821	1125221.797	2074848.775	19	19.19	19.29	0.10	557.31	557.21	Outer Harbor
20030821	1125254.686	2075011.196	20	18.37	18.50	0.13	558.13	558.00	Outside_Out_Harbor
20030821	1125127.533	2074981.864	21	17.72	18.00	0.28	558.78	558.50	Outside_Out_Harbor
20030821	1125165.653	2074795.846	22	18.70	19.00	0.30	557.80	557.50	Outer Harbor
20030821	1125123.128	2074632.473	23	19.36	19.75	0.39	557.14	556.75	Outer Harbor
20030821	1125167.847	2074464.218	24	16.40	17.00	0.60	560.10	559.50	Outer Harbor
20030821	1125156.073	2074368.359	25	15.42	16.25	0.83	561.08	560.25	Outside_Out_Harbor
20030821	1125072.198	2074353.361	26	17.39	18.75	1.36	559.11	557.75	Outside_Out_Harbor
20030821	1125103.303	2074522.766	27	18.70	19.50	0.80	557.80	557.00	Outer Harbor
20030821	1125125.61	2074704.705	28	18.70	18.80	0.10	557.80	557.70	Outer Harbor
20030821	1125103.83	2074844.489	29	18.04	18.50	0.46	558.46	558.00	Outer Harbor
20030821	1125042.424	2074953.758	30	17.22	17.50	0.28	559.28	559.00	Outside_Out_Harbor
20030821	1125077.064	2074836.562	31	17.72	18.50	0.78	558.78	558.00	Outer Harbor
20030821	1125047.948	2074690.391	32	18.21	18.50	0.29	558.29	558.00	Outer Harbor
20030821	1125011.607	2074531.376	33	19.03	19.50	0.47	557.47	557.00	Outer Harbor
20030821	1124984.922	2074419.729	34	19.03	19.50	0.47	557.47	557.00	Outer Harbor
20030821	1124902.025	2074400.883	35	19.03	19.50	0.47	557.47	557.00	Outer Harbor
20030821	1124894.985	2074520.631	36	18.86	19.50	0.64	557.64	557.00	Outer Harbor
20030821	1124941.579	2074682.19	37	18.04	18.25	0.21	558.46	558.25	Outer Harbor
20030821	1124953.995	2074842.835	38	17.39	17.50	0.11	559.11	559.00	Outer Harbor
20030821	1124921.06	2074958.25	39	16.90	17.25	0.35	559.60	559.25	Outside_Out_Harbor
20030821	1124796.62	2074953.551	40	16.24	16.50	0.26	560.26	560.00	Outside_Out_Harbor
20030821	1124839.881	2074806.34	41	17.22	17.75	0.53	559.28	558.75	Outer Harbor
20030821	1124841.469	2074676.816	42	17.88	18.25	0.37	558.62	558.25	Outer Harbor

USEPA Probe Investigation Results[a]

DATE	X_COORD	Y_COORD	ID	WATER_DEPT	SED_BOT_DE	THICKNESS	SURF_ELEV	SEDBOTELEV	Harbor Segment
20030821	1124809.894	2074498.847	43	19.36	19.75	0.39	557.14	556.75	Outer Harbor
20030821	1124682.668	2074478.519	44	14.44	20.25	5.81	562.06	556.25	Outer Harbor
20030821	1124721.492	2074628.765	45	18.37	18.50	0.13	558.13	558.00	Outer Harbor
20030821	1124707.479	2074759.665	46	17.06	17.25	0.19	559.44	559.25	Outer Harbor
20030821	1124720.099	2074895.094	47	16.24	16.50	0.26	560.26	560.00	Outer Harbor
20030821	1124647.378	2074891.261	48	15.58	15.75	0.17	560.92	560.75	Outer Harbor
20030821	1124651.9	2074774.921	49	16.73	17.25	0.52	559.77	559.25	Outer Harbor
20030821	1124626.58	2074615.187	50	18.54	19.00	0.46	557.96	557.50	Outer Harbor
20030821	1124565.343	2074498.717	51	19.52	21.75	2.23	556.98	554.75	Outer Harbor
20030821	1124459.538	2074496.172	53	20.67	23.75	3.08	555.83	552.75	Outer Harbor
20030821	1124488.752	2074644.128	54	18.37	19.00	0.63	558.13	557.50	Outer Harbor
20030821	1124524.872	2074819.884	55	15.26	15.75	0.49	561.24	560.75	Outer Harbor

[a] Data provided electroincally by USEPA

Appendix B
Summary of Physical and Chemical Data

APPENDIX B

Summary of Physical and Chemical Data

This appendix provides summaries of the physical and chemical data from the various source documents (see Appendix A) for each of the harbor segments. The information has been summarized in the following tables:

Geotechnical results:

- Table B-1 Summary of Geotechnical Properties
- Table B-2 Comparison of Individual Core and Probe Data

Chemical results:

- Table B-3 PCB Results
- Table B-4 Compounds Detected in Outer Harbor Samples
- Table B-5 Compounds Detected in Entrance Channel Samples
- Table B-6 Compounds Detected in Marina Samples
- Table B-7 Compounds Detected in Inner Harbor Samples
- Table B-8 Compounds Detected in Inner Harbor Extension Samples
- Table B-9 Compounds Detected in North Harbor Samples

TABLE B-1
Summary of Geotechnical Properties

Harbor Segment	Boring Number	Upper Depth LWD (ft.)	Lower Depth LWD (ft.)	Thickness (ft.)	Sediment Class	Total O.C. (%)	Atterberg Limits Liquid Limit	Atterberg Limits Plastic Limit	Atterberg Limits Plastic Index	Moisture Content (%)	Source
Outer Harbor	WH-2000-02	-15.2	-25.2	10.0	Silty Sand (SM)					20.7	a
Outer Harbor	WH-2000-03	-18.0	-24.5	6.5	Silty Sand (SM)					19.9	a
Outer Harbor	WIH-1197-001S	-18.0	-27.0	9.0	Silty Sand (SM)	5.59	NA	NA	NA	34.7	c
Outer Harbor	WIH-0995-006	-18.4	-24.9	6.5	Sand	NA				24.2	d
Outer Harbor	CAG-0502-7.1	-22.0	---	---	Poorly Graded Silty Sand (SM-SP)	1.01				20.9	e
Outer Harbor	CAG-0502-7.2	-22.0	---	---	Poorly Graded Silty Sand (SM-SP)	2.15				23.7	e
Outer Harbor	CAG-0502-8.1	-24.0	---	---	Poorly Graded Silty Sand (SM-SP)	1.10				20.2	e
Outer Harbor	CAG-0502-8.2	-24.0	---	---	Poorly Graded Silty Sand (SM-SP)	1.01				21.7	e
Outer Harbor	WH-2000-02	-25.2	---	---	Clayey Silt (CL-ML)					10.5	a
Outer Harbor	WH-2000-03	-24.5	---	---	Clayey Silt (CL-ML)					15.9	a
Outer Harbor	WIH-1197-001S	-27.0	---	---	Clay (CL)						c
Entrance Channel	WH-2000-04	-19.5	-30.0	10.5	Silty Sand (SM)					24.0	a
Entrance Channel	WH-2000-05	-17.5	-27.0	9.5	Silty Sand (SM)					29.6	a
Entrance Channel	WH-2000-06	-13.1	-22.1	9.0	Silty Sand (SM)					28.5	a
Entrance Channel	WH-0496-03	---	---	---	Clay Loam (ML)	2.2				45.0	b
Entrance Channel	WH-0496-04	---	---	---	Sandy Clay Loam (SC-SM)	2.8				46.0	b
Entrance Channel	WIH-1197-002S	-20.5	-24.7	4.2	Silt (ML)	7.04	24.5	24.8	NA	56.9	c
Entrance Channel	WIH-0995-007	-19.4	-23.9	4.5	Sand	NA				31.9	d
Entrance Channel	WIH-0995-008	-20.4	-24.9	4.5	Sandy Silt	NA				26.3	d
Entrance Channel	CAG-0502-1.1	-21.0	---	---	Organic Silt (OL)	0.92				32.3	e
Entrance Channel	CAG-0502-1.2	-21.0	---	---	Organic Silt (OL)	1.85				34.3	e
Entrance Channel	CAG-0502-2.1	-17.0	---	---	Poorly Graded Silty Sand (SM-SP)	3.45				27.3	e
Entrance Channel	CAG-0502-2.2	-17.0	---	---	Poorly Graded Silty Sand (SM-SP)	1.66				23.7	e
Entrance Channel	CAG-0502-4.1	-18.0	---	---	Poorly Graded Sand (SP)	1.39				18	e
Entrance Channel	CAG-0502-4.2	-18.0	---	---	Poorly Graded Sand (SP)	7.11				23.3	e
Entrance Channel	CAG-0502-4.3	-18.0	---	---	Poorly Graded Sand (SP)	1.28				22.9	e
Entrance Channel	CAG-0502-3.1	-10.0	---	---	Poorly Graded Sand (SP)	0.04				22.2	e
Entrance Channel	CAG-0502-3.2	-10.0	---	---	Poorly Graded Sand (SP)	0.06				23.7	e
Entrance Channel	CAG-0502-3.3	-10.0	---	---	Poorly Graded Sand (SP)	0.04				23.4	e
Entrance Channel	CAG-0502-5.1	-18.0	---	---	Organic Silt (OL)	14.20				28.1	e
Entrance Channel	CAG-0502-5.3	-18.0	---	---	Organic Silt (OL)	18.70				27.6	e
Entrance Channel	WH-2000-04	-30.0	---	---	Clayey Silt (CL-ML)					10.3	a
Entrance Channel	WH-2000-05	-27.0	---	---	Clayey Silt (CL-ML)					11.6	a
Entrance Channel	WH-2000-06	-22.1	---	---	Clayey Silt (CL-ML)					9.5	a
Entrance Channel	WIH-1197-002S	-24.7	---	---	Clay (CL)						c

TABLE B-1
Summary of Geotechnical Properties

Harbor Segment	Boring Number	Upper Depth LWD (ft.)	Lower Depth LWD (ft.)	Thickness (ft.)	Sediment Class	Total O.C. (%)	Atterberg Limits Liquid Limit	Atterberg Limits Plastic Limit	Atterberg Limits Plastic Index	Moisture Content (%)	Source
Marina	WHSP-01	-5.6	-15.1	9.5	Sand (SP)					24.5	a
Marina	WH-0496-19	---	---	---	Silt Loam (ML)	4.0				56.0	b
Marina	WH-0496-06	---	---	---	Silty Clay Loam (ML)	3.5				57.0	b
Marina	WIH-1'97-003S	-15.5	-26.0	10.5	Silt (ML)	9.79	35.3	28.6	6.7	76.8	c
Marina	WHSP-01	-15.1	---	---	Silty Clay (CL to CL-ML)					16.0	a
Inner Harbor	WH-2000-07	-19.3	-23.3	4.0	Silt (ML,MH)					40.8	a
Inner Harbor	WH-2000-08	-26.1	-26.6	0.5	Silt (ML,MH)					50.4	a
Inner Harbor	WH-2000-09	-20.1	-26.1	6.0	Silt (ML,MH)					41.9	a
Inner Harbor	WH-0496-01	---	---	---	Clay Loam (CL)	3.9				51.0	b
Inner Harbor	WH-0496-02	---	---	---	Silty Clay Loam/Silty Clay (ML)	2.9				55.0	b
Inner Harbor	WH-0496-05	---	---	---	Clay Loam (CL)	3.0				52.0	b
Inner Harbor	WIH-0995-004	-21.4	-24.4	3.0	Silt	NA				NA	d
Inner Harbor	WH-0496-07	---	---	---	Clay (CL)	4.4				65.0	b
Inner Harbor	WH-0496-18	---	---	---	Silty Clay (ML-CL)	4.2				58.0	b
Inner Harbor	WIH-1'97-004S	-20.8	-24.8	4.0	Clayey-Silty Sand (SC-SM)	8.00	24.9	21.1	3.8	72.5	c
Inner Harbor	WIH-1'97-005S	-13.3	-15.8	2.5	Silt (MH)	7.63	49.8	32.2	17.6	121.0	c
Inner Harbor	WIH-0995-002	-14.9	-18.9	4.0	Silt	NA				56.4	d
Inner Harbor	WIH-0995-003	-22.4	-27.4	5.0	Silt	NA				49.2	d
Inner Harbor	WIH-0995-005	-13.9	-17.4	3.5	Silt	NA				31.2	d
Inner Harbor	WH-2000-07	-23.3	---	---	Clayey Silt (CL-ML)					12	a
Inner Harbor	WH-2000-08	-26.6	---	---	Clayey Silt (CL-ML)					16.4	a
Inner Harbor	WH-2000-09	-26.1	---	---	Clayey Silt (CL-ML)					13.3	a
Inner Harbor	WIH-1'97-003S	-26.0	---	---	Clay (CL)						c
Inner Harbor	WIH-1'97-004S	-24.8	---	---	Clay (CL)						c
Inner Harbor	WIH-1'97-005S	-15.8	---	---	Clay (CL)						c
Inner Harbor Extension	WH-2000-10	-22.2	-22.3	0.1	Clean Sand (SW)					27.5	a
Inner Harbor Extension	WH-2000-11	-22.1	-22.4	0.3	Clean Sand (SW)					15.9	a
Inner Harbor Extension	WH-2000-12	-22.2	-22.3	0.1	Clean Sand (SW)						a
Inner Harbor Extension	WIH-1'97-006S	-19.0	-21.3	2.3	Clay (CL)	7.58	28.5	13.9	14.6	65.3	c
Inner Harbor Extension	WIH-0995-001	-19.0	-19.4	0.4	Clay	NA				14.5	d
Inner Harbor Extension	WIH-0995-009	-18.9	-19.4	0.5	Clay	NA				15.8	d
Inner Harbor Extension	WH-2000-10	-22.3	---	---	Clayey Silt (CL-ML)					14	a
Inner Harbor Extension	WH-2000-11	-22.4	---	---	Clayey Silt (CL-ML)					11.5	a
Inner Harbor Extension	WH-2000-12	-22.3	---	---	Clayey Silt (CL-ML)					12.6	a
Inner Harbor Extension	WIH-1'97-006S	-21.3	---	---	Clay (CL)						c
North Harbor	WH-2000-13	-21.0	-23.0	2.0	Silt/Organic Silt (ML/OL)						a
North Harbor	WH-2000-13A	-23.0	-24.0	1.0	Clean Sand (SW)						a
North Harbor	WH-2000-15	-23.1	-23.4	0.3	Silty Sand (SM)					17.2	a
North Harbor	WH-0496-10	---	---	---	Loam (ML)	3.1				44.0	b
North Harbor	WH-0496-11	---	---	---	Sandy Clay Loam (SC)	3.9				48.0	b

TABLE B-1
Summary of Geotechnical Properties

Harbor Segment	Boring Number	Upper Depth LWD (ft.)	Lower Depth LWD (ft.)	Thickness (ft.)	Sediment Class	Total O.C. (%)	Atterberg Limits Liquid Limit	Atterberg Limits Plastic Limit	Atterberg Limits Plastic Index	Moisture Content (%)	Source
North Harbor	WH-0496-12	---	---	---	Clay (CL)	5.7				65.0	b
North Harbor	WH-0496-13	---	---	---	Clay Loam	4.1				51.0	b
North Harbor	WH-0496-14	---	---	---	Silty Clay (CL-ML)	4.9				63.0	b
North Harbor	WH-0496-15	---	---	---	Sandy Clay Loam (SC-SM)	3.3				44.0	b
North Harbor	*WH-0496-16*	---	---	---	*Clay Loam (CL)*	*3.8*				*55.0*	*b*
North Harbor	WH-0496-17	---	---	---	Clay (CL)	3.8				20.0	b
North Harbor	WIH-1197-007S	-14.8	-16.1	1.3	Silt (ML)	7.2	44.0	27.3	16.7	94.3	c
North Harbor	WH-2000-13	-23.0	---	---	Clay (CL)					9.9	a
North Harbor	WH-2000-13A	-24.0	---	---	Clayey Silt (CL-ML)						a
North Harbor	WH-2000-14	-22.1	---	---	Clayey Silt (CL-ML)					13.5	a
North Harbor	WH-2000-15	-23.4	---	---	Clayey Silt (CL-ML)					16.2	a
North Harbor	WIH-1197-007S	-16.1	---	---	Clay (CL)						c
Slip 1	WH-0496-08	---	---	---	Clay Loam (ML-CL)	7.8				47.0	b
Slip 1	WH-0496-09	---	---	---	Sandy Clay Loam/Clay Loam(SM-SC to CL)	4.2				42.5	b
Slip 1	WIH-1197-008S	-19.4	-21.7	2.3	Silt (ML)	6.32	28.2	22.5	5.7	62.1	c
Slip 1	WIH-1197-008S	24.7	---	---	Clay (CL)						

Data Sources:
a = Patrick Engineering Inc. Boring Results (March-2003)
b = EPA Evaluation of Toxicity (Oct. 1999)
c = Summary of Sampling Events - QS" Environmental (Nov 97)
d = USACE (Nov 95)
e = CAG (2002)

TABLE B-2
Comparison of Individual Core and Probe Data

	Core Data				Probe Data			
Harbor Segment	Boring Number	Depth to Top of Sediment (ft LWD)	Depth to Bottom of Sediment [a] (ft LWD)	Thickness (ft.)	Probe Number	Depth to Top of Sediment (ft LWD)	Depth to Bottom [b] (ft LWD)	Thickness (ft.)
Outer Harbor	WH-2000-02	15.2	25.2	10.0	16	13.78	13.88	0.10
					17	16.08	16.50	0.42
					24	16.40	17.00	0.60
Outer Harbor	WH-2000-03	18.0	24.5	6.5	41	17.22	17.75	0.53
					46	17.06	17.25	0.19
					47	16.24	16.50	0.26
Outer Harbor	WIH-1197-001S	18.0	27.0	9.0	42	17.88	18.25	0.37
					37	18.04	18.25	0.21
Outer Harbor	WIH-0995-006	18.4	24.9	6.5	42	17.88	18.25	0.37
Entrance Channel	WH-2000-04	19.5	30.0	10.5	56	20.01	21.75	1.74
					P96	17.50	18.40	0.90
					P97	20.10	22.00	1.90
Entrance Channel	WH-2000-05	17.5	27.0	9.5	P102	19.70	25.00	5.30
					P101	17.30	18.00	0.70
Entrance Channel	WH-2000-06	13.1	22.1	9.0	P106	19.20	22.00	2.80
					58	21.98	22.75	0.77
Entrance Channel	WIH-1197-002S	20.5	24.7	4.2	P102	19.70	25.00	5.30
					57	21.82	22.00	0.18
Entrance Channel	WIH-0995-007	19.4	23.9	4.5	56	20.01	21.75	1.74
					P97	20.10	22.00	1.90
Entrance Channel	WIH-0995-008	20.4	24.9	4.5	57	21.82	22.00	0.18
					P104	20.50	24.00	3.50
Marina	WHSP-01	5.6	15.1	9.5	P122	6.10	7.80	1.70
					P124	5.60	6.40	0.80
Marina	WIH-0995-003	22.4	27.4	5.0	p80	16.00	26.50	10.50
					P86	12.80	24.30	11.50
Inner Harbor	WH-2000-07	19.3	23.3	4.0	60	16.73	26.00	9.27
Inner Harbor	WH-2000-08	26.1	26.6	0.5	p69	13.70	16.30	2.60
					p70	21.10	21.80	0.70
Inner Harbor	WH-2000-09	20.1	26.1	6.0	p66	18.50	25.00	6.50
					p65	13.40	16.00	2.60

TABLE B-2
Comparison of Individual Core and Probe Data

	Core Data				Probe Data			
Harbor Segment	Boring Number	Depth to Top of Sediment (ft LWD)	Depth to Bottom of Sediment [a] (ft LWD)	Thickness (ft.)	Probe Number	Depth to Top of Sediment (ft LWD)	Depth to Bottom [b] (ft LWD)	Thickness (ft.)
Inner Harbor	WIH-0995-004	21.4	24.4	3.0	P110	21.70	24.00	2.30
					P112	21.90	23.50	1.60
Inner Harbor	WIH-1197-003S	15.5	26.0	10.5	60	16.73	26.00	9.27
Inner Harbor	WIH-1197-004S	20.8	24.8	4.0	P85	19.20	24.60	5.40
Inner Harbor	WIH-1197-005S	13.3	15.8	2.5	p74	12.60	25.80	13.20
Inner Harbor	WIH-0995-002	14.9	18.9	4.0	p62	21.60	22.30	0.70
					P84	22.30	25.80	3.50
					p72	9.50	11.50	2.00
					p71	16.30	27.50	11.20
Inner Harbor	WIH-0995-005	13.9	17.4	3.5	P85	19.20	24.60	5.40
Inner Harbor Extension	WH-2000-10	22.2	22.3	0.1	66	18.86	19.50	0.64
Inner Harbor Extension	WH-2000-11	22.1	22.4	0.3	65	21.98	22.75	0.77
					p59	20.90	21.00	0.10
Inner Harbor Extension	WH-2000-12	22.2	22.3	0.1	p81	20.40	20.60	0.20
					p57	16.00	18.80	2.80
Inner Harbor Extension	WIH-1197-006S	19.0	21.3	2.3	65	21.98	22.75	0.77
Inner Harbor Extension	WIH-0995-001	19.0	19.4	0.4	p81	20.40	20.60	0.20
					p59	20.90	21.00	0.10
Inner Harbor Extension	WIH-0995-009	18.9	19.4	0.5	67	21.65	21.75	0.10
North Harbor	WH-2000-13A	23.0	24.0	1.0	p49	17.40	17.60	0.20
					p50	22.50	22.60	0.10
North Harbor	WH-2000-15	23.1	23.4	0.3	p32	18.20	21.50	3.30
					p31	14.90	17.00	2.10
North Harbor	WIH-1197-007S	14.8	16.1	1.3	p37	18.90	22.80	3.90
North Harbor	WH-2000-14	22.1	22.1	0.0	70	17.39	20.00	2.61
					p41	15.50	16.10	0.60
					p43	17.60	20.80	3.20

[a]Depth to bottom of sediment defined as the top of the hard clay till as indicated by boring logs from cores.
[b]Depth to bottom defined by probe refusal

TABLE B-3
Summary of PCB Concentrations

Location	Sample No.	Coordinates X	Coordinates Y	Matrix	Sampled Depth Interval Top	Bottom	Units	Date Sampled	Sample Type	Total Detected PCB Concentrations		Detection Limits		Total PCB Concentrations[a]	
WIH-0995-001	WIH-0995-001	1122206	2075608.9	till	0	5	IN	1995	Core	ND	mg/kg	0.033	mg/kg	0.116	mg/kg
WIH-0995-002	WIH-0995-002.1	1122116	2075042.8	sediment	0	24	IN	1995	Core	7	mg/kg	0.033	mg/kg	7.083	mg/kg
WIH-0995-002	WIH-0995-002.2	1122116	2075042.8	sediment	24	48	IN	1995	Core	10.9	mg/kg	0.033	mg/kg	10.983	mg/kg
WIH-0995-003	WIH-0995-003.1	1122277	2074727.7	sediment	0	30	IN	1995	Core	8.9	mg/kg	0.033	mg/kg	8.983	mg/kg
WIH-0995-003	WIH-0995-003.2	1122277	2074727.1	sediment	30	60	IN	1995	Core	4.92	mg/kg	0.033	mg/kg	5.003	mg/kg
WIH-0995-004	WIH-0995-004	1122964	2074562	sediment	0	36	IN	1995	Core	1.17	mg/kg	0.033	mg/kg	1.253	mg/kg
WIH-0995-005	WIH-0995-005	1122549	2074901.4	sediment	0	42	IN	1995	Core	3.57	mg/kg	0.033	mg/kg	3.653	mg/kg
WIH-0995-006	WIH-0995-006.1	1124769	2074689.1	sediment	0	40	IN	1995	Core	0.247	mg/kg	0.033	mg/kg	0.33	mg/kg
WIH-0995-006	WIH-0995-006.2	1124769	2074689.1	sediment	40	79	IN	1995	Core	1.26	mg/kg	0.033	mg/kg	1.343	mg/kg
WIH-0995-007	WIH-0995-007	1124284	2074582.7	sediment	0	54	IN	1995	Core	1.63	mg/kg	0.033	mg/kg	1.713	mg/kg
WIH-0995-008	WIH-0995-008.1	1123712	2074580.8	sediment	0	28	IN	1995	Core	3.71	mg/kg	0.033	mg/kg	3.793	mg/kg
WIH-0995-008	WIH-0995-008.2	1123712	2074580.8	sediment	28	55	IN	1995	Core	0.14	mg/kg	0.033	mg/kg	0.239	mg/kg
WIH-0995-009	WIH-0995-009	1122318	2075674.2	till	0	6	IN	1995	Core	ND	mg/kg	0.033	mg/kg	0.116	mg/kg
WH-0496-01	WH-0496-01	1122560	2074654.8	sediment	0	22	IN	1996	Grab	5.100	mg/kg	0	mg/kg	5.1	mg/kg
WH-0496-03	WH-0496-03	1123642	2074551.4	sediment	0	2	IN	1996	Grab	6.300	mg/kg	0	mg/kg	6.3	mg/kg
WH-0496-04	WH-0496-04	1122970	2074639.7	sediment	0	2	IN	1996	Grab	0.870	mg/kg	0	mg/kg	0.87	mg/kg
WH-0496-05	WH-0496-05	1122396	2075244.8	sediment	0	2	IN	1996	Grab	3.600	mg/kg	0	mg/kg	3.6	mg/kg
WH-0496-06	WH-0496-06	1122091	2074858.9	sediment	0	2	IN	1996	Grab	5.200	mg/kg	0	mg/kg	5.2	mg/kg
WH-0496-07	WH-0496-07	1122289	2075313.7	sediment	0	2	IN	1996	Grab	4.700	mg/kg	0	mg/kg	4.7	mg/kg
WH-0496-09	WH-0496-09	1122035	2075740.4	sediment	0	2	IN	1996	Grab	5.000	mg/kg	0	mg/kg	5	mg/kg
WH-0496-10	WH-0496-10	1122451	2076191.6	sediment	0	2	IN	1996	Grab	3.000	mg/kg	0	mg/kg	3	mg/kg
WH-0496-11	WH-0496-11	1122535	2076270.6	sediment	0	2	IN	1996	Grab	4.300	mg/kg	0	mg/kg	4.3	mg/kg
WH-0496-12	WH-0496-12	1123069	2076878.9	sediment	0	2	IN	1996	Grab	8.900	mg/kg	0	mg/kg	8.9	mg/kg
WH-0496-13	WH-0496-13	1122484	2075888.6	sediment	0	2	IN	1996	Grab	7.400	mg/kg	0	mg/kg	7.4	mg/kg
WH-0496-14	WH-0496-14	1122676	2076710.4	sediment	0	2	IN	1996	Grab	7.700	mg/kg	0	mg/kg	7.7	mg/kg
WH-0496-15	WH-0496-15	1122430	2075760.7	sediment	0	2	IN	1996	Grab	4.900	mg/kg	0	mg/kg	4.9	mg/kg
WH-0496-16	WH-0496-16	1122717	2076809.9	sediment	0	2	IN	1996	Grab	7.300	mg/kg	0	mg/kg	7.3	mg/kg
WH-0496-17	WH-0496-17	1122518	2076016.2	sediment	0	2	IN	1996	Grab	7.300	mg/kg	0	mg/kg	7.3	mg/kg
WH-0496-18	WH-0496-18	1122143	2075120.9	sediment	0	2	IN	1996	Grab	4.400	mg/kg	0	mg/kg	4.4	mg/kg
WH-0496-19	WH-0496-19	1122089	2074555.3	sediment	0	2	IN	1996	Grab	5.200	mg/kg	0	mg/kg	5.2	mg/kg
WIH-1197-001S	WIH-1197-001S	1124899	2074687.2	sediment	0	108	IN	1997	Core	0.726	mg/kg	0	mg/kg	0.726	mg/kg
WIH-1197-002S	WIH-1197-002S	1123780	2074581.7	sediment	0	50	IN	1997	Core	0.835	mg/kg	0	mg/kg	0.835	mg/kg
WIH-1197-003S	WIH-1197-003S	1122659	2074573.9	sediment	0	126	IN	1997	Core	5.120	mg/kg	0	mg/kg	5.12	mg/kg
WIH-1197-004S	WIH-1197-004S	1122524	2074945.5	sediment	0	48	IN	1997	Core	4.110	mg/kg	0	mg/kg	4.11	mg/kg
WIH-1197-005S	WIH-1197-005S	1122149	2074864.7	sediment	0	30	IN	1997	Core	6.030	mg/kg	0	mg/kg	6.03	mg/kg

TABLE B-3
Summary of PCB Concentrations

Location	Sample No.	Coordinates X	Coordinates Y	Matrix	Sampled Depth Interval Top	Bottom	Units	Date Sampled	Sample Type	Total Detected PCB Concentrations		Detection Limits	Total PCB Concentrations[a]
WIH-1197-006S	WIH-1197-006S	1122301	2075528.7	sediment	0	28	IN	1997	Core	24.970	mg/kg	0 mg/kg	24.97 mg/kg
WIH-1197-007S	WIH-1197-007S	1122548	2076349.4	sediment	0	15	IN	1997	Core	9.340	mg/kg	0 mg/kg	9.34 mg/kg
CAG-0502-1	CAG-0502-1.1	1123058	2074556.6	Sediment	0	20	IN	2002	Core	0.0696	mg/kg	0.036 mg/kg	0.178 mg/kg
CAG-0502-1	CAG-0502-1.2	1123058	2074556.6	Sediment	20	41	IN	2002	Core	0.0934	mg/kg	0.038 mg/kg	0.208 mg/kg
CAG-0502-2	CAG-0502-2.1	1123418	2074631.6	Sediment	0	20	IN	2002	Core	0.101	mg/kg	0.033 mg/kg	0.201 mg/kg
CAG-0502-2	CAG-0502-2.2	1123418	2074631.6	Sediment	20	41	IN	2002	Core	0.0521	mg/kg	0.032 mg/kg	0.618 mg/kg
CAG-0502-3	CAG-0502-3.1	1123729	2074667.3	Sediment	0	16	IN	2002	Core	ND	mg/kg	0.031 mg/kg	0.108 mg/kg
CAG-0502-3	CAG-0502-3.2	1123729	2074667.3	Sediment	16	30	IN	2002	Core	ND	mg/kg	0.031 mg/kg	0.11 mg/kg
CAG-0502-3	CAG-0502-3.3	1123729	2074667.3	Sediment	30	46	IN	2002	Core	ND	mg/kg	0.031 mg/kg	0.11 mg/kg
CAG-0502-4	CAG-0502-4.1	1123730	2074624.4	Sediment	0	16	IN	2002	Core	0.0594	mg/kg	0.031 mg/kg	0.153 mg/kg
CAG-0502-4	CAG-0502-4.2	1123730	2074624.4	Sediment	16	30	IN	2002	Core	0.125	mg/kg	0.033 mg/kg	0.225 mg/kg
CAG-0502-4	CAG-0502-4.3	1123730	2074624.4	Sediment	30	46	IN	2002	Core	0.119	mg/kg	0.031 mg/kg	0.212 mg/kg
CAG-0502-5	CAG-0502-5.1	1123735	2074555.3	Sediment	0	20	IN	2002	Core	0.405	mg/kg	0.035 mg/kg	0.511 mg/kg
CAG-0502-5	CAG-0502-5.2	1123735	2074555.3	Sediment	20	41	IN	2002	Core	0.0436	mg/kg	0.036 mg/kg	0.151 mg/kg
CAG-0502-7	CAG-0502-7.1	1124643	2074579.1	Sediment	0	20	IN	2002	Core	0.101	mg/kg	0.031 mg/kg	0.194 mg/kg
CAG-0502-7	CAG-0502-7.2	1124643	2074579.1	Sediment	20	41	IN	2002	Core	0.0769	mg/kg	0.032 mg/kg	0.172 mg/kg
CAG-0502-8	CAG-0502-8.1	1125177	2074576.8	Sediment	0	20	IN	2002	Core	0.058	mg/kg	0.031 mg/kg	0.15 mg/kg
CAG-0502-8	CAG-0502-8.2	1125177	2074576.8	Sediment	20	41	IN	2002	Core	0.0869	mg/kg	0.031 mg/kg	0.181 mg/kg
WH-2002-02	WH-2002-2.1	1125265	2074445	Soil	0	19	IN	1/16/2003	Boring	ND	mg/kg	0.022 mg/kg	0.115 mg/kg
WH-2002-02	WH-2002-2.2	1125265	2074445	Soil	19	38	IN	1/16/2003	Boring	0.0481	mg/kg	0.025 mg/kg	0.184 mg/kg
WH-2002-02	WH-2002-2.3	1125265	2074445	Till	112	124	IN	1/16/2003	Boring	ND	mg/kg	0.018 mg/kg	0.108 mg/kg
WH-2002-03	WH-2002-3.1	1124782	2074817	Soil	0	12	IN	1/16/2003	Boring	0.152	mg/kg	0.019 mg/kg	0.254 mg/kg
WH-2002-03	WH-2002-3.2	1124782	2074817	Soil	12	24	IN	1/16/2003	Boring	0.165	mg/kg	0.019 mg/kg	0.266 mg/kg
WH-2002-03	WH-2002-3.3	1124782	2074817	Till	66	79	IN	1/16/2003	Boring	ND	mg/kg	0.017 mg/kg	0.098 mg/kg
WH-2002-04	WH-2002-4.1	1124288	2074641	Soil	0	20	IN	1/16/2003	Boring	0.385	mg/kg	0.022 mg/kg	0.505 mg/kg
WH-2002-04	WH-2002-4.2	1124288	2074641	Soil	20	40	IN	1/16/2003	Boring	0.0538	mg/kg	0.018 mg/kg	0.148 mg/kg
WH-2002-04	WH-2002-4.3	1124288	2074641	Till	125	138	IN	1/16/2003	Boring	ND	mg/kg	0.019 mg/kg	0.105 mg/kg
WH-2002-05	WH-2002-5.1	1123830	2074537	Soil	0	18	IN	1/16/2003	Boring	0.878	mg/kg	0.022 mg/kg	1.001 mg/kg
WH-2002-05	WH-2002-5.2	1123830	2074537	Soil	18	36	IN	1/16/2003	Boring	9.34	mg/kg	0.252 mg/kg	10.383 mg/kg
WH-2002-05	WH-2002-5.3	1123830	2074537	Till	126	144	IN	1/16/2003	Boring	ND	mg/kg	0.016 mg/kg	0.089 mg/kg
WH-2002-06	WH-2002-6.1	1123432	2074545	Soil	0	18	IN	1/16/2003	Boring	1.69	mg/kg	0.027 mg/kg	1.836 mg/kg
WH-2002-06	WH-2002-6.2	1123432	2074545	Soil	18	34	IN	1/16/2003	Boring	2.70	mg/kg	0.04 mg/kg	2.907 mg/kg
WH-2002-06	WH-2002-6.3	1123432	2074545	Till	116	132	IN	1/16/2003	Boring	ND	mg/kg	0.017 mg/kg	0.249 mg/kg
WH-2002-07	WH-2002-7.1	1122659	2074601	Soil	0	22	IN	1/16/2003	Boring	13.9	mg/kg	0.27 mg/kg	15.045 mg/kg
WH-2002-07	WH-2002-7.2	1122659	2074601	Soil	28	40	IN	1/16/2003	Boring	5.45	mg/kg	0.12 mg/kg	6.01 mg/kg
WH-2002-07	WH-2002-7.3	1122659	2074601	Till	40	49	IN	1/16/2003	Boring	0.0277	mg/kg	0.021 mg/kg	0.236 mg/kg
WH-2002-08	WH-2002-8.1	1122370	2075136	Soil	0	10	IN	1/15/2003	Boring	7.25	mg/kg	0.167 mg/kg	7.956 mg/kg
WH-2002-08	WH-2002-8.3	1122370	2075136	Till	13	25	IN	1/15/2003	Boring	0.0528	mg/kg	0.024 mg/kg	0.184 mg/kg

TABLE B-3

Summary of PCB Concentrations

Location	Sample No.	Coordinates X	Coordinates Y	Matrix	Sampled Depth Interval Top	Sampled Depth Interval Bottom	Sampled Depth Interval Units	Date Sampled	Sample Type	Total Detected PCB Concentrations		Detection Limits		Total PCB Concentrations[a]	
WH-2002-09	WH-2002-9.1	1122084	2075246	Soil	0	42	IN	1/15/2003	Boring	29.8	mg/kg	0.614	mg/kg	32.298	mg/kg
WH-2002-09	WH-2002-9.2	1122084	2075246	Soil	48	58	IN	1/15/2003	Boring	23.1	mg/kg	0.548	mg/kg	25.333	mg/kg
WH-2002-09	WH-2002-9.3	1122084	2075246	Till	58	64	IN	1/15/2003	Boring	0.197	mg/kg	0.023	mg/kg	0.311	mg/kg
WH-2002-10	WH-2002-10.1	1122113	2075499	Soil	0	4	IN	1/15/2003	Boring	1.53	mg/kg	0.023	mg/kg	1.727	mg/kg
WH-2002-10	WH-2002-10.3	1122113	2075499	Till	6	18	IN	1/15/2003	Boring	0.0923	mg/kg	0.614	mg/kg	0.207	mg/kg
WH-2002-11	WH-2002-11.1	1122338	2075510	Soil	0	2	IN	1/15/2003	Boring	0.0384	mg/kg	0.072	mg/kg	0.151	mg/kg
WH-2002-11	WH-2002-11.3	1122338	2075510	Till	2	16	IN	1/15/2003	Boring	0.946	mg/kg	0.023	mg/kg	1.045	mg/kg
WH-2002-12	WH-2002-12.3	1122217	2075682	Till	0	12	IN	1/15/2003	Boring	0.0520	mg/kg	0.045	mg/kg	0.165	mg/kg
WH-2002-13A	WH-2002-13.3	1122403	2075936	Sediment	4	6	IN	1/15/2003	Boring	0.169	mg/kg	0.019	mg/kg	0.285	mg/kg
WH-2002-14	WH-2002-14.1	1122491	2076271	Soil	0	1	IN	1/15/2003	Boring	6.56	mg/kg	0.022	mg/kg	7.062	mg/kg
WH-2002-14	WH-2002-14.3	1122491	2076271	Till	6	12	IN	1/15/2003	Boring	0.0673	mg/kg	0.022	mg/kg	0.19	mg/kg
WH-2002-15	WH-2002-15.1	1122609	2076585	Soil	0	4	IN	1/15/2003	Boring	2.16	mg/kg	0.024	mg/kg	2.488	mg/kg
WH-2002-15	WH-2002-15.3	1122609	2076585	Till	6	10	IN	1/15/2003	Boring	ND	mg/kg	0.123	mg/kg	0.14	mg/kg
WHSP-01	WH-2002-16.1	1122218	2074305	Soil	0	6	IN	1/16/2003	Boring	0.761	mg/kg	0.021	mg/kg	0.877	mg/kg
WHSP-01	WH-2002-16.2	1122218	2074305	Soil	6	22	IN	1/16/2003	Boring	0.0488	mg/kg	0.017	mg/kg	0.145	mg/kg
WHSP-01	WH-2002-16.3	1122218	2074305	Till	22	30	IN	1/16/2003	Boring	ND	mg/kg	0.02	mg/kg	0.947	mg/kg
SD-1b	S-042303-WP-C01	1122991	2076745.4	sediment	0	13	IN	04/23/2003	Boring	0.76	mg/kg	0.094	mg/kg	1.042	mg/kg
SD-2b	S-042303-WP-C03	1122987	2076756.1	sediment	0	22	IN	04/23/2003	Boring	0.64	mg/kg	0.042	mg/kg	0.766	mg/kg
SD-3b	S-042303-WP-C05	1122995	2076776.2	sediment	0	24	IN	04/23/2003	Boring	0.22	mg/kg	0.041	mg/kg	0.343	mg/kg

[a]Total PCB concentrations provided by USEPA except where noted. The total PCB concentrations were calculated using half the detection limits for nondetected concentrations

[b]Results from CRA 2003

TABLE B-4
Compounds Detected in the Outer Harbor Samples

Compounds Detected	Units	Number of Locations Sampled	Number of Samples Collected	Number of Detections	Minimum Detected Concentration	Maximum Detected Concentration
Inorganic Analyses						
Aluminum	mg/kg	1	1	1		1920
Arsenic	mg/kg	5	11	7	1.7	7.4
Barium	mg/kg	5	11	7	4.6	34
Calcuim	mg/kg	1	1	1		84400
Chromium	mg/kg	5	11	10	1.9	16.4
Cobalt	mg/kg	1	1	1		2.78
Copper	mg/kg	5	11	5	4.63	17.8
Iron	mg/kg	3	7	7	3500	19000
Lead	mg/kg	5	11	11	3.4	19
Magnesium	mg/kg	1	1	1		43700
Manganese	mg/kg	1	1	1		407
Mercury	mg/kg	3	7	2	0.04	0.047
Nickel	mg/kg	5	11	11	3	21
Potassium	mg/kg	1	1	1		239
Sodium	mg/kg	1	1	1		165
Vanadium	mg/kg	1	1	1		7.85
Zinc	mg/kg	5	11	10	28	95
Nutrients						
Ammonia - N	mg/kg	5	11	9	8.92	160
Chemical Oxygen Demand (COD)	mg/kg	1	1	1		1870
Kjeldahl Nitrogen, Total (TKN)	mg/kg	3	5	5	149	300
Phosphorus, Total	mg/kg	3	5	3	1.05	165
Other						
Dry Density	pcf	1	1	1		80.1
Flash Point		1	2	2	>140	>140
Moisture Content	%	1	1	1		34.7
pH		2	3	3	8.13	8.4
Specific Gravity	g/mL	2	3	3	1.68	2.4
Total Organic Carbon (TOC)	mg/kg	1	1	1		55.9
Total Recoverable Petroleum Hydrocarbons (TRPH)	mg/kg	1	1	1		143
Total Solids	%	5	12	12	71.8	99.5
Total Volatile Solids	%	2	6	4	1.06	1.74
Volatile Organic Compounds						
Methylene Chloride	ug/kg	1	1	1		8.6
Semivolatile Organic Compounds						
Phenol	ug/kg	5	11	2	0.7	2.14
Naphthalene	ug/kg	3	5	1		120
Phenanthrene	ug/kg	3	5	1		410
Fluoranthene	ug/kg	3	5	1		520
Pyrene	ug/kg	3	5	2	132	550
Benzo(a)anthracene	ug/kg	3	5	1		260
Chrysene	ug/kg	3	5	1		330
bis(2-ethylhexyl)phthalate	ug/kg	1	1	1		300
Benzo(b)fluoranthene	ug/kg	3	5	1		260
Benzo(k)fluoranthene	ug/kg	1	1	1		210
Benzo(a)pyrene	ug/kg	5	11	6	19	220
Organochlorine Pesticides						
DDD	ug/kg	1	1	1		7.97
DDE	ug/kg	1	1	1		4.05
TCLP Metals						
Arsenic	mg/L	1	2	1		0.12
Barium	mg/L	1	2	2	0.15	0.28
Cadmium	mg/L	1	2	1		0.018
Chromium	mg/L	1	2	2	0.008	0.009
Copper	mg/L	1	2	2	0.014	0.027
Lead	mg/L	1	2	2	0.055	0.074
Nickel	mg/L	1	2	2	0.027	0.097
Zinc	mg/L	1	2	2	0.35	2.1

Sample locations include:

WIH-0995 6 1, WIH-0995-6.2	(USACE, November 1995)
WIH-1197-001S	*(QST Environmental Inc., 1998)*
CAG-0502-07-01, CAG-0502-07-02, CAG-0502-08-01, CAG-0502-08-02	Data provided electronically by USEPA
WH-2003-02.1, WH2003-02 2, WH2003-02.3 WH2003-03.1, WH2003-03 2, WH2003-03 3	Data provided electronically by USEPA

TABLE B-5
Compounds Detected in the Entrance Channel Samples

	Units	Number of Locations Sampled	Number of Samples Collected	Number of Detections	Minimum Detected Concentration	Maximum Detected Concentration
Inorganic Analyses						
Aluminum	mg/kg	1	1	1		2300
Arsenic	mg/kg	10	23	14	1.5	24.7
Barium	mg/kg	10	23	12	7	42
Cadmium	mg/kg	10	23	6	0.991	6.2
Calcuim	mg/kg	1	1	1		74300
Chromium	mg/kg	10	23	22	1.8	76
Cobalt	mg/kg	1	1	1		3.28
Copper	mg/kg	10	23	18	3.15	138
Iron	mg/kg	5	11	11	5400	22000
Lead	mg/kg	10	23	23	2.24	129
Magnesium	mg/kg	1	1	1		38600
Manganese	mg/kg	2	2	2	348	505
Mercury	mg/kg	5	11	7	0.04	0.27
Nickel	mg/kg	10	23	17	5.4	25
Potassium	mg/kg	2	2	2	319	1300
Sodium	mg/kg	1	1	1		422
Vanadium	mg/kg	1	1	1		8.68
Zinc	mg/kg	10	23	17	46	233
Nutrients						
Ammonia - N	mg/kg	9	22	21	6.98	253
Chemical Oxygen Demand (COD)	mg/kg	1	1	1		8980
Kjeldahl Nitrogen, Total (TKN)	mg/kg	7	14	14	15.9	996
Phosphorus. Total	mg/kg	7	14	9	0.505	571
Other						
Acid Volatile Sulfides (AVS)	umoles/g	1	1	1		4.41
Dry Density	pcf	1	1	1		61.4
Flash Point		2	3	3	>140	>140
Moisture Content	%	1	1	1		56.9
pH		3	4	4	7.8	8.5
Specific Gravity	g/mL	3	4	4	1.45	2.5
Total Organic Carbor (TOC)	mg/kg	1	1	13		70.4
Total Recoverable Petroleum Hydrocarbons (TRPH)	mg/kg	1	1	1		331
Total Solids	%	10	24	24	65.7	90.5
Volatile Solids, total	%	4	10	9	2.21	5.24
Volatile Organic Compounds						
Benzene	ug/kg	6	13	2	31	38
Methylene Chloride	ug/kg	1	1	1		7.8
Semivolatile Organic Compounds						
Phenol	ug/kg	10	23	19	200	2920
Naphthalene	ug/kg	7	14	2	155	250
2-Methylnaphthalene	ug/kg	2	2	1		180
Acenaphthene	ug/kg	7	14	1		93
Acenaphthylene	ug/kg	7	14	1		120
Fluorene	ug/kg	7	14	1		180
Phenanthrene	ug/kg	7	14	2	222	1100
Anthracene	ug/kg	7	14	1		390
Fluoranthene	ug/kg	7	14	2	202	1200
Pyrene	ug/kg	7	14	1		1500
Benzo(a)anthracene	ug/kg	7	14	1		810
Chrysene	ug/kg	7	14	1		1000
bis(2-ethylhexyl)phthalate	ug/kg	2	2	1		280
Benzo(b)fluoranthene	ug/kg	7	14	1		650
Benzo(k)fluoranthene	ug/kg	7	14	1		570
Benzo(a)pyrene	ug/kg	11	23	13	25	600
Indeno(1,2,3-cd)pyrene	ug/kg	7	14	1		210

TABLE B-5
Compounds Detected in the Entrance Channel Samples

	Units	Number of Locations Sampled	Number of Samples Collected	Number of Detections	Minimum Detected Concentration	Maximum Detected Concentration
Dibenz(a,h)anthracene	ug/kg	7	14	3	11	97
Organochlorine Pesticides						
TCLP Metals						
Arsenic	mg/L	2	3	2	0.093	0.17
Barium	mg/L	2	3	3	0.27	0.33
Cadmium	mg/L	2	3	3	0.012	0.065
Chromium	mg/L	2	3	2	0.005	0.006
Copper	mg/L	2	3	3	0.031	0.051
Lead	mg/L	2	3	3	0.055	0.14
Nickel	mg/L	2	3	3	0.078	0.33
Zinc	mg/L	2	3	3	0.48	2.8

Sample locations	
WIH-0995-007, WIH-0995-008.1, WIH-0995-008.2	(USACE, November 1995)
WIH-1197-002S	(QST Environmental Inc., 1998)
WH-0469-03	(USEPA, October 1999)
CAG-0502-1-1, CAG-0502-1-2, CAG-0502-2-1, CAG-0502-2-2, CAG-0502-4-1, CAG-0502-4-2, CAG-052-4-3, CAG-0502-5-1, CAG-0502-5-2, CAG-0502-3-1, CAG-0502-3-2, CAG-0502-3-3	Data provided electronically by USEPA
WH-2003-04.1, WH2003-04.2, WH2003-04.3 WH2003-05.1, WH2003-05.2, WH2003-05.3 WH2003-06.1, WH2003-06.2, WH2003-06.3	Data provided electronically by USEPA

TABLE B-6
Compounds Detected in the Marina Samples

	Units	Number of Locations Sampled	Number of Samples Collected	Number of Detections	Minimum Detected Concentration	Maximum Detected Concentration
Inorganic Analyses						
Arsenic	mg/kg	3	5	5	3.7	27
Barium	mg/kg	3	5	5	8.6	43
Cadmium	mg/kg	3	5	2	12	13
Chromium	mg/kg	3	5	5	2.7	82
Copper	mg/kg	3	5	5	3.6	98
Iron	mg/kg	3	5	5	5200	19000
Lead	mg/kg	3	5	5	4.1	130
Manganese	mg/kg	2	2	2	497	540
Mercury	mg/kg	3	5	3	0.09	0.39
Nickel	mg/kg	3	5	5	5	23
Potassium	mg/kg	2	2	2	1100	1200
Zinc	mg/kg	3	5	5	22	220
Nutrients						
Phosphorus, Total	mg/kg	2	2	2	618	837
Other						
Acid Volatile Sulfides	umoles/g	2	2	2	9.85	16.2
Flash Point		1	2	2	>140	>140
pH		1	2	2	7.5	7.6
Specific Gravity	g/mL	1	2	2	1.29	2.54
Total Solids	%	2	5	5	48	87.1
Volatile Solids, total	%	3	5	4	1.55	7.4
Semivolatile Organic Compounds						
Phenol		3	5	2	0.4	1.2
Benzo(a)pyrene	ug/kg	3	5	2	55.2	281
Organochlorine Pesticides						
Hexachlorobenzene	ug/kg	2	2	1		14
TCLP Metals						
Barium	mg/L	1	2	2	0.39	0.45
Cadmium	mg/L	1	2	2	0.47	0.53
Chromium	mg/L	1	2	2	0.024	0.025
Copper	mg/L	1	2	2	0.073	0.11
Lead	mg/L	1	2	2	0.31	0.55
Nickel	mg/L	1	2	2	0.1	0.12
Zinc	mg/L	1	2	2	1.6	1.8

Sample locations include:

WIH-0995-003.1, WIH-0995-003.2	(USACE, November 1995)
WH-0496-03, WH-0496-19	(USEPA, October 1999)
WH-2003-16.1, WH2003-16.2, WH2003-16.3	Data provided electronically by USEPA

TABLE B-7
Compounds Detected in the Inner Harbor Samples

	Units	Number of Locations Sampled	Number of Samples Collected	Number of Detections	Minimum Detected Concentration	Maximum Detected Concentration
Inorganic Analyses						
Aluminum	mg/kg	3	5	5	2280	11500
Arsenic	mg/kg	12	19	19	3.72	63
Barium	mg/kg	12	19	19	13.9	71
Cadmium	mg/kg	12	19	16	6.71	39
Calcuim	mg/kg	3	5	5	63800	105000
Chromium	mg/kg	12	19	19	3.5	160
Cobalt	mg/kg	3	5	5	4.01	9.09
Copper	mg/kg	12	19	19	14	140
Iron	mg/kg	12	19	19	9490	28000
Lead	mg/kg	12	19	19	6.24	230
Magnesium	mg/kg	3	5	5	32100	56400
Manganese	mg/kg	9	11	11	376	615
Mercury	mg/kg	12	19	19	0.01	0.89
Nickel	mg/kg	12	19	19	9.22	32
Potassium	mg/kg	9	11	11	394	1800
Sodium	mg/kg	3	5	5	406	664
Vanadium	mg/kg	3	5	5	8.48	17.1
Zinc	mg/kg	12	19	19	28.5	460
Nutrients						
Ammonia - N	mg/kg	6	13	10	17.3	368
Chemical Oxygen Demand (COD)	mg/kg	3	5	5	2720	24500
Kjeldahl Nitrogen, Total (TKN)	mg/kg	9	11	11	247	5000
Phosphorus, Total	mg/kg	9	11	11	244	914
Other						
Acid Volatile Sulfides	umoles/g	6	6	6	4.25	10.2
Dry Density	pcf	3	3	3	45.2	54.1
Flash Point		3	4	4	>140	>140
Moisture Content	%	3	5	5	6.3	121
pH		6	9	9	7.6	8.47
Specific Gravity	g/mL	6	7	7	1.28	2.5
Total Organic Carbor (TOC)	mg/kg	3	5	5	42.9	97.9
Total Recoverable Petroleum Hydrocarbons (TRPH)	mg/kg	3	5	4	83.2	2610
Total Solids	%	6	12	12	41.8	88.0
Volatile Solids, total	%	9	14	14	1.23	11.8
Volatile Organic Compounds						
Methylene Chloride	ug/kg	3	5	2	6.4	10
Semivolatile Organic Compounds						
Phenol	ug/kg	11	18	5	0.4	2.7
Naphthalene	ug/kg	8	10	3	440	950
2-Methylnaphthalene	ug/kg	8	10	3	550	1400
Phenanthrene	ug/kg	8	10	3	530	830
Fluoranthene	ug/kg	8	10	4	840	1100
Pyrene	ug/kg	8	10	3	1000	1300
Benzo(a)anthracene	ug/kg	8	10	2	490	560
Chrysene	ug/kg	8	10	1		740
bis(2-ethylhexyl)phthalate	ug/kg	8	10	5	110	1500
Benzo(b)fluoranthene	ug/kg	8	10	2	450	560
Benzo(k)fluoranthene	ug/kg	8	10	2	430	450
Benzo(a)pyrene	ug/kg	11	18	6	50.8	385
Organochlorine Pesticides						
Chlordane, Trans Isomer	ug/kg	8	10	1		17

TABLE B-7
Compounds Detected in the Inner Harbor Samples

	Units	Number of Locations Sampled	Number of Samples Collected	Number of Detections	Minimum Detected Concentration	Maximum Detected Concentration
TCLP Metals						
Barium	mg/L	3	4	4	0.24	0.45
Cadmium	mg/L	3	4	4	0.018	0.42
Chromium	mg/L	3	4	3	0.005	0.038
Copper	mg/L	3	4	4	0.022	0.049
Lead	mg/L	3	4	4	0.012	0.43
Nickel	mg/L	3	4	4	0.044	0.078
Zinc	mg/L	3	4	4	0.36	0.83

Sample locations	
WIH-0995-002.1, WIH-0995-002.2, WIH-0995-004, WIH-0095-005	(USACE, November 1995)
WIH-1197-003S, WIH-1997-004S, WIH-1997-004C, WIH-1197-005S, WIH-1197-005C	(QST Environmental Inc., 1998)
WH-0469-04, WH-0496-01, WH-0469-18, WH-0469-05, WH-0469-07	(USEPA, October 1999)
WH-2003-07.1, WH2003-07.2, WH2003-07.3 WH2003-08.1, WH2003-08.3 WH2003-09.1, WH2003-09.2, WH2003-09.3	Data provided electronically by USEPA

TABLE B-8
Compounds Detected in the Inner Harbor Extension Samples

	Units	Number of Locations Sampled	Number of Samples Collected	Number of Detections	Minimum Detected Concentration	Maximum Detected Concentration
Inorganic Analyses						
Aluminum	mg/kg	1	1	1		11500
Arsenic	mg/kg	5	7	7	4.7	28.1
Barium	mg/kg	5	7	7	13	57
Cadmium	mg/kg	5	7	3	3.9	13.5
Calcuim	mg/kg	1	1	1		63400
Chromium	mg/kg	5	7	7	9.5	86.4
Cobalt	mg/kg	1	1	1		5.81
Copper	mg/kg	5	7	7	16	125
Cyanide, total	mg/kg	1	1	1		1.41
Iron	mg/kg	5	7	7	12000	21000
Lead	mg/kg	5	7	7	10	151
Magnesium	mg/kg	1	1	1		34400
Manganese	mg/kg	2	2	2	309	352
Mercury	mg/kg	2	2	2	0.12	0.873
Nickel	mg/kg	5	7	7	10	24
Potassium	mg/kg	2	2	2	803	1000
Sodium	mg/kg	1	1	1		759
Vanadium	mg/kg	1	1	1		15.2
Zinc	mg/kg	5	7	7	59	195
Nutrients						
Ammonia - N	mg/kg	4	6	2	14.2	197
Chemical Oxygen Demand (COD)	mg/kg	1	1	1		21100
Kjeldahl Nitrogen, Total (TKN)	mg/kg	2	2	2	966	980
Phosphorus, Total	mg/kg	2	2	2	515	684
Other						
Acid Volatile Sulfides	umoles/g	1	1	1		7.09
Dry Density	pcf	1	1	1		58.4
Flash Point		2	2	2	>140	>140
Moisture Content	%	1	1	1		65.3
pH		3	3	3	7.89	8.9
Specific Gravity	g/mL	3	3	3	1.37	2.5
Total Organic Carbor (TOC)	mg/kg	1	1	1		75.8
Total Recoverable Petroleum Hydrocarbons (TRPH)	mg/kg	1	1	1		3200
Total Solids	%	5	7	7	72.5	88.5
Volatile Solids, total	mg/kg	4	6	6	1.76	5.4
Volatile Organic Compounds						
Semivolatile Organic Compounds						
Phenol	ug/kg	4	5	1		495
Naphthalene	ug/kg	2	2	1		1000
2-Methylnaphthalene	ug/kg	2	2	1		1700
Phenanthrene	ug/kg	2	2	1		1600
Fluoranthene	ug/kg	2	2	1		2000
Pyrene	ug/kg	2	2	1		2000
Chrysene	ug/kg	2	2	1		970
bis(2-ethylhexyl)phthalate	ug/kg	2	2	1		940
Benzo(a)pyrene	ug/kg	5	7	1		44.3
Organochlorine Pesticides						
TCLP Metals						
Arsenic	mg/L	2	2	1		0.086
Barium	mg/L	2	2	2	0.33	0.48
Chromium	mg/L	2	2	1		0.005

TABLE B-8
Compounds Detected in the Inner Harbor Extension Samples

	Units	Number of Locations Sampled	Number of Samples Collected	Number of Detections	Minimum Detected Concentration	Maximum Detected Concentration
Copper	mg/L	2	2	1		0.009
Nickel	mg/L	2	2	1		0.032
Zinc	mg/L	2	2	2	0.064	0.084

Sample locations

WIH-0995-001, WIH-0995-009 (USACE, November 1995)

WIH-1197-006 (QST Environmental Inc., 1998)

WH-2003-10.1, WH2003-10.3
WH2003-11.1, WH2003-11.3
WH2003-12.3 Data provided electronically by USEPA

TABLE B-9
Compounds Detected in the North Harbor Samples

	Units	Number of Locations Sampled	Number of Samples Collected	Number of Detections	Minimum Detected Concentration	Maximum Detected Concentration
Inorganic Analyses						
Aluminum	mg/kg	1	2	2	5900	9480
Arsenic	mg/kg	15	18	18	1.3	120
Barium	mg/kg	15	15	15	13	53
Cadmium	mg/kg	12	15	12	0.664	27.4
Calcuim	mg/kg	1	2	2	54100	68100
Chromium	mg/kg	12	15	15	4.6	125
Cobalt	mg/kg	1	15	2	8.19	5.68
Copper	mg/kg	12	15	15	13	228
Iron	mg/kg	12	15	15	7600	23000
Lead	mg/kg	12	15	15	6.57	216
Magnesium	mg/kg	1	2	2	32200	37100
Manganese	mg/kg	9	10	10	261	492
Mercury	mg/kg	9	10	10	0.035	0.741
Nickel	mg/kg	12	15	15	7.6	100
Potassium	mg/kg	9	10	10	1000	1600
Selenium	mg/kg	1	2	1		0.535
Sodium	mg/kg	1	2	2	437	725
Vanadium	mg/kg	1	2	2	13.7	17.3
Zinc	mg/kg	12	15	15	38.9	290
Nutrients						
Ammonia - N	mg/kg	1	2	2	67.9	230
Chemical Oxygen Demand (COD)	mg/kg	1	2	2	1520	27200
Kjeldahl Nitrogen, Total (TKN)	mg/kg	9	10	10	224	3333
Phosphorus, Total	mg/kg	9	10	10	209	1320
Other						
Acid Volatile Sulfides	umoles/g	8	8	8	8.26	39.4
Moisture Content	%	1	2	2	13.6	94.3
pH		1	2	2	7.45	8.16
Specific Gravity	g/mL	1	1	1		2.4
Total Organic Carbon (TOC)	mg/kg	1	2	2	72.2	85
Total Recoverable Petroleum Hydrocarbons (TRPH)	mg/kg	1	2	2	83.2	3470
Total Solids	%	3	5	5	81.6	91.5
Volatile Solids, total	%	11	13	13	1.65	13.2
Volatile Organic Compounds						
Acetone	ug/kg	1	2	1		39
Methylene Chloride	ug/kg	1	2	1		14
Semivolatile Organic Compounds						
Phenol	ug/kg	12	13	1		604
Naphthalene	ug/kg	12	13	2	680	11000
2-Methylnaphthalene	ug/kg	9	10	1		3300
Acenaphthene	ug/kg	12	13	1	690	2000
Acenaphthylene	ug/kg	12	13	3	66	170
Fluorene	ug/kg	12	13	1	250	2330
Phenanthrene	ug/kg	12	13	6	560	8900
Anthracene	ug/kg	12	13	2	480	2500
Fluoranthene	ug/kg	12	13	7	580	5700
Pyrene	ug/kg	12	13	5	130	4400
Benzo(a)anthracene	ug/kg	12	13	2	720	1400
Chrysene	ug/kg	12	13	3	660	1800
bis(2-ethylhexyl)phthalate	ug/kg	9	10	4	580	2800
Benzo(b)fluoranthene	ug/kg	12	13	5	530	1700
Benzo(a)pyrene	ug/kg	15	18	2	327	810
Dibenz(a,h)anthracene	ug/kg	12	13	3	65	130
Organochlorine Pesticides						
Hexachlorobenzene	ug/kg	8	8	1		1.2

Sample locations:

WIH-1197-007S, WIH-1197-007C	(USACE, November 1995)
WH-0496-10, WH-0496-11, WH-0496-12, WH-0496-13, WH-0496-14, WH-0496-15, WH-0496-16, WH-0496-17	(USEPA, October 1999)
WH-2003-13.3	Data provided electronically by USEPA
WH2003-14.1, WH2003-14.3	
WH2003-15.1, WH2003-15.3	
SD-1, SD-2, SD-3	(CRA, 2003)

Appendix C
SWAC Evaluation for Waukegan Harbor Sediments

SWAC Evaluation for Waukegan Harbor Sediments

PREPARED FOR: Kevin Adler/USEPA
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Phil Smith/CH2M HILL

DATE: September 15, 2003

Introduction

This memorandum summarizes the evaluation of the PCB data collected for the shallow sediments in the Waukegan Harbor. USEPA's *Risk Evaluation of Waukegan Harbor Sediments* (Clark 2003) indicated that to achieve acceptable PCB levels in fish, the current average PCB levels in sediment would need to be reduced to an overall surface weighted average concentration (SWAC) of 0.25 mg/kg (Clark, 2003). Based on this remedial action objective, the SWAC approach was used to evaluate the existing conditions and the overall effectiveness of potential sediment removal alternatives for the individual harbor segments and the entire Waukegan Harbor.

SWAC for Baseline Conditions

The basis of the SWAC approach is that the exposure domain for receptors is broader than the small areas represented by individual samples, so an average concentration of the exposure domain should be used. The following steps were used to develop the SWACs for the individual reaches and for the entire Harbor.

1. The harbor was divided into the seven segments, and the boundaries for each segment were delineated within the geographic information system (GIS) database (see Figure C-1). Slip 1 was not included in this SWAC evaluation because the slip was recently dredged and therefore, the sediments in Slip 1 need not be considered for removal.

2. Each sediment location was assigned to a harbor segment such that a SWAC could be calculated for each of the individual segments.

3. The estimated area of harbor bottom to be assigned to each sample core was determined based on polygonal declustering. This method divides the total area of influence into polygons (one for each sample), with the area of the polygon representing the relative weighting of that sample. The polygons of influence, or Theissen polygons, are drawn using the GIS tool, such that a polygon contains all the area that is closer to a given sample point than to any other sample point. The area polygons used in this evaluation are shown in Figure 1.

4. Upon defining the Theissen polygons for each sediment sample location, the weighted concentration for each polygon (Cw_i) was calculated by multiplying the concentration (C_i) by the area (A_i), or:

$$Cw_i = C_i \times A_i$$

5. The products of the sediment concentrations and surface areas were summed and the total divided by the total surface area for each segment to get a SWAC for the entire segment, or:

$$SWAC_{Segment} = \frac{\sum_{i=1}^{n} Cw_i}{A_{Segment}}$$

6. Once the SWACs were determined for the individual segments, a representative sediment deposit SWAC was calculated to represent sediment in the entire harbor:

$$SWAC_{Harbor} = \frac{\sum_{r=1}^{6} SWAC_{Segment,r} \times Area_{Segment,r}}{A_{Harbor}}$$

The methodology requires that each polygon area be assigned a representative sediment concentration. Before calculating the SWAC for the individual segments, a representative concentration for each sample location was, therefore, determined.

- *The results of individual Aroclors were summed to determine a total PCB concentration* for each location. If an individual Aroclor was not detected, one-half the detection limit was used in the calculation of the total PCB concentration.
- The results for the samples that included the 0- to 2-foot interval were used in the analysis.
- If two shallow samples (i.e., less than a depth of 2 feet) were collected at a location at different depths, a vertically weighted average of the results was used. This process allows the data to be comparable to results from other investigations that included collection and analyses of depth-composite samples.

The data used in the calculation of the SWACs are included in Attachment 1. The calculated SWACs for each reach and for the overall harbor, based on the existing analytical data, are summarized in Table B-1. The calculated SWACs from existing PCB concentrations indicate that the SWACs for all the segments exceeded the remedial action objective of 0.25 mg/kg. The SWACs ranged from 0.261 mg/kg for Outer Harbor to 7.89 mg/kg for the Inner Harbor. The SWAC for the entire harbor area was estimated to be about 3.7 mg/kg.

Removal Actions

The SWAC approach was used to evaluate the overall effectiveness of potential removal actions on the harbor environment. A theoretical post-remediation SWAC for the Harbor was calculated for different removal action activities. The removal action was modeled by replacing the existing PCB concentration with one-half of the detection limit (i.e., 0.016

mg/kg). The effectiveness of the action could then be assessed by comparing the pre- and post-remedial conditions, based on the changes in the calculated SWAC.

Based on the evaluation of potential alternatives, different removal actions were modeled to include the removal of sediment from different combinations of harbor segments. The different removal actions evaluated were:

- Removal of all sediments in the navigational harbor segments (Outer Harbor, Entrance Channel, Inner Harbor Extension)
- Removal of all sediments in the navigation harbor segments and the North Harbor
- Removal of all sediments in the navigation harbor segments and the Marina
- Removal of all sediments in all of the harbor segments

The SWACs for the individual harbor segments and the entire harbor for the different removal actions are presented in Table C-1. The evaluation indicates that although removal of sediments from the individual harbor segments may reduce the SWACs, the overall objective will not be achieved unless all the shallow sediments are removed. Removal of the sediments in the navigational channel will reduce the overall SWAC by almost 50 percent, and inclusion of the North Harbor and Marina will further reduce the SWACs. The 0.25 mg/kg objective will not, however, be reached unless the sediments from all of the segments are removed (SWAC of 0.020 mg/kg).

References Cited

Clark, Milt. *Risk Evaluation of Waukegan Harbor Sediments*. Memorandum to Matthew Ohl/USEPA. July 9, 2003.

TABLE C-1
SWACs for PCBs under Different Removal Options
Waukegan Harbor AOC

	SWACs for PCBs (ppm)						
Harbor Segment	**Existing Conditions**	**Remove Sediments from Navigational Channel[a]**	**Remove Sediments from Navigational Channel and North Harbor[a]**	**Remove Sediments from Navigational Channel and the Marina[a]**	**Remove Sediments from all Segments**	**Remove Sediments from all Segments Except for Outer Harbor**	**Remove Sediments from all Segments Except for Outer Harbor and Entrance Channel**
Outer Harbor	0.261	0.016	0.016	0.016	0.016	0.261	0.261
Entrance Channel	1.241	0.016	0.016	0.016	0.016	0.016	1.241
Marina	4.610	4.610	4.610	0.016	0.016	0.016	0.016
Inner Harbor	7.890	0.016	0.016	0.016	0.016	0.016	0.016
Inner Harbor Extension	2.606	0.016	0.016	0.016	0.016	0.016	0.016
North Harbor	5.751	5.751	0.038[b]	5.751	0.038[b]	0.038[b]	0.038[b]
Entire Harbor	**3.712**	**1.635**	**0.707**	**0.948**	**0.020**	**0.082**	**0.259**

[a]Navigational Channel includes the Outer Harbor, Entrance Channel, Inner Harbor, and Inner Harbor Extension.
[b]Estimation for SWAC in this segment includes the PCB concentrations in till remaining after soft sediments are removed.

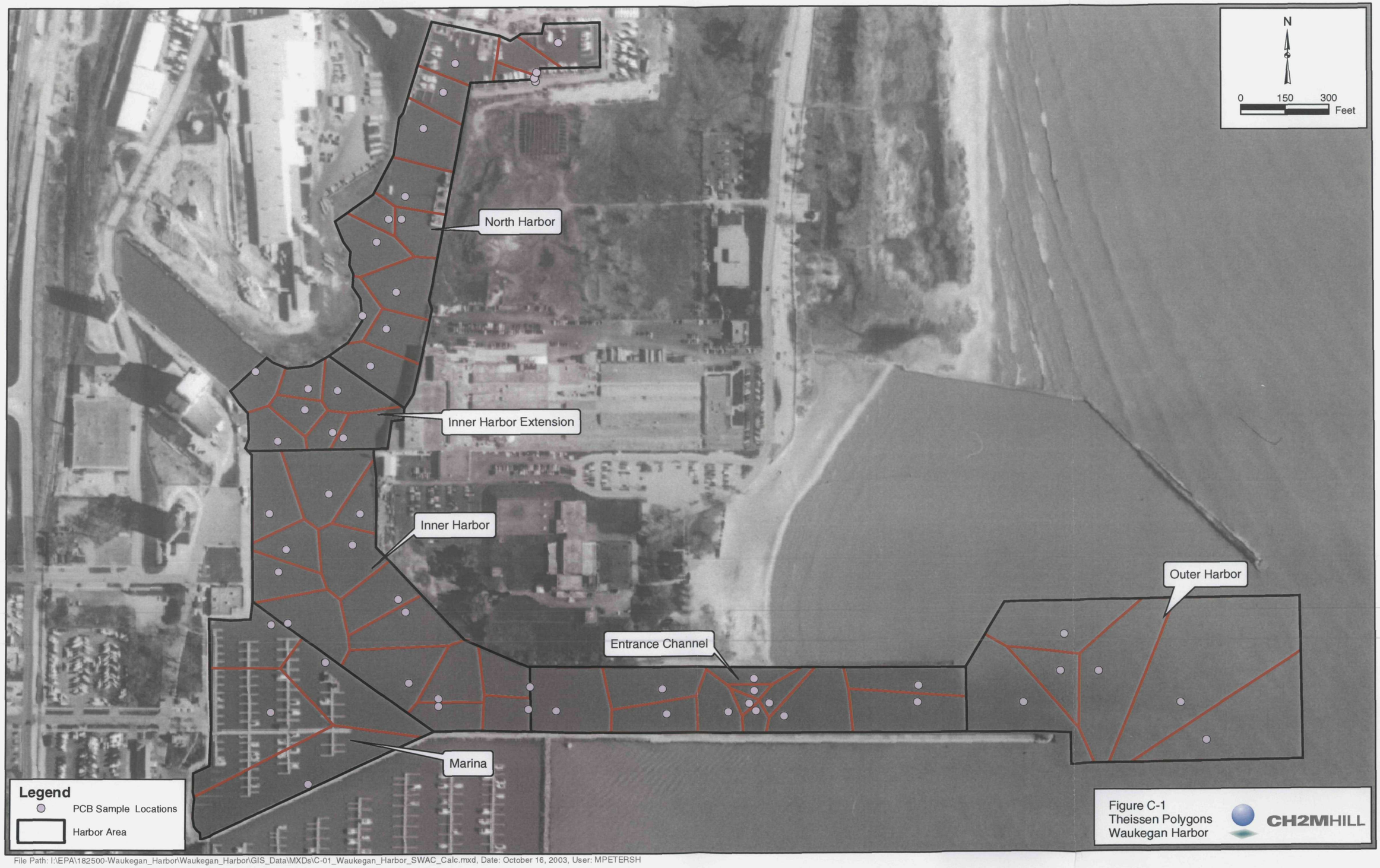

Figure C-1
Theissen Polygons
Waukegan Harbor

CH2MHILL

File Path: I:\EPA\182500-Waukegan_Harbor\Waukegan_Harbor\GIS_Data\MXDs\C-01_Waukegan_Harbor_SWAC_Calc.mxd, Date: October 16, 2003, User: MPETERSH

Attachment 1

Calculation of Surface Weighted Average PCB Concentration

Calculation of Surface Weighted Average PCB Concentration

			Removal of Sediments in Navigational Channel		
Harbor Segment	Sample Location	Area of Influence	PCB Concentration (ppm)	Weighted Concentration	SWAC (ppm)
Outer Harbor	WIH-0995-006	32011	0.016	512	
Outer Harbor	WIH-1197-001S	98154	0.016	1570	
Outer Harbor	CAG-0502-7	86113	0.016	1378	
Outer Harbor	CAG-0502-8	196704	0.016	3147	
Outer Harbor	WH-2002-02	109542	0.016	1753	
Outer Harbor	WH-2002-03	68809	0.016	1101	
Segment Total =		**591332**		**9461**	**0.016**
Entrance Channel	WIH-0995-007	53509	0.016	856	
Entrance Channel	WIH-0995-008	3904	0.016	62	
Entrance Channel	WH-0496-03	24911	0.016	399	
Entrance Channel	WIH-1197-002S	11731	0.016	188	
Entrance Channel	CAG-0502-1	59928	0.016	959	
Entrance Channel	CAG-0502-2	40252	0.016	644	
Entrance Channel	CAG-0502-3	14628	0.016	234	
Entrance Channel	CAG-0502-4	4526	0.016	72	
Entrance Channel	CAG-0502-5	7124	0.016	114	
Entrance Channel	WH-2002-04	35984	0.016	576	
Entrance Channel	WH-2002-05	48201	0.016	771	
Entrance Channel	WH-2002-06	30131	0.016	482	
Segment Total =		**334830**		**5357**	**0.016**
Marina	WIH-0995-003	71020	8.98300	637975	
Marina	WH-0496-06	50093	5.20000	260481	
Marina	WH-0496-19	117214	5.20000	609513	
Marina	WHSP-01	108735	0.8450	91881	
Segment Total =		**347062**		**1599850**	**4.610**

Calculation of Surface Weighted Average PCB Concentration

			Removal of Sediments in Navigational Channel		
Harbor Segment	**Sample Location**	**Area of Influence**	**PCB Concentration (ppm)**	**Weighted Concentration**	**SWAC (ppm)**
Inner Harbor	WIH-0995-002	29242	0.016	468	
Inner Harbor	WIH-0995-004	19312	0.016	309	
Inner Harbor	WIH-0995-005	42192	0.016	675	
Inner Harbor	WH-0496-01	47837	0.016	765	
Inner Harbor	WH-0496-04	22293	0.016	357	
Inner Harbor	WH-0496-05	20319	0.016	325	
Inner Harbor	WH-0496-07	55405	0.016	886	
Inner Harbor	WH-0496-18	25865	0.016	414	
Inner Harbor	WIH-1197-003S	22166	0.016	355	
Inner Harbor	WIH-1197-004S	34360	0.016	550	
Inner Harbor	WIH-1197-005S	43479	0.016	696	
Inner Harbor	WH-2002-07	33380	0.016	534	
Inner Harbor	WH-2002-08	41176	0.016	659	
Inner Harbor	WH-2002-09	41417	0.016	663	
Segment Total =		**478446**		**7655**	**0.016**
Inner Harbor Ext	WIH-0995-001	16493	0.016	264	
Inner Harbor Ext	WIH-0995-009	28463	0.016	455	
Inner Harbor Ext	WH-0496-09	20444	0.016	327	
Inner Harbor Ext	WIH-1197-006S	12565	0.016	201	
Inner Harbor Ext	WH-2002-10	23502	0.016	376	
Inner Harbor Ext	WH-2002-10	23502	0.016	376	
Inner Harbor Ext	WH-2002-11	24520	0.016	392	
Inner Harbor Ext	WH-2002-11	24520	0.016	392	
Inner Harbor Ext	WH-2002-12	16476	0.016	264	
Segment Total =		**190485**		**3048**	**0.016**
North Harbor	WH-0496-10	31460	3.00000	94381	
North Harbor	WH-0496-11	23329	4.30000	100316	
North Harbor	WH-0496-12	31555	8.90000	280837	
North Harbor	WH-0496-13	26437	7.40000	195633	
North Harbor	WH-0496-14	24797	7.70000	190935	
North Harbor	WH-0496-15	36199	4.90000	177374	
North Harbor	WH-0496-16	43426	7.30000	317013	
North Harbor	WH-0496-17	36797	7.30000	268618	
North Harbor	WIH-1197-007S	36155	9.34000	337688	
North Harbor	WH-2002-13A	11597	0.2578	2990	
North Harbor	WH-2002-14	13189	7.0520	93010	
North Harbor	WH-2002-15	39985	2.4496	97946	
North Harbor	SD-1	6036	0.7660	4624	
North Harbor	SD-3	15812	0.3430	5424	
Segment Total =		**376774**		**2166789**	**5.751**
Harbor Total =		**2318930**		**3792160**	**1.635**

Calculation of Surface Weighted Average PCB Concentration

			Removal of Sediments in Navigational Channel and the North Harbor		
Harbor Segment	Sample Location	Area of Influence	PCB Concentration (ppm)	Weighted Concentration	SWAC (ppm)
Outer Harbor	WIH-0995-006	32011	0.016	512	
Outer Harbor	WIH-1197-001S	98154	0.016	1570	
Outer Harbor	CAG-0502-7	86113	0.016	1378	
Outer Harbor	CAG-0502-8	196704	0.016	3147	
Outer Harbor	WH-2002-02	109542	0.016	1753	
Outer Harbor	WH-2002-03	68809	0.016	1101	
Segment Total =		**591332**		**9461**	**0.016**
Entrance Channel	WIH-0995-007	53509	0.016	856	
Entrance Channel	WIH-0995-008	3904	0.016	62	
Entrance Channel	WH-0496-03	24911	0.016	399	
Entrance Channel	WIH-1197-002S	11731	0.016	188	
Entrance Channel	CAG-0502-1	59928	0.016	959	
Entrance Channel	CAG-0502-2	40252	0.016	644	
Entrance Channel	CAG-0502-3	14628	0.016	234	
Entrance Channel	CAG-0502-4	4526	0.016	72	
Entrance Channel	CAG-0502-5	7124	0.016	114	
Entrance Channel	WH-2002-04	35984	0.016	576	
Entrance Channel	WH-2002-05	48201	0.016	771	
Entrance Channel	WH-2002-06	30131	0.016	482	
Segment Total =		**334830**		**5357**	**0.016**
Marina	WIH-0995-003	71020	8.98300	637975	
Marina	WH-0496-06	50093	5.20000	260481	
Marina	WH-0496-19	117214	5.20000	609513	
Marina	WHSP-01	108735	0.8450	91881	
Segment Total =		**347062**		**1599850**	**4.610**

Calculation of Surface Weighted Average PCB Concentration

			Removal of Sediments in Navigational Channel and the North Harbor		
Harbor Segment	**Sample Location**	**Area of Influence**	**PCB Concentration (ppm)**	**Weighted Concentration**	**SWAC (ppm)**
Inner Harbor	WIH-0995-002	29242	0.016	468	
Inner Harbor	WIH-0995-004	19312	0.016	309	
Inner Harbor	WIH-0995-005	42192	0.016	675	
Inner Harbor	WH-0496-01	47837	0.016	765	
Inner Harbor	WH-0496-04	22293	0.016	357	
Inner Harbor	WH-0496-05	20319	0.016	325	
Inner Harbor	WH-0496-07	55405	0.016	886	
Inner Harbor	WH-0496-18	25865	0.016	414	
Inner Harbor	WIH-1197-003S	22166	0.016	355	
Inner Harbor	WIH-1197-004S	34360	0.016	550	
Inner Harbor	WIH-1197-005S	43479	0.016	696	
Inner Harbor	WH-2002-07	33380	0.016	534	
Inner Harbor	WH-2002-08	41176	0.016	659	
Inner Harbor	WH-2002-09	41417	0.016	663	
Segment Total =		**478446**		**7655**	**0.016**
Inner Harbor Ext	WIH-0995-001	16493	0.016	264	
Inner Harbor Ext	WIH-0995-009	28463	0.016	455	
Inner Harbor Ext	WH-0496-09	20444	0.016	327	
Inner Harbor Ext	WIH-1197-006S	12565	0.016	201	
Inner Harbor Ext	WH-2002-10	23502	0.016	376	
Inner Harbor Ext	WH-2002-10	23502	0.016	376	
Inner Harbor Ext	WH-2002-11	24520	0.016	392	
Inner Harbor Ext	WH-2002-11	24520	0.016	392	
Inner Harbor Ext	WH-2002-12	16476	0.016	264	
Segment Total =		**190485**		**3048**	**0.016**
North Harbor	WH-0496-10	31460	0.016	503	
North Harbor	WH-0496-11	23329	0.016	373	
North Harbor	WH-0496-12	31555	0.016	505	
North Harbor	WH-0496-13	26437	0.016	423	
North Harbor	WH-0496-14	24797	0.016	397	
North Harbor	WH-0496-15	36199	0.016	579	
North Harbor	WH-0496-16	43426	0.016	695	
North Harbor	WH-0496-17	36797	0.016	589	
North Harbor	WIH-1197-007S	36155	0.016	578	
North Harbor	WH-2002-13A	11597	0.258	2990	
North Harbor	WH-2002-14	13189	0.155	2038	
North Harbor	WH-2002-15	39985	0.108	4300	
North Harbor	SD-1	6036	0.016	97	
North Harbor	SD-3	15812	0.016	253	
Segment Total =		**376774**		**14320**	**0.038**
Harbor Total =		**2318930**		**1639692**	**0.707**

Calculation of Surface Weighted Average PCB Concentration

			Removal of Sediments in Navigational Channel and the Marina		
Harbor Segment	Sample Location	Area of Influence	PCB Concentration (ppm)	Weighted Concentration	SWAC (ppm)
Outer Harbor	WIH-0995-006	32011	0.016	512	
Outer Harbor	WIH-1197-001S	98154	0.016	1570	
Outer Harbor	CAG-0502-7	86113	0.016	1378	
Outer Harbor	CAG-0502-8	196704	0.016	3147	
Outer Harbor	WH-2002-02	109542	0.016	1753	
Outer Harbor	WH-2002-03	68809	0.016	1101	
Segment Total =		**591332**		**9461**	**0.016**
Entrance Channel	WIH-0995-007	53509	0.016	856	
Entrance Channel	WIH-0995-008	3904	0.016	62	
Entrance Channel	WH-0496-03	24911	0.016	399	
Entrance Channel	WIH-1197-002S	11731	0.016	188	
Entrance Channel	CAG-0502-1	59928	0.016	959	
Entrance Channel	CAG-0502-2	40252	0.016	644	
Entrance Channel	CAG-0502-3	14628	0.016	234	
Entrance Channel	CAG-0502-4	4526	0.016	72	
Entrance Channel	CAG-0502-5	7124	0.016	114	
Entrance Channel	WH-2002-04	35984	0.016	576	
Entrance Channel	WH-2002-05	48201	0.016	771	
Entrance Channel	WH-2002-06	30131	0.016	482	
Segment Total =		**334830**		**5357**	**0.016**
Marina	WIH-0995-003	71020	0.016	1136	
Marina	WH-0496-06	50093	0.016	801	
Marina	WH-0496-19	117214	0.016	1875	
Marina	WHSP-01	108735	0.016	1740	
Segment Total =		**347062**		**5553**	**0.016**

Calculation of Surface Weighted Average PCB Concentration

			Removal of Sediments in Navigational Channel and the Marina		
Harbor Segment	**Sample Location**	**Area of Influence**	**PCB Concentration (ppm)**	**Weighted Concentration**	**SWAC (ppm)**
Inner Harbor	WIH-0995-002	29242	0.016	468	
Inner Harbor	WIH-0995-004	19312	0.016	309	
Inner Harbor	WIH-0995-005	42192	0.016	675	
Inner Harbor	WH-0496-01	47837	0.016	765	
Inner Harbor	WH-0496-04	22293	0.016	357	
Inner Harbor	WH-0496-05	20319	0.016	325	
Inner Harbor	WH-0496-07	55405	0.016	886	
Inner Harbor	WH-0496-18	25865	0.016	414	
Inner Harbor	WIH-1197-003S	22166	0.016	355	
Inner Harbor	WIH-1197-004S	34360	0.016	550	
Inner Harbor	WIH-1197-005S	43479	0.016	696	
Inner Harbor	WH-2002-07	33380	0.016	534	
Inner Harbor	WH-2002-08	41176	0.016	659	
Inner Harbor	WH-2002-09	41417	0.016	663	
Segment Total =		**478446**		**7655**	**0.016**
Inner Harbor Ext	WIH-0995-001	16493	0.016	264	
Inner Harbor Ext	WIH-0995-009	28463	0.016	455	
Inner Harbor Ext	WH-0496-09	20444	0.016	327	
Inner Harbor Ext	WIH-1197-006S	12565	0.016	201	
Inner Harbor Ext	WH-2002-10	23502	0.016	376	
Inner Harbor Ext	WH-2002-10	23502	0.016	376	
Inner Harbor Ext	WH-2002-11	24520	0.016	392	
Inner Harbor Ext	WH-2002-11	24520	0.016	392	
Inner Harbor Ext	WH-2002-12	16476	0.016	264	
Segment Total =		**190485**		**3048**	**0.016**
North Harbor	WH-0496-10	31460	3.00000	94381	
North Harbor	WH-0496-11	23329	4.30000	100316	
North Harbor	WH-0496-12	31555	8.90000	280837	
North Harbor	WH-0496-13	26437	7.40000	195633	
North Harbor	WH-0496-14	24797	7.70000	190935	
North Harbor	WH-0496-15	36199	4.90000	177374	
North Harbor	WH-0496-16	43426	7.30000	317013	
North Harbor	WH-0496-17	36797	7.30000	268618	
North Harbor	WIH-1197-007S	36155	9.34000	337688	
North Harbor	WH-2002-13A	11597	0.2578	2990	
North Harbor	WH-2002-14	13189	7.0520	93010	
North Harbor	WH-2002-15	39985	2.4496	97946	
North Harbor	SD-1	6036	0.7660	4624	
North Harbor	SD-3	15812	0.3430	5424	
Segment Total =		**376774**		**2166789**	**5.751**
Harbor Total =		**2318930**		**2197863**	**0.948**

Calculation of Surface Weighted Average PCB Concentration

			Removal of Sediments in all Harbor Segments		
Harbor Segment	Sample Location	Area of Influence	PCB Concentration (ppm)	Weighted Concentration	SWAC (ppm)
Outer Harbor	WIH-0995-006	32011	0.016	512	
Outer Harbor	WIH-1197-001S	98154	0.016	1570	
Outer Harbor	CAG-0502-7	86113	0.016	1378	
Outer Harbor	CAG-0502-8	196704	0.016	3147	
Outer Harbor	WH-2002-02	109542	0.016	1753	
Outer Harbor	WH-2002-03	68809	0.016	1101	
Segment Total =		**591332**		**9461**	**0.016**
Entrance Channel	WIH-0995-007	53509	0.016	856	
Entrance Channel	WIH-0995-008	3904	0.016	62	
Entrance Channel	WH-0496-03	24911	0.016	399	
Entrance Channel	WIH-1197-002S	11731	0.016	188	
Entrance Channel	CAG-0502-1	59928	0.016	959	
Entrance Channel	CAG-0502-2	40252	0.016	644	
Entrance Channel	CAG-0502-3	14628	0.016	234	
Entrance Channel	CAG-0502-4	4526	0.016	72	
Entrance Channel	CAG-0502-5	7124	0.016	114	
Entrance Channel	WH-2002-04	35984	0.016	576	
Entrance Channel	WH-2002-05	48201	0.016	771	
Entrance Channel	WH-2002-06	30131	0.016	482	
Segment Total =		**334830**		**5357**	**0.016**
Marina	WIH-0995-003	71020	0.016	1136	
Marina	WH-0496-06	50093	0.016	801	
Marina	WH-0496-19	117214	0.016	1875	
Marina	WHSP-01	108735	0.016	1740	
Segment Total =		**347062**		**5553**	**0.016**

Calculation of Surface Weighted Average PCB Concentration

			Removal of Sediments in all Harbor Segments		
Harbor Segment	Sample Location	Area of Influence	PCB Concentration (ppm)	Weighted Concentration	SWAC (ppm)
Inner Harbor	WIH-0995-002	29242	0.016	468	
Inner Harbor	WIH-0995-004	19312	0.016	309	
Inner Harbor	WIH-0995-005	42192	0.016	675	
Inner Harbor	WH-0496-01	47837	0.016	765	
Inner Harbor	WH-0496-04	22293	0.016	357	
Inner Harbor	WH-0496-05	20319	0.016	325	
Inner Harbor	WH-0496-07	55405	0.016	886	
Inner Harbor	WH-0496-18	25865	0.016	414	
Inner Harbor	WIH-1197-003S	22166	0.016	355	
Inner Harbor	WIH-1197-004S	34360	0.016	550	
Inner Harbor	WIH-1197-005S	43479	0.016	696	
Inner Harbor	WH-2002-07	33380	0.016	534	
Inner Harbor	WH-2002-08	41176	0.016	659	
Inner Harbor	WH-2002-09	41417	0.016	663	
Segment Total =		**478446**		**7655**	**0.016**
Inner Harbor Ext	WIH-0995-001	16493	0.016	264	
Inner Harbor Ext	WIH-0995-009	28463	0.016	455	
Inner Harbor Ext	WH-0496-09	20444	0.016	327	
Inner Harbor Ext	WIH-1197-006S	12565	0.016	201	
Inner Harbor Ext	*WH-2002-10*	*23502*	*0.016*	*376*	
Inner Harbor Ext	WH-2002-10	23502	0.016	376	
Inner Harbor Ext	WH-2002-11	24520	0.016	392	
Inner Harbor Ext	WH-2002-11	24520	0.016	392	
Inner Harbor Ext	WH-2002-12	16476	0.016	264	
Segment Total =		**190485**		**3048**	**0.016**
North Harbor	WH-0496-10	31460	0.016	503	
North Harbor	WH-0496-11	23329	0.016	373	
North Harbor	WH-0496-12	31555	0.016	505	
North Harbor	WH-0496-13	26437	0.016	423	
North Harbor	WH-0496-14	24797	0.016	397	
North Harbor	WH-0496-15	36199	0.016	579	
North Harbor	WH-0496-16	43426	0.016	695	
North Harbor	WH-0496-17	36797	0.016	589	
North Harbor	WIH-1197-007S	36155	0.016	578	
North Harbor	WH-2002-13A	11597	0.2578	2990	
North Harbor	WH-2002-14	13189	0.155	2038	
North Harbor	WH-2002-15	39985	0.108	4300	
North Harbor	SD-1	6036	0.016	97	
North Harbor	SD-3	15812	0.016	253	
Segment Total =		**376774**		**14320**	**0.038**
Harbor Total =		**2318930**		**45394**	**0.020**

Calculation of Surface Weighted Average PCB Concentration

			Removal of Sediments in all Harbor Segments Except for Outer Harbor		
Harbor Segment	Sample Location	Area of Influence	PCB Concentration (ppm)	Weighted Concentration	SWAC (ppm)
Outer Harbor	WIH-0995-006	32011	0.33000	10564	
Outer Harbor	WIH-1197-001S	98154	0.72600	71260	
Outer Harbor	CAG-0502-7	86113	0.19400	16706	
Outer Harbor	CAG-0502-8	196704	0.15000	29506	
Outer Harbor	WH-2002-02	109542	0.0977	10702	
Outer Harbor	WH-2002-03	68809	0.2288	15743	
Segment Total =		**591332**		**154480**	**0.261**
Entrance Channel	WIH-0995-007	53509	0.016	856	
Entrance Channel	WIH-0995-008	3904	0.016	62	
Entrance Channel	WH-0496-03	24911	0.016	399	
Entrance Channel	WIH-1197-002S	11731	0.016	188	
Entrance Channel	CAG-0502-1	59928	0.016	959	
Entrance Channel	CAG-0502-2	40252	0.016	644	
Entrance Channel	CAG-0502-3	14628	0.016	234	
Entrance Channel	CAG-0502-4	4526	0.016	72	
Entrance Channel	CAG-0502-5	7124	0.016	114	
Entrance Channel	WH-2002-04	35984	0.016	576	
Entrance Channel	WH-2002-05	48201	0.016	771	
Entrance Channel	WH-2002-06	30131	0.016	482	
Segment Total =		**334830**		**5357**	**0.016**
Marina	WIH-0995-003	71020	0.016	1136	
Marina	WH-0496-06	50093	0.016	801	
Marina	WH-0496-19	117214	0.016	1875	
Marina	WHSP-01	108735	0.016	1740	
Segment Total =		**347062**		**5553**	**0.016**

Calculation of Surface Weighted Average PCB Concentration

			Removal of Sediments in all Harbor Segments Except for Outer Harbor		
Harbor Segment	**Sample Location**	**Area of Influence**	**PCB Concentration (ppm)**	**Weighted Concentration**	**SWAC (ppm)**
Inner Harbor	WIH-0995-002	29242	0.016	468	
Inner Harbor	WIH-0995-004	19312	0.016	309	
Inner Harbor	WIH-0995-005	42192	0.016	675	
Inner Harbor	WH-0496-01	47837	0.016	765	
Inner Harbor	WH-0496-04	22293	0.016	357	
Inner Harbor	WH-0496-05	20319	0.016	325	
Inner Harbor	WH-0496-07	55405	0.016	886	
Inner Harbor	WH-0496-18	25865	0.016	414	
Inner Harbor	WIH-1197-003S	22166	0.016	355	
Inner Harbor	WIH-1197-004S	34360	0.016	550	
Inner Harbor	WIH-1197-005S	43479	0.016	696	
Inner Harbor	WH-2002-07	33380	0.016	534	
Inner Harbor	WH-2002-08	41176	0.016	659	
Inner Harbor	WH-2002-09	41417	0.016	663	
Segment Total =		**478446**		**7655**	**0.016**
Inner Harbor Ext	WIH-0995-001	16493	0.016	264	
Inner Harbor Ext	WIH-0995-009	28463	0.016	455	
Inner Harbor Ext	WH-0496-09	20444	0.016	327	
Inner Harbor Ext	WIH-1197-006S	12565	0.016	201	
Inner Harbor Ext	WH-2002-10	23502	0.016	376	
Inner Harbor Ext	WH-2002-10	23502	0.016	376	
Inner Harbor Ext	WH-2002-11	24520	0.016	392	
Inner Harbor Ext	WH-2002-11	24520	0.016	392	
Inner Harbor Ext	WH-2002-12	16476	0.016	264	
Segment Total =		**190485**		**3048**	**0.016**
North Harbor	WH-0496-10	31460	0.016	503	
North Harbor	WH-0496-11	23329	0.016	373	
North Harbor	WH-0496-12	31555	0.016	505	
North Harbor	WH-0496-13	26437	0.016	423	
North Harbor	WH-0496-14	24797	0.016	397	
North Harbor	WH-0496-15	36199	0.016	579	
North Harbor	WH-0496-16	43426	0.016	695	
North Harbor	WH-0496-17	36797	0.016	589	
North Harbor	WIH-1197-007S	36155	0.016	578	
North Harbor	WH-2002-13A	11597	0.2578	2990	
North Harbor	WH-2002-14	13189	0.155	2038	
North Harbor	WH-2002-15	39985	0.108	4300	
North Harbor	SD-1	6036	0.016	97	
North Harbor	SD-3	15812	0.016	253	
Segment Total =		**376774**		**14320**	**0.038**
Harbor Total =		**2318930**		**190414**	**0.082**

Calculation of Surface Weighted Average PCB Concentration

			Removal of Sediments in all Harbor Segments Except for Outer Harbor and Entrance Channel		
Harbor Segment	**Sample Location**	**Area of Influence**	**PCB Concentration (ppm)**	**Weighted Concentration**	**SWAC (ppm)**
Outer Harbor	WIH-0995-006	32011	0.33000	10564	
Outer Harbor	WIH-1197-001S	98154	0.72600	71260	
Outer Harbor	CAG-0502-7	86113	0.19400	16706	
Outer Harbor	CAG-0502-8	196704	0.15000	29506	
Outer Harbor	WH-2002-02	109542	0.0977	10702	
Outer Harbor	WH-2002-03	68809	0.2288	15743	
Segment Total =		**591332**		**154480**	**0.261**
Entrance Channel	WIH-0995-007	53509	1.71300	91660	
Entrance Channel	WIH-0995-008	3904	3.79300	14810	
Entrance Channel	WH-0496-03	24911	6.30000	156941	
Entrance Channel	WIH-1197-002S	11731	0.83500	9795	
Entrance Channel	CAG-0502-1	59928	0.17800	10667	
Entrance Channel	CAG-0502-2	40252	0.20100	8091	
Entrance Channel	CAG-0502-3	14628	0.10800	1580	
Entrance Channel	CAG-0502-4	4526	0.15300	693	
Entrance Channel	CAG-0502-5	7124	0.51100	3640	
Entrance Channel	WH-2002-04	35984	0.4714	16963	
Entrance Channel	WH-2002-05	48201	0.9676	46639	
Entrance Channel	WH-2002-06	30131	1.7964	54128	
Segment Total =		**334830**		**415607**	**1.241**
Marina	WIH-0995-003	71020	0.016	1136	
Marina	WH-0496-06	50093	0.016	801	
Marina	WH-0496-19	117214	0.016	1875	
Marina	WHSP-01	108735	0.016	1740	
Segment Total =		**347062**		**5553**	**0.016**

Calculation of Surface Weighted Average PCB Concentration

			Removal of Sediments in all Harbor Segments Except for Outer Harbor and Entrance Channel		
Harbor Segment	**Sample Location**	**Area of Influence**	**PCB Concentration (ppm)**	**Weighted Concentration**	**SWAC (ppm)**
Inner Harbor	WIH-0995-002	29242	0.016	468	
Inner Harbor	WIH-0995-004	19312	0.016	309	
Inner Harbor	WIH-0995-005	42192	0.016	675	
Inner Harbor	WH-0496-01	47837	0.016	765	
Inner Harbor	WH-0496-04	22293	0.016	357	
Inner Harbor	WH-0496-05	20319	0.016	325	
Inner Harbor	WH-0496-07	55405	0.016	886	
Inner Harbor	WH-0496-18	25865	0.016	414	
Inner Harbor	WIH-1197-003S	22166	0.016	355	
Inner Harbor	WIH-1197-004S	34360	0.016	550	
Inner Harbor	WIH-1197-005S	43479	0.016	696	
Inner Harbor	WH-2002-07	33380	0.016	534	
Inner Harbor	WH-2002-08	41176	0.016	659	
Inner Harbor	WH-2002-09	41417	0.016	663	
Segment Total =		**478446**		**7655**	**0.016**
Inner Harbor Ext	WIH-0995-001	16493	0.016	264	
Inner Harbor Ext	WIH-0995-009	28463	0.016	455	
Inner Harbor Ext	WH-0496-09	20444	0.016	327	
Inner Harbor Ext	WIH-1197-006S	12565	0.016	201	
Inner Harbor Ext	WH-2002-10	23502	0.016	376	
Inner Harbor Ext	WH-2002-10	23502	0.016	376	
Inner Harbor Ext	WH-2002-11	24520	0.016	392	
Inner Harbor Ext	WH-2002-11	24520	0.016	392	
Inner Harbor Ext	WH-2002-12	16476	0.016	264	
Segment Total =		**190485**		**3048**	**0.016**
North Harbor	WH-0496-10	31460	0.016	503	
North Harbor	WH-0496-11	23329	0.016	373	
North Harbor	WH-0496-12	31555	0.016	505	
North Harbor	WH-0496-13	26437	0.016	423	
North Harbor	WH-0496-14	24797	0.016	397	
North Harbor	WH-0496-15	36199	0.016	579	
North Harbor	WH-0496-16	43426	0.016	695	
North Harbor	WH-0496-17	36797	0.016	589	
North Harbor	WIH-1197-007S	36155	0.016	578	
North Harbor	WH-2002-13A	11597	0.2578	2990	
North Harbor	WH-2002-14	13189	0.155	2038	
North Harbor	WH-2002-15	39985	0.108	4300	
North Harbor	SD-1	6036	0.016	97	
North Harbor	SD-3	15812	0.016	253	
Segment Total =		**376774**		**14320**	**0.038**
Harbor Total =		**2318930**		**600663**	**0.259**

Appendix D
Hydraulic Dredging Description

APPENDIX D

Hydraulic Dredging Description

Hydraulic dredging is considered the representative process option for all alternatives that require sediment removal (Alternatives 2 through 9). This appendix provides a description of hydraulic dredging, materials handling, and water treatment processes that are deemed to be suitable for sediment removal at the Waukegan Harbor site. The processes described herein are based upon data and site knowledge obtained to date, and assumptions that have been made, such as dredging rates, availability of nearby sites for staging facilities, etc. Should sediment removal be part of the selected remedy, the actual dredging, materials handling, and water treatment processes will be chosen based upon data collected during the predesign investigation and the completion of a thorough design.

Hydraulic Dredging

Hydraulic dredging using an 8-inch dredge with a standard cutterhead is assumed. Material will be pumped from the dredge to shore through a double-lined flexible HDPE pipe. This pipe normally floats on the water surface but will be sunk to the bottom of the harbor using concrete anchors as necessary to allow the normal flow of boat traffic to continue during dredging. Sections of this HDPE double-walled pipeline are joined using heat welding to facilitate easier setup and relocation of the pipe as necessary during dredging operations.

The potential for sediment suspension and redeposition outside of the area being dredged will be controlled during dredging activities. Turbidity barriers in the form of curtains and screens will be used to completely enclose the area being dredged. Turbidity monitoring will be conducted several times per day at established locations both inside and outside of the enclosed dredging area to see if dredging activities are causing elevated readings outside of the dredge area above background (continuous real-time monitoring stations may also be used). If elevated readings are detected, either modification to the dredging operations will be made to reduce turbidity or water sampling with quick turnaround laboratory analysis for PCB concentrations will be done to determine the risk of recontaminating areas already dredged or contaminating areas outside the harbor.

Invariably, sediment suspension within the dredging area will occur. Dredging will progress using two passes. The initial passes will remove the bulk of the material, followed by a more careful, measured final pass to achieve the final desired depth of cut. The bulk of the suspended sediment within the turbidity barrier should settle before the final cleanup pass is done. This will help to minimize the amount of contaminated residual sediment that settles after dredging is completed.

The most likely scenario is that sediment removal will start at the north end of the north harbor (for those alternatives that include sediment removal in the north harbor) and progress to the south. Turbidity barriers will be moved as work progresses. The individual harbor segments will be divided longitudinally and only one side of the segment at a time

will be enclosed in a turbidity barrier to maintain an open channel for passing vessels. This will work to minimize impacts to normal harbor operations.

Sediment removal within the marina (applicable to Alternatives 2 and 6 through 9) will require additional effort compared to other segments. There are two possibilities for consideration. The first method involves maneuvering the 8-inch dredge in between the long, parallel docks to remove the bulk of the sediment in those reaches. Then, divers with special microdredging equipment would remove the sediment left in between the piles beneath the individual slips. The other method of removing sediment in the marina is to completely remove the walkways and slips in the marina, including the pilings. The 8-inch dredge could be used in the marina to remove all of the soft sediment. Following sediment removal, a new marina would be constructed, possibly a floating structure that would not require users to climb down ladders to their vessels due to low lake levels.

Sediment Dewatering

There are several methods available for thickening and dewatering hydraulic dredge slurries. These can include thickening followed by belt presses, filter presses, and geotextile tubes. The selected alternative for purposes of this study is geotextile tubes. This technology has been recently been gaining favor where enough land area is available. This technology is simple and robust and can allow the dredge to achieve high production rates.

Large diameter geotextile-woven tubes will be employed for sediment dewatering. These tubes will be placed on open space available at the Waukegan Coke Plant (WCP) site. The size of individual tubes is assumed to be 45 feet in circumference by 200 feet long. The area where the tubes are located will be prepared by grading, placement of two geomembrane liners with a leak detection layer between them, and placement of a granular drainage layer on top of the upper geomembrane. Berms will be constructed around the perimeter of the tube filling areas. Channels or troughs will be created between the tubes to facilitate collection of water seeping from the tubes at one or more collection points.

Sediment slurry will be pumped directly into these tubes from the dredge. A polymer will be added to the slurry at the dredge to assist in flocculation of fine particles. Tubes will be grouped together, with each group called a "battery." Initially, each tube in a battery will be filled from empty to about 80 percent full. When all tubes in the battery are filled to this level, filling of the tubes in the next battery will commence and the water in the initial tubes will be allowed to drain. This process will continue for subsequent batteries. After sufficient time has passed such that the sediment in the first battery has drained significantly, sediment slurry will again be pumped into the first battery until it is full, and then the second battery, and so on. After the solids content of the sediment in the tubes reaches 50 to 60 percent, the tubes are cut open and the sediment and tube material is removed from the tubes using conventional excavation equipment, loaded into trucks, and transported to its final disposal location. New tubes are then laid out for filling and the cycle is repeated. Total time for turnover of a battery is estimated at 75 days.

Water Treatment

Water seeping from the geotextile-woven tubes will be collected within the granular drainage layer and pumped to a clarifier as the first step in water treatment. Prior to introduction into the clarifier, more coagulants will be added to the water. Solids from the clarifier will be collected and recycled into the dredge slurry being pumped into the tubes. Water passing through the clarifier will then be pumped through a sand filter, and finally through activated carbon as a polishing step. Backwash from the sand filter will also be recycled back to the dredge slurry being pumped into the tubes.

After polishing through activated carbon, the water should meet the no detection of PCBs criterion required for discharge back into Waukegan Harbor. Regular sampling at several points throughout the water treatment train will verify this criterion is being met.

Capping and Clean Layer Placement

Environmentally clean sand will be used for capping and clean layer placement in other harbor segments under several alternatives (Alternatives 2 and 4 through 9). All clean sand will be dredged from the entrance channel, outer channel, and/or the approach channel. No polymer will be added to this material as it is dredged.

Clean sand will be pumped from the dredge directly to the segment where capping or clean layer placement is required. Discharge from the pipeline will flow over a barge and/or incorporate some other means of dissipating energy to minimize subsurface disturbance during placement. Each lift will be about 6 inches thick, and multiple passes of the delivery barge will be made until the final design thickness is achieved.

Appendix E
Cost Tables

Cost Estimate
General Calculations
Waukegan Harbor AOC - Remedial Alternative Array Document and Data Gaps Analysis Report

Assumptions

Dredging

8" cutterhead dredge used that can achieve removal of 75 CY/hr with sediment and 50 CY/hr with glacial till.
Dredge operates 24 hours per day, 6 days per week with 30% downtime.
Dredging in Marina involves use of divers and microdredging equipment.
90% of the sediment in the Marina can be dredged with the cutterhead at a rate of 30 CY/hr, and 10% will be microdredged by divers.

Dewatering

Percent solids in dredge slurry (by weight): 8% for sediment and 12% for glacial till.
In situ density is 80 pcf for sediment and 130 pcf for glacial till.
In situ percent moisture is 100% for sediment and 20% for glacial till.
Geotubes used for dewatering are 45' circumference X 200' long, and are turned over every 75 days.

Water Treatment

Construction of water treatment system is included in mobilization costs.

Calculations

Dredging

Operational time	0.7	(ratio)
Days per week	6	days/week
Weeks per year	30	weeks/yr
Cost	$ 400.00	$/hr

Sediment, not in Marina

In situ bulk density	80	lbs./cf
In situ moisture ratio	0.5	lbs. water/lbs. total
Dredge rate	75	cy/hr
Slurry % solids	8	%
Moisture ratio after dewatering	0.4	lbs. water/lbs. total
Dredge rate	7,560	cy/week
Water pumped during dredging	1,861	gal water/min
Water requiring treatment (avg)	1,052	gal water/min
Water requiring treatment (avg)	1,403	gal water/cy sediment
Cost	$ 8.89	$/cy

Sediment, in Marina

In situ bulk density	80	lbs./cf
In situ moisture ratio	0.5	lbs. water/lbs. total
Dredge rate	30	cy/hr
Slurry % solids	8	%
Moisture ratio after dewatering	0.4	lbs. water/lbs. total
Dredge rate	3,024	cy/week
Water pumped during dredging	745	gal water/min
Water requiring treatment (avg)	421	gal water/min
Water requiring treatment (avg)	1,403	gal water/cy sediment
Cost	$ 22.22	$/cy

Cost Estimate
General Calculations
Waukegan Harbor AOC - Remedial Alternative Array Document and Data Gaps Analysis Report

Till

In situ bulk density	130	lbs./cf
In situ moisture ratio	0.167	lbs. water/lbs. total
Dredge rate	50	cy/hr
Slurry % solids	12	%
Moisture ratio after dewatering	0.4	lbs. water/lbs. total
Dredge rate	5,040	cy/week
Water pumped during dredging	2,142	gal water/min
Water requiring treatment (avg)	1,168	gal water/min
Water requiring treatment (avg)	2,337	gal water/cy till
Cost	$ 13.33	$/cy

Cost Estimate
Summary of All Remedial Alternatives
Waukegan Harbor AOC - Remedial Alternative Array Document and Data Gaps Analysis Report

Alternative Number	Description	Cost
1	No Action	$ -
2	Environmental Sediment Removal and YCL Disposal	$ 18,000,000.00
3	Monitored Natural Recovery, Navigational Channel Sediment Removal, and YCL Disposal	$ 21,000,000.00
4	Capping, Navigational Channel Sediment Removal, and YCL Disposal	$ 25,000,000.00
5	Capping, Limited Navigational Channel Sediment Removal, and YCL Disposal	$ 24,000,000.00
6	Sediment Removal and Near-Site Disposal	$ 31,000,000.00
7	Sediment Removal and JMS/YCL Disposal	$ 33,000,000.00
8	Sediment Removal and YCL Disposal	$ 34,000,000.00
9	Sediment Removal and YCL/Subtitle D Disposal	$ 46,000,000.00

Cost Estimate
Alternative 2 - Environmental Sediment Removal and YCL Disposal
Waukegan Harbor AOC - Remedial Alternative Array Document and Data Gaps Analysis Report

Item	Unit of Measure	# of Units	Cost per Unit	Total Cost
Remedial Design & Permitting (8% of capital costs)	Lump Sum	1	$ 1,000,000.00	$ 1,000,000.00
Mobilization	Lump Sum	1	$ 2,000,000.00	$ 2,000,000.00
Dredging, sediment, not in Marina	Cubic Yard	107,000	$ 9.00	$ 963,000.00
Dredging in Marina, 8" cutterhead	Cubic Yard	67,000	$ 23.00	$ 1,541,000.00
Microdredging in Marina	Cubic Yard	7,000	$ 125.00	$ 875,000.00
Sediment Dewatering	Cubic Yard	181,000	$ 9.00	$ 1,629,000.00
Water Treatment	Million Gallons	254	$ 9,000.00	$ 2,286,000.00
Sediment Trucking	Cubic Yard	181,000	$ 7.00	$ 1,267,000.00
YCL Disposal	Cubic Yard	181,000	$ 4.00	$ 724,000.00
Clean Layer Placement & Capping (Besides Marina)	Cubic Yard	74,000	$ 14.00	$ 1,036,000.00
Clean Layer Placement & Capping in Marina	Cubic Yard	13,000	$ 30.00	$ 390,000.00
Project and Construction Management (12% of capital costs)	Lump Sum	1	$ 1,500,000.00	$ 1,500,000.00
Post-Construction Monitoring	Lump Sum	1	$87,000.00	$ 87,000.00
Contingencies (20% of all costs)	Lump Sum	1	$ 3,100,000.00	$ 3,100,000.00
Total				**$ 18,398,000.00**

Assumptions
Total duration of field effort will be 2 full seasons, including 3 months for preparation of the WCP site.
Mobilization includes setup of water treatment system.
Sediment dewatering includes geotubes and pumping water to clarifier.
Trucking includes removal of material from geotubes.
YCL disposal includes spreading and compacting material in lifts within the landfill cap.
Clean layer placement and capping includes dredging costs (not included under dredging line item).
Post-construction monitoring includes one bathymetic survey and collection and analysis of 20 sediment cores every five years.

Note
Removal and replacement of existing Marina with a floating dock system of comparable size is estimated to be $1,500,000. This would allow the removal of 74,000 cubic yards of sediment in the Marina at a cost of $666,000, rather than $2,416,000, which would be a slight savings overall.

Cost Estimate
Alternative 3 - Monitored Natural Recovery, Navigational Channel Sediment Removal, and YCL Disposal
Waukegan Harbor AOC - Remedial Alternative Array Document and Data Gaps Analysis Report

Item	Unit of Measure	# of Units	Cost per Unit	Total Cost
Remedial Design & Permitting (8% of capital costs)	Lump Sum	1	$ 1,100,000.00	$ 1,100,000.00
Mobilization	Lump Sum	1	$ 2,000,000.00	$ 2,000,000.00
Dredging, sediment, not in Marina	Cubic Yard	127,000	$ 9.00	$ 1,143,000.00
Dredging, till	Cubic Yard	104,000	$ 14.00	$ 1,456,000.00
Sediment and Till Dewatering	Cubic Yard	231,000	$ 9.00	$ 2,079,000.00
Water Treatment	Million Gallons	421	$ 9,000.00	$ 3,789,000.00
Sediment Trucking	Cubic Yard	127,000	$ 7.00	$ 889,000.00
WCP Disposal	Cubic Yard	104,000	$ 6.00	$ 624,000.00
Unconfined Lake Disposal	Cubic Yard	100,000	$ 16.00	$ 1,600,000.00
YCL Disposal	Cubic Yard	127,000	$ 4.00	$ 508,000.00
Project and Construction Management (12% of capital costs)	Lump Sum	1	$ 1,700,000.00	$ 1,700,000.00
Post-Construction Monitoring	Lump Sum	1	$230,000.00	$ 230,000.00
Contingencies (20% of all costs)	Lump Sum	1	$ 3,400,000.00	$ 3,400,000.00
Total				**$ 20,518,000.00**

Assumptions
Total duration of field effort will be 3 full seasons, including 3 months for preparation of the WCP site.
Mobilization includes setup of water treatment system.
Sediment dewatering includes geotubes and pumping water to clarifier.
Trucking includes removal of material from geotubes.
WCP disposal includes removal of material from geotubes, transporting, and compacting in lifts.
Unconfined lake disposal includes dredging costs (not included under dredging line item).
YCL disposal includes spreading and compacting material in lifts within the landfill cap.
Post-construction monitoring includes one bathymetic survey, collection and analysis of 20 sediment cores every five years, and annual fish tissue monitoring.

Cost Estimate
Alternative 4 - Capping, Navigational Channel Sediment Removal, and YCL Disposal
Waukegan Harbor AOC - Remedial Alternative Array Document and Data Gaps Analysis Report

Item	Unit of Measure	# of Units	Cost per Unit	Total Cost
Remedial Design & Permitting (8% of capital costs)	Lump Sum	1	$ 1,400,000.00	$ 1,400,000.00
Mobilization	Lump Sum	1	$ 2,000,000.00	$ 2,000,000.00
Dredging, sediment, not in Marina	Cubic Yard	170,000	$ 9.00	$ 1,530,000.00
Dredging, till	Cubic Yard	127,000	$ 14.00	$ 1,778,000.00
Sediment and Till Dewatering	Cubic Yard	297,000	$ 9.00	$ 2,673,000.00
Water Treatment	Million Gallons	535	$ 9,000.00	$ 4,815,000.00
Sediment Trucking	Cubic Yard	170,000	$ 7.00	$ 1,190,000.00
WCP Disposal	Cubic Yard	127,000	$ 6.00	$ 762,000.00
Unconfined Lake Disposal	Cubic Yard	15,000	$ 16.00	$ 240,000.00
YCL Disposal	Cubic Yard	170,000	$ 4.00	$ 680,000.00
Clean Layer Placement & Capping (Besides Marina)	Cubic Yard	65,000	$ 14.00	$ 910,000.00
Clean Layer Placement & Capping in Marina	Cubic Yard	26,000	$ 30.00	$ 780,000.00
Project and Construction Management (12% of capital costs)	Lump Sum	1	$ 2,100,000.00	$ 2,100,000.00
Post-Construction Monitoring	Lump Sum	1	$87,000.00	$ 87,000.00
Contingencies (20% of all costs)	Lump Sum	1	$ 4,200,000.00	$ 4,200,000.00
Total				**$ 25,145,000.00**

Assumptions

Total duration of field effort will be 3 full seasons, including 3 months for preparation of the WCP site.
Mobilization includes setup of water treatment system.
Sediment dewatering includes geotubes and pumping water to clarifier.
Trucking includes removal of material from geotubes.
WCP disposal includes removal of material from geotubes, transporting, and compacting in lifts.
Unconfined lake disposal includes dredging costs (not included under dredging line item).
YCL disposal includes spreading and compacting material in lifts within the landfill cap.
Clean layer placement and capping includes dredging costs (not included under dredging line item).
Post-construction monitoring includes one bathymetic survey and collection and analysis of 20 sediment cores every five years.

Cost Estimate
Alternative 5 - Capping, Limited Navigational Channel Sediment Removal, and YCL Disposal
Waukegan Harbor AOC - Remedial Alternative Array Document and Data Gaps Analysis Report

Item	Unit of Measure	# of Units	Cost per Unit	Total Cost
Remedial Design & Permitting (3% of capital costs)	Lump Sum	1	$ 1,200,000.00	$ 1,200,000.00
Mobilization	Lump Sum	1	$ 2,000,000.00	$ 2,000,000.00
Dredging, sediment, not in Marina	Cubic Yard	56,000	$ 9.00	$ 504,000.00
Dredging, till	Cubic Yard	28,000	$ 14.00	$ 392,000.00
Sediment and Till Dewatering	Cubic Yard	84,000	$ 9.00	$ 756,000.00
Water Treatment	Million Gallons	144	$ 9,000.00	$ 1,296,000.00
Sediment Trucking	Cubic Yard	56,000	$ 7.00	$ 392,000.00
WCP Disposal	Cubic Yard	28,000	$ 6.00	$ 168,000.00
YCL Disposal	Cubic Yard	56,000	$ 4.00	$ 224,000.00
Clean Layer Placement & Capping (Besides Marina)	Cubic Yard	95,000	$ 14.00	$ 1,330,000.00
Clean Layer Placement & Capping in Marina	Cubic Yard	26,000	$ 30.00	$ 780,000.00
Subsurface Armoring	Square Feet	1,400,000	$ 5.00	$ 7,000,000.00
Project and Construction Management (12% of capital costs)	Lump Sum	1	$ 1,800,000.00	$ 1,800,000.00
Post-Construction Monitoring	Lump Sum	1	$87,000.00	$ 87,000.00
Long-Term Maintenance	Lump Sum	1	$2,219,000.00	$ 2,219,000.00
Contingencies (20% of all costs)	Lump Sum	1	$ 4,000,000.00	$ 4,000,000.00
Total				**$ 24,148,000.00**

Assumptions
Total duration of field effort will be 3 full seasons, including 3 months for preparation of the WCP site.
Mobilization includes setup of water treatment system.
Sediment dewatering includes geotubes and pumping water to clarifier.
Trucking includes removal of material from geotubes.
WCP disposal includes removal of material from geotubes, transporting, and compacting in lifts.
Unconfined lake disposal includes dredging costs (not included under dredging line item).
YCL disposal includes spreading and compacting material in lifts within the landfill cap.
Clean layer placement and capping includes dredging costs (not included under dredging line item).
Post-construction monitoring includes one bathymetic survey, collection and analysis of 20 sediment cores every five years.
Long-term maintenance assumes 100,000 square feet of armored cap require replacement every 3 years.

Cost Estimate
Alternative 6 - Sediment Removal and Near-Site Disposal
Waukegan Harbor AOC - Remedial Alternative Array Document and Data Gaps Analysis Report

Item	Unit of Measure	# of Units	Cost per Unit	Total Cost
Remedial Design & Permitting (8% of capital costs)	Lump Sum	1	$ 1,700,000.00	$ 1,700,000.00
Mobilization	Lump Sum	1	$ 2,300,000.00	$ 2,300,000.00
Dredging, sediment, not in Marina	Cubic Yard	182,000	$ 9.00	$ 1,638,000.00
Dredging in Marina, 8" cutterhead	Cubic Yard	67,000	$ 23.00	$ 1,541,000.00
Microdredging in Marina	Cubic Yard	7,000	$ 125.00	$ 875,000.00
Dredging, till	Cubic Yard	131,000	$ 14.00	$ 1,834,000.00
Sediment and Till Dewatering	Cubic Yard	217,000	$ 9.00	$ 1,953,000.00
Water Treatment	Million Gallons	571	$ 9,000.00	$ 5,139,000.00
CDF Disposal	Cubic Yard	170,000	$ 16.00	$ 2,720,000.00
WCP Disposal	Cubic Yard	150,000	$ 6.00	$ 900,000.00
Unconfined Lake Disposal	Cubic Yard	29,000	$ 16.00	$ 464,000.00
JMS Disposal	Cubic Yard	67,000	$ (1.00)	$ (67,000.00)
Clean Layer Placement & Capping (Besides Marina)	Cubic Yard	51,000	$ 14.00	$ 714,000.00
Clean Layer Placement & Capping in Marina	Cubic Yard	26,000	$ 30.00	$ 780,000.00
Project and Construction Management (12% of capital costs)	Lump Sum	1	$ 2,500,000.00	$ 2,500,000.00
Post-Construction Monitoring	Lump Sum	1	$87,000.00	$ 87,000.00
Long-Term Maintenance	Lump Sum	1	$428,000.00	$ 428,000.00
Contingencies (20% of all costs)	Lump Sum	1	$ 5,100,000.00	$ 5,100,000.00
Total				**$ 30,606,000.00**

Assumptions
Total duration of field effort will be 3 full seasons, including 3 months for preparation of the WCP site.
Mobilization includes setup of water treatment system.
Sediment dewatering includes geotubes and pumping water to clarifier.
WCP disposal includes removal of material from geotubes, transporting, and compacting in lifts.
Unconfined lake disposal includes dredging costs (not included under dredging line item).
JMS disposal assumes value for clean fill delivered to the site.
Clean layer placement and capping includes dredging costs (not included under dredging line item).
Post-construction monitoring includes one bathymetic survey and collection and analysis of 20 sediment cores every five years.
Long-term maintenance assumes $30,000 annually for groundwater pumping and treatment in CDF.

Note
Removal and replacement of existing Marina with a floating dock system of comparable size is estimated to be $1,500,000. This would allow the removal of 74,000 cubic yards of sediment in the Marina at a cost of $666,000, rather than $2,416,000, which would be a slight savings overall.

Cost Estimate
Alternative 7 - Sediment Removal and JMS/YCL Disposal
Waukegan Harbor AOC - Remedial Alternative Array Document and Data Gaps Analysis Report

Item	Unit of Measure	# of Units	Cost per Unit	Total Cost
Remedial Design & Permitting (8% of capital costs)	Lump Sum	1	$ 1,800,000.00	$ 1,800,000.00
Mobilization	Lump Sum	1	$ 2,000,000.00	$ 2,000,000.00
Dredging, sediment, not in Marina	Cubic Yard	201,000	$ 9.00	$ 1,809,000.00
Dredging in Marina, 8" cutterhead	Cubic Yard	67,000	$ 23.00	$ 1,541,000.00
Microdredging in Marina	Cubic Yard	7,000	$ 125.00	$ 875,000.00
Dredging, till	Cubic Yard	131,000	$ 14.00	$ 1,834,000.00
Sediment and Till Dewatering	Cubic Yard	406,000	$ 9.00	$ 3,654,000.00
Water Treatment	Million Gallons	692	$ 9,000.00	$ 6,228,000.00
Sediment Trucking	Cubic Yard	406,000	$ 7.00	$ 2,842,000.00
YCL Disposal	Cubic Yard	256,000	$ 4.00	$ 1,024,000.00
JMS Disposal	Cubic Yard	150,000	$ (1.00)	$ (150,000.00)
Clean Layer Placement & Capping (Besides Marina)	Cubic Yard	74,000	$ 14.00	$ 1,036,000.00
Clean Layer Placement & Capping in Marina	Cubic Yard	13,000	$ 30.00	$ 390,000.00
Project and Construction Management (12% of capital costs)	Lump Sum	1	$ 2,800,000.00	$ 2,800,000.00
Post-Construction Monitoring	Lump Sum	1	$87,000.00	$ 87,000.00
Contingencies (20% of all costs)	Lump Sum	1	$ 5,600,000.00	$ 5,600,000.00
Total				**$ 33,370,000.00**

Assumptions
Total duration of field effort will be 3 full seasons, including 3 months for preparation of the WCP site.
Mobilization includes setup of water treatment system.
Sediment dewatering includes geotubes and pumping water to clarifier.
Trucking includes removal of material from geotubes.
YCL disposal includes spreading and compacting material in lifts within the landfill cap.
JMS disposal assumes value for clean fill delivered to the site.
Clean layer placement and capping includes dredging costs (not included under dredging line item).
Post-construction monitoring includes one bathymetic survey and collection and analysis of 20 sediment cores every five years.

Note
Removal and replacement of existing Marina with a floating dock system of comparable size is estimated to be $1,500,000. This would allow the removal of 74,000 cubic yards of sediment in the Marina at a cost of $666,000, rather than $2,416,000, which would be a slight savings overall.

Cost Estimate
Alternative 8 - Sediment Removal and YCL Disposal
Waukegan Harbor AOC - Remedial Alternative Array Document and Data Gaps Analysis Report

Item	Unit of Measure	# of Units	Cost per Unit	Total Cost
Remedial Design & Permitting (8% of capital costs)	Lump Sum	1	$ 1,900,000.00	$ 1,900,000.00
Mobilization	Lump Sum	1	$ 2,000,000.00	$ 2,000,000.00
Dredging, sediment, not in Marina	Cubic Yard	201,000	$ 9.00	$ 1,809,000.00
Dredging in Marina, 8" cutterhead	Cubic Yard	67,000	$ 23.00	$ 1,541,000.00
Microdredging in Marina	Cubic Yard	7,000	$ 125.00	$ 875,000.00
Dredging, till	Cubic Yard	131,000	$ 14.00	$ 1,834,000.00
Sediment and Till Dewatering	Cubic Yard	406,000	$ 9.00	$ 3,654,000.00
Water Treatment	Million Gallons	692	$ 9,000.00	$ 6,228,000.00
Sediment Trucking	Cubic Yard	406,000	$ 7.00	$ 2,842,000.00
YCL Disposal	Cubic Yard	406,000	$ 4.00	$ 1,624,000.00
Clean Layer Placement & Capping (Besides Marina)	Cubic Yard	74,000	$ 14.00	$ 1,036,000.00
Clean Layer Placement & Capping in Marina	Cubic Yard	13,000	$ 30.00	$ 390,000.00
Project and Construction Management (12% of capital costs)	Lump Sum	1	$ 2,900,000.00	$ 2,900,000.00
Post-Construction Monitoring	Lump Sum	1	$87,000.00	$ 87,000.00
Contingencies (20% of all costs)	Lump Sum	1	$ 5,700,000.00	$ 5,700,000.00
Total				**$ 34,420,000.00**

Assumptions
Total duration of field effort will be 3 full seasons, including 3 months for preparation of the WCP site.
Mobilization includes setup of water treatment system.
Sediment dewatering includes geotubes and pumping water to clarifier.
Trucking includes removal of material from geotubes.
YCL disposal includes spreading and compacting material in lifts within the landfill cap.
Clean layer placement and capping includes dredging costs (not included under dredging line item).
Post-construction monitoring includes one bathymetic survey and collection and analysis of 20 sediment cores every five years.

Note
Removal and replacement of existing Marina with a floating dock system of comparable size is estimated to be $1,500,000. This would allow the removal of 74,000 cubic yards of sediment in the Marina at a cost of $666,000, rather than $2,416,000, which would be a slight savings overall.

Cost Estimate
Alternative 9 - Sediment Removal and YCL/Subtitle D Disposal
Waukegan Harbor AOC - Remedial Alternative Array Document and Data Gaps Analysis Report

Item	Unit of Measure	# of Units	Cost per Unit	Total Cost
Remedial Design & Permitting (8% of capital costs)	Lump Sum	1	$ 2,500,000.00	$ 2,500,000.00
Mobilization	Lump Sum	1	$ 2,000,000.00	$ 2,000,000.00
Dredging, sediment, not in Marina	Cubic Yard	201,000	$ 9.00	$ 1,809,000.00
Dredging in Marina, 8" cutterhead	Cubic Yard	67,000	$ 23.00	$ 1,541,000.00
Microdredging in Marina	Cubic Yard	7,000	$ 125.00	$ 875,000.00
Dredging, till	Cubic Yard	131,000	$ 14.00	$ 1,834,000.00
Sediment and Till Dewatering	Cubic Yard	406,000	$ 9.00	$ 3,654,000.00
Water Treatment	Million Gallons	692	$ 9,000.00	$ 6,228,000.00
Sediment Trucking	Cubic Yard	406,000	$ 7.00	$ 2,842,000.00
YCL Disposal	Cubic Yard	150,000	$ 4.00	$ 600,000.00
Subtitle D Disposal	Cubic Yard	256,000	$ 35.00	$ 8,960,000.00
Clean Layer Placement & Capping (Besides Marina)	Cubic Yard	74,000	$ 14.00	$ 1,036,000.00
Clean Layer Placement & Capping in Marina	Cubic Yard	13,000	$ 30.00	$ 390,000.00
Project and Construction Management (12% of capital costs)	Lump Sum	1	$ 3,800,000.00	$ 3,800,000.00
Post-Construction Monitoring	Lump Sum	1	$87,000.00	$ 87,000.00
Contingencies (20% of all costs)	Lump Sum	1	$ 7,600,000.00	$ 7,600,000.00
Total				**$ 45,756,000.00**

Assumptions
Total duration of field effort will be 3 full seasons, including 3 months for preparation of the WCP site.
Mobilization includes setup of water treatment system.
Sediment dewatering includes geotubes and pumping water to clarifier.
Trucking includes removal of material from geotubes.
YCL disposal includes spreading and compacting material in lifts within the landfill cap.
Clean layer placement and capping includes dredging costs (not included under dredging line item).
Post-construction monitoring includes one bathymetic survey and collection and analysis of 20 sediment cores every five years.

Note
Removal and replacement of existing Marina with a floating dock system of comparable size is estimated to be $1,500,000. This would allow the removal of 74,000 cubic yards of sediment in the Marina at a cost of $666,000, rather than $2,416,000, which would be a slight savings overall.