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DEPARTMENT OF THE ARMY

BUFFALO DISTRICT, CORPS OF ENGINEERS
1776 NIAGARA STREET
BUFFALO, NEW YORK 14207-3199

REPLY TO
ATTENTION OF

October 14, 2011

Environmental Analysis Team

SUBJECT: Cleveland Harbor, Cuyahoga County, Ohio - Request for Section 401 Water Quality Certification for Scheduled 2012 Maintenance Dredging Project

2011 OCT 18 AM 10:03

OHIO EPA - DSW

Mr. Scott J. Nally
Director
Ohio Environmental Protection Agency
Division of Surface Water
P.O. Box 1049
Columbus, Ohio 43216-1049

Dear Mr. Nally:

Enclosed for your review and comment is the Section 404(a) Public Notice and Section 401 State Water Quality Certification (WQC) application for our scheduled 2012 maintenance dredging project at Cleveland Harbor, Ohio. This project entails the maintenance dredging of authorized Federal navigation channels, and placement of the associated dredged material in the Harbor's existing dredged material confined disposal facilities (CDFs). The Public Notice has been prepared in conformance with U.S. Army Corps of Engineers (USACE) regulation, "Practice and Procedure: Final Rule for Operation and Maintenance of Army Corps of Engineers Civil Works Projects involving the Discharge of Dredged Materials into Waters of the United States or Ocean Waters," 33 Code of Federal Regulations (CFR) 337.1.

The USACE, Buffalo District, is requesting Ohio Environmental Protection Agency (OEPA) WQC for the scheduled 2012 maintenance dredging project at Cleveland Harbor, or waiver thereof, under Section 401 of the Clean Water Act.

The following items are contained within this package:

a. Enclosure 1 is the Section 404(a) Public Notice.
b. Enclosure 2 is our Section 401 WQC application.
c. Enclosure 3 is an aerial photograph of Cleveland Harbor.
d. Enclosures 4 and 5 are contract drawings depicting the minimum degradation and preferred alternatives.
e. Enclosure 6 is most recent Tiered Evaluation on channel sediments.

SUBJECT: Cleveland Harbor, Cuyahoga County, Ohio - Request for Section 401 Water Quality Certification for Scheduled 2012 Maintenance Dredging Project

Please note that all associated National Environmental Policy Act (NEPA) documents (Environmental Impact Statements and Environmental Assessments) and Section 404(b)(1) Evaluations have been completed for this maintenance dredging project, and were previously furnished to your office. The majority of the information requested in Item 10 of the WQC application is contained in these documents in further detail.

During the 2011 dredging season, USACE undertook a study designed to characterize the spatial dimensions and suspended sediment concentration gradients of plumes generated during maintenance dredging of the Cuyahoga River. These data can be used to evaluate risks posed by the plumes for selected resources and to support decisions regarding the need to apply protective management practices during dredging in the Cuyahoga River. The report documenting this study is currently under review by USACE - Buffalo District personnel and will be shared with OEPA and ODNR when complete.

As you know, we require WQC in order to accept contract bids on this project. The bid opening date has been scheduled for March 10, 2012 and our goal is to secure the WQC by March 7, 2012. Therefore, we ask that you schedule the Public Hearing on this application at your earliest possible convenience. Please advise us regarding the status of the WQC by November 29, 2011. We appreciate your cooperation in this matter.

Questions pertaining to this matter should be directed to Mr. Eric E. Hannes at (716) 879-4311, by writing to the following address: U.S. Army Corps of Engineers, 1776 Niagara Street, Buffalo, New York, 14207-3199, or by e-mail at: Eric.E.Hannes@usace.army.mil.

Sincerely,

William E. Butler III
Acting Team Leader
Environmental Analysis Team

Enclosures

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US Army Corps of Engineers

Public Notice

Issuing Office: CELRB-PM-EA
Notice No: CLEVELAND-12

Published: 14 OCT 2011
Expires: 13 NOV 2011

OPERATION AND MAINTENANCE DREDGING AND DREDGED MATERIAL PLACEMENT

CLEVELAND HARBOR

CUYAHOGA COUNTY, OHIO

This Public Notice has been prepared and distributed in conformance with U.S. Army Corps of Engineers (USACE) regulation, "Practice and Procedure: Final Rule for Operation and Maintenance of Army Corps of Engineers Civil Works Projects involving the Discharge of Dredged Materials into Waters of the United States or Ocean Waters," 33 Code of Federal Regulations (CFR) 337.1. Its purpose is to specify what dredged/fill materials would be discharged into waters of the United States by implementation of the proposed action, and advise all interested parties of the proposed project and to provide an opportunity to submit comments, or request a public hearing.

The USACE-Buffalo District anticipates the need to dredge and place material excavated from the Federal navigation channels of the Cleveland Harbor project, including the Cuyahoga River, Old River, Lake Approach Channel, and Outer Harbor Channel, in order to maintain sufficient depth for deep-draft commercial vessels. The attached map (Figure 1) shows the authorized limits and depths of the Federal navigation channels. To insure the minimum authorized depth in the Cuyahoga River Channel is maintained throughout the shipping season, an additional four feet of shoal may be removed, including one foot of overdepth and three feet of advance maintenance dredging. An estimated total of up to 300,000 cubic yards of material will be dredged from Cleveland Harbor Federal navigation channels during the 2012 dredging operation.

The 2012 dredging operation at Cleveland Harbor is tentatively scheduled to be performed during the period between 1 April and 31 December.

A contractor of the Federal government will accomplish the project. Sediments will be removed from the channel bottom by a mechanical or hydraulic dredge and placed into hoppers aboard ship or scow for transport to the placement areas. The method of excavation will be determined by the contractor performing the maintenance dredging. In previous years, clamshell and hopper dredges have been used to complete the required work.

The material to be dredged from the Cleveland Harbor Federal navigation channels consists primarily of silts and clays, with some sands and gravels. The quality of the material has been evaluated using 2007 sediment data in accordance with the protocols and guidelines contained in the U.S. Environmental Protection Agency (USEPA)/USACE Great Lakes Dredged Material Testing and Evaluation Manual (1998). This evaluation concluded that sediments in the Cleveland Harbor Federal navigation channels are not toxicologically comparable to sediments at the open-lake reference area in Lake Erie. Therefore, material dredged from Cleveland Harbor does not meet Federal guidelines for open-lake placement. Consequently, all of the dredged material will be placed in either confined disposal facility (CDF) No. 9, CDF No. 10B or CDF No. 12, all of which are located in the Cleveland Outer Harbor (Figure 2).

Bottom material that is dredged from the upstream end of the Cuyahoga River Channel (between approximate Stations 799+00 [upstream limit of the channel] and 787+00; see Figure 1) may contain a significant fraction of sands and gravels, intermixed with silts and clays. This material was sampled and analyzed in 2007 to specifically re-evaluate its suitability for littoral nourishment, and was re-affirmed to be unsuitable for open-lake placement. This determination is consistent with the results of 1997 and 2002 sediment testing, which indicated the material within this reach of channel was unsuitable for open-lake placement based on the results of prescribed acute toxicity tests (bioassays). Based on a review of the data, it also does not appear to meet Ohio Environmental Protection Agency (OEPA) criteria pertaining to the use of dredged material for littoral nourishment.

Water Quality Certification (WQC) from the Ohio Environmental Protection Agency (OEPA) is required for this action, pursuant to Section 401 of the Clean Water Act. Therefore, a copy of this Public Notice has been provided to OEPA requesting WQC for the associated placement of dredged material and resultant overflow effluent from CDF Nos. 9, 10B and 12.

The environmental effects of the dredging operation are documented in the ***Final Environmental Impact Statement (FEIS), Operation and Maintenance, Cleveland Harbor, Ohio (1974); and FEIS, Harbor Maintenance and Confined Disposal Facility Site 10B, Cleveland Harbor, Ohio (1994).*** These documents, and supplemental documentation, have been submitted to USEPA. Copies are available for examination at the Buffalo District office.

There are no listed historic properties or properties determined as being eligible for listing in the National Register of Historic Places that will be affected by this project. By this notice, the National Park Service is advised that currently unknown archaeological, scientific, prehistorical or historical data may be lost or destroyed by the work to be accomplished.

This office has determined that the proposed project will have No Effect upon any species proposed or designated by the U.S. Department of the Interior as threatened or endangered, nor will the proposed work result in an Adverse Modification of designated critical habitat for any such species. Therefore, unless new information indicates otherwise, no further consultation pursuant to Section 7 of the Endangered Species Act Amendments of 1978 will be undertaken with the U.S. Fish and Wildlife Service.

This work will be undertaken in a manner consistent, to the maximum extent practicable, with the State of Ohio Coastal Management Program. A Coastal Management Program Federal Consistency Determination has been submitted to the Ohio Department of Natural Resources (ODNR) documenting this determination.

The decision whether to perform dredging has been based on an evaluation of the probable impact, including cumulative impacts of the proposed activity on the public interest. That decision reflects the national concern for both protection and utilization of important resources. The benefit which is reasonably expected to accrue from the proposal has been balanced against its reasonably foreseeable detriments. All factors which may be relevant to the proposal have been considered including the cumulative factors thereof; among those are conservation, economics, aesthetics, general environmental concerns, wetlands, historic properties, fish and wildlife values, flood hazards, floodplain values, land use, navigation, shoreline erosion and accretion, recreation, water supply and conservation, water quality, energy needs, safety, food and fiber production, mineral needs, considerations of property ownership and, in general, the needs and welfare of the people.

This activity is being coordinated with the following agencies, as well as other appropriate Federal, State and local agencies and organizations:

Ohio Department of Natural Resources
Ohio Environmental Protection Agency
Ohio Historic Preservation Office
U.S. Coast Guard
U.S. Department of the Interior, Fish and Wildlife Service
U.S. Environmental Protection Agency

Any interested parties and/or agencies desiring to express their views concerning these proposed discharges of dredged material may do so by filing their comments, in writing, no later than 30 days from the date of this notice. Any person who has an interest which may be affected by the discharge of this dredged material may request a public hearing. The request must be submitted in writing to the undersigned within 30 days of the date of this Public Notice. The request must clearly set forth the interest which may be affected, and the manner in which the interest may be affected, by this activity.

Questions and comments concerning this project should be directed to Mr. Eric E. Hannes of my Environmental Analysis Team who may be contacted by calling (716) 879-4311 (FAX 716-879-4225); e-mail: Eric.E.Hannes@usace.army.mil, or by writing to the following address:

District Commander
Department of the Army
U.S. Army Engineer District, Buffalo
Environmental Analysis Team
1776 Niagara Street
Buffalo, New York 14207-3199

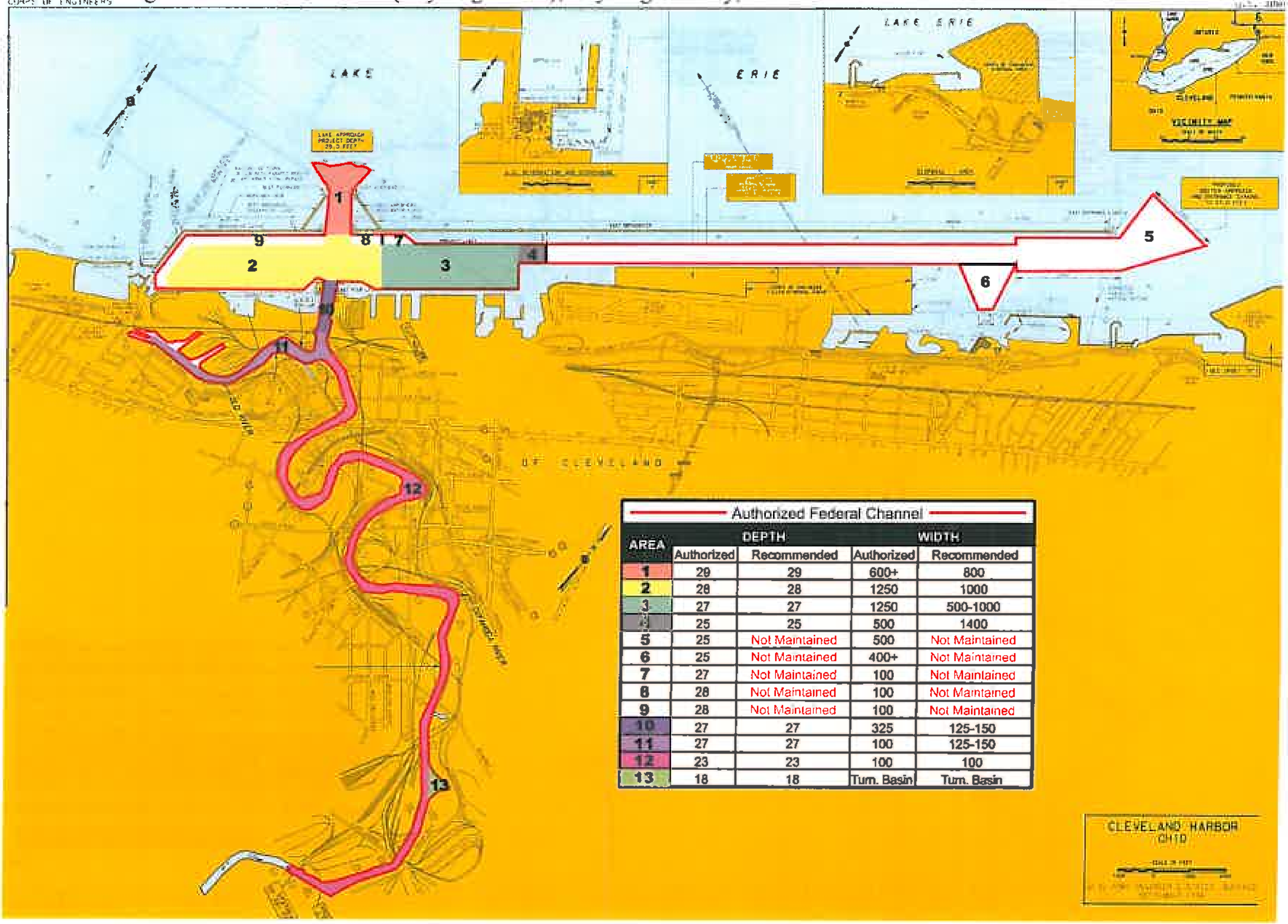
This Public Notice is published in conformance with 33 CFR 337.1. All dredging and dredged material discharge will be performed in conformance with Sections 313 and 404 of the Clean Water Act (33 USC 1323 and 1344, respectively).

William E. Butler III
Acting Team Leader
Environmental Analysis Team

Attachments

NOTICE TO THE POSTMASTER: It is requested that the above notice be conspicuously displayed for 30 days from the date of issuance.

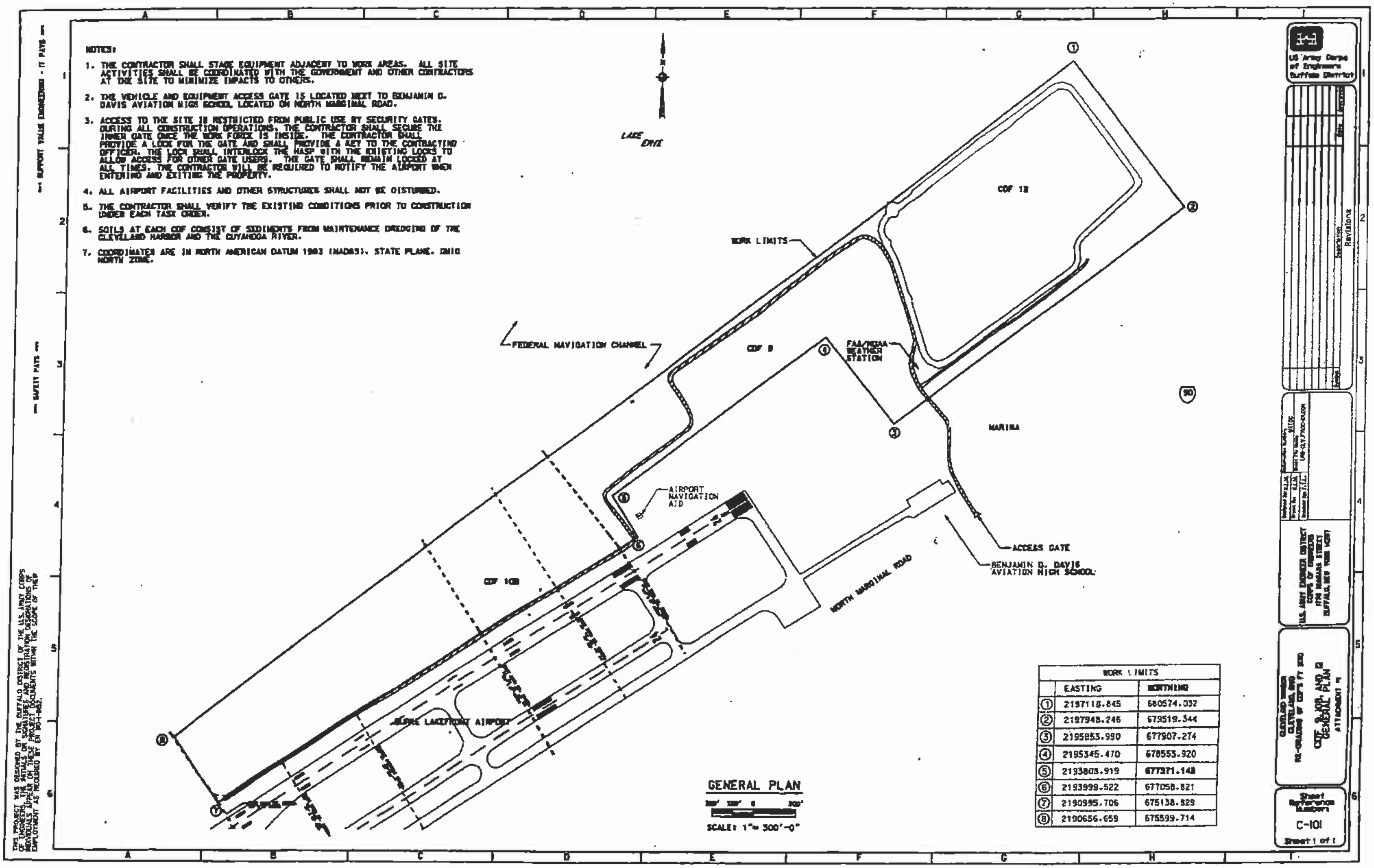
Figure 1 - Cleveland Harbor (Cuyahoga River), Cuyahoga County, Ohio.



AREA	DEPTH		WIDTH	
	Authorized	Recommended	Authorized	Recommended
1	29	29	600+	800
2	28	28	1250	1000
3	27	27	1250	500-1000
4	25	25	500	1400
5	25	Not Maintained	500	Not Maintained
6	25	Not Maintained	400+	Not Maintained
7	27	Not Maintained	100	Not Maintained
8	28	Not Maintained	100	Not Maintained
9	28	Not Maintained	100	Not Maintained
10	27	27	325	125-150
11	27	27	100	125-150
12	23	23	100	100
13	18	18	Turn. Basin	Turn. Basin

Authorized Federal Channel

FIGURE 2. Dredged material Confined Disposal Facilities (CDFs), Cleveland Harbor, Cuyahoga County, Ohio,



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APPLICATION FOR OHIO EPA
SECTION 401 WATER QUALITY CERTIFICATION

Effective October 1, 1996
Revised August, 1998

This application must be completed whenever a proposed activity requires an individual Clean Water Act Section 401 Water Quality Certification (Section 401 certification) from Ohio EPA. A Section 401 certification from the State is required to obtain a federal Clean Water Act Section 404 permit from the U.S. Army Corps Engineers, or any other federal permits or licenses for projects that will result in a discharge of dredged or fill material to any waters of the State. To determine whether you need to submit this application to Ohio EPA, contact the U.S. Army Corps of Engineers District Office with jurisdiction over your project, or other federal agencies reviewing your application for a federal permit to discharge dredged or fill material to waters of the State, or an Ohio EPA Section 401 Coordinator at (614) 644-2001.

The Ohio EPA Section 401 Water Quality Certification Program is authorized by Section 401 of the Clean Water Act (33 U.S.C. 1251) and the Ohio Revised Code Section 6111.03(P). Ohio Administrative Code (OAC) Chapter 3745-32 outlines the application process and criteria for decision by the Director of Ohio EPA. In order for Ohio EPA to issue a Section 401 certification, the project must comply with Ohio's Water Quality Standards (OAC 3745-1) and not potentially result in an adverse long-term or short-term impact on water quality. Included in the Water Quality Standards is the Antidegradation Rule (OAC Rule 3745-1-05), effective October 1, 1996, revised October, 1997 and May, 1998. The Rule includes additional application requirements and public participation procedures. **Because there is a lowering of water quality associated with every project being reviewed for Section 401 certification, every Section 401 certification applicant must provide the information required in Part 10 (pages 3 and 4) of this application.** In addition, applications for projects that will result in discharges of dredged or fill material to wetlands must include a wetland delineation report approved by the Corps of Engineers, a wetland assessment with a proposed assignment of wetland category (ies), official documentation on evaluation of the wetland for threatened or endangered species, and appropriate avoidance, minimization, and mitigation as prescribed in OAC 3745-1-50 to 3745-1-54. Ohio EPA will evaluate the applicant's proposed wetland category assignment and make the final assignment.

Information provided with the application will be used to evaluate the project for certification and is a matter of public record. If the Director determines that the application lacks information necessary to determine whether the applicant has demonstrated the criteria set forth in OAC Rule 3745-32-05(A) and OAC Chapter 3745-1, Ohio EPA will inform the applicant in writing of the additional information that must be submitted. The application will not be accepted until the application is considered complete by the Section 401 Coordinator. An Ohio EPA Section 401 Coordinator will inform you in writing when your application is determined to be complete.

Please submit the following to "Section 401 Supervisor, Ohio EPA/DSW, P.O. Box 1049, Columbus, Ohio 43216-1049:

- Four (4) sets of the completed application form, including the location of the project (preferably on a USGS quadrangle) and 8-1/2 x 11" scaled plan drawings and sections.
- One (1) set of original scaled plan drawings and cross-sections (or good reproducible copies).

(See Application Primer for detailed instructions)

1. The federal permitting agency has determined this project: (check appropriate box and fill in blanks)

   a. X requires an individual 404 permit/401 certification- Public Notice # (if known) CLEVELAND-12

   b.____ requires a Section 401 certification to be authorized by Nationwide Permit #____________

   c.____ requires a modified 404 permit/401 certification for original Public Notice #____________

   d.____ requires a federal permit under ____________ jurisdiction identified by #____________

   e.____ requires a modified federal permit under____________ jurisdiction identified by #____________

Enclosure 2

2. Application number (to be assigned by Ohio EPA):

3. Name and address of applicant:
William E. Butler III
U.S. Army Corps of Engineers, Buffalo District
1776 Niagara Street
Buffalo, NY 14207-3199

Telephone number during business hours:
(________)____________________(Residence)
(716) 879-4268 (Office)

3a. Signature of Applicant: Will E. Butler III Date: 10/13/11

4. Name, address and title of authorized agent:
Eric E. Hannes
U.S. Army Corps of Engineers, Buffalo District
1776 Niagara Street
Buffalo, NY 14207-3199

Telephone number during business hours:
(________)____________________(Residence)
(716) 879-4311 (Office)

4a. Statement of Authorization: I hereby designate and authorize the above-named agent to act in my behalf in the processing of this permit application, and to furnish, upon request, supplemental information in support of the application.

Signature of Applicant: Will E. Butler III Date: 10/13/11

5. Location on land where activity exists or is proposed. Indicate coordinates of a fixed reference point at the impact site (if known) and the coordinate system and datum used.

Address:
SEE ATTACHED CONTINUATION SHEET

Street, Road, Route, and Coordinates, or other descriptive location

Watershed	County	Township	City	State	Zip Code

6. Is any portion of the activity for which authorization is sought complete? ______ Yes X No
If answer is "yes," give reasons, month and year activity was completed. Indicate the existing work on the drawings.

7. List all approvals or certifications and denials received from other federal, interstate, state or local agencies for any structures, construction, discharge or other activities described in this application.

Issuing Agency	Type of Approval	Identification No.	Date of Application	Date of Approval	Date of Denial

SEE ATTACHED CONTINUATION SHEET

8. **DESCRIPTION OF THE ACTIVITY (fill in information in the following four blocks - 8a, 8b, 8c & 9)**

8a. Activity: Describe the Overall Activity:

SEE ATTACHED CONTINUATION SHEET

8b. Purpose: Describe the purpose, need and intended use of the activity:

SEE ATTACHED CONTINUATION SHEET

8c. Discharge of dredged or fill material: Describe type, quantity of dredged material (in cubic yards), and quantity of fill material (in cubic yards). **(OAC 3745-1-05(B)(2)(a))**

SEE ATTACHED CONTINUATION SHEET

9. Waterbody and location of waterbody or upland where activity exists or is proposed, or location in relation to a stream, lake, wetland, wellhead or water intake (if known). Indicate the distance to, and the name of any receiving stream, if appropriate.

SEE ATTACHED CONTINUATION SHEET

10. To address the requirements of the Antidegradation Rule, your application must include a report evaluating the:

- Preferred Design (your project) and Mitigative Techniques
- Minimal Degradation Alternative(s) (scaled-down version(s) of your project) and Mitigative Techniques
- Non-Degradation Alternative(s) (project resulting in avoidance of all waters of the state)

At a minimum, item a) below must be completed for the Preferred Design, the Minimal Degradation Alternative(s), and the Non-Degradation Alternative(s), followed by completion of item b) for each alternative, and so on, until all items have been discussed for each alternative (see Primer for specific instructions). (Application and review requirements appear at **OAC 3745-1-05(B)(2), OAC 3745-1-05(C)(6), OAC 3745-1-05(C)(1) and OAC 3745-1-54**).

10a) Provide a detailed description of any construction work, fill or other structures to occur or to be placed in or near the surface water. Identify all substances to be discharged, including the cubic yardage of dredged or fill material to be discharged to the surface water. **(OAC 3745-1-05(B)(2)(b))**

10b) Describe the magnitude of the proposed lowering of water quality. Include the anticipated impact of the proposed lowering of water quality on aquatic life and wildlife, including threatened and endangered species (include written comments from Ohio Department of Natural Resources and U.S. Fish and Wildlife Service), important commercial or recreational sport fish species, other individual species, and the overall aquatic community structure and function. Include a Corps of Engineers approved wetland delineation. **(OAC 3745-1-05(C)(6)(a, b) and OAC 3745-1-54)**

10c) Include a discussion of the technical feasibility, cost effectiveness, and availability. In addition, the reliability of each alternative shall be addressed (including potential recurring operational and maintenance difficulties that could lead to increased surface water degradation.) **(OAC 3745-1-05(C)(6)(h, j-k) and OAC 3745-1-54)**

10d) For regional sewage collection and treatment facilities, include a discussion of the technical feasibility, cost effectiveness and availability, and long-range plans outlined in state or local water quality management planning documents and applicable facility planning documents. **(OAC 3745-1-05(C)(6)(i))**

10e) To the extent that information is available, list and describe any government and/or privately sponsored conservation projects that exist or may have been formed to specifically target improvement of water quality or enhancement of recreational opportunities on the affected water resource. **(OAC 3745-1-05(B)(2)(g))**

10f) Provide an outline of the costs of water pollution controls associated with the proposed activity. This may include the cost of best management practices to be used during construction and operation of the project. **(OAC 3745-01-05(C)(6)(g))**

10g) Describe any impacts on human health and the overall quality and value of the water resource. **(OAC 3745-1-05(C)(6)(c) and OAC 3745-1-54)**

10h) Describe and provide an estimate of the important social and economic benefits to be realized through this project. Include the number and types of jobs created and tax revenues generated and a brief discussion on the condition of the local economy. **(OAC 3745-1-5(B)(2)(e), and OAC 3745-1-05(C)(6)(i))**

10i) Describe and provide an estimate of the important social and economic benefits that may be lost as a result of this project. Include the effect on commercial and recreational use of the water resource, including effects of lower water quality on recreation, tourism, aesthetics, or other use and enjoyment by humans. **(OAC 3745-1-05(B)(2)(e,f), and OAC 3745-1-05(C)(6)(e))**

10j) Describe environmental benefits, including water quality, lost and gained as a result of this project. Include the effects on the aquatic life, wildlife, threatened or endangered species. **(OAC 3745-1-05 (B)(2)(e,f), OAC 3745-1-05 (C)(6)(b) and OAC 3745-1-54)**

10k) Describe mitigation techniques proposed (except for the Non-Degradation Alternative):

- Describe proposed Wetland Mitigation (see **OAC 3745-1-54** and Primer)
- Describe proposed Stream, Lake, Pond Mitigation (see Primer)

11. Application is hereby made for a Section 401 Water Quality Certification. I certify that I am familiar with the information contained in this application and, to the best of my knowledge and belief, such information is true, complete and accurate. I further certify that I possess the authority to undertake the proposed activities or I am acting as the duly authorized agent of the applicant.

Will E. Bird III — 10/13/11 — C. E. [signature]

Signature of Applicant — Date — Signature of Agent

The application must be signed by the person who desires to undertake the proposed activity (applicant) or it may be signed by a duly authorized agent if the statement in Block 3 has been filled out and signed.

Do not send a certification processing fee with this application. The appropriate fee will be assessed when a certification is issued.

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CONTINUATION SHEET

Application for OEPA Section 401 State Water Quality Certification

CLEVELAND HARBOR
MAINTENANCE DREDGING PROJECT

5. The project is located in Cleveland Harbor, Cuyahoga County, Ohio. The latitude/longitude of the dredging activity (near the head of navigation in the upper river) is 41°27'54"N/81°40'27"W. The latitude/longitude of the center of each confined disposal facility (CDF) is: CDF No. 9: 41°31'36"N/81°40'22"W; CDF No. 10B: 41°31'14"N/81°40'57"W; and CDF No. 12: 41°31'44"N/81°39'58"W.

7. Final Environmental Impact Statement (FEIS), Operation and Maintenance, Cleveland Harbor, Ohio

< Issuing Agency - U.S. Army Corps of Engineers
< Type of Approval - Record of Decision (ROD) and Section 404(b)(1) Evaluation
< Date of Application - January 1972
< Date of Approval - April 1974

FEIS and Section 404(b)(1) Evaluation for Confined Disposal Facility No. 10B, Cleveland Harbor, Ohio

< Issuing Agency - U.S. Army Corps of Engineers
< Type of Approval - Record of Decision (ROD) and Section 404(b)(1) Evaluation
< Date of Application - January 1993
< Date of Approval - March 1994

8a. The project will entail the maintenance dredging of sediments from the authorized Federal navigation channels of Cleveland Harbor, Cuyahoga County, Ohio. The channels will be dredged to the authorized depth. To ensure that the minimum depth in the Cuyahoga River Channel is maintained throughout the shipping season, an additional four feet of shoal may be removed including one foot of overdepth and three feet of advance maintenance dredging. Approximately 300,000 cubic yards of sediments will be dredged from the harbor in 2012. The dredging is scheduled to occur between 1 April and 31 December 2012. The project will be accomplished by a contractor of the Federal government. The project is described in further detail in the attached Public Notice.

8b. The purpose of the project is to maintain sufficient water depths for commercial navigation in Cleveland Harbor. This project was congressionally authorized by the 1875, 1886, 1888, 1896, 1899, 1902, 1907, 1910, 1916, 1917, 1935, 1937, 1945, 1958, 1960 and 1962 River and Harbor Acts, 1976 and 1986 Water Resources Development Acts, 1985 Supplemental Appropriations Act and 1988 Energy and Water Appropriations Act. Cleveland Harbor is the 51st leading port in the United States and is ranked 7th among Great Lakes Ports (2nd on Lake Erie) with 12.8 million tons of material shipped or received in 2007. Commodities shipped or received include iron ore, limestone, sand and gravel, salt, cement and concrete, general cargo and liquid bulk. The Harbor contains a major iron ore transshipment facility that provides iron ore to inland steel mills at lower delivery costs when compared to truck or direct rail delivery, and also ships more than one million tons of salt annually that is used by local municipalities for road deicing. Bulk commodities that pass through the Harbor generate approximately $159 million dollars annually in direct revenue which supports over 2,611 jobs. These jobs generate over $96 million dollars per year in personal income.

8c. Approximately 300,000 cubic yards of sediments will be dredged from the harbor in 2012. The material to be dredged from the Cleveland Harbor Federal navigation channels consists primarily of silts and clays, with some sands and gravels. The quality of the material has been evaluated using 2007 sediment data in accordance with the protocols and guidelines contained in the U.S. Environmental Protection Agency (USEPA)/USACE Great Lakes Dredged Material Testing and Evaluation Manual (1998). This evaluation concluded that sediments in the Cleveland Harbor Federal navigation channels are not toxicologically comparable to sediments at the open-lake reference area in Lake Erie. Therefore, material dredged from Cleveland Harbor does not meet Federal guidelines for open-lake placement. Consequently, all of the dredged material will be placed in either confined disposal facility (CDF) No. 9, CDF No. 10B or CDF No. 12, all of which are located in the Cleveland Outer Harbor.

9. The dredging portion of the project is located in Cleveland Harbor, which is located at the mouth of the Cuyahoga River (a major tributary to Lake Erie) and within the Cuyahoga River. The Cuyahoga River and Lake Erie are the receiving water for dredging activities, and Lake Erie is the receiving water for dredged material placement activities (via CDF weir discharges).

10. Information required under this item is included in the above noted FEISs and Section 404(b)(1) Evaluation prepared for the project and furnished to OEPA. The following is a summary of the information contained in these documents that apply to this item of the application:

10a) Descriptions.

(1) _Preferred Design Alternative_: This alternative would entail the dredging of an estimated 675,000 cubic yards of material in 2012, with the placement of the dredged material at the existing Cleveland Harbor CDFs. The type of equipment used to complete the maintenance dredging operation would be selected by the contractor performing the work. Dredging would not be performed during Lake Erie storm events. A contractor of the Federal government would accomplish the project. The project would take about 120 to 150 days to complete.

(2) _Non-Degradation Alternative_: This is the "No Action" alternative. No construction or filling of surface waters would occur as a result of this alternative.

(3) _Minimum Degradation Alternative_: This alternative would entail the dredging of an estimated 300,000 cubic yards of dredged material from the Federal navigation channels in 2012, with the placement of the dredged material at the existing Cleveland Harbor CDFs. The type of

equipment used to complete the maintenance dredging operation would be selected by the contractor performing the work. Dredging would not be performed during Lake Erie storm events. This project would take about 90 to 120 days to complete.

Note that the Minimum Degradation Alternative estimates dredging 375,000 cubic yards less than the Preferred Design Alternative. It is estimated that dredging activities specified in the Minimum Degradation Alternative will impact an estimated 40 acres less of channel bottom/habitat than what would be impacted under the Preferred Design Alternative. The estimated length of stream to be dredged under the Preferred Design and Minimum Degradation Alternatives are 23,300 and 10,000 linear feet, respectively. Note that the actual shoal thickness cannot be determined until just before the dredging begins. In addition, shoal thickness will vary throughout the harbor and greatly depend on weather conditions. Therefore, the above quantities are merely estimates regarding the acreage of Federal navigation channel to be dredged/impacted under either alternative.

10b) Water Quality Impacts.

(1) *Preferred Design Alternative*: The material that would be dredged under this alternative consists of sediments that have been deposited in the Federal navigation channels since the last maintenance dredging effort. These types of sediments are homogenous and residually contaminated with pollutants that are ubiquitous throughout the Great Lakes. As such, these sediments, although not virgin material with high levels of pollutants, contain levels of contaminants that are elevated in relation to Lake Erie background levels and should be confined from the aquatic environment after dredging. A characterization of this material is contained in the sediment evaluation included as Enclosure 6 of the application package. This alternative would result in a short-term, negligible lowering of ambient water quality. Dredging and placement activities would result in excavation, smothering, and mortality of benthic macroinvertebrates, and the temporary avoidance of work areas during the dredging operation by fish and wildlife species (i.e., mostly waterfowl). Following dredging and placement activities, benthic communities would recolonize the impacted areas, and fish and wildlife would return. The dredging area is industrialized, so benthic, fish and wildlife use of the water resource is limited; therefore, impacts in this regard would be minor. No impacts to threatened or endangered species would occur from dredging or placement of dredged material.

(2) *Non-Degradation Alternative*: Since this alternative involves no construction or filling of surface waters, no lowering of water quality would result.

(3) *Minimum Degradation Alternative*: The material that would be dredged under this alternative consists of sediments that have been deposited in the Federal navigation channels since the last maintenance dredging effort. These types of sediments are homogenous and residually contaminated with pollutants that are ubiquitous throughout the Great Lakes. As such, these sediments, although not virgin material with high levels of pollutants, contain levels of contaminants that are elevated in relation to Lake Erie background levels and should be confined from the aquatic environment after dredging. A characterization of this material is contained in the sediment evaluation included as Enclosure 6 of the application package. This alternative would result in a short-term, negligible lowering of ambient water quality, comparable to that

which occurs during Lake Erie storm events. Dredging and placement activities would result in excavation, smothering, and mortality of benthic macroinvertebrates, and the temporary avoidance of work areas during the dredging operation by fish and wildlife species (i.e., mostly waterfowl). Following dredging and placement activities, benthic communities would recolonize the impacted areas, and fish and wildlife would return. The dredging area is industrialized, so benthic, fish and wildlife use of the water resource is limited; therefore, impacts in this regard would be minor. No impacts to threatened or endangered species would occur from dredging or placement of dredged material.

10c) Feasibility.

(1) *Preferred Design Alternative*: This alternative is technically feasible, as it involves routine maintenance dredging and dredged material placement procedures. Equipment is readily available to accomplish this type of work. The Benefit/Cost (B/C) ratio for this alternative with respect to commercial navigation in the harbor is greater than or equal to 1.0. Costs of this project have ranged from $5.00 to $7.00 per cubic yard of dredged material over the past five years. Although this alternative is viable for commercial navigation, recurrent maintenance dredging needs of the Federal navigation channels, as required, would continue to marginally and temporarily degrade water quality.

(2) *Non-Degradation Alternative*: Since this alternative involves no construction or filling of surface waters, this alternative is technically feasible and available, but would not be cost effective from a commercial navigation standpoint. Under this alternative, the Federal navigation channels would progressively shoal in and impede commercial navigation, which would result in an increased cost of commodities to the local community. Deep-draft commercial navigation in the harbor would become economically nonviable and gradually cease. As described in Section 8b above, this would negatively impact the annual $159 million in direct revenue, 2,611 jobs, and $96 million in personal income generated by the continued viability of the Harbor. Losses of between one and two feet of channel depth would result in increased transportation costs of between $2.6 million and $6.3 million annually.

(3) *Minimum Degradation Alternative*: This alternative is technically feasible, as it involves routine maintenance dredging and dredged material placement procedures. Equipment is readily available to accomplish this type of work. The Benefit/Cost (B/C) ratio for this alternative with respect to commercial navigation in the harbor is greater than or equal to 1.0. Costs of this project have ranged from $5.00 to $7.00 per cubic yard of dredged material over the past five years. Although this alternative is viable for commercial navigation, recurrent maintenance dredging needs of the Federal navigation channels, as required, would continue to marginally degrade water quality.

10d) Regional Sewage Collection/Treatment Facilities. N/A.

10e) *Water Quality Improvement/Recreation Projects:* A 1992 Cuyahoga River Remedial Action Plan, Stage One Report, 1996 Stage One Update, and 1996 Early Implementation Report have been completed and approved by OEPA.

10f) Water Pollution Control Costs.

(1) *Preferred Design Alternative*: Not dredging or placing material during storm events constitutes "blow days," which cost about $5,000 to $10,000 per day of lost work. The decision not to dredge based on weather conditions would be due to safety concerns.

(2) *Non-Degradation Alternative*: Since this alternative involves no construction or filling of surface waters, no costs result from water pollution controls.

(3) *Minimum Degradation Alternative*: Not dredging or placing material during storm events constitutes "blow days," which cost about $5,000 to $10,000 per day of lost work. The decision not to dredge based on weather conditions would be due to safety concerns.

10g) Human Health Impacts.

(1) *Preferred Design Alternative*: The human health impacts associated with this alternative would be indiscernible. The generation of turbidity and low dissolved oxygen in the water column would be the major effects associated with dredging and placement activities. The dredging area is within an industrialized water resource designed for commercial navigation. This alternative would result in short-term, minor, negative impacts to the quality and value of the receiving waters. Contaminated sediments would be removed from the Federal navigation channels and contained in a CDF, which would serve to improve water quality in the harbor on the long-term, and remove sediment contaminants and reduce their availability to aquatic life and wildlife.

(2) *Non-Degradation Alternative*: Since this alternative involves no construction or filling of surface waters, no effects to human health would occur.

(3) *Minimum Degradation Alternative*: The human health impacts associated with this alternative would be indiscernible. The generation of turbidity and low dissolved oxygen in the water column would be the major effects associated with dredging and placement activities. This alternative would result in short-term, minor, negative impacts to the quality and value of the receiving waters. Due to the smaller scope of dredging under this alternative, turbidity and dissolved oxygen effects would occur over a shorter period of time when compared to the Preferred Design Alternative. Contaminated sediments would be removed from the Federal navigation channels and contained in a CDF, which would serve to improve water quality in the harbor on the long-term, and remove sediment contaminants and reduce their availability to aquatic life and wildlife.

10h) Social/Economic Benefits Gained.

(1) *Preferred Design Alternative*: This alternative would restore navigable depths in the harbor channels for commercial vessel traffic. A large industrial base depends on the harbor to receive commercial goods and ship them off-site for a reasonable cost. As such, it would allow for the cost-effective transport of commodities through the local community. Cleveland Harbor is the 51st leading port in the United States and is ranked 7th among Great Lakes Ports (2nd on Lake

Erie) with 12.8 million tons of material shipped or received in 2007. Commodities shipped or received include iron ore, limestone, sand and gravel, salt, cement and concrete, general cargo and liquid bulk. The Harbor contains a major iron ore transshipment facility that provides iron ore to inland steel mills at lower delivery costs when compared to truck or direct rail delivery, and also ships more than one million tons of salt annually that is used by local municipalities for road deicing. Bulk commodities that pass through the Harbor generate approximately $159 million dollars annually in direct revenue which supports over 2,611 jobs. These jobs generate over $96 million dollars per year in personal income.

(2) *Non-Degradation Alternative*: This alternative would involve the cessation of maintenance of harbor Federal navigation channels. However, benefits would accrue to recreational navigation until the channels shoal into a degree at which they would no longer be usable for shallow-draft vessels. Recreational benefits in this regard would include primarily those associated with local marinas and the leisure craft they support.

(3) *Minimum Degradation Alternative*: This alternative would restore navigable depths in the harbor channels for commercial vessel traffic. A large industrial base depends on the harbor to receive commercial goods and ship them off-site for a reasonable cost. As such, it would allow for the cost-effective transport of commodities through the local community. Cleveland Harbor is the 51st leading port in the United States and is ranked 7th among Great Lakes Ports (2nd on Lake Erie) with 12.8 million tons of material shipped or received in 2007. Commodities shipped or received include iron ore, limestone, sand and gravel, salt, cement and concrete, general cargo and liquid bulk. The Harbor contains a major iron ore transshipment facility that provides iron ore to inland steel mills at lower delivery costs when compared to truck or direct rail delivery, and also ships more than one million tons of salt annually that is used by local municipalities for road deicing. Bulk commodities that pass through the Harbor generate approximately $159 million dollars annually in direct revenue which supports over 2,611 jobs. These jobs generate over $96 million dollars per year in personal income.

10i) Social/Economic Benefits Lost.

(1) *Preferred Design Alternative*: Lowered water quality associated with the alternative, such as short-term turbidity and reduced dissolved oxygen levels in the water column, would be aesthetically displeasing and may not be attractive to recreational boaters in the area. Recreational fishing activities in the harbor may be temporarily negatively affected by the lowering of water quality. Except for commercial industries such as restaurants and other riparian retail establishments, the lowering of water quality would have minimal negative effects on commercial activities.

(2) *Non-Degradation Alternative*: Since this alternative involves no construction or filling of surface waters, no lowering of water quality would occur. Therefore, negative effects on the recreational use of the harbor would not occur. However, substantial effects on commercial navigation and associated industries would occur as a result of this alternative. The overall value of the harbor as a water resource to commercial navigation would progressively deteriorate to a point at which deep-draft commercial vessels would no longer be able to navigate the harbor due to inadequate depths. The large industrial base that depends on the harbor to transport

commodities would no longer be able to do so cost-effectively. The harbor would no longer be a viable alternative for the transportation of goods. As described in Section 8b above, this would negatively impact the annual $159 million in direct revenue, 2,611 jobs, and $96 million in personal income generated by the continued viability of the Harbor. Losses of between one and two feet of channel depth would result in increased transportation costs of between $2.6 million and $6.7 million annually.

(3) *Minimum Degradation Alternative*: Lowered water quality associated with the alternative, such as turbidity and low dissolved oxygen levels in the water column, would be aesthetically displeasing and may not be attractive to recreational boaters in the area. Recreational fishing activities in the harbor may be negatively affected by the lowering of water quality. Except for commercial industries such as restaurants and other riparian retail establishments, the lowering of water quality would have minimal negative effects on commercial activities.

10j) Environmental Benefits Lost/Gained.

(1) *Preferred Design Alternative*: This alternative would result in a short-term reduction of water quality in the receiving waters. Dredging and placement activities would result in excavation, smothering, and mortality of benthic macroinvertebrates, and temporary avoidance of work areas by fish and wildlife species (i.e., mostly waterfowl). The dredging area is quite industrialized, so benthic, fish and wildlife use of the water resource is limited; therefore, impacts in this regard would be minor. Following dredging and placement activities, benthic communities would recolonize impacted areas, and fish and wildlife would return. Regarding environmental benefits, polluted sediments would be removed from the Federal navigation channels and contained in a CDF, which would serve to improve water quality in the harbor on the long-term, remove sediment contaminants, and reduce their availability to aquatic life and wildlife. No effects to endangered or threatened species would occur.

(2) *Non-Degradation Alternative*: Since this alternative involves no construction or filling of surface waters, associated environmental benefits would include no degradation of water quality in receiving waters, and no physical disturbances to benthos, or fish and wildlife. Regarding environmental losses, polluted sediments would not be removed from the Federal navigation channels and contained in a CDF, which would leave sediment contaminants in-place and available to aquatic life and wildlife, and serve to degrade water quality in the harbor on the long-term. No effects to endangered or threatened species would occur.

(3) *Minimum Degradation Alternative*: This alternative would result in a short-term reduction of water quality in the receiving waters. Dredging and placement activities would result in excavation, smothering, and mortality of benthic macroinvertebrates, and temporary avoidance of work areas by fish and wildlife species (i.e., mostly waterfowl). The dredging area is quite industrialized, so benthic, fish, and wildlife use of the water resource is limited; therefore, impacts in this regard would be minor. Following dredging and placement activities, benthic communities would recolonize the impacted areas, and fish and wildlife would return. Regarding environmental benefits, polluted sediments would be removed from the Federal navigation channels and contained in a CDF, which would serve to improve water quality in the

harbor on the long-term, remove sediment contaminants, and reduce their availability to aquatic life and wildlife. No effects to endangered or threatened species would occur.

10k) Mitigative Techniques.

(1) *Preferred Design Alternative:* Dredging would not be performed during Lake Erie storm events. Sediments dredged from the harbor would be contained in the CDF. Care would be employed throughout the course of the dredging/placement operations to avoid the creation of unnecessary turbidity that may degrade water quality or adversely affect aquatic life outside the project area.

(2) *Non-Degradation Alternative:* N/A.

(3) *Minimum Degradation Alternative:* Dredging would not be performed during Lake Erie storm events. Sediments dredged from the harbor would be contained in the CDF. Care would be employed throughout the course of the dredging/placement operations to avoid the creation of unnecessary turbidity that may degrade water quality or adversely affect aquatic life outside the project area.

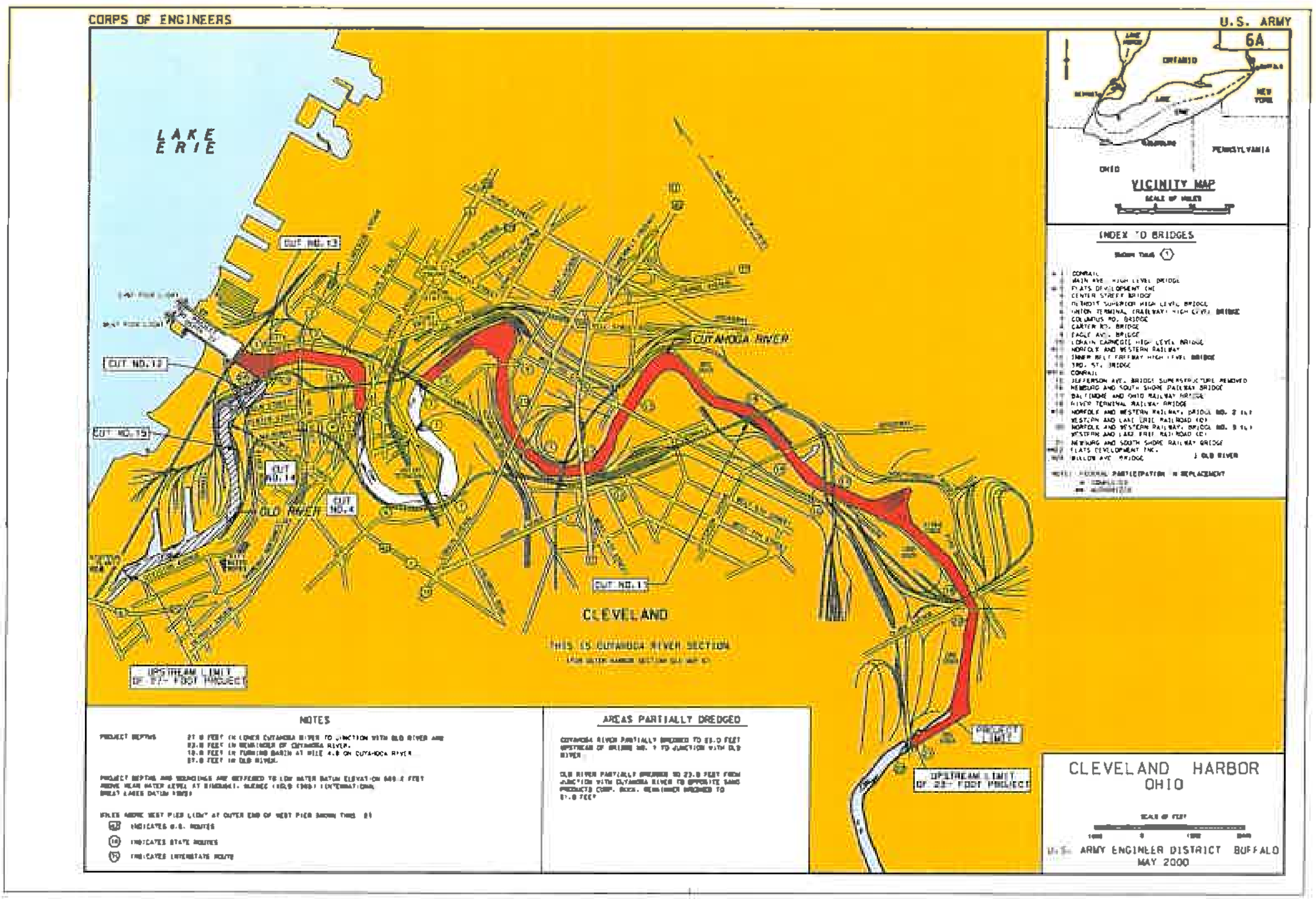
Aerial Photo of Cleveland Harbor

Enclosure 3

PREFERRED ALTERNATIVE

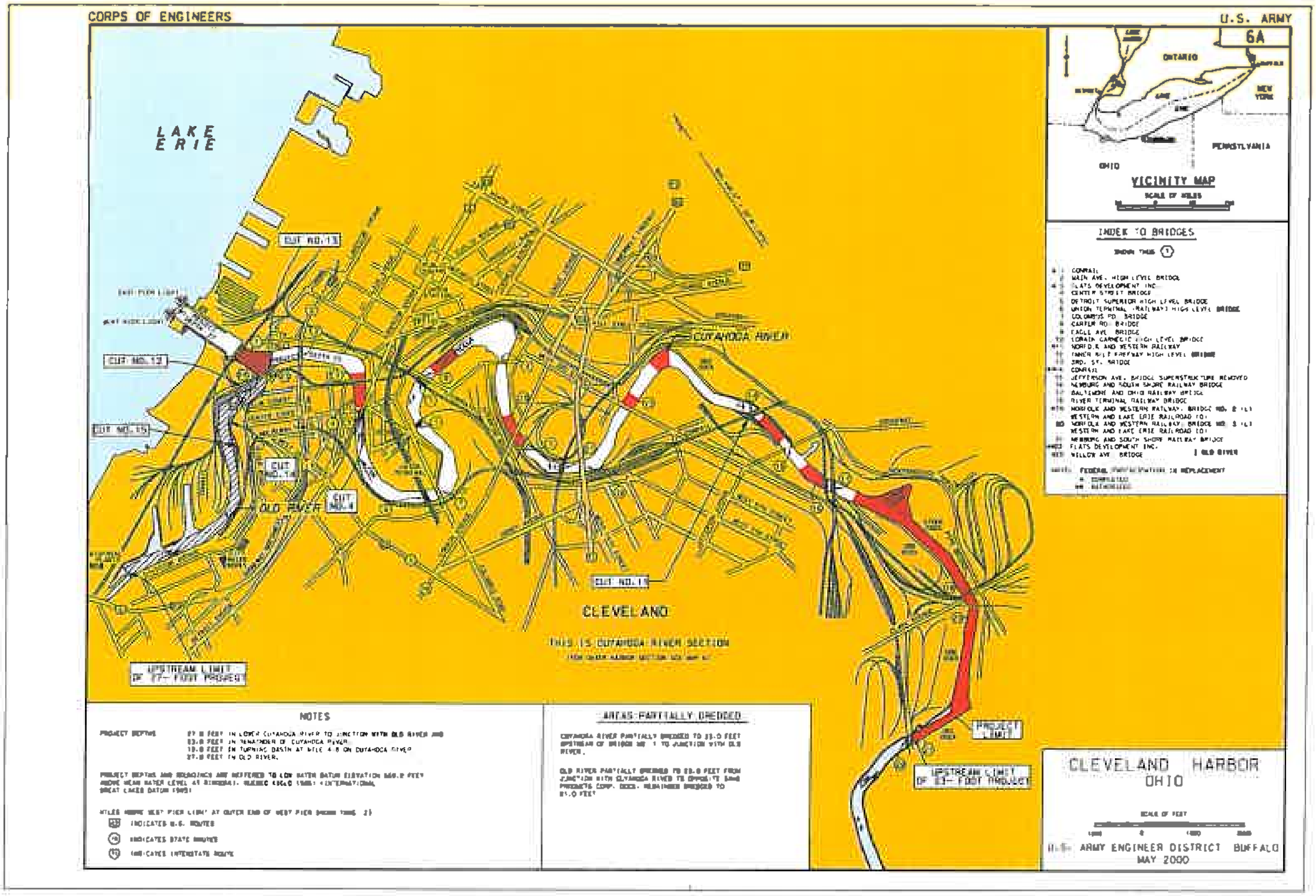
(DREDGE AREA LOCATIONS AND EXTENTS WILL BE ADJUSTED

BASED ON ACTUAL SHOALING LOCATIONS AND DEPTHS)



Enclosure 4

MINIMUM DEGRADATION ALTERNATIVE
(DREDGE AREA LOCATIONS AND EXTENTS WILL BE ADJUSTED
BASED ON ACTUAL SHOALING LOCATIONS AND DEPTHS)



Enclosure 5

US Army Corps
of Engineers®
Buffalo District

CLEVELAND HARBOR, CUYAHOGA COUNTY, OHIO

EVALUATION OF FEDERAL NAVIGATION CHANNEL SEDIMENTS WITH RESPECT TO THEIR SUITABILITY FOR OPEN-LAKE PLACEMENT

I. Introduction

This preliminary Tiered Evaluation on Cleveland Harbor Federal navigation channel sediments has been performed in accordance with guidelines contained in the 1998 U.S. Environmental Protection Agency (USEPA)/U.S. Army Corps of Engineers (USACE) Great Lakes Dredged Material Testing and Evaluation Manual (USEPA/USACE 1998). It is based on 2007 data on the Federal navigation channel sediments (Engineering and Environment, Inc. [EEI] 2007).

II. Sediment Quality Assessment

Background and Potential Sources of Sediment Contamination

Traditional chemical contaminants in Cleveland Harbor Federal navigation channel sediments include heavy metals, nutrients, polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs) and pesticides. Cleveland Harbor is located within the Cuyahoga River Area of Concern (AOC), which includes the lower 45 miles of the river between the Ohio Edison Dam and mouth, and approximately 10 miles of Lake Erie shoreline, between Edgewater Park eastward to Wildwood Park (http://www.epa.gov/glnpo/aoc/cuyahoga.html). Major sources of contamination to bottom sediments in the harbor's Cuyahoga River, Old River and Outer Harbor Channels include (1) point source municipal and industrial wastewater discharges; (2) bank erosion; (3) commercial/recreational development; (4) atmospheric deposition; (5) leachate from hazardous waste disposal sites; (6) urban storm water runoff; (7) combined sewer overflows (CSOs); and (8) wastewater treatment plant bypasses.

Evaluation Based on Existing Sediment Data

In 2007, 30 surface grab samples were collected from the River Channel (Sites CH-1 through CH-19), Old River Channel (Sites CH-20 through CH-22) and Outer

Harbor Channels (Sites CH-23 through CH-30) (Figure 1). The reach of River Channel, referred to as the "Upper End" located at the upstream limit between approximate Stations 799+92 and 788, was sampled more rigorously relative to other areas of the harbor, and was represented by Sites CH-1 through CH-5. In addition, four surface grab sediment samples were collected from the open-lake reference area in Lake Erie (Sites CL-1 through CL-4) (Figure 2). All sediment samples were subjected to bulk particle size analyses, and analyzed for the following: Inorganics—heavy metals, total cyanide, ammonia and total organic carbon (TOC); and organics—PAHs, PCBs and pesticides (EEI 2007). A modified elutriate test (MET) for the same inorganic and organic contaminants was performed on five composited sediment samples used to represent management units (MUs) within the Federal navigation channels: CH-UEMU (CH-1 through CH-5); CH-URMU (CH-6 through CH-11); CH-LRMU (CH-12 through CH-19); CH-ORMU (CH-20 through CH-22); and CH-OHMU (CH-23 through CH-30). In addition, two solid phase acute toxicity tests (bioassays) were applied to the Cuyahoga River Upper End MU sediments (EEI 2007) to verify that the material dredged from this reach, which is traditionally comprised of an appreciable fraction of coarse-grain sediment, does not meet Federal guidelines for open-lake (and/or nearshore) placement.

Based on the 2007 data, our toxicological assessment of these sediments is summarized as follows:

a. <u>Bulk sediment analyses</u>.

1. **Physical testing:** Table 1 presents the results of the sieve analyses performed on the sediment samples. The River Channel material was comprised of between 35.7% (Site CH-1) and 98.3 % (Site CH-13) silts and clays, with the remainder sands. The Upper End material within the River Channel was comprised of between 49.8% (Site CH-4) and 64.3% (Site CH-1) sands, with the remainder silts and clays. The Old River Channel material was composed of between 39.8% (Site CH-22) and 63.4% (Site CH-21) sands, with the remainder silts and clays. With respect to the Outer Harbor Channel material, it was comprised of between 90.9% (Site CH-30) and 99.1% (Site CH-27) silts and clays, with the remainder sands. Sediments at the open-lake reference area were comprised predominantly of silts and clays (98.3% [Site CL-4] to 98.9% [Site CL-2]), with a very small fraction of sands.

2. **Chemical testing:** The open-lake reference area was (Figure 2) was used to represent the Lake Erie environs. As such, contaminant concentrations in the Federal navigation channel sediment samples were compared to these areas to determine if they significantly exceeded lake sediment concentrations.

(a) *Inorganic analyses*—Table 2 presents the results of inorganic analyses on the sediment samples.

(1) Heavy metals—Relative to open-lake reference area levels, heavy metal concentrations in the Federal navigation channel sediments were generally comparable. Some sediment samples within the Federal navigation channel showed significantly elevated heavy metals concentrations in comparison when compared to those at the open-lake reference area. Arsenic concentrations at Sites CH-9, CH-12, CH-13, CH-14, CH-25 and CH-29, which range from 17.4 mg/kg to 20.3 mg/kg, may be of toxicological concern. At Site CH-6, the mercury concentration of 2.88 mg/kg could be acutely toxic. The lead concentration of 127 mg/kg at Site CH-22 would appear to be acutely toxic. Zinc concentrations at Sites CH-9, CH-13 and CH-17, which ranged from 379 mg/kg to 428 mg/kg, may be of toxicological concern. Based on these data, the following heavy metal COCs were identified: mercury at Site CH-6; arsenic and zinc at Site Ch-9; arsenic at Site CH-12; arsenic and zinc at Site CH-13; arsenic at Site CH-14; zinc at Site CH-17; lead at Site CH-22; arsenic at Site CH-25; and arsenic at Site CH-29.

(2) TOC and other inorganic parameters—TOC levels in the Federal navigation channel sediment samples ranged from 0.68% (Site CH-22) to 4.0% (Site CH-30). At the open-lake reference area, TOC concentrations ranged from 2.7% (Site CL-4) to 3.06% (Site CL-2). With respect to other inorganic contaminants, ammonia levels at Sites CH-3, CH-10 and CH-25 (range 190 mg/kg to 201 mg/kg) may be toxicologically significant. With respect to cyanide, concentrations at Sites CH-21 and CH-22 (range 2.62 mg/kg to 3.63 mg/kg) could be of toxicological concern. Based on these data, ammonia was identified as a COC at Sites CH-3, CH-10 and CH-25, and cyanide was identified as a COC at Sites CH-21 and CH-22.

(b) *Organic analyses*

(1) PAHs—Table 3 presents the results of these analyses. Total PAH concentrations in the Federal navigation channel sediments ranged from 1.13 mg/kg (Site CH-11) to 7.18 mg/kg (Site CH-6). Total PAH levels at the open-lake reference area were quite low, ranging from 0.03 mg/kg (Site CL-1) to 0.69 mg/kg (Site CL-4). While total PAH concentrations at all of the Federal navigation channel sites exceeded those at the open-lake reference area, many may not be of significant toxicological concern. Nevertheless, given the relatively low level of TOC throughout the Federal navigation channel sediments and an assumed low fraction of black carbon, some PAH compounds may be more bioavailable and therefore capable of exerting acute toxicity. For example, TOC levels at all sites, except for Sites CH-6, CH-7, CH-9, CH-10, CH-13, Ch-23 and CH-30, were significantly below the lowest open-lake reference area TOC level of

2.7%.

In order to ascertain whether total PAHs would bioaccumulate from harbor sediments at levels higher than those of the open-lake reference area, a Tier 2 theoretical bioaccumulation potential (TBP) model was employed. TBP is an equilibrium theory-based algorithm used to predict the potential bioaccumulation of neutral, organic compounds, such as PCBs, in sediments (McFarland 1984). This model is expressed as:

$$TBP = BSAF\ (L)\ (C_s/TOC)$$

Where:

TBP = Predicted whole body tissue concentration of the neutral organic compound (µg/kg wet weight)
BSAF = Biota-sediment accumulation factor, a measure of bioavailability
L = Concentration of lipid in target animals (percent of wet weight)
C_s = Concentration of neutral organic compound in sediment (µg/kg dry weight)
TOC = Total organic carbon concentration in sediment (percent of dry weight)

The target animal used in this case is an oligochaete worm. In this model, a 1% lipid content in oligochaete worms, an average that is characteristically representative (e.g., Ankley *et al.* 1992, Pickard *et al.* 2001), a BSAF of 1.0 (Pickard *et al.* 2006) and TOC data from Table 2 were used. The total PAH TBP for open-lake reference area sediments (Site CL-4) was 0.26 mg/kg. The total PAH TBP predictions for the Federal navigation channel sediments are summarized in Table 4. Predicted TBP values for total PAHs at individual harbor sites ranged from 0.41 mg/kg (Site CH-10) to 3.76 mg/kg (Site CH-22), and were 1.6 to 14.6 times that of the open-lake reference area sediments.

Great Lakes harbor and lake reference sediments with total PAH levels on the order of up to about 7 mg/kg have been shown to not exhibit acute toxicity. However, in this case, generally lower TOC levels and other factors (coarse-grain fraction of sediment, origin of organic carbon, etc.) could be factors that contribute to lower total PAH levels potentially being acutely toxic. For example, in the Upper End of the River Channel, sediments were one-half or greater coarse-grain and had TOC levels (1.42% to 2.19%) that were below those of the open-lake reference area. As a result, it is possible that some total PAH concentrations in this reach, which ranged from 1.55 mg/kg to 5.85 mg/kg (mean = 3.03 mg/kg), could potentially exert some acute toxicity.

Preliminary calculations were performed on selected Cleveland Harbor sites to derive concentrations of PAH mixtures in sediments that may be toxic to benthic organisms. The equilibrium partitioning (EqP) approach was applied to calculate

EqP sediment benchmarks (EBS) for PAH mixtures, termed an EqP Sediment Benchmark Toxic Unit ($\Sigma ESBTU_{FCV}$) (USEPA 2003). Using this approach, freshwater sediments containing $\Sigma ESBTU_{FCV} \leq 1.0$ of a mixture of 34 or more PAH compounds are acceptable for the protection of aquatic organisms. In this case, an uncertainty factor had to be applied because the analyses covered only 16 PAHs. These calculations suggested that most of the concentrations of most of the PAH mixtures in Cleveland Harbor sediments probably cause chronic toxicity. In addition, it suggested that the total PAH concentrations at Sites CH-9, CH-11, CH-25 and CH-28 are not chronically or acutely toxic. It should be noted that ESBs do not consider the antagonistic, additive or synergistic effects of other sediment contaminants in combination with PAH mixtures or the potential for bioaccumulation and trophic transfer of PAH mixtures to aquatic life, wildlife or humans. The weight-of-the-evidence suggests that total PAHs are COCs at all sites, excluding Sites CH-9, CH-11, CH-25 and CH-28.

(2) PCBs—Table 5 presents the results of these analyses. PCBs were measured at all of the Federal navigation channel sites, with Aroclors 1242, 1254 and 1260 being the mixtures that were predominantly detected. Individual Aroclor mixtures that were detected ranged from 22.2 µg/kg of Aroclor 1254 at Site CH-8 to 260 µg/kg of Aroclor 1254 at Site CH-27_{QC}. "Total PCB" concentrations (the sum of the three predominant Aroclors, valuing non-detectable concentrations at the laboratory reporting limit [LRL]) in the Federal navigation channel sediments ranged from 96.6 µg/kg to 504 µg/kg at Sites CH-14 to CH-27_{QC}, respectively. Aroclor 1254 was the only PCB mixture detected in the open-lake reference area sediments, ranging in concentration from 35.4 µg/kg (Site CL-3) to 42.8 µg/kg (Site CL-2). Since Aroclor 1254 was the only detected PCB mixture, the measured level was assumed to represent the "total PCB" concentration. Total PCB concentrations at all of the Federal navigation channel sites exceeded those at the open-lake reference area sediments.

The TBP model was employed to ascertain whether total PCBs would bioaccumulate from Federal navigation channel sediments at levels higher than the open-lake reference area. The model used an oligochaete worm as the target animal with a 1% lipid content, PCB BSAF of 1.2 (unpublished Lake Erie data) and TOC data from Table 2. The open-lake reference area PCB TBP was calculated to be 16.8 µg/kg, and the total PCB TBP predictions for the Federal navigation channel sediments are summarized in Table 6. The TBP for total PCBs ranged from 44.2 µg/kg (Site CH-10) to 388 µg/kg (Site CH-27), all of which exceeded the open-lake reference area total PCB TBP. The predicted total PCB TBP values were over 2.6 to 23-fold that of the open-lake reference area. Relative to the open-lake reference area sediments, it is possible that PCBs may not bioaccumulate to statistically significant higher levels at Sites CH-6 through CH-17 (TBP range = 44.2 µg/kg to 84.4 µg/kg). Nevertheless, based on these

TBP predictions and existing information, total PCBs were retained as a COC at all of the Federal navigation channel sites.

(3) Pesticides—Table 7 presents the results of these analyses. Most pesticides in the Federal navigation channel sediment samples were non-detectable at LRLs ranging from 1.02 μg/kg to 623 μg/kg. With the exception of dieldrin at Site CH-10 (11.6 μg/kg), 4,4′-dichlorodiphenyltrichloroethane (DDT) and its metabolites/breakdown products 4,4′-dichlorodiphenyldichloroethylene (DDE) and 4,4′-dichlorodiphenyldichloroethane (DDD) were detected at most of the Federal navigation channel sites. DDD was the only pesticide detected in the open-lake reference area sediments, ranging in concentration from 7.89 μg/kg to 8.95 μg/kg at Sites CL-1 and CL-2, respectively. The sum of DDT, DDE and DDD (ΣDDT) was used to interpret the data and for comparison purposes, based on the following rationale:

1—4,4′-DDT, 4,4′-DDE and 4,4′-DDD are considered highly hydrophobic, having Log K_{ow}s of 6.91, 6.51 and 6.02 respectively (ATSDR 2002). Hydrophobicities tend to reduce the bioavailability of sediment-associated neutral organic contaminants;

2—BSAFs in the literature for sediment-processing benthic organisms show that the bioavailability of DDT, DDE and DDD is similar (Ingersoll *et al.* 2003), or that DDT (Mulsow and Landrum 1995) can be less bioavailable than DDE (Ferraro *et al.* 1990); and

3—The sediment samples were processed through gas chromatographic analysis. This method has been shown to cause a breakdown of DDT into DDE and DDD, which would tend to make the analytical differentiation of the three compounds based on these sediment data obscure (Forman and Gates 1997).

Concentrations of ΣDDT in the Federal navigation channel sediments ranged from 6.09 μg/kg (Site CH-21) to 105 μg/kg (Site CH-4) (see Table 8). The open-lake reference area ΣDDT concentration was 41.4 μg/kg. Concentrations of ΣDDT at Sites CH-4, CH-5 and CH-8 (range 59.4 to 105 μg/kg) significantly exceeded that of the open-lake reference area. Tier 2 TBP predictions using an oligochaete worm as the target animal, 1% lipid content, BSAF of 2.5 (Ingersoll *et al.* 2003) and TOC data from Table 2 are summarized in Table 8. Projected ΣDDT bioaccumulation levels at these sites ranged from 85.8 μg/kg (Site CH-8) to 120 μg/kg (Site CH-4), and were 2.5 to 3.6 times the open-lake reference area ΣDDT TBP of 33.8 μg/kg. Therefore, ΣDDT was determined to be a COC at Sites CH-4, CH-5 and CH-8.

(c) *Elutriate testing*—Tables 9 through 12 present the results of the MET performed on the Federal navigation channel sediments. The results showed releases of some heavy metals, ammonia and cyanide from the sediments (Table 9). Evidenced heavy metal releases from the harbor sediments were low, and maximum releases (dissolved) generally occurred from MUs CH-URMU and CH-LRMU sediments. The highest releases of copper and mercury (dissolved) were 1.5 µg/L and 0.0024 µg/L from MU CH-URMU sediments, respectively. Maximum ammonia-nitrogen (total) releases ranged from 5.22 µg/L (MU CH-ORMU) to 11 µg/L (MU CH-URMU). At a water pH of 8.1 and temperature of 21°C, and after consideration of mixing in the water column, ammonia concentrations would not appear to contravene applicable State Water Quality Standards. Releases of PAH compounds (dissolved) were indicated at several of the Federal navigation channels sites (Table 10). Maximum benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(ghi)perylene, chrysene, fluoranthene and pyrene releases (dissolved) were 0.156 µg/L, 0.181 µg/L, 0.405 µg/L, 0.143 µg/L, 0.172 µg/L, 0.254 µg/L and 0.386 µg/L at MU CH-LRMU in the Lower River channel reach, respectively. With respect to PCBs, no releases (dissolved) were shown at LRLs ranging from 0.0102 µg/L to 0.104 µg/L (Table 11). Pesticide releases (dissolved) from the sediments were non-detectable at LRLs ranging from 0.0222 µg/L to 2.78 µg/L (Table 12).

b. Biological testing. Tier 3, 10-day solid phase bioassays applied to MU CH-UEMU sediments employed the test species *Hyalella azteca* (amphipod) and *Chironomus tentans* (mayfly nymph) (USEPA/USACE 1998). The biological measurement endpoints for the *H. azteca* and *C. tentans* bioassays were survival, and survival and growth, respectively. The results are presented in Table 13 and are summarized as follows:

1. ***H. azteca***: The mean survival of this species was 0.52±0.02% and statistically lower than the survival associated with open-lake reference area sediments (0.88%).

2. ***C. tentans***: The mean survival of this species was 0.72±0.03% and statistically lower than the survival associated with the open-lake reference area sediments (0.94%). The mean growth of this species was 1.06±0.09 mg/org and not statistically different from that associated with open-lake reference area sediments (1.01mg/org).

These combined bioassay results indicate that the MU CH-UEMU sediments are acutely toxic. Based on the bulk chemistry data on these sediments, this toxicity may be attributable to total PAHs and/or ∑DDT.

c. Final COC List. COCs identified in Cleveland Harbor Federal navigation channel sediments are summarized as follows:

1. Arsenic at Sites CH-9, CH-12, CH-13, CH-14, CH-25 and CH-29 in the River and Outer Harbor channels.

2. Lead at Site CH-22 in the River Channel.

3. Mercury at Site CH-6 in the River Channel.

4. Zinc at Sites CH-9, CH-13 and CH-17 in the River Channel.

5. Ammonia-nitrogen at Sites CH-3, CH-10 and CH-25 in the River and Outer Harbor channels.

6. Cyanide at Sites CH-21 and CH-22 in the River Channel.

7. Total PAHs at all River, Old River and Outer Harbor Channel sites, except Sites CH-9, CH-11, CH-25 and CH-28.

8. Total PCBs at Sites CH-1 through CH-30 in the River, Old River and Outer Harbor Channels.

11. ΣDDT at Sites CH-4, CH-5 and CH-8 in the River Channel.

Based on the data considered in this evaluation, it is possible that PCBs may not bioaccumulate to statistically significant higher levels from sediments at Sites CH-6 through CH-17. If that were shown to be the case, and if the sediments were also shown to not exhibit acute toxicity through the prescribed bioassays, dredged material at Sites CH-7, CH-11, CH-15 and CH-16 would meet Federal guidelines for open-lake placement. All three solid-phases tests would be required on these sediments to make such a determination.

d. Quality Assurance (QA)/Quality Control (QC) Documentation. QA/QC information and records on the data contained in this evaluation are available in EEI (2007).

Conclusion

This evaluation has determined that sediments dredged from all Cleveland Harbor Federal navigation channels, as represented by Sites CH-1 through CH-30 (Figure 1), do not meet Federal guidelines for open-lake placement based on existing information.

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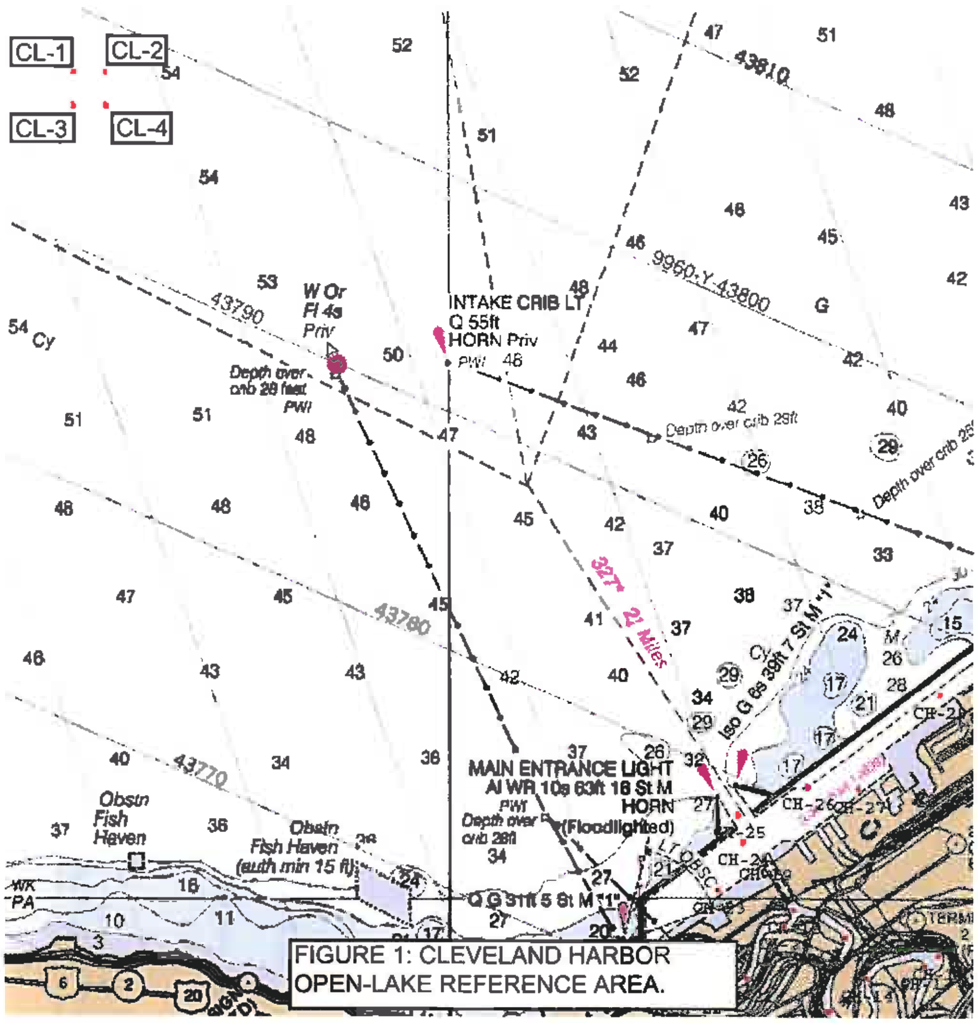

FIGURE 1: CLEVELAND HARBOR OPEN-LAKE REFERENCE AREA.

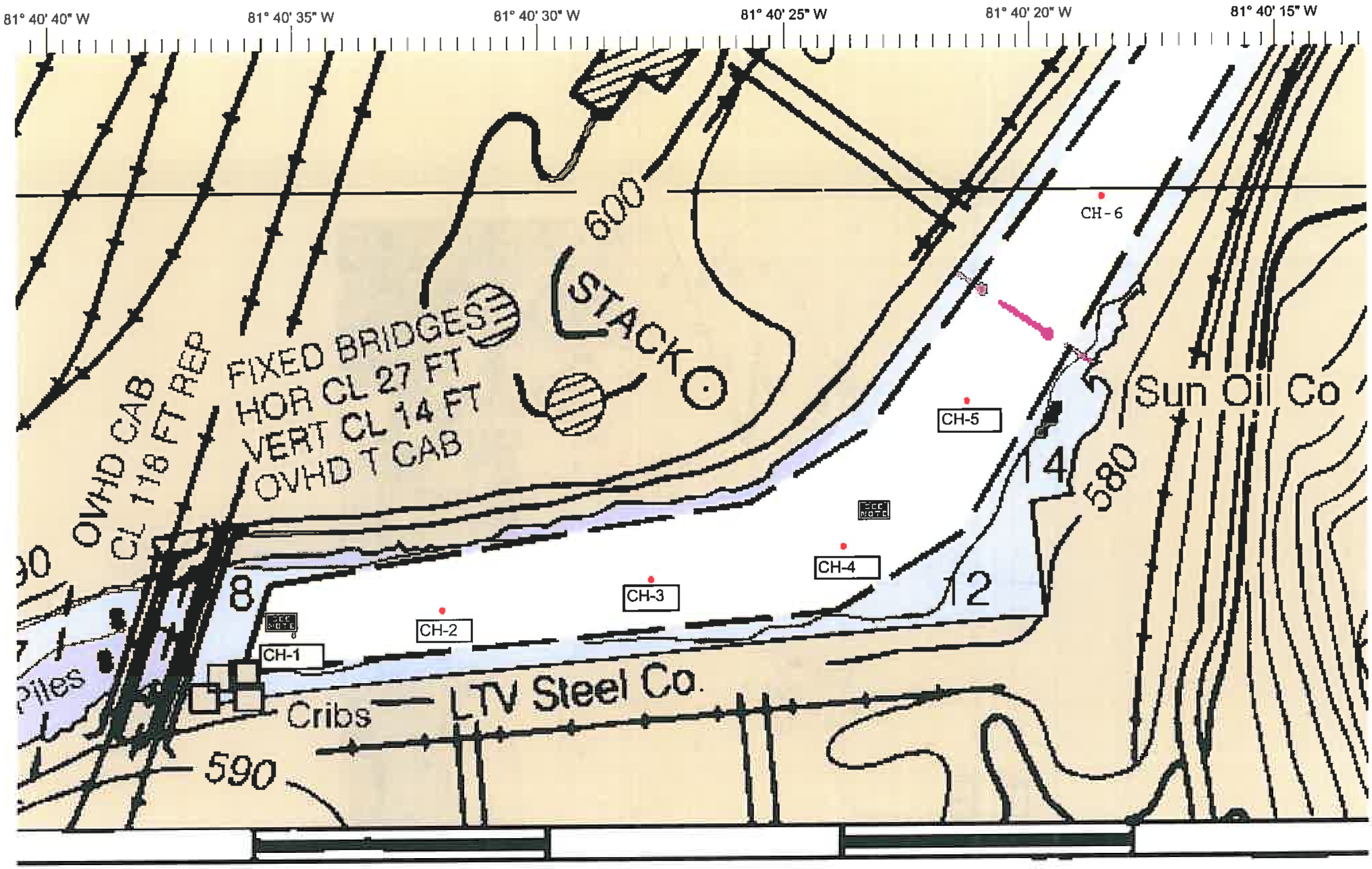

FIGURE 2: CLEVELAND HARBOR (CUYAHOGA RIVER) UPPER END MANAGEMENT UNIT

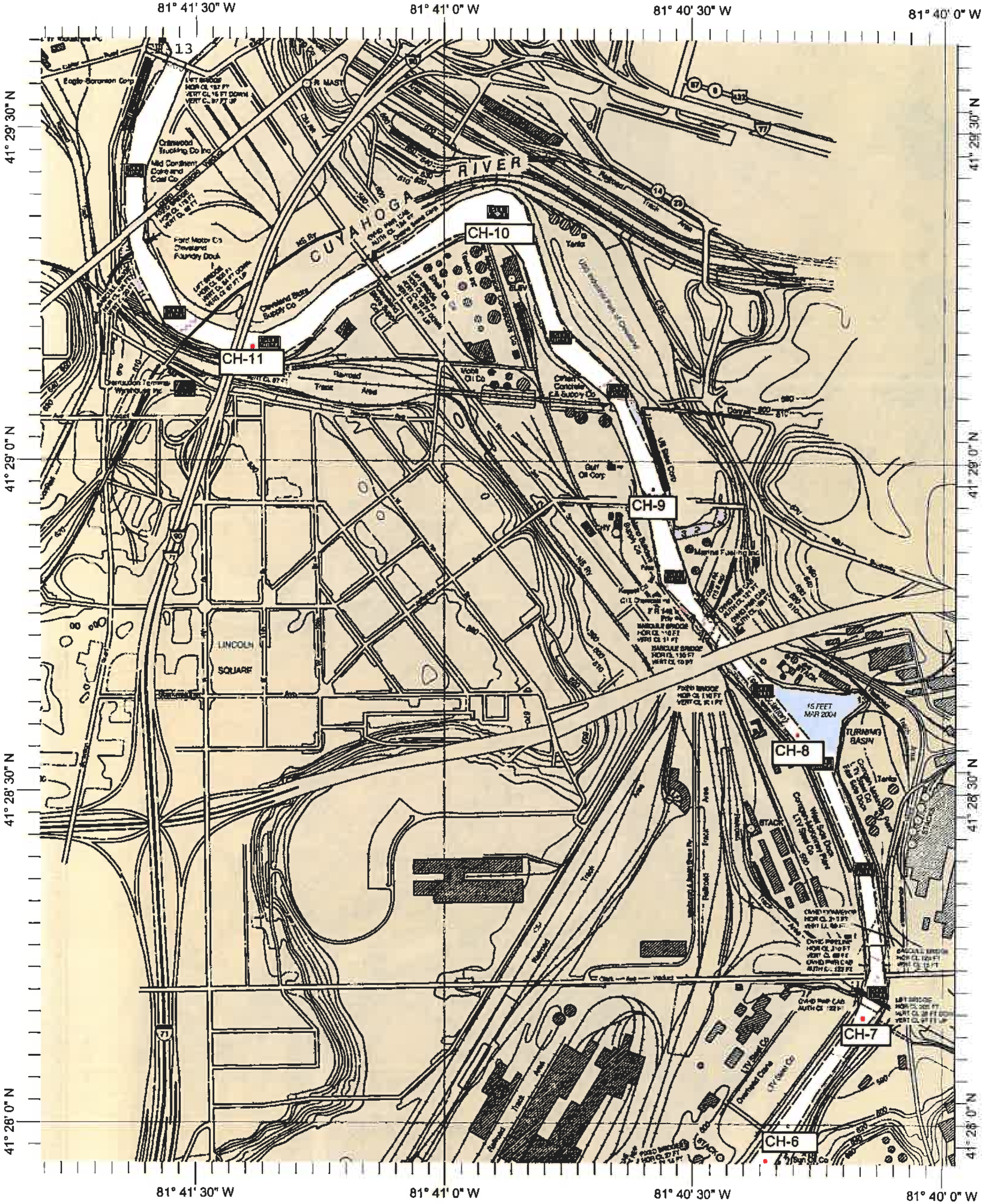

FIGURE 3: CLEVELAND HARBOR (CUYAHOGA RIVER) UPPER RIVER MANAGEMENT UNIT

® MAPTECH, INC.

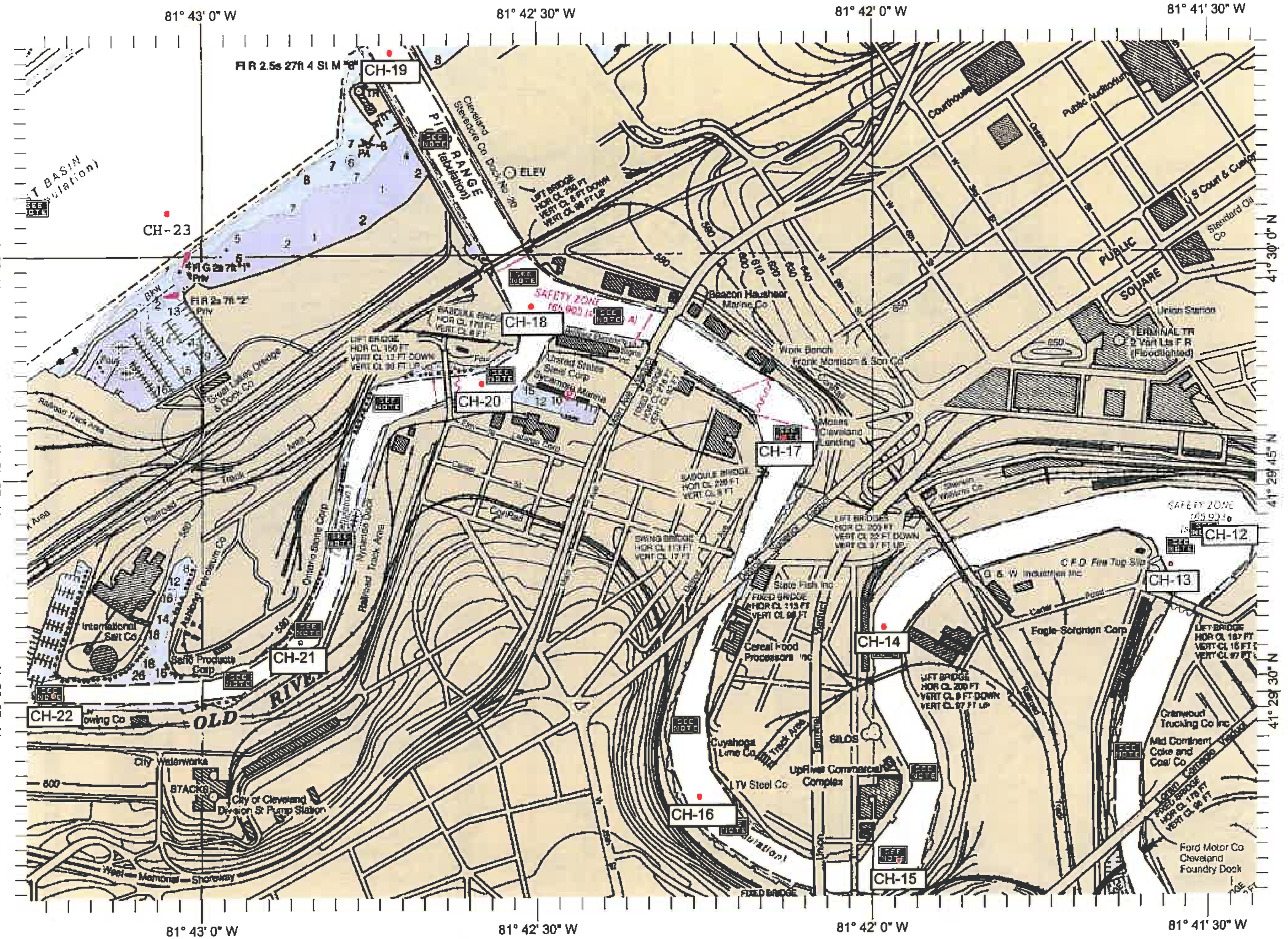

FIGURE 4: CLEVELAND HARBOR (CUYAHOGA RIVER) LOWER RIVER AND OLD RIVER CHANNEL **MANAGEMENT UNITS.**

® MAPTECH, INC.

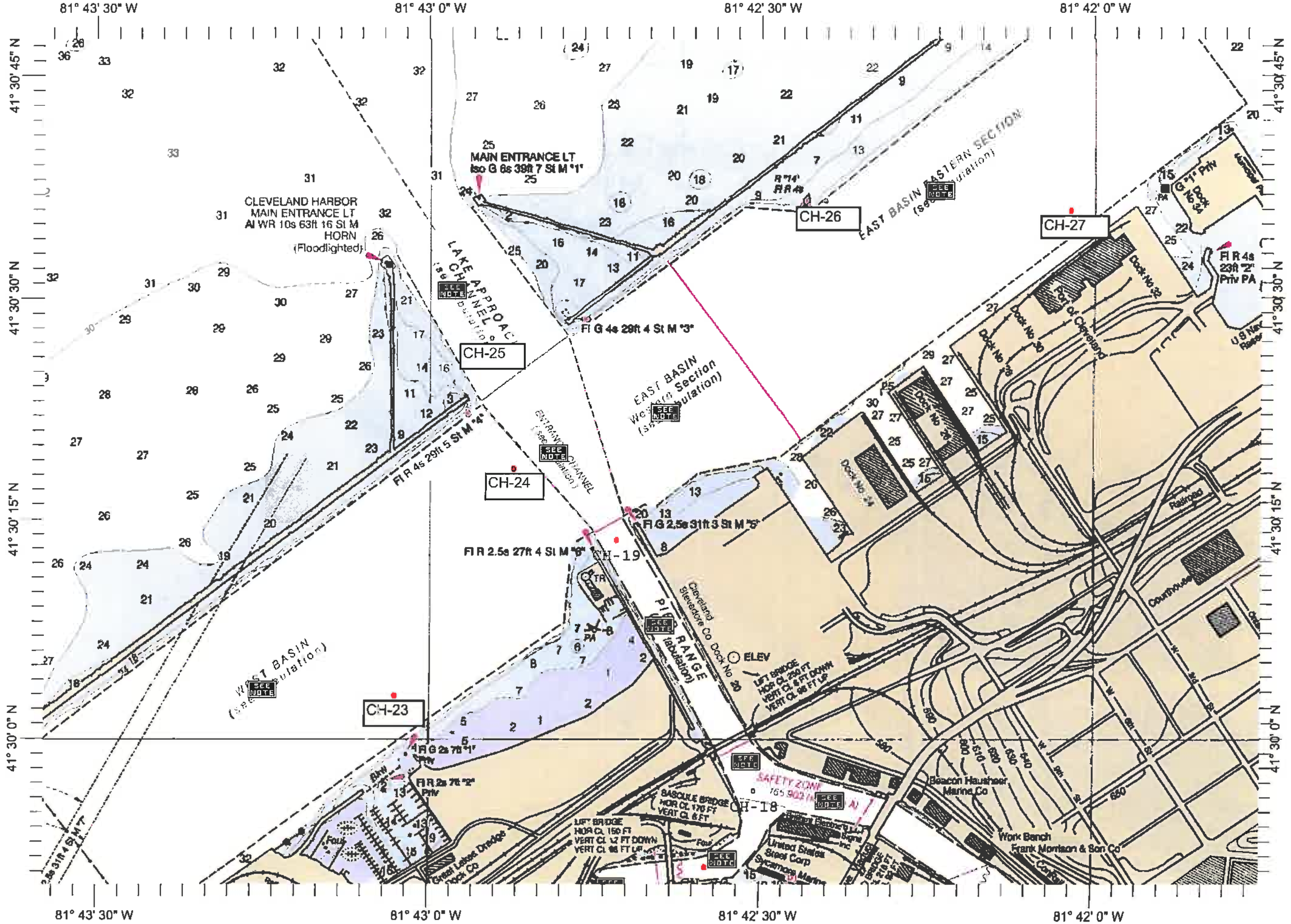

FIGURE 5: CLEVELAND HARBOR OUTER HARBOR MANAGEMENT UNIT (SITES CH-23 - CH-27)

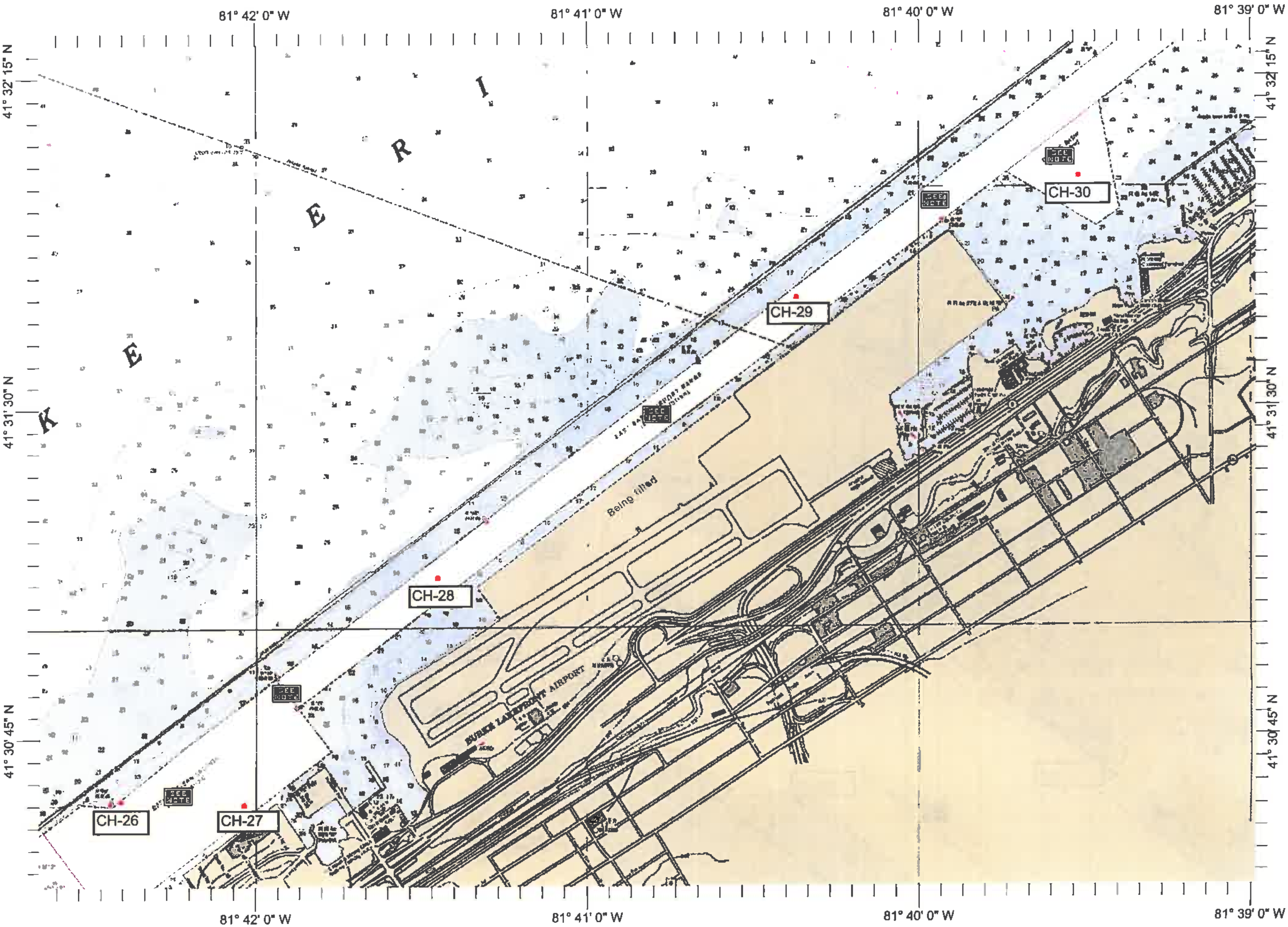

FIGURE 6: CLEVELAND HARBOR OUTER HARBOR MANAGEMENT UNIT (SITES CH-26 - CH-30)

TABLE 1. Particle size distribution of Cleveland Harbor Federal navigation channel sediments (from EEI 2007).

Particle Size Distribution	Harbor Sediments																
	Sampling Sites																
	CH-1	CH-2	CH-3	CH-4	CH-5	CH-6	CH-7	CH-8	CH-9	CH-10	CH-11	CH-12	CH-13	CH-14	CH-15	CH-16	CH-17
Clay	8.1	11.2	12.6	10.6	8.4	15.1	15.3	11.2	25.4	25.2	31.1	25.8	33.1	23.4	28.7	26.9	32.9
Silt	27.6	34.1	35.4	39.6	36.6	56.2	55.2	68.4	71.3	68.3	62	71.2	65.2	72.1	66.8	67.8	53.5
Sand	64.3	54.7	52	49.8	55	28.7	29.5	20.4	3.3	6.5	6.9	3	1.7	4.5	4.5	5.3	13.6
Gravel	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Particle Size Distribution	Harbor Sediments													Open-Lake Reference Area Sediments			
	Sampling Sites													Sampling Sites			
	CH-18	CH-19	CH-20	CH-21	CH-22	CH-23	CH-24	CH-25	CH-26	CH-27	CH-28	CH-29	CH-30	CL-1	CL-2	CL-3	CL-4
Clay	24.1	18.6	12.6	14.3	28.2	38	26.3	25	36.9	48.9	46.3	45	30.3	33.8	28	38	33.7
Silt	69.4	73.6	29.2	22.3	32	53.5	70.6	72.2	58.3	50.2	51.1	53.5	60.6	64.7	70.9	60.7	64.6
Sand	6.5	2.8	56.5	63.4	39.8	8.5	3.1	2.8	4.8	0.9	2.6	1.5	9.1	1.5	1.1	1.3	1.7
Gravel	0	0	1.7	0	0	0	0	0	0	0	0	0	0	0	0	0	0

TABLE 2. Bulk inorganic analyses on Cleveland Harbor Federal navigation channel sediments. Boldface/shaded values indicate a concentration that is greater in comparison to the open-lake reference area (from EEI 2007).

Metal (mg/kg)	Harbor Sediments — Sampling Sites																
	CH-1	CH-2	CH-3	CH-4	CH-5	CH-6	CH-7	CH-8	CH-9	CH-10	CH-11	CH-12	CH-13	CH-14	CH-15	CH-16	CH-17
Aluminum	6850	5860	6910	7720	7180	9040	8690	7950	11400	9130	10900	12800	13800	10300	9030	9560	10700
Antimony	0.895J*	0.782J	0.786J	0.849J	1.47U**	0.523J	1.55U	0.508J	**11**	1.31J	0.179U	0.157U	0.169U	0.146U	0.86	0.157U	0.180U
Arsenic	10.4	9.33	**11.1**	**14.1**	**12.5**	**14.5**	**16.8**	**12.8**	**17.4**	**13.7**	**16.1**	**20.3**	**20.2**	**19.4**	**14.5**	**14.3**	**14.4**
Barium	52.7	41.6	60	56.8	55.1	66.6	67.2	58.1	87.7	69.2	72.9	84	91.5	74.6	62.2	65.5	82.7
Beryllium	0.438J	0.387J	0.456J	0.553J	0.476J	0.561J	0.555U	0.515J	0.719J	0.571J	0.67	0.76	0.82	0.62	0.55	0.59	0.65
Cadmium	0.664J	0.456J	0.8	0.687J	0.577J	0.593J	0.311U	0.633J	1.31J	0.619J	0.99	0.96	1.6	1	0.37	0.47	1.2
Calcium	10400	10400	**13200**	**13700**	**14000**	**15100**	**14700**	**12500**	**18200**	**14200**	**15500**	**16300**	**19800**	**14200**	**13700**	**14500**	**16400**
Chromium	19.9	14.8	20.7	22.2	19.4	23.4	21.3	22.6	36	24.2	31	30.7	37.4	23.2	22.3	23	35.1
Cobalt	7.77	6.46	8.11	9.35	8.36	10.1	10.1	9.19	12.5	10.2	11.1	11.8	**14.2**	10.4	10	10.1	10.8
Copper	43.2	**55.5**	**56**	48.2	46.2	50.6	43.3	52.8	**67.8**	49.2	48.5	50.1	**67.6**	42.3	40.8	43.2	52
Iron	21000	18900	22800	27700	26000	30200	30300	27600	34100	29800	33100	35500	**42000**	33600	30600	32000	32100
Lead	36	26.1	41.6	39.8	36.7	41.8	38.9	38.2	**66.3**	41.3	45.4	43.9	62.3	37.9	36.4	41.7	45.9
Magnesium	4100	3370	4620	5090	4870	5700	5710	5070	6990	5640	7430	7780	8000	6590	5720	6170	6450
Manganese	455	397	485	498	517	661	576	462	580	525	528	585	580	512	443	434	486
Mercury	0.0855	0.0733	0.0708	0.0759	0.0702	**2.88**	0.0624	0.081	0.105	0.128	0.0793	0.0884	0.126	0.104	0.0766	0.0835	0.123
Nickel	25	34.7	28	31.7	31.2	31.4	29.7	27.7	39.1	30.9	34.1	34.4	41.4	29.4	28.5	28.7	31.2
Potassium	912	703	859	1000	926	1160	1070	988	1370	1230	1360	1560	1720	1180	1120	1180	1340
Selenium	0.752J	2.25U	1.46J	2.40U	1.5J	1.52J	2.34	1.72J	**13.9U**	1.62J	0.894U	0.785U	0.843U	0.729U	2	1.4	1.3
Silver	0.182J	0.155J	0.764U	0.802U	0.4J	0.198J	0.776U	0.194J	0.927U	0.192J	0.200J	0.26	0.33	0.250J	0.250J	0.2	0.33
Sodium	**232**	**207**	**224**	**222**	**198**	**254**	**216**	**214**	**304**	**247**	**269**	**236**	**328**	**232**	**255**	**252**	**269**
Thallium	2.91U	1.26J	1.36J	3.21U	1.03J	3.26U	1.14	1.07J	**18.5U**	3.31U	0.300J	0.42	0.49	0.37	1.9	1.8	0.360J
Vanadium	14.3	12.6	14.6	17.8	15.9	18.4	18.5	16.5	23.1	19.5	21	22.9	26.6	19.9	18.1	18.8	20.3
Zinc	156	130	137	193	170	189	167	**296**	**428**	**226**	**323**	243	**417**	194	216	**236**	**379**

Misc. (mg/kg)	Harbor Sediments — Sampling Sites																
	CH-1	CH-2	CH-3	CH-4	CH-5	CH-6	CH-7	CH-8	CH-9	CH-10	CH-11	CH-12	CH-13	CH-14	CH-15	CH-16	CH-17
Ammonia	48	98.7	**201**	69.4	66.9	101	90.6	68.7	116	**195**	89.9	101	105	99.7	91.1	98.3	153
Total cyanide	0.117J	0.104J	0.355J	0.197J	0.101J	0.469	0.116J	0.492	0.531	0.430U	0.195J	0.190J	0.499	0.3J	0.548	**1.03**	**1.08**
TOC	14200	20500	21200	21900	20100	25200	24100	17300	26500	27400	22900	20300	28000	14000	14500	14500	22300

*Estimated value between the detection limit and reporting limit.
**Not detected at or above the specified reporting limit.

TABLE 2 (continued). Bulk inorganic analyses on Cleveland Harbor Federal navigation channel sediments. Boldface/shaded values indicate a concentration that is greater in comparison to the open-lake reference area (from EEI 2007).

	Harbor Sediments													Open-Lake Reference Area			
	Sampling Sites													Sampling Sites			
Metal (mg/kg)	CH-18	CH-19	CH-20	CH-21	CH-22	CH-23	CH-24	CH-25	CH-26	CH-27	CH-28	CH-29	CH-30	CL-1	CL-2	CL-3	CL-4
Aluminum	9680	10600	5420	6460	10400	10800	9080	11700	9630	9490	11900	17200	11700	16600	19700	18600	17500
Antimony	**6.7**	0.190J	0.84	0.56	0.7	0.193U	1.2	**4.8**	1	0.197U	0.198U	0.239U	1.5	3.77U	3.87U	3.76U	3.74U
Arsenic	**16.3**	**16.5**	7.3	8.5	**15**	**12.8**	**15.9**	**20.2**	**12.8**	10	**13.8**	**17.5**	**12.9**	11	9.75	9.35	8.54
Barium	79.5	79.2	36.2	51.9	78.2	64.5	70.1	85.6	60.5	56.7	78	108	78.9	108	123	115	110
Beryllium	0.63	0.77	0.37	0.42	0.65	0.67	0.58	0.72	0.59	0.56	0.74	1.1	0.89	1.02J	1.22J	1.1J	1.07J
Cadmium	**3.4**	0.99	0.41	0.92	1.2	1	0.71	0.94	0.8	0.64	1.2	1.4	1.4	1.77J	1.97	1.78J	1.77J
Calcium	**14100**	**19500**	**22800**	**17400**	379	10300	11300	**13700**	9820	7130	11000	12000	9560	11900	12100	11300	10700
Chromium	41.5	26.1	14.8	21.2	38.3	27.2	23.8	26.9	24.4	22.1	31.3	44.5	36.2	46.6	55.7	49.6	49.9
Cobalt	11.5	10.8	6.1	5.6	9.7	11.1	10.2	12.2	10.3	9.3	12.2	**15.3**	11.4	12.8	14.1	13.7	12.8
Copper	**58.8**	47	24	32.5	**69.6**	38	48	47.1	40	32	49.8	**56.6**	53	46.6	53.4	49.2	47.1
Iron	30000	34400	18100	17700	34100	30100	28900	35900	29400	25000	33100	**45600**	**39800**	34100	39500	36800	35100
Lead	**71.5**	41.4	27.9	37.1	**127**	38.5	41	40.1	37.9	30.2	50.3	62.2	61.4	53.3	65.9	57.5	59.3
Magnesium	6160	9120	9350	6000	**12600**	5870	5320	6750	5590	4740	6740	9010	6580	10700	11500	10700	10100
Manganese	502	551	251	238	471	538	507	758	479	420	561	832	512	833	650	584	618
Mercury	0.151	0.0663	0.0352	0.0626	0.0177	0.0128	0.0763	0.0942	0.0118	0.0109	0.0122	0.0164	0.0211	0.253	0.294	0.286	0.345
Nickel	40.9	32.9	18.1	18.2	33.3	32.2	30.7	35.3	29.4	26.3	36.4	46.2	35.6	51	57.6	54.2	53.5
Potassium	1190	1250	710	808	1220	1540	1150	1450	1260	1360	154	2230	1560	2420	2790	2660	2490
Selenium	0.772U	0.744U	0.91	0.734U	1.5	2	1.7	0.792U	0.915U	1.4	1.1	1.19U	3.6	5.66U	3.94J	2.14J	5.60U
Silver	0.45	0.19	0.120J	0.170J	0.270J	0.330J	0.260J	0.280J	0.300J	0.43	0.31	0.53	0.75	1.89U	1.93U	1.88U	1.87U
Sodium	**252**	159	174	**445**	**306**	**203**	179	180	138	170	151	188	174	189	196	181	184
Thallium	0.49	6.2	0.240J	0.230J	0.47	0.6	0.46	0.42	0.38	0.58	0.57	0.51	0.82	7.55U	7.74U	7.52U	7.47U
Vanadium	21.2	21.7	12.2	11.7	19.8	22.1	19.4	23.4	19.3	18	23.5	33.5	25	36.7	43	40.6	38.5
Zinc	**339**	207	132	211	**307**	205	208	193	203	173	**259**	**299**	**238**	185	217	199	196

	Harbor Sediments													Open-Lake Reference Area			
	Sampling Sites													Sampling Sites			
Misc. (mg/kg)	CH-18	CH-19	CH-20	CH-21	CH-22	CH-23	CH-24	CH-25	CH-26	CH-27	CH-28	CH-29	CH-30	CL-1	CL-2	CL-3	CL-4
Ammonia	133	108	51.5	102	120	152	140	**190**	139	**165**	126	127	82	158	142	132	118
Total cyanide	**1.05**	0.111U	0.481	**2.62**	**3.63**	0.131U	0.189J	0.289J	0.121U	0.144U	0.148U	0.161U	0.153U	0.997U	1.01U	0.979U	0.965U
TOC	19900	17500	12500	6850	6780	26300	20700	20400	19400	15600	20400	15600	40000	30100	30600	29600	27000

*Estimated value between the detection limit and reporting limit.

**Not detected at or above the specified reporting limit.

TABLE 3. Bulk Polycyclic Aromatic Hydrocarbon (PAH) analyses on Cleveland Harbor Federal navigation channel sediments. Boldface/shaded values indicate a concentration that is greater in comparison to the open-lake reference area (from EEI 2007).

PAH Compound (ug/kg)	Harbor Sediments																
	Sampling Sites																
	CH-1	CH-2	CH-3	CH-4	CH-5	CH-6	CH-7	CH-8	CH-9	CH-10	CH-11	CH-12	CH-13	CH-14	CH-15	CH-16	CH-17
Acenaphthene	16.9	10.6	9.89	31.8	32.1	46.6	24.3	18.3	6.86	14.2	9.36	25.8	14.6	29.4	14.5	21.8	17.4
Acenaphthylene	16.2	11.4	8.24	32	30.3	42	14.4	15.2	5.88	12.1	6.84	20.5	11.7	24.7	12.7	18.5	18.4
Anthracene	61.3	27.6	31.3	117	134	137	74.8	64	20.8	39.5	19.7	65.5	32.9	83.5	36.1	44.1	50.9
Benzo(a)Anthracene	213	112	142	449	424	558	270	216	102	170	84.9	224	123	355	154	168	167
Benzo(a)Pyrene	262	136	163	495	426	628	268	227	122	196	99.1	266	148	401	191	205	190
Benzo(b)Flouranthene	352	203	260	814	719	948	391	356	204	340	166	449	272	695	338	347	291
Benzo(ghi)Perylene	141	77.6	91.9	273	242	340	144	116	72.6	117	56.7	160	98.4	248	117	113	96.1
Benzo(k)Fluoranthene	131	67.1	72.3	204	165	340	135	96.5	63.5	95.8	49.2	136	79.1	202	97.3	116	97.3
Chrysene	274	149	171	594	509	657	301	246	129	225	100	312	168	497	219	231	203
Dibenz(a,h)Anthracene	38.9	21	28.7	79.2	71.8	102	39.9	33.1	21.6	31.7	16.4	43.9	26.4	69.1	32.1	36.9	30.1
Fluoranthene	534	287	334	1020	991	1310	612	487	254	419	210	548	306	863	390	400	355
Fluorene	26.9	15.2	15.3	48.8	47.4	71.6	32.7	28.7	10.2	22.2	13.2	39.9	21.3	45.2	21.8	30.2	23.1
Indeno(1,2,3-cd)Pyrene	126	70.6	84.6	257	224	314	135	106	65.9	103	51.2	144	87.4	231	109	102	91.1
Naphthalene	4.08U*	3.94U	4.47U	4.61U	6.82U	22.1U	4.79U	4.39U	5.45U	5.06U	5.03U	17.2U	5.28U	25U	5U	5.13U	5.2U
Phenanthrene	258	138	154	522	488	618	327	269	106	199	89.4	290	135	429	176	187	155
Pyrene	452	223	271	909	825	1070	508	414	202	352	159	453	240	734	317	340	296
Total PAHs	**2903**	**1549**	**1837**	**5846**	**5329**	**7182**	**3277**	**2693**	**1386**	**2337**	**1131**	**3178**	**1764**	**4907**	**2226**	**2361**	**2081**

*Not detected at or above the specified reoprting limit.

TABLE 3 (continued). Bulk Polycyclic Aromatic Hydrocarbon (PAH) analyses on Cleveland Harbor Federal navigation channel sediments. Boldface/shaded values indicate a concentration that is greater in comparison to the open-lake reference area (from EEI 2007).

PAH compound (ug/kg)	Harbor Sediments													Open-Lake Reference Area			
	Sampling Sites													Sampling Sites			
	CH-18	CH-19	CH-20	CH-21	CH-22	CH-23	CH-24	CH-25	CH-26	CH-27	CH-28	CH-29	CH-30	CL-1	CL-2	CL-3	CL-4
Acenaphthene	54.8	11.5	38.2	12.5	23.1	14.8	22	8.07	14.5	15.5	19.4	13	46.4	10.7U*	11.9U	12U	6.48
Acenaphthylene	47	12.9	20.3	12.4	22.7	12.5	20.7	9	25.1	16.9	23.8	30.8	50.4	10.7U	6.12	12U	13.5
Anthracene	122	33.4	59.1	31.8	70.7	41.9	63.9	24.6	40.6	42.3	38.4	41.3	145	10.7U	8.61	12U	18.4
Benzo(a)Anthracene	379	131	182	127	236	136	283	102	138	165	107	131	510	16.8	45.2	39.6	57.2
Benzo(a)Pyrene	417	159	205	142	222	141	327	112	165	192	126	152	478	10.7U	15.5	10.5	75.5
Benzo(b)Fluoranthene	677	253	315	242	338	239	586	202	242	346	187	232	818	10.7U	17.9	11.5	103
Benzo(ghi)Perylene	249	86.2	107	75.7	114	74.9	206	64.3	83.5	117	68.2	80.2	224	10.7U	6.38	12U	46.3
Benzo(k)Fluoranthene	193	86.1	106	58.1	91.9	60.9	156	51.4	60.7	94.6	69.2	66.4	221	10.7U	9.83	10.5	44.2
Chrysene	466	168	221	143	244	136	375	113	127	202	114	122	593	10.7U	11.9U	12U	40.1
Dibenz(a,h)Anthracene	75.5	26.4	33	21.8	38.6	23.1	60.2	19	26.2	33.3	22.9	25.8	74.5	10.7U	11.9U	12U	11.6
Fluoranthene	815	318	387	256	404	283	662	247	237	367	214	237	1040	13.2	34.3	25.5	122
Fluorene	84.4	17.7	39.7	18.4	37.1	23.1	35.3	12.3	21	26.7	25.9	22.8	73.9	10.7U	11.9U	12U	11.1
Indeno(1,2,3-cd)Pyrene	227	83	99.1	67.5	105	69.1	194	59.3	79.4	106	65.9	78.7	212	10.7U	11.9U	12U	41.7
Naphthalene	38	4.86U	77.4	4.06U	3.25	6.26U	4.81U	5.31U	5.42U	6.45U	6.26U	7.6U	39.2	10.7U	11.9U	12U	11.5U
Phenanthrene	465	143	220	114	206	141	324	103	120	156	78	97.3	515	10.7U	11.9U	12U	14.8
Pyrene	714	260	357	248	393	227	563	193	197	292	167	185	1020	10.7U	7.19	12U	87.2
Total PAHs	**5024**	**1789**	**2467**	**1570**	**2549**	**1623**	**3878**	**1320**	**1577**	**2172**	**1327**	**1515**	**6060**	30	151	97.6	693.08

*Not detected at or above the specified reporting limit.

TABLE 4. Theoretical bioaccumulation potential (TBP) for total PAH concentrations in Cleveland Harbor Federal navigation channel sediments (based on data from EEI 2007). TBP Boldface/shaded values indicate a TBP that is greater than the calculated open-lake reference area total PAH TBP of 257 μg/kg.

Site	Total PAH concentration (μg/kg)	TOC concentration (%)	BSAF	Lipid level (%)	TBP (μg/kg)
CH-1	2903	0.0142	1	0.01	**2044.3662**
CH-2	1549	0.0205	1	0.01	**755.60976**
CH-3	1837	0.0212	1	0.01	**2757.5472**
CH-4	5846	0.0219	1	0.01	**2433.3333**
CH-5	5329	0.0201	1	0.01	**3573.1343**
CH-6	7182	0.0252	1	0.01	**1300.3968**
CH-7	3277	0.0241	1	0.01	**1117.4274**
CH-8	2693	0.0173	1	0.01	**801.15607**
CH-9	1386	0.0265	1	0.01	**881.88679**
CH-10	2337	0.0274	1	0.01	**412.77372**
CH-11	1131	0.0229	1	0.01	**1387.7729**
CH-12	3178	0.0203	1	0.01	**868.96552**
CH-13	1764	0.028	1	0.01	**1752.5**
CH-14	4907	0.014	1	0.01	**1590**
CH-15	2226	0.0145	1	0.01	**1628.2759**
CH-16	2361	0.0145	1	0.01	**1435.1724**
CH-17	2081	0.0223	1	0.01	**2252.9148**
CH-18	5024	0.0199	1	0.01	**2524.6231**
CH-19	1789	0.0175	1	0.01	**1022.2857**
CH-20	2467	0.0125	1	0.01	**1973.6**
CH-21	1570	0.00685	1	0.01	**2291.9708**
CH-22	2549	0.00678	1	0.01	**3759.587**
CH-23	1623	0.0263	1	0.01	**617.11027**
CH-24	3878	0.0207	1	0.01	**1873.43**
CH-25	1320	0.0204	1	0.01	**647.05882**
CH-26	1577	0.0194	1	0.01	**812.8866**
CH-27	2172	0.0156	1	0.01	**1392.3077**
CH-28	1327	0.0204	1	0.01	**650.4902**
CH-29	1515	0.0156	1	0.01	**971.15385**
CH-30	6060	0.04	1	0.01	**1515**

TABLE 5. Bulk Polychlorinated Biphenyl (PCB) analyses on Cleveland Harbor Federal navigation channel sediments. Boldface/shaded values indicate a concentration that is greater in comparison to the open-lake reference area (from EEI 2007).

	Harbor Sediments																
	Sampling Sites																
Aroclor (ug/kg)	CH-1	CH-2	CH-3	CH-4	CH-5qc	CH-6	CH-7	CH-8	CH-9	CH-10	CH-11	CH-12	CH-13	CH-14	CH-15	CH-16	CH-17
1016	58.1U*	60.7U	63.8U	67.3U	63.8U	66.8U	63.9U	29.3U	36.9U	34.5U	35.9U	32.9U	38.0U	32.2U	32.5U	34.0U	36.0U
1221	58.1U	60.7U	63.8U	67.3U	63.8U	66.8U	63.9U	29.3U	36.9U	34.5U	35.9U	32.9U	38.0U	32.2U	32.5U	34.0U	36.0U
1232	58.1U	60.7U	63.8U	67.3U	63.8U	66.8U	63.9U	29.3U	36.9U	34.5U	35.9U	32.9U	38.0U	32.2U	32.5U	34.0U	36.0U
1242	58.8	56.2J**	61.6J	56.3J	**111**	51.6J	53.2J	29.3U	36.9U	34.5U	35.9U	32.9U	38.0U	32.2U	32.5U	34.0U	36.0U
1248	58.1U	60.7U	63.8U	67.3U	63.8U	66.8U	63.9U	29.3U	36.9U	34.5U	35.9U	32.9U	38.0U	32.2U	32.5U	34.0U	36.0U
1254	**163**	**75**	**63.2J**	**68**	**126**	**48.2J**	42.8J	22.2J	28.1J	30.1J	33.8J	32.9U	38.0U	32.2U	32.5U	34.0U	**46.7**
1260	29.1J	60.7U	63.8U	67.3U	32.4J	66.8U	63.9U	29.3U	36.9U	34.5U	35.9U	32.9U	38.0U	32.2U	32.5U	34.0U	27.1J
"Total"***	**251**	**192**	**189**	**192**	**269**	**167**	**160**	**80.8**	**102**	**101**	**106**	**98.7**	**114**	**96.6**	**97.5**	**102**	**110**

	Harbor Sediments													Open-Lake Reference Area Sediments			
	Sampling Sites													Sampling Sites			
Aroclor (ug/kg)	CH-18	CH-19	CH-20	CH-21	CH-22	CH-23	CH-24	CH-25	CH-26	CH-27qc	CH-28	CH-29	CH-30	CL-1	CL-2	CL-3	CL-4
1016	68.3U	65.3U	55.1U	60.9U	71.9U	77.8U	66.6U	76.4U	75.5U	90.3U	86.7U	48.8U	91.7U	78.6U	81.1U	77.1U	77.7U
1221	68.3U	65.3U	55.1U	60.9U	71.9U	77.8U	66.6U	76.4U	75.5U	90.3U	86.7U	48.8U	91.7U	78.6U	81.1U	77.1U	77.7U
1232	68.3U	65.3U	55.1U	60.9U	71.9U	77.8U	66.6U	76.4U	75.5U	90.3U	86.7U	48.8U	91.7U	78.6U	81.1U	77.1U	77.7U
1242	53.4J	43.7J	79.5	55.7J	47.7J	68.9J	60.8J	46.6J	**99.7**	**163**	**147**	48.8U	**83.0J**	78.6U	81.1U	77.1U	77.7U
1248	68.3U	65.3U	55.1U	60.9U	71.9U	77.8U	66.6U	76.4U	75.5U	90.3U	86.7U	48.8U	91.7U	78.6U	81.1U	77.1U	77.7U
1254	**56.6J**	65.3U	**73.5**	**80.9**	**75.5**	**85.3**	**64.4J**	38.7J	**138**	**260**	**221**	**62.1**	**102**	36.6J	42.8J	35.4J	37.9J
1260	68.3U	65.3U	55.1U	34.4J	30.5J	77.8U	66.6U	76.4U	44.9J	81J	62.6J	31.0J	44.4J	78.6U	81.1U	77.1U	77.7U
"Total"	**179**	**174**	**208**	**171**	**153**	**232**	**192**	**162**	**283**	**504**	**431**	**142**	**230**	36.6	42.8	35.4	37.9

*Not detected at or above the specified reporting limit.
**Estimated value between the detection limit and reporting limit.
***Sum of aroclor(s) evidenced in harbor or lake sediments, with non-detectable concentrations valued at the reporting limit.

TABLE 6. TBP for total PCB concentrations in Cleveland Harbor Federal navigation channel sediments (based on data from EEI 2007). TBP Boldface/shaded values indicate a TBP that is greater than the calculated open-lake reference area total PCB TBP of 16.8 μg/kg.

Site	Total PCB concentration (μg/kg)	TOC concentration (%)	BSAF	Lipid level (%)	TBP (μg/kg)
CH-1	251	0.0142	1.2	0.01	**212.1127**
CH-2	192	0.0205	1.2	0.01	**112.3902**
CH-3	189	0.0212	1.2	0.01	**106.9811**
CH-4	192	0.0219	1.2	0.01	**105.2055**
CH-5	269	0.0201	1.2	0.01	**160.597**
CH-6	167	0.0252	1.2	0.01	**79.52381**
CH-7	160	0.0241	1.2	0.01	**79.66805**
CH-8	80.8	0.0173	1.2	0.01	**56.04624**
CH-9	102	0.0265	1.2	0.01	**46.18868**
CH-10	101	0.0274	1.2	0.01	**44.23358**
CH-11	106	0.0229	1.2	0.01	**55.54585**
CH-12	98.7	0.0203	1.2	0.01	**58.34483**
CH-13	114	0.028	1.2	0.01	**48.85714**
CH-14	96.6	0.014	1.2	0.01	**82.8**
CH-15	97.5	0.0145	1.2	0.01	**80.68966**
CH-16	102	0.0145	1.2	0.01	**84.41379**
CH-17	110	0.0223	1.2	0.01	**59.19283**
CH-18	179	0.0199	1.2	0.01	**107.9397**
CH-19	174	0.0175	1.2	0.01	**119.3143**
CH-20	208	0.0125	1.2	0.01	**199.68**
CH-21	171	0.00685	1.2	0.01	**299.562**
CH-22	153	0.00678	1.2	0.01	**270.7965**
CH-23	232	0.0263	1.2	0.01	**105.8555**
CH-24	192	0.0207	1.2	0.01	**111.3043**
CH-25	162	0.0204	1.2	0.01	**95.29412**
CH-26	283	0.0194	1.2	0.01	**175.0515**
CH-27	504	0.0156	1.2	0.01	**387.6923**
CH-28	431	0.0204	1.2	0.01	**253.5294**
CH-29	142	0.0156	1.2	0.01	**109.2308**
CH-30	230	0.04	1.2	0.01	**69**

TABLE 7. Bulk pesticide analyses on Cleveland Harbor Federal navigation channel sediments. Boldface/shaded values indicate a concentration that is greater in comparison to the open-lake reference area (from EEI 2007).

Pesticide (ug/kg)	Harbor Sediments																
	Sampling Sites																
	CH-1	CH-2	CH-3	CH-4	CH-5	CH-6	CH-7	CH-8	CH-9	CH-10	CH-11	CH-12	CH-13	CH-14	CH-15	CH-16	CH-17
4,4-DDD	4.70J*	6.07U**	6.38U	22.4U	20.0U	4.95J	2.13U	19.8U	8.16J	14.9J	2.38J	2.21J	2.58U	3.05	2.20U	2.06J	2.42U
4,4-DDE	5.81U	6.07U	6.38U	22.4U	20.0U	6.68U	2.13U	19.8U	24.9U	11.1J	7.19U	5.54	2.58U	2.18U	2.20U	2.28U	4.36
4,4-DDT	5.81U	6.07U	6.38U	**60.6**	**55.7**	10.2	11.3	19.8U	10.7J	11.7J	7.19U	9.52	11.6	9.9	10.3	13.1	2.42U
Aldrin	2.91U	3.03U	3.19U	11.2U	10.0U	3.34U	1.07U	9.90U	12.5U	11.6U	3.59U	1.11U	1.29U	1.09U	1.10U	1.14U	1.21U
Alpha-BHC	2.91U	3.03U	3.19U	11.2U	10.0U	3.34U	1.07U	9.90U	12.5U	11.6U	3.59U	1.11U	1.29U	1.09U	1.10U	1.14U	1.21U
Beta-BHC	2.91U	3.03U	3.19U	11.2U	10.0U	3.34U	1.07U	9.90U	12.5U	11.6U	3.59U	1.11U	1.29U	1.09U	1.10U	1.31	2.07
Chlordane	36.3U	37.9U	39.9U	140U	125U	41.8U	13.3U	124U	156U	145U	44.9U	16.8U	16.1U	13.7U	13.7U	14.3U	15.1U
Delta-BHC	2.91U	3.03U	3.19U	11.2U	10.0U	3.34U	1.07U	9.90U	12.5U	11.6U	3.59U	1.11U	1.29U	1.09U	1.10U	1.14U	1.21U
Dieldrin	5.81U	6.07U	6.38U	22.4U	20.0U	6.68U	2.13U	19.8U	24.9U	**11.6**	7.19U	2.21U	2.58U	1.09U	2.20U	2.28U	2.42U
Endosulfan I	2.91U	6.07U	3.19U	11.2U	10.0U	3.34U	1.07U	9.90U	12.5U	11.6U	3.59U	1.11U	1.29U	1.09U	1.10U	2.28U	1.21U
Endosulfan II	2.91U	3.03U	6.38U	22.4U	20.0U	6.68U	2.13U	19.8U	24.9U	11.2J	7.19U	2.21U	2.58U	2.18U	2.20U	1.14U	2.42U
Endosulfan Sulfate	5.81U	6.07U	6.38U	22.4U	20.0U	6.68U	2.13U	19.8U	24.95U	11.6U	7.19U	2.21U	2.58U	2.18	2.20U	2.28U	2.42U
Endrin	5.81U	6.07U	6.38U	22.4U	20.0U	6.68U	2.13U	19.8U	24.9U	23.2U	7.19U	2.21U	2.58	1.09U	2.20U	2.28U	2.42U
Endrin Aldehyde	2.91U	6.07U	6.38U	22.4U	20.0U	6.68U	2.13U	19.8U	24.9U	7.23J	7.19U	2.21U	2.58U	2.18U	2.20U	2.28U	2.42U
Endrin Ketone	5.81U	6.07U	6.38U	22.4U	20.0U	6.68U	2.13U	19.8U	24.9U	8.34J	7.19U	2.21U	2.58U	2.18U	2.20U	1.14U	2.42U
Gamma-BHC	2.91U	3.03U	3.19U	11.2U	10.0U	3.34U	1.07U	9.90U	12.5U	11.6U	3.59U	1.11U	1.29U	1.09U	1.10U	1.14U	1.21U
Gamma-Chlordane	2.91U	3.03U	3.19U	11.2U	10.0U	3.34U	1.07U	9.90U	12.5U	11.6U	3.59U	1.11U	1.29U	1.09U	1.10U	1.14U	1.21U
Heptachlor	2.91U	3.03U	3.19U	11.2U	10.0U	3.34U	1.07U	9.90U	12.5U	11.6U	3.59U	1.11U	1.29U	1.09U	1.10U	1.14U	1.21U
Heptachlor Epoxide	2.91U	3.03U	3.19U	11.2U	10.0U	3.34U	1.07U	9.90U	12.5U	11.6U	3.59U	1.11U	1.29U	1.09U	1.10U	1.14U	1.21U
Methoxychlor	29.1U	30.3U	31.9U	112U	100U	33.4U	10.77U	99.0U	125U	36J	35.9U	11.1U	12.9U	10.9U	11.0U	1.14U	12.1U
Toxaphene	145U	152U	159U	561U	501U	167U	53.3U	495U	623U	579U	180U	55.3U	64.5U	54.6U	55.0U	57.0U	60.4U

*Estimated value between the detection limit and reporting limit.
**Not detected at or above the specified reporting limit.

TABLE 7 (continued). Bulk pesticides analyses on Cleveland Harbor Federal navigation channel sediments. Boldface/shaded values indicate a concentration that is greater in comparison to the open-lake reference area (from EEI 2007).

Pesticide (ug/kg)	Harbor Sediments													Open-Lake Reference Area			
	Sampling Sites													Sampling Sites			
	CH-18	CH-19	CH-20	CH-21	CH-22	CH-23	CH-24	CH-25	CH-26	CH-27	CH-28	CH-29	CH-30	CL-1	CL-2	CL-3	CL-4
4,4-DDD	2.28U	6.53U	5.51U	2.03U	7.19U	7.78JU	6.66J	7.64J	7.55J	8.85J	**13.5**	9.82J	**12.5**	7.89J	8.95J	15.5U	7.92J
4,4-DDE	2.28U	6.53U	5.51U	2.03U	7.19U	7.78U	6.66U	7.64U	7.55U	8.85U	8.67U	9.82U	9.17U	15.8U	16.2U	15.5U	15.6U
4,4-DDT	2.28U	6.53U	5.51U	2.03U	7.19U	7.78U	6.66U	7.64U	7.55U	8.85U	12.7	9.82U	9.17U	15.8U	16.2U	15.5U	15.6U
Aldrin	1.14U	3.27U	2.75U	1.02U	3.59U	3.89U	3.33U	3.82U	3.78U	4.43U	4.33U	4.91U	4.58U	7.89U	8.09U	7.76U	7.80U
Alpha-BHC	1.14U	3.27U	2.75U	1.02U	3.59U	3.89U	3.33U	3.82U	3.78U	4.43U	4.33U	4.91U	4.58U	7.89U	8.09U	7.76U	7.80U
Beta-BHC	1.14U	3.27U	2.75U	1.02U	3.59U	3.89U	3.33U	3.82U	3.78U	4.43U	4.33U	4.91U	4.58U	7.89U	8.09U	7.76U	7.80U
Chlordane	14.2U	40.8U	34.4U	12.7U	44.9U	48.6U	41.6U	47.7U	47.2U	55.3U	54.2U	61.4U	57.3U	98.7U	101U	97.0U	97.5U
Delta-BHC	1.14U	3.27U	2.75U	1.02U	3.59U	3.89U	3.33U	3.82U	3.78U	4.43U	4.33U	4.91U	4.58U	7.89U	8.09U	7.76U	7.80U
Dieldrin	2.28U	6.53U	5.51U	2.03U	7.19U	7.78U	6.66U	7.64U	7.55U	8.85U	8.67U	9.82U	9.17U	15.8U	16.2U	15.5U	15.6U
Endosulfan I	1.14U	3.27U	2.75U	1.02U	3.59U	3.89U	3.33U	3.82U	3.78U	4.43U	4.33U	4.91U	4.58U	7.89U	8.09U	7.76U	7.80U
Endosulfan II	2.28U	6.53U	5.51U	2.03U	7.19U	7.78U	6.66U	7.64U	7.55U	8.85U	8.67U	9.82U	9.17U	15.8U	16.2U	15.5U	15.6U
Endosulfan Sulfate	2.28U	6.53U	5.51U	2.03U	7.19U	3.89U	6.66U	7.64U	7.55U	8.85U	8.67U	9.82U	9.17U	15.8U	16.2U	15.5U	15.6U
Endrin	2.28U	6.53U	5.51U	2.03U	7.19U	7.78U	6.66U	7.64U	7.55U	8.85U	8.67U	9.82U	9.17U	15.8U	16.2U	15.5U	15.6U
Endrin Aldehyde	2.28U	6.53U	5.51U	2.03U	7.19U	7.78U	6.66U	7.64U	7.55U	8.85U	8.67U	9.82U	9.17U	15.8U	16.2U	15.5U	15.6U
Endrin Ketone	2.28U	6.53U	5.51U	2.03U	7.19U	7.78U	6.66U	7.64U	7.55U	8.85U	8.67U	9.82U	9.17U	15.8U	16.2U	7.76U	15.6U
Gamma-BHC	1.14U	3.27U	2.75U	1.02U	3.59U	3.89U	3.33U	3.82U	3.78U	4.43U	4.33U	4.91U	4.58U	7.89U	8.09U	7.76U	7.80U
Gamma-Chlordane	1.14U	3.27U	2.75U	1.02U	3.59U	3.89U	3.33U	3.82U	3.78U	4.43U	4.33U	4.91U	4.58U	15.8U	16.2U	15.5U	15.6U
Heptachlor	1.14U	3.27U	2.75U	1.02U	3.59U	3.89U	3.33U	3.82U	3.78U	4.43U	4.33U	4.91U	4.58U	7.89U	8.09U	15.5U	7.80U
Heptachlor Epoxide	1.14U	3.27U	2.75U	1.02U	3.59U	3.89U	3.33U	3.82U	3.78U	4.43U	4.33U	4.91U	4.58U	7.89U	8.09U	7.76U	7.80U
Methoxychlor	11.4U	32.7U	27.5U	10.2U	35.9U	38.9U	33.3U	38.2U	37.8U	44.3U	43.3U	49.1U	45.8U	78.9U	80.9U	77.6U	78.0U
Toxaphene	56.9U	163U	138U	50.8U	180U	195U	166U	191U	189U	221U	217U	245U	229U	395U	405U	388U	390U

*Not detected at or above the specified reporting limit.

**Estimated value between the detection limit and reporting limit.

TABLE 8. TPB for ∑DDT concentrations in Cleveland Harbor Federal navigation channel sediments (based on data from EEI 2007). Boldface/shaded values indicate a TBP that is greater than the calculated open-lake reference area ∑DDT TBP of 33.8 µg/kg.

Site	∑DDT concentration (µg/kg)	TOC concentration (%)	BSAF	Lipid level (%)	TBP (µg/kg)
CH-1	16.3	0.0142	2.5	0.01	28.6971831
CH-2	18.2	0.0205	2.5	0.01	22.195122
CH-3	19.1	0.0212	2.5	0.01	22.5235849
CH-4	105	0.0219	2.5	0.01	**119.863**
CH-5	95.7	0.0201	2.5	0.01	**119.0299**
CH-6	21.8	0.0252	2.5	0.01	21.6269841
CH-7	15.6	0.0241	2.5	0.01	16.1825726
CH-8	59.4	0.0173	2.5	0.01	**85.83815**
CH-9	43.8	0.0265	2.5	0.01	**41.32075**
CH-10	37.7	0.0274	2.5	0.01	**34.39781**
CH-11	16.8	0.0229	2.5	0.01	18.3406114
CH-12	17.3	0.0203	2.5	0.01	21.3054187
CH-13	16.8	0.028	2.5	0.01	15
CH-14	15.1	0.014	2.5	0.01	26.9642857
CH-15	14.7	0.0145	2.5	0.01	25.3448276
CH-16	17.4	0.0145	2.5	0.01	30
CH-17	9.2	0.0223	2.5	0.01	10.3139013
CH-18	6.84	0.0199	2.5	0.01	8.59296482
CH-19	19.6	0.0175	2.5	0.01	28
CH-20	16.5	0.0125	2.5	0.01	33
CH-21	6.09	0.00685	2.5	0.01	22.2262774
CH-22	21.6	0.00678	2.5	0.01	**79.64602**
CH-23	23.3	0.0263	2.5	0.01	22.148289
CH-24	19.9	0.0207	2.5	0.01	24.0338164
CH-25	22.9	0.0204	2.5	0.01	28.0637255
CH-26	22.7	0.0194	2.5	0.01	29.2525773
CH-27	26.6	0.0156	2.5	0.01	**42.62821**
CH-28	34.9	0.0204	2.5	0.01	**42.76961**
CH-29	29.5	0.0156	2.5	0.01	**47.27564**
CH-30	30.8	0.04	2.5	0.01	19.25

TABLE 9. Inorganic Modified Elutriate Test results on Cleveland Harbor Federal navigation sediments (from EEI 2007).

	Harbor Sediments									
	Sampling Sites									
	CH-UEMU		CH-URMU		CH-LRMU		CH-OHMU		CH-ORMU	
Metal (µg/L)	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved
Aluminum	4970	51.4	4970	126	2940	35.1	4530	46.9	3810	69
Antimony	1.3	0.89	2.3	0.85	1.7	1.1	0.5U	0.5U	0.8	0.75
Arsenic	16	4.6	13	9.4	16	12.1	10	4	7	4.1
Barium	81.9	32.3	83.2	46.4	82.2	59.1	104	67.7	53.4	30.2
Beryllium	0.42	0.1U*	0.31	0.1U	0.19	0.1U	0.2	0.1U	0.22	0.1U
Cadmium	0.88	0.11U	1.7	0.11U	1.1	0.11U	0.34	0.11U	0.39	0.11U
Calcium	49900	45900	55700	55400	59800	57800	44600	44200	36600	36100
Chromium	15.9	1U	17.8	1U	11	1U	7.3	1U	9.1	1U
Cobalt	5.1	1.2	4	1.6	2.5	1.1	2.8	1.1	2.1	1.2
Copper	37.5	1.3	27.9	1.5	18.1	0.66	11	1.1	13	1.5
Iron	13200	267	9090	582	5930	651	6280	245	5560	199
Lead	33.2	0.5U	30.3	0.77	20.9	0.5U	11.9	0.5U	13.8	0.5U
Magnesium	13300	11400	13500	13600	13800	13300	10800	10400	9820	8600
Manganese	748	323	430	396	591	509	1660	1530	248	157
Mercury	0.0398	0.0012	0.0391	0.0024	0.0267	0.0017	0.0212	0.00099	0.0251	0.0011
Nickel	20.6	4.1	17.3	5.4	11.7	4	9.1	3	8.2	2.2
Potassium	8030	6460	7750	7230	7080	6810	5010	4290	4520	3620
Selenium	1U	1U	1U	1U	1U	1U	1U	1U	1U	1U
Sodium	22100	21200	25500	29900	28600	25000	20700	18500	22500	23400
Thallium	0.3U	0.3U	0.3U	0.3U	0.3U	0.3U	0.3U	0.3U	0.51	0.3U
Vanadium	14.1	3U	7.4	3U	4.8	3U	5.2	3U	4.5	3U
Zinc	131	3.4	163	7.4	103	2.8	48.5	3.3	61.2	6.6

	CH-UEMU		CH-URMU		CH-LRMU		CH-OHMU		CH-ORMU	
Misc. (mg/L)	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved
Ammonia	6.06	5.93	11	9.37	8.74	8.67	7.52	7.32	5.22	7.22
Total cyanide	0.00232J	0.00226J	0.0021J	0.00361J	0.0015U	0.0038	0.005U	0.00331U	0.00237J	0.0034J

*Not detected at or above the specified reporting limit.

**Estimated value between the detection limit and reporting limit.

TABLE 10. PAH Modified Elutriate Test results on Cleveland Harbor Federal navigation sediments (from EEI 2007).

	Harbor Sediments									
	Sampling Sites									
	CH-UEMU		CH-URMU		CH-LRMU		CH-OHMU		CH-ORMU	
PAH compound (µg/L)	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved
Acenaphthene	0.481U*	0.521U	0.485U	0.521U	0.197J**	0.521U	0.481U	0.521U	0.472U	0.521U
Acenaphthylene	0.481U	0.521U	0.485U	0.521U	0.481U	0.521U	0.481U	0.521U	0.472U	0.521U
Anthracene	0.481U	0.521U	0.485U	0.521U	0.481U	0.521U	0.481U	0.521U	0.472U	0.521U
Benzo(a)Anthracene	0.104	0.0786	0.127	0.0776	0.149	0.156	0.0839	0.0855	0.091	0.0784
Benzo(a)Pyrene	0.113	0.0917	0.152	0.0961	0.168	0.181	0.122	0.112	0.137	0.0957
Benzo(b)Fluoranthene	0.201	0.184	0.36	0.125	0.223	0.405	0.241	0.129	0.23	0.118
Benzo(ghi)Perylene	0.106	0.0871	0.142	0.0704	0.129	0.143	0.0762	0.0698	0.0693	0.0609
Benzo(k)Fluoranthene	0.024U	0.026U	0.0243U	0.026U	0.024U	0.026U	0.024U	0.026U	0.105	0.026U
Chrysene	0.134	0.113	0.17	0.0929	0.167	0.172	0.0918	0.0851	0.0922	0.0786
Dibenz(a,h)Anthracene	0.0481U	0.0521U	0.0485U	0.0521U	0.0481U	0.0521U	0.0481U	0.0521U	0.472U	0.0521U
Fluoranthene	0.287	0.234	0.379	0.169	0.411	0.254	0.213	0.149	0.134	0.0989
Fluorene	0.481U	0.521U	0.485U	0.521U	0.123J	0.521U	0.481U	0.521U	0.472U	0.521U
Indeno(1,2,3-cd)Pyrene	0.0481U	0.0521U	0.0485U	0.0521U	0.0481U	0.0521U	0.0481U	0.0521U	0.0472U	0.0521U
Naphthalene	0.481U	0.521U	0.485U	0.521U	0.481U	0.521U	0.481U	0.521U	0.472U	0.521U
Phenanthrene	0.481U	0.521U	0.294J	0.521U	0.258J	0.521U	0.481U	0.521U	0.472U	0.521U
Pyrene	0.303	0.249	0.444	0.203	0.506	0.386	0.268	0.159	0.237	0.154

*Not detected at or above the specified reporting limit.
**Estimated value between the detection limit and reporting limit.

TABLE 11. PCB Modified Elutriate Test results on Cleveland Harbor Federal navigation sediments (from EEI 2007).

	Harbor Sediments									
	Sampling Sites									
	CH-UEMU		CH-URMU		CH-LRMU		CH-ORMU		CH-OHMU	
Aroclor (µg/L)	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved
1016	0.0952U*	0.0106U	0.100U	0.103U	0.0952U	0.104U	0.098U	0.103U	0.0962U	0.0102U
1221	0.0952U	0.0106U	0.100U	0.103U	0.0952U	0.104U	0.098U	0.103U	0.0962U	0.0102U
1232	0.0952U	0.0106U	0.100U	0.103U	0.0952U	0.104U	0.098U	0.103U	0.0962U	0.0102U
1242	0.0952U	0.0106U	0.100U	0.103U	0.0952U	0.104U	0.098U	0.103U	0.0962U	0.0102U
1248	0.0952U	0.0106U	0.100U	0.103U	0.0952U	0.104U	0.098U	0.103U	0.0962U	0.0102U
1254	0.0952U	0.0106U	0.100U	0.103U	0.0952U	0.104U	0.098U	0.103U	0.0962U	0.0102U
1260	0.0952U	0.0106U	0.100U	0.103U	0.0952U	0.104U	0.098U	0.103U	0.0962U	0.0102U

*Not detected at or above the specified reporting limit.

TABLE 12. Pesticide Modified Elutriate Test results on Cleveland Harbor Federal navigation sediments (from EEI 2007).

	Harbor Sediments									
	Sampling Sites									
	CH-UEMU		CH-URMU		CH-LRMU		CH-OHMU		CH-ORMU	
Pesticide (µg/L)	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved
4,4-DDD	0.189U	0.222U	0.200U	0.222U	0.192U	0.222U	0.0388U	0.0444U	0.196U	0.222U
4,4-DDE	0.189U	0.222U	0.200U	0.222U	0.192U	0.222U	0.0388U	0.0444U	0.196U	0.222U
4,4-DDT	0.189U	0.222U	0.200U	0.222U	0.192U	0.222U	0.0388U	0.0444U	0.196U	0.222U
Aldrin	0.0943U	0.111U	0.100U	0.111U	0.0962U	0.111U	0.0194U	0.0222U	0.098U	0.111U
Alpha-BHC	0.0943U	0.111U	0.100U	0.111U	0.0962U	0.111U	0.0194U	0.0222U	0.098U	0.111U
Alpha-Chlordane	0.0943U	0.111U	0.100U	0.111U	0.0962U	0.111U	0.0194U	0.0222U	0.098U	0.111U
Beta-BHC	0.0943U	0.111U	0.100U	0.111U	0.192U	0.111U	0.0194U	0.0222U	0.098U	0.111U
Chlordane	1.18U	1.39U	1.25U	1.39U	1.20U	1.39U	0.243U	0.278U	1.23U	1.39U
Delta-BHC	0.0943U	0.111U	0.100U	0.111U	0.0962U	0.111U	0.0194U	0.0222U	0.098U	0.111U
Dieldrin	0.189U	0.222U	0.200U	0.222U	0.192U	0.222U	0.0388U	0.0444U	0.196U	0.222U
Endosulfan I	0.0943U	0.111U	0.100U	0.111U	0.0962U	0.111U	0.0194U	0.0222U	0.098U	0.111U
Endosulfan II	0.189U	0.222U	0.200U	0.222U	0.192U	0.222U	0.0388U	0.0444U	0.196U	0.222U
Endosulfan Sulfate	0.189U	0.222U	0.200U	0.222U	0.192U	0.222U	0.0388U	0.0444U	0.196U	0.222U
Endrin	0.189U	0.222U	0.200U	0.222U	0.192U	0.222U	0.0388U	0.0444U	0.196U	0.222U
Endrin Aldehyde	0.189U	0.222U	0.200U	0.222U	0.192U	0.222U	0.0388U	0.0444U	0.196U	0.222U
Endrin Ketone	0.189U	0.222U	0.200U	0.222U	0.192U	0.222U	0.0388U	0.0444U	0.196U	0.222U
Gamma-BHC	0.0943U	0.111U	0.100U	0.111U	0.0962U	0.111U	0.0194U	0.0222U	0.098U	0.111U
Gamma-Chlordane	0.0943U	0.111U	0.200U	0.111U	0.0962U	0.111U	0.0194U	0.0444U	0.098U	0.111U
Heptachlor	0.0943U	0.111U	0.100U	0.111U	0.0962U	0.111U	0.0194U	0.0222U	0.098U	0.111U
Heptachlor Epoxide	0.0943U	0.111U	0.100U	0.111U	0.0962U	0.111U	0.0194U	0.0222U	0.098U	0.111U
Methoxychlor	0.943U	1.11U	0.100U	1.11U	0.962U	1.11U	0.194U	0.222U	2.45U	1.11U
Toxaphene	2.36U	2.78U	2.50U	2.78U	2.40U	2.78U	0.485U	0.556U	2.45U	2.78U

*Not detected at or above the specified reporting limit.

TABLE 13. Results of 10-day solid phase toxicity tests (bioassays) on Cuyahoga River sediments near upstream limit of Cleveland Harbor Federal navigation channels (from EEI 2007). Boldface/shaded values indicate statistically significant (P=0.05) difference relative to the open-lake reference area.

Composite sediment sample	Test species		
	H. azteca	*C. tentans*	
	Mean survival (%)	Mean survival (%)	Mean growth (mg/org*
CH-UEMU	**0.52±02**	**0.72±0.03**	1.06±0.09
CL	0.88	0.94	1.01

*Ash-free dried weight.