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August 1988

WATER RESOURCES

An In-Depth Look at Overflow Dredging on the Great Lakes

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The Honorable David Durenberger
Co-chair, Great Lakes Task Force
United States Senate

The Honorable John Glenn
Co-chair, Great Lakes Task Force
United States Senate

This briefing report responds to your request of July 15, 1987, regarding the U.S. Army Corps of Engineers' use of overflow dredging on the Great Lakes. It summarizes the information that we presented to the Great Lakes Task Force staff in a briefing on May 19, 1988, and to the offices of other Great Lakes states' senators during a subsequent briefing.

Dredging is used to improve navigation channels on the Great Lakes. In fiscal years 1986 and 1987, about 56 percent of the sediment dredged by the Corps on the Great Lakes was done by a hopper dredge which pumps water and sediment from the river or harbor bottom into an open bin in the dredge vessel for storage and disposal. During overflow dredging, pumping continues after the bin is full. Excess water and some lightweight sediment overflow the sides of the dredge back into the harbor or river. This process allows more sediment to settle into the bin. (See sections 1 and 2 for additional information on dredging operations and sediment-sampling requirements.)

Your letter expressed concern that overflow dredging, if used in areas of highly contaminated sediment, could cause serious environmental damage by resuspending toxic chemicals in the water. As you requested, we addressed several issues regarding overflow dredging during our review, including

-- its environmental impact,

-- the effect of Environmental Protection Agency (EPA) regional guidelines and Clean Water Act provisions on Corps' decisions on allowing its use,

-- its cost-effectiveness as a dredging method, and

-- the extent of its use in areas of highly contaminated sediment.

RESULTS IN BRIEF

In summary, we found that:

-- The environmental impacts of overflow dredging are unknown and no research is currently underway by the Corps or EPA to determine such impacts. The Corps believes that models can be developed to predict the environmental impacts of overflow dredging, but according to the Corps, developing these models would take about 7 years and cost $7 million to $8 million. Corps headquarters officials told us that self-initiated research on overflow dredging by the Corps' experimental research station has been given a low priority because other environmental issues are considered more important. We did identify research performed to assess the impact of resuspending contaminated sediment during open water disposal (dumping) where the density of sediment discharged into the water is much higher than in overflow dredging. Because of the high density, however, the conclusions from open water disposal research cannot be directly applied to overflow dredging. (See section 3.)

-- EPA Region V (Chicago) guidelines, issued in 1977, only cover open water disposal of sediment in the Great Lakes and consequently are of limited use to states making decisions about allowing overflow dredging. They contain scientific data on polychlorinated biphenyls (commonly known as PCBs) and mercury, but classify other pollutants by broad levels without scientific basis. EPA headquarters plans to issue nationwide guidelines covering sediment disposal in early 1989, but these guidelines will not be directed at overflow dredging. The eight Great Lakes states whose boundaries extend into the lakes have taken different positions on certifying (as required by the Clean Water Act) that the use of overflow dredging will not violate the EPA-approved state water quality standards. Minnesota and Wisconsin have banned overflow dredging of either contaminated or clean sediment, five states do not allow it in areas of certain contaminated sediments, and Ohio allows it without restriction. The Corps believes that restrictions imposed by some states, such as not allowing overflow

dredging in nonpolluted areas, will affect its ability to carry out its dredging responsibilities. (See sections 4 and 5.)

-- For many harbors and rivers, overflow dredging is the least expensive dredging method because it maximizes the amount of sediment in the hopper or bin of the dredge. In fiscal years 1986 and 1987, dredges using the overflow method removed about 56 percent of all the sediment dredged on the Great Lakes. Corps division officials responsible for overseeing the dredging projects on the Great Lakes estimated that if overflow dredging had been banned in 1987, dredging costs on the Great Lakes would have increased between 30 and 55 percent because less sediment would have been loaded into the dredge hopper, thus requiring more trips to the disposal site, and increasing the time needed to complete the dredging. On one project, the contractor estimated that the use of overflow dredging reduced the number of trips to the disposal site, 18.5 miles away, from 307 to 63. (See section 6.)

-- We identified only one instance where overflow dredging was used in an area of highly contaminated sediment on the Great Lakes--in the Saginaw River, near Bay City, Michigan. Following its guidelines, the Corps allowed overflow dredging in a part of the river where heavy metals existed but restricted its use in the area where PCBs exceeded EPA guidelines. Periodic Corps monitoring of the dredging contractor's work showed no evidence of overflow dredging in areas where its use was restricted. (See section 7.)

SCOPE AND METHODOLOGY

To obtain information on the issues in your request, we performed a literature search of computerized engineering, environmental, and technical information files; several local university libraries; and the libraries of the International Joint Commission in Windsor, Ontario, and the U.S. Army Waterways Experiment Station (WES) in Vicksburg, Mississippi.

We obtained information through discussions with officials at the U.S. Army Corps of Engineers headquarters; WES; the North Central Division in Chicago, Illinois; and district offices in Buffalo, Chicago, and Detroit. We discussed dredging operations and responsibilities, sediment-sampling

criteria, environmental impacts of dredging, EPA guidelines, the dredging certification process, and the cost-effectiveness of overflow dredging with EPA officials at headquarters and Region V, and with EPA's Great Lakes National Program Office in Chicago.

We also obtained information on the environmental impacts of dredging from discussions with officials at the U.S. Fish and Wildlife Service's Michigan Field Office in Lansing and its National Fisheries Research Center-Great Lakes in Ann Arbor.

We discussed past and current dredging activities in the Saginaw River with officials from the Corps' Detroit District and Saginaw Field Offices, the Michigan Department of Natural Resources, and the contractor that dredged the navigation channel in 1986 and 1987. We observed a hopper dredge overflowing in Saginaw Bay, Michigan, in September 1987.

We obtained information about the states' role in the dredging certification process, the implementation of EPA Region V guidelines, and current Great Lakes dredging projects through discussions with officials from the eight Great Lakes states--Illinois, Indiana, Michigan, Minnesota, New York, Ohio, Pennsylvania, and Wisconsin.

As agreed with your offices, we did not obtain official agency comments on this report. However, we discussed the contents of this document with the Corps and EPA, and incorporated their comments where appropriate. We conducted our work between August 1987 and April 1988.

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As arranged with your offices, unless you publicly announce its contents earlier, we plan no further distribution of this report until 30 days from the date of this letter. At that time, we will send copies to the Secretary of Defense, the Secretary of the Army, the EPA Administrator, and other interested parties. If you have any questions regarding this information, please call me at (202) 275-7756. Major contributors to this report are listed in appendix I.

James Duffus III

James Duffus III
Associate Director

C O N T E N T S

ABBREVIATIONS

DDT	Dichloro-diphenyl-trichloro-ethane
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
FWS	Fish and Wildlife Service
IJC	International Joint Commission
PCBs	Polycholorinated Biphenyls
WES	Waterways Experiment Station

SECTION 1

DREDGING OPERATIONS

Question: Why does the Corps of Engineers dredge the rivers and harbors on the Great Lakes?

Response: The Corps is required by various river and harbor acts passed since the 1800s to do periodic dredging at various harbors in the Great Lakes and elsewhere in the United States to maintain certain water depths to meet the needs of commercial ships using the harbors. Individual dredging actions are subject to administrative and congressional determinations premised on engineering, economic, environmental, and fiscal considerations. Ports such as Toledo, Ohio; Saginaw, Michigan; and Rochester, New York; are dredged to depths of 16.5 to 29 feet.

Question: How does the Corps oversee dredging operations on the Great Lakes?

Response: The Corps has generally delegated the administration of its dredging program to its 11 geographical divisions, which delegate responsibility to 36 districts. The North Central Division in Chicago oversees the three districts which are responsible for the dredging in the portions of the Great Lakes states as follows:

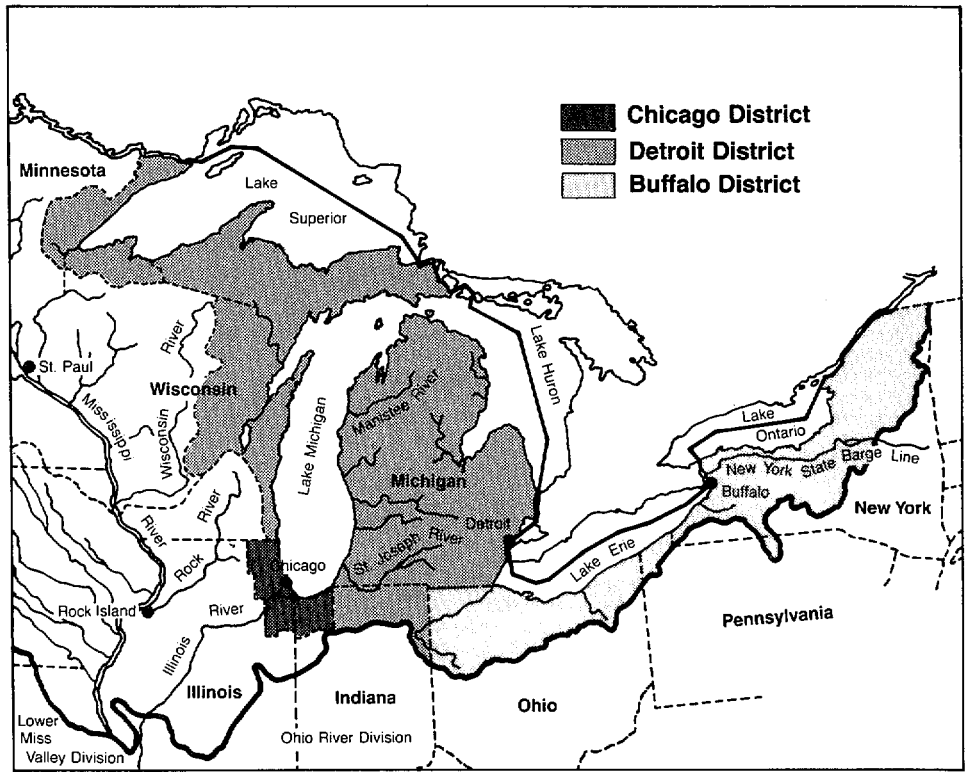
-- Buffalo District (New York, Ohio, and Pennsylvania).

-- Chicago District (Illinois and Indiana).

-- Detroit District (Michigan, Minnesota, and Wisconsin).

Figure 1.1 shows the boundaries of the three districts.

Figure 1.1: Boundaries for the Great Lakes District Corps Offices



Source: U.S. Army Corps of Engineers.

Each district determines the need to dredge the harbors and rivers within its jurisdiction on the basis of underwater surveys and historical data consisting of patterns in water flow and sediment buildup. The larger commercial harbors and rivers receive top priority, while the smaller recreational harbors and rivers are dredged if funds are available.

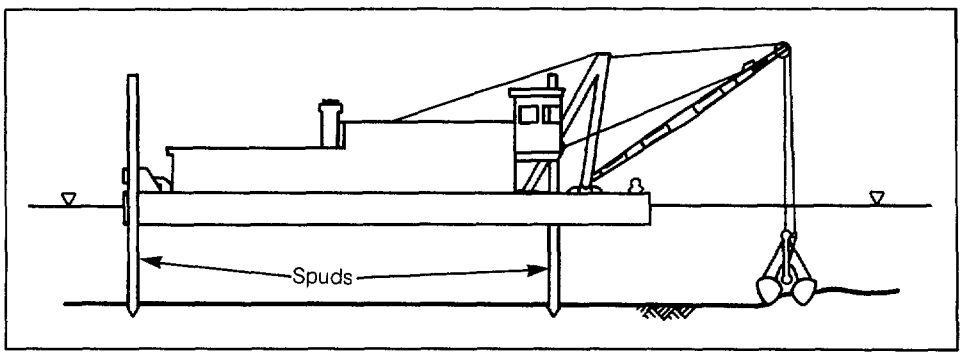
Prior to 1984, the Corps did most of the dredging on the Great Lakes. Since then, all Corps dredging on the Great Lakes has been contracted to private industry. Nearly all dredging contracts are awarded through sealed competitive bids. Decisions on where and when to dredge, acceptable dredging methods, and disposal sites are made by the Corps in consultation with EPA, the Department of Interior's Fish and Wildlife Service (FWS), the state in which the dredging is to be done, and interested local agencies.

Question: What types of dredges are used on the Great Lakes?

Response: Two primary types of dredges are used on river and harbor projects on the Great Lakes--bucket dredges and hopper dredges.

A bucket dredge is a mechanical form of dredge that uses a type of bucket attached to a crane to lift sediment off the channel bottom and load it onto a barge. A tug boat hauls the barge to the disposal site for unloading by way of hydraulic pumping, mechanical equipment, or bottom dumping--opening the bottom of the barge and releasing the sediment into the water. Bucket dredges are generally used when small amounts of sediment are dredged or when the channel to be dredged is shallow or narrow. Figure 1.2 illustrates a mechanical bucket dredge.

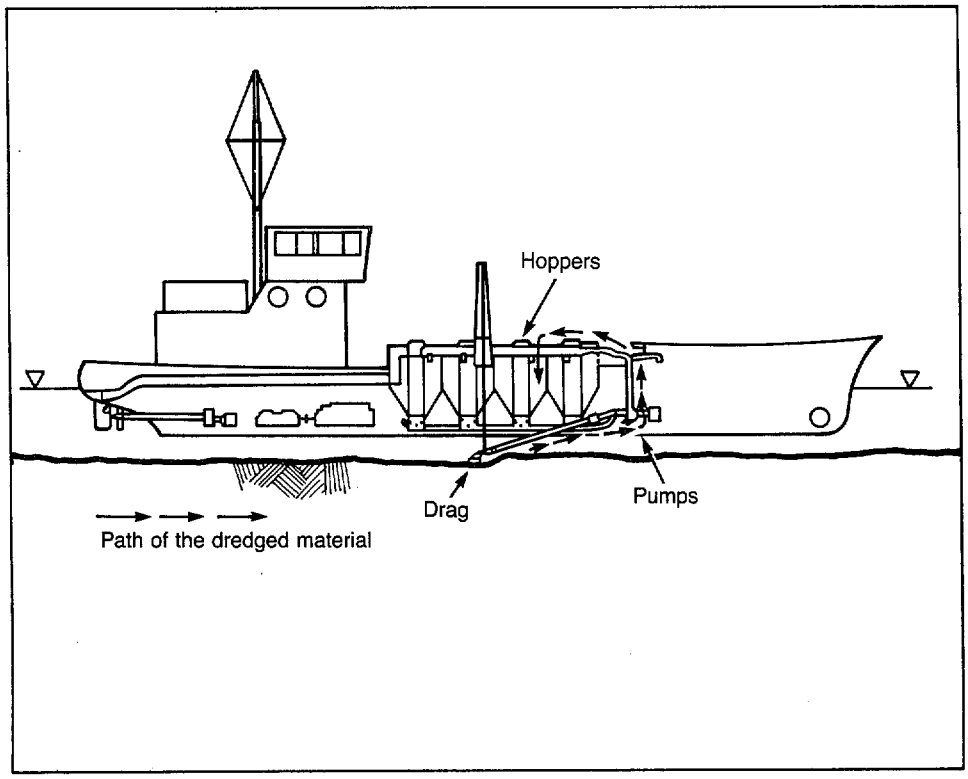
Figure 1.2: Mechanical Bucket Dredge



Source: U.S. Army Corps of Engineers.

A hopper dredge uses large hydraulic pumps to suction sediment off the channel bottom through drag arms and into a bin in the ship. The bin of the hopper dredge we observed can hold 3,600 cubic yards of sediment. Hopper dredges are generally used in harbors not protected by land, and on large mobile projects where ship traffic rules out the use of stationary dredges; and in areas of rough, open water. The dredge sails to the disposal site under its own power. Figure 1.3 illustrates a typical hopper dredge.

Figure 1.3: Hopper Dredge

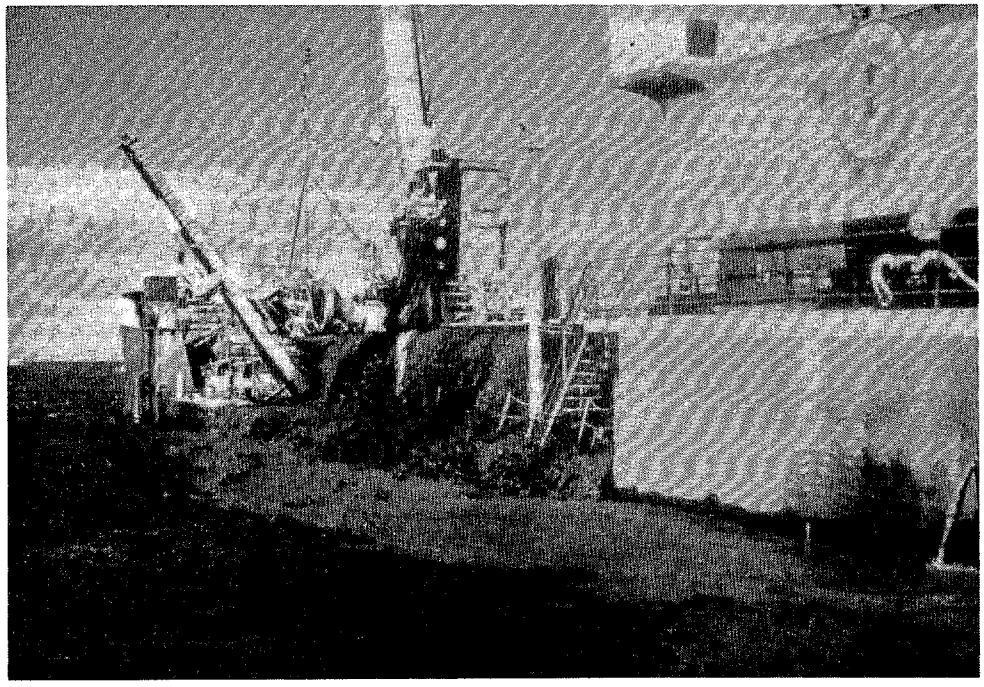


Source: U.S. Army Corps of Engineers.

Question: What is overflow dredging?

Response: Overflow dredging is a method used to increase the amount of sediment loaded into the bin of a dredge by continuing to dredge after the bin is full. Excess water and some lightweight sediment overflows the sides of the dredge, while heavier sediment settles to the bottom of the hopper. When the amount of sediment retained in the bin reaches the desired capacity, dredging is halted and the dredge sails to the disposal site. Hopper dredges are extensively used in overflow dredging because of the volume of dredged material they can contain. Figure 1.4 shows a hopper dredge in the process of overflow dredging.

Figure 1.4: Hopper Dredge Overflowing



Source: U.S. Army Corps of Engineers.

Question: How much hopper dredging is done on the Great Lakes?

Response: Corps records showed that 13 (18 percent) of the 74 dredging projects on the Great Lakes in fiscal years 1986 and 1987 used a hopper dredge. Of the 7.8 million cubic yards of material dredged on the Great Lakes in fiscal years 1986 and 1987, 4.4 million cubic yards (56 percent) were dredged with a hopper dredge.

Question: How does the Corps decide what type of dredge to use on each dredging project and when the dredging will be done?

Response: According to Detroit District officials, the contractor may use either a mechanical (bucket) or hydraulic (hopper) dredge on a project unless otherwise specified by the Corps in its bid solicitation. A contractor on the Great Lakes that uses both mechanical and hydraulic dredges told us that the type of dredge used on a project depends on the size of the river or harbor, the amount of sediment to be removed, time restrictions, and whether the disposal will be made into the open water or into containment facilities.

Corps district officials may impose restrictions on the type of dredge used or the time of the dredging on the basis of EPA,

state, or FWS concerns about the harm that the dredging could have on such events as fish runs and fish spawning. For example, EPA officials told us that because resuspension of contaminated sediment during dredging could be harmful to fish, the contractors at Indiana Harbor, Indiana; Ashtabula, Ohio; and Waukegon, Illinois; were required to use dredges which kept resuspension to a minimum. On other projects, such as the Saginaw River, Michigan project, dredging was scheduled in August or September, when the fish spawning season is over for fish which spawn in the dredged area.

SECTION 2

SEDIMENT-SAMPLING REQUIREMENTS PRIOR TO DREDGING

Question: What are the federal requirements for sediment-sampling and testing prior to dredging?

Response: EPA regulations implementing the Clean Water Act require the Corps to characterize the sediment dredged and assess the potential short- and long-term effects that the proposed disposal method could have on water quality. Under the regulations an EPA region may specify sediment-sampling and testing practices. Officials at EPA headquarters, EPA Region V in Chicago, and the three Great Lakes district Corps offices told us they do not have specific sediment-sampling criteria on content, location, method, or frequency, but they have an agreement that the Corps will have sampled each planned dredging site within the previous 5 years.

Question: Is EPA developing sediment-sampling and testing criteria?

Response: EPA Region V officials told us that to establish sampling consistency within Region V, they have developed sediment-sampling criteria. The guidance was scheduled to be issued by the end of August 1988.

EPA headquarters officials informed us that they are developing sediment-testing criteria to be issued in late 1988 that will give the Corps specific guidance on testing procedures and interpreting test results.

Question: How does the Corps carry out its sediment-sampling and testing responsibilities?

Response: According to the Corps' Detroit District project engineers, sediment-sampling is based on such historical data as the type of contaminants that are expected to be found in the sediment, considering the type of industries previously and currently located in the area, and the patterns in which the sediment builds up in the navigation channel. The Corps uses underwater surveys to determine the areas of sediment build up. The number of samples taken in each area of buildup depends on its size, that is, the larger the area of build up, the greater the number of samples taken. Corps' Detroit District officials also said that if a high amount of contamination is anticipated, additional samples scattered throughout each buildup area may be taken to determine the expanse of contamination.

To meet EPA requirements for assessing the potential environmental impacts of the disposal method, the Corps identifies the

composition of the channel bottom sediment prior to soliciting bids for its removal. The sediment is tested for contaminants and physical properties (particulate size, density, color, etc.) by private environmental laboratories, although the Detroit District occasionally uses Corps laboratories. The test results are evaluated by the Corps for potential water quality impacts. On the basis of EPA Region V guidelines for open water disposal, the Corps classifies the extent of sediment contamination to aid in determining the disposal method. Laboratory results and proposed disposal methods are forwarded to EPA, FWS, and the state for concurrence.

The agreed-upon disposal methods are given to district project engineers for preparing bid solicitations and contracts for dredging. The same assessment is used for subsequent dredging at the same location. However, an assessment is reconsidered when the disposal method changes or other events occur, such as when new test data on sediment contamination differ from previous test data.

SECTION 3

ENVIRONMENTAL IMPACT OF OVERFLOW DREDGING

Question: What research has been done on the environmental impact of overflow dredging?

Response: Our review identified no specific studies on the environmental impact of overflow dredging. In addition, researchers at the Corps' Waterways Experiment Station (WES),[1] FWS, and EPA told us that their agencies have not initiated any studies on the environmental impacts of overflow dredging, nor were they aware of any research conducted on the environmental impacts of overflow dredging. They mentioned that some research on the environmental impacts of resuspending sediment during open water disposal had been completed.

Question: What are the research results of the environmental impacts of resuspending contaminated sediment during open water disposal?

Response: Our literature searches and interviews with researchers at WES, EPA, and FWS showed that several studies have been conducted on the environmental impacts of resuspending contaminated sediment during open water disposal. For example, a 1985 WES information exchange bulletin on the environmental effects of dredging showed that a number of scientific reports, dating back to 1970, concluded that PCBs and mercury build up in fish and other aquatic animals and are passed on through the food chain. Also, the studies showed that resuspending sediment contaminated with PCB and mercury makes the sediment more available to fish and other aquatic animals. Other reports indicated that wildlife that ate contaminated fish developed adverse health effects and suggested potential harmful health effects for humans. The WES bulletin also contained a literature review of research on heavy metals which concluded that although metals other than mercury build up in the tissues of fish, they are not passed on through the food chain.

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[1]The Waterways Experiment Station in Vicksburg, Mississippi, is a research, development, and testing complex of six internationally recognized laboratories supporting the civil and military missions of the Corps.

Question: What are the research results on the environmental impacts of resuspending uncontaminated sediment during open water disposal?

Response: Our review of studies addressing open water disposal and discussions with WES and FWS officials showed that a concern with resuspending sediment during open water disposal is the burial of organisms when the sediment settles. FWS also is concerned that resuspended sediment makes it difficult for fish to breathe and reduces the amount of oxygen in the water at the disposal area. EPA regulations state that the discharge of dredged material can greatly elevate the level of particles suspended in the water and reduce light penetration. If this condition persists, it can lower plant photosynthesis, as well as reduce feeding for fish and other aquatic animals that rely on light to find their food, limit their growth, and lower their resistance to disease.

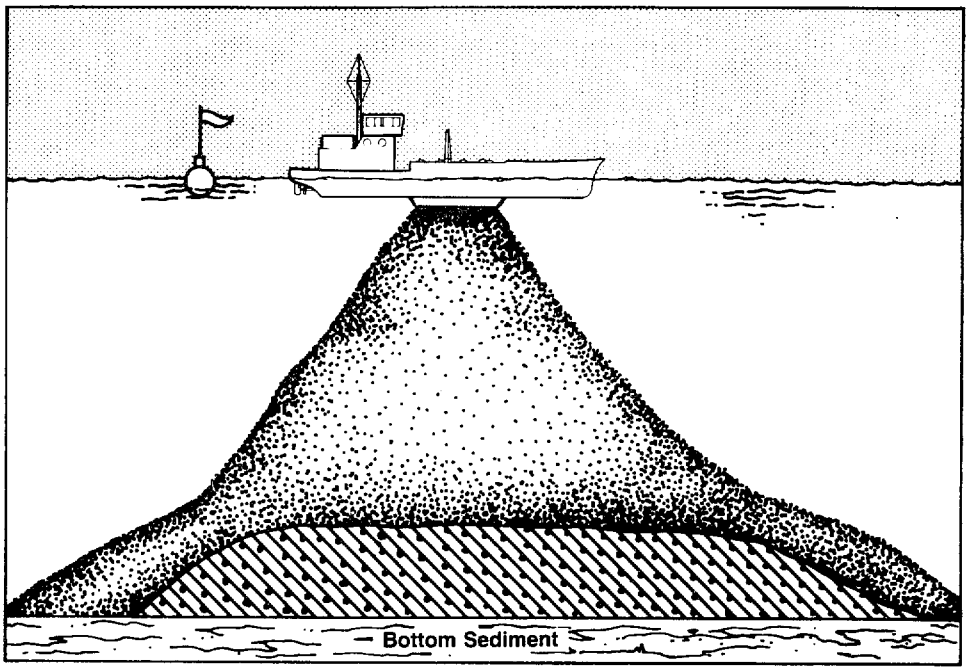
Researchers at WES and FWS agreed that these concerns should be considered when assessing the impact of open water disposal, but noted that the amount of harm is dependent on the amount of sediment in suspension and how long it stays resuspended. An aquatic biologist at WES told us that most fish will avoid the area of resuspension and, thus, would not be exposed to any possible impacts. However, a FWS fishery research biologist told us that some fish are attracted to the suspended sediment and would be exposed to possible impacts. Both WES and FWS researchers told us that the effects of resuspension dissipate within a few minutes depending on the type of sediment, the rate of discharge, and the current patterns in the disposal area.

Question: Can the environmental impacts of resuspended sediment from overflow dredging be compared with those of open water disposal?

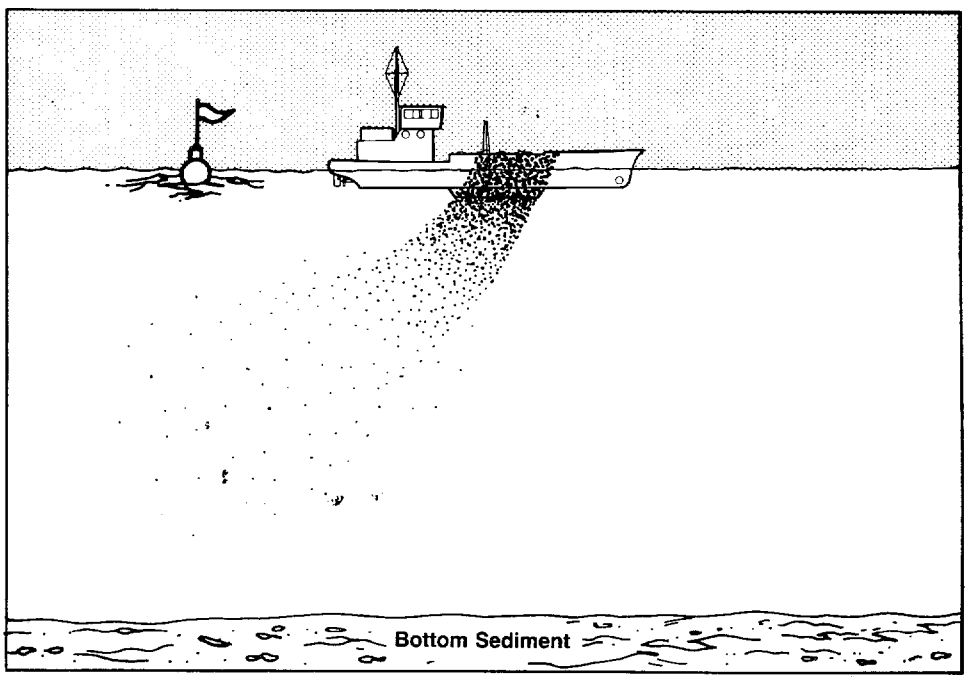
Response: According to WES researchers, no such comparison can be made. Although overflow dredging is similar to open water disposal in that sediment is resuspended in the water, the amount of resuspension from overflow dredging is significantly less than from open water disposal. Figure 3.1 illustrates the relative amounts of sediment resuspended by open water disposal and overflow dredging.

Figure 3.1: Relative Amounts of Sediment Resuspended by Open Water Disposal and Overflow Dredging

Sediment plume from open water disposal



Sediment plume from overflow dredging



Source: U.S. Army Corps of Engineers Waterways Experiment Station, Vicksburg, Mississippi.

WES, EPA, and FWS scientists, as well as a paper presented at the World Dredging Congress in 1983[2] and research by the Mineral Technological Institute of Holland in 1977[3], conclude that the amount of dredged material discharged during overflow dredging varies by the type of sediment dredged and the duration of the overflow. WES researchers noted, however, that the amount of sediment resuspended during overflow dredging varies but is no more than the amount resuspended by a storm or ship traffic.

WES and Corps Buffalo and Detroit District officials told us that because the amount of dredged material discharged during overflow dredging varies by the type of sediment dredged, the Corps continues to base its decisions about the environmental impacts of overflow dredging on what is generally known about resuspension of sediment during open water disposal, including research on short-term resuspended sediment.

Question: Is any research being planned by the Corps on the environmental impacts of overflow when dredging?

Response: WES researchers told us that research on dredging will continue to focus on cost-effectiveness and resuspension of sediment as it relates to open water disposal. The manager of the Environmental Effects of Dredging Programs at WES told us that a study composed of laboratory and field research assessing the potential environmental impact of overflow dredging would take about 7 years and cost $7 million to $8 million. According to this manager, WES recently proposed studies on the environmental impact of overflow dredging to Corps headquarters but has not received funding because other research has received higher priority. Corps headquarters officials also told us that research on the impact of overflow dredging has been given a low priority because other environmental issues such as the construction of disposal facilities are considered more significant.

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[2]"Overflow Effects When Trailing Very Soft Silts and Clays." J. H. Volbeda. Ham-Dredging, Rijswijk, Holland.

[3]"Hopper Dredge Loading Problems Considered." Ir. S.E.M. de Bree.

SECTION 4

EPA REGION V GUIDELINES FOR OPEN WATER DISPOSAL

Question: What do the 1977 EPA Region V guidelines on open water disposal of dredged sediment cover?

Response: There are no national EPA guidelines on disposal of dredged sediment. However, in 1977, EPA Region V developed guidelines for open water disposal to classify organic and inorganic contaminants found in the Great Lakes and to assist the states (whose boundaries extend into the lakes) and the Corps' Great Lakes district offices in determining whether dredged sediment can be disposed of in open water or should be placed in containment facilities.

Pollution levels for some heavy metals and other organic compounds are divided into three categories--nonpolluted, moderately polluted, and heavily polluted. These levels were based on a survey of 100 harbors located throughout the Great Lakes since 1967 and another survey of 34 Great Lakes harbors in 1974 and 1975. The Region V guidance document describes the guidelines as not adequately relating to the impact of the sediments and as interim until more scientifically sound guidelines are developed. The classifications are based on relative amounts of contaminants found in the harbors and do not limit disposal of sediment containing heavy metals other than mercury. Other contaminants such as hydrocarbons, dichloro-diphenyl-trichloro-ethane, commonly known as DDT, and dioxin are not addressed in the guidelines. Pollution levels for PCBs and mercury are based on scientific studies that identify levels at which the two contaminants have adverse effects on fish. If the levels of PCBs or mercury in sediment are excessive, the guidelines classify the sediment as polluted and unacceptable for open water disposal. Contaminants listed in 1977 EPA Region V guidelines for open water disposal are as follows:

--Ammonia
--Arsenic
--Barium
--Cadmium
--Chemical oxygen demand
--Chromium
--Copper
--Cyanide
--Iron
--Lead
--Manganese
--Mercury
--Nickel
--Oil and grease

--Polychlorinated biphenyls (PCBs)
--Phosphorus
--Total Kjedahl nitrogen
--Volatile solids
--Zinc

Question: Do these guidelines cover overflow dredging?

Response: According to EPA officials, these guidelines do not specifically apply to overflow dredging because this type of dredging puts significantly less volume and density of sediment into the water than open water disposal.

Question: How have the Great Lakes states used these guidelines?

Response: Four of the eight Great Lakes states--Indiana, Michigan, Minnesota, and Ohio--use these guidelines as an aid in deciding if dredged sediment can be disposed of in open water. Pennsylvania uses the International Joint Commission (IJC)[1] guidelines while New York uses the IJC guidelines together with its own. According to an EPA Great Lakes Program Office official who serves on the IJC, its guidelines are similar to EPA Region V guidelines. Illinois and Wisconsin use their own guidelines.

Michigan has also used the guidelines for restricting overflow when dredging in areas of PCBs or mercury contamination. New York restricts overflow dredging if open water disposal is not allowed.

Question: Is EPA developing new guidelines for open water disposal and will these guidelines cover overflow dredging?

Response: EPA headquarters has recently developed new scientifically based sediment quality criteria to determine the toxicity of sediment. An EPA official said the criteria may help the regions make decisions about open water disposal. Interim criteria were issued to the EPA regional offices in January 1988, and the guidance is expected to be finalized for official use in early 1989.

WES and EPA headquarters officials told us that the guidance recently developed and its supporting research do not specifically address overflow dredging. In addition, FWS researchers told us that while the new guidelines will take into account the effect of resuspended sediment on water quality, they will not take into account the effect resuspended contaminated sediment will have on fish that ingest it.

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[1]The IJC is a binational body that promotes cooperation between the United States and Canada on several topics, including water pollution.

SECTION 5

CERTIFICATION PROCESS FOR DREDGING

Question: How does the Clean Water Act's 401 certification process work?

Response: Under Section 401 of the Clean Water Act, states must certify that any discharge into the navigable waters will not violate that state's EPA-approved water quality standards. To receive state authorization to dispose of dredge material in the water, the Corps must establish that the disposal will not degrade water quality.

As part of the certification process, the Corps district offices are required to notify each state of all dredging activities planned for the upcoming dredging season (March through December). The Corps identifies the river or harbor to be dredged, the contaminants identified in the sediment, the type of disposal planned, and its determination--based on EPA guidelines--of the level of sediment contamination in the river or harbor identified. Also, officials at each of the district offices hold annual meetings with state, FWS, and EPA officials to review all proposed dredging operations for the upcoming fiscal year, and agree on any restrictions that should be imposed, such as limiting dredging during fish runs. When the state is satisfied that the dredging will comply with its water quality standards for dredging operations, the Corps receives its section 401 certification.

Question: Does the section 401 certification process relate to overflow dredging?

Response: The section 401 process relates to overflow dredging because sediment is discharged into the water during overflow. However, each state applies its water quality standards differently to overflow dredging. Wisconsin and Minnesota do not allow overflow dredging of contaminated or clean sediment. Illinois, Indiana, New York, and Pennsylvania do not allow overflow dredging of contaminated sediments. Michigan restricts overflow dredging of sediments containing PCBs or mercury, while Ohio does not restrict overflow dredging.

Question: What are the Great Lakes states' reasons for their policies on overflow dredging?

Response: Wisconsin and Minnesota do not allow any overflow dredging because they are concerned that the resuspension of any sediment--contaminated or not--may harm fish. The other six states believe that overflow dredging resuspends only a small amount of sediment and is therefore not harmful to fish. For example, a

Pennsylvania Bureau of Water Quality and Management official told us that sediment resuspended by overflow disperses quickly and causes only a minor disturbance.

An Illinois official told us that the state allows overflow when dredging in noncontaminated areas because the resuspension of sediment caused by overflow dredging is temporary. According to Michigan Department of Natural Resources officials, Michigan restricts overflow in areas of high PCBs or mercury because these contaminants are known to accumulate in fish. Overflow dredging in other areas is considered to have little impact on fish, plants, and water quality.

An Ohio State Environmental Protection Agency official told us that dredging is needed to allow commercial shipping access to industrial ports. The official said that since the resuspension of sediment from dredging results in only a temporary degradation of water quality, the state has not restricted dredging in its waters. However, Ohio officials have recently placed a restriction on overflow dredging for 1988 in parts of Lorain Harbor (near Cleveland) because they are concerned that the dredging is too close to the city's fresh water intake system.

Question: Do any other agencies or groups get involved in the dredging process?

Response: The Corps discusses proposed dredging projects and concerns with FWS, EPA, and state agencies, such as the departments of natural resources or state environmental protection agencies, and the local communities. In the Great Lakes area the Corps also holds annual conferences with state, EPA, and FWS officials to discuss the forthcoming year's dredging schedule. At these conferences, the Corps responds to any environmental concerns that arise. Also, as required by the Clean Water Act, the Corps issues a public notice of planned discharge into the water.

Question: What are EPA's general views on allowing overflow dredging?

Response: EPA has approved each state's water quality standards, and EPA Region V officials in Chicago told us that if the state approves overflow dredging, EPA will probably not have any objection. EPA headquarters officials told us that Region V has expressed more concern about overflow dredging than other EPA regions because more of its dredging projects contain contaminated sediment and overflow is frequently used in the region. EPA Region V officials' primary concern is the disposal of dredged sediment because disposal issues, particularly those involving PCBs and mercury, are more crucial to environmental protection. Overflow dredging is an issue that EPA is aware of, but the impact of resuspending sediment during overflow dredging is seen as

relatively small compared with resuspension resulting from ship traffic and strong winds.

Question: What are FWS' general views on allowing overflow dredging?

Response: Officials with the FWS Michigan Field Office and National Fisheries Research Center--Great Lakes in Ann Arbor, Michigan--told us that they are concerned about the resuspension of contaminants during overflow dredging. Their general research studies have shown that resuspension of contaminated sediment makes contaminants more available to living organisms but that various factors such as the type of contaminant, the type of sediment, and the organism exposed to the contaminant make it difficult to determine the environmental impact of resuspending sediment. They added their belief that in some cases, overflow dredging should be restricted even if open water disposal is allowed because organisms that breed and live in near shore dredging areas are more sensitive to resuspension of sediment than those further offshore where open water dumping usually occurs. However, as noted previously, no research exists to support this belief.

Question: What are the Corps' general views on allowing overflow dredging?

Response: Officials at Corps headquarters, the Great Lakes district offices, and WES agree that overflow dredging can be a very useful tool for saving time and money. However, the Corps' position is that if open water disposal is not allowed, overflow dredging should not be used unless laboratory or field tests have established that there are no potentially adverse impacts. An environmental scientist and a research engineer from WES told us that the potential environmental impacts of overflow dredging are dependent on the amount of sediment released back into the water during overflow.

The Corps' 1983 Engineer Manual--Guidance on Management of Dredging Projects--points out that the amount of sediment released during overflow dredging of clean sand is relatively small but in areas where the sediment is contaminated and adverse environmental effects have been identified, the manual does not recommend overflow dredging.

Question: What is the Corps' reaction to state restrictions of sediment resuspension including overflow dredging?

Response: Officials at the Corps' Detroit District Office told us that when states impose additional requirements, such as additional sediment testing, which the Corps believes is justified, the Corps' district office will pay the additional cost of testing the sediment. However, to deal with restrictions that the Corps considers unjustified, such as restricting overflow dredging

because it looks bad or restricting open water disposal of clean sediment, the Corps recently issued regulations to require that states pay the additional costs of complying with such restrictions.

Added costs can arise when a state requires a mechanical dredge to be used or when the state restricts open water disposal of clean sand, which would require the Corps to build additional disposal facilities. For example, Wisconsin has not allowed any discharge into open waters within its jurisdiction, except for a few test projects. Since the Corps' practice is not to dispose of clean sediment in a federal disposal facility, the Corps has not dredged nonpolluted areas because Wisconsin has no place to dispose of the sediment.

SECTION 6

COST OF OVERFLOW DREDGING

Question: Is overflow dredging less expensive than other methods?

Response: Studies by the Corps and independent researchers in Japan, Holland, and the United Kingdom--nations that use overflow dredging--indicate that where hydraulic hopper dredges can be used, expenses are reduced if the sediment is relatively heavy or the disposal site is not nearby. Corps division officials responsible for overseeing the dredging projects on the Great Lakes estimated that if overflow dredging had been banned in 1987, dredging costs on the Great Lakes would have increased from 30 to 55 percent.

Corps division officials told us that on some projects, a mechanical dredge could have been used in lieu of a hopper. However, mechanical dredging is usually more expensive than a hopper because it has a slower loading process--a bucket is used to pull sediment up from the channel bottom and load it into the barge one scoop at a time--and the barges that carry the sediment are much smaller than the hoppers used in overflow dredging. As a result, more trips are made to the disposal site.

Question: How does overflow dredging cut costs?

Response: Overflow dredging increases the amount of sediment that can be loaded by releasing excess water over the sides of the dredge. This technique reduces the number of trips to the disposal site and the time needed to complete the dredging.

For example, on the Saginaw River in Michigan, one of the areas dredged was 18.5 miles from the disposal site, and the Corps had classified the sediment as sand which is ideal for overflow dredging. The contractor told us that overflow dredging increased the amount of sediment in the hopper bin from 430 cubic yards to 2,098 cubic yards on each load hauled to the disposal site, which reduced the number of trips to the disposal site by one-fifth--from 307 to 63.

Contractor records show that sailing time to and from the confined disposal facility was over 4 hours. According to the contractor, overflow dredging enabled them to finish the job in 25 days, whereas 85 days (a 240-percent increase) would have been needed if overflow dredging had not been used, with a commensurate impact on costs.

The contracting officer at the Corps' Saginaw Field Office told us that overflow dredging in this case was particularly advantageous because of various obstacles to the dredging. For example, the

area dredged was upstream of the old Zilwaukee Bridge on Interstate 75--a drawbridge that needed to be raised when the dredge traveled to the disposal facility. Also, some of the dredging was done on Labor Day weekend, a time when Michigan officials requested ships to avoid the bridge during most of the daylight hours because of heavy highway traffic.

Question: Does the type of dredged material relate to cost-effectiveness?

Response: The consensus of the studies we reviewed is that overflow dredging is most cost-effective in areas of sand, which settles quickly in the hopper bin and allows maximum loading. Opportunities to increase loads when dredging in fine grain sediment are fewer because the sediment tends to stay suspended in the hopper bin and overflows with the water. A 1975 study[1] by the Hydraulics Research Station, Wallingford, United Kingdom, states that when overflow dredging is used in areas of silt, the amount of sediment in the bin may actually decrease as dredging continues past the point where the bin in full.

According to the Detroit District Corps Office and the contractor that dredged the Saginaw River, sediment that is a mix of coarse and fine grains is more difficult to assess. They told us that very few channel bottoms are one or the other, and most tend to be a combination of both. In these cases, the economic benefit of using overflow dredging is best determined on a case-by-case basis.

Question: Are there any studies of the cost-effectiveness of overflow dredging on the Great Lakes?

Response: At the request of the Corps' Detroit District Office, WES conducted a study to evaluate the economic effects of loading different types of sediment in the hopper bin in two areas of the Saginaw River in August and September of 1987. One area contained sand, and the other contained silt. Sediment from both areas was sampled during loading, overflow, and disposal. The test also monitored the amount of sediment suspended in the water immediately after overflow dredging. At the end of April 1988 preliminary data were under review by WES officials, who said a report of the results would be available later in the year.

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[1] "Loading and Consolidation of Dredged Silt in a Trailer Suction Hopper Dredger." M.F.C. Thorn. Wallingford, United Kingdom.

SECTION 7

EXTENT OF OVERFLOW DREDGING OCCURRING IN AREAS CLASSIFIED AS HEAVILY POLLUTED

Question: Is overflow dredging presently occurring in areas of high sediment contamination?

Response: Our review of Corps records of all dredging projects on the Great Lakes in fiscal years 1986 and 1987 showed that the Corps allowed overflow dredging in only one area that met EPA Region V guidelines as being heavily polluted. This area was located in the Saginaw River near Bay City, Michigan. According to Corps records of 1983 sediment samples, the sediment contained a combination of contaminants in the moderately to heavily polluted categories, including arsenic, nickel, copper, lead, iron, zinc, ammonia nitrogen, total Kjeldahl nitrogen, phosphorus, and manganese.

Question: What is the history behind the Saginaw River's dredging problems?

Response: In 1866 and 1867, the federal government provided funds to dredge an extensive bar blocking the entrance to the Saginaw River. Since that time, the Corps has improved and maintained the Saginaw River navigation channel to accommodate large commercial ships that service the industrial communities of Saginaw and Bay City, Michigan. The 36-mile navigation channel is located in east-central Michigan and the southern portion of Saginaw Bay, which opens into Lake Huron. The channel extends 22 miles up the Saginaw River, which drains into Saginaw Bay, and 14 miles into the bay itself. Figure 7.1 shows the location of the navigation channel in Michigan.

According to an IJC staff member, a 1974 IJC report classified the Saginaw River as an area of concern because of taste and odor problems caused by phosphorus in the water. The river continues to be an area of concern because of the phosphorus and other contaminants such as PCBs in the water and sediment. Corps sediment samples show that the river sediment is moderately to heavily polluted throughout most of the navigation channel, with some high levels of PCBs. Table 7.1 lists the contaminants found in areas dredged in 1987 on the Saginaw River in moderately to heavily polluted levels according to EPA guidelines for open water disposal.

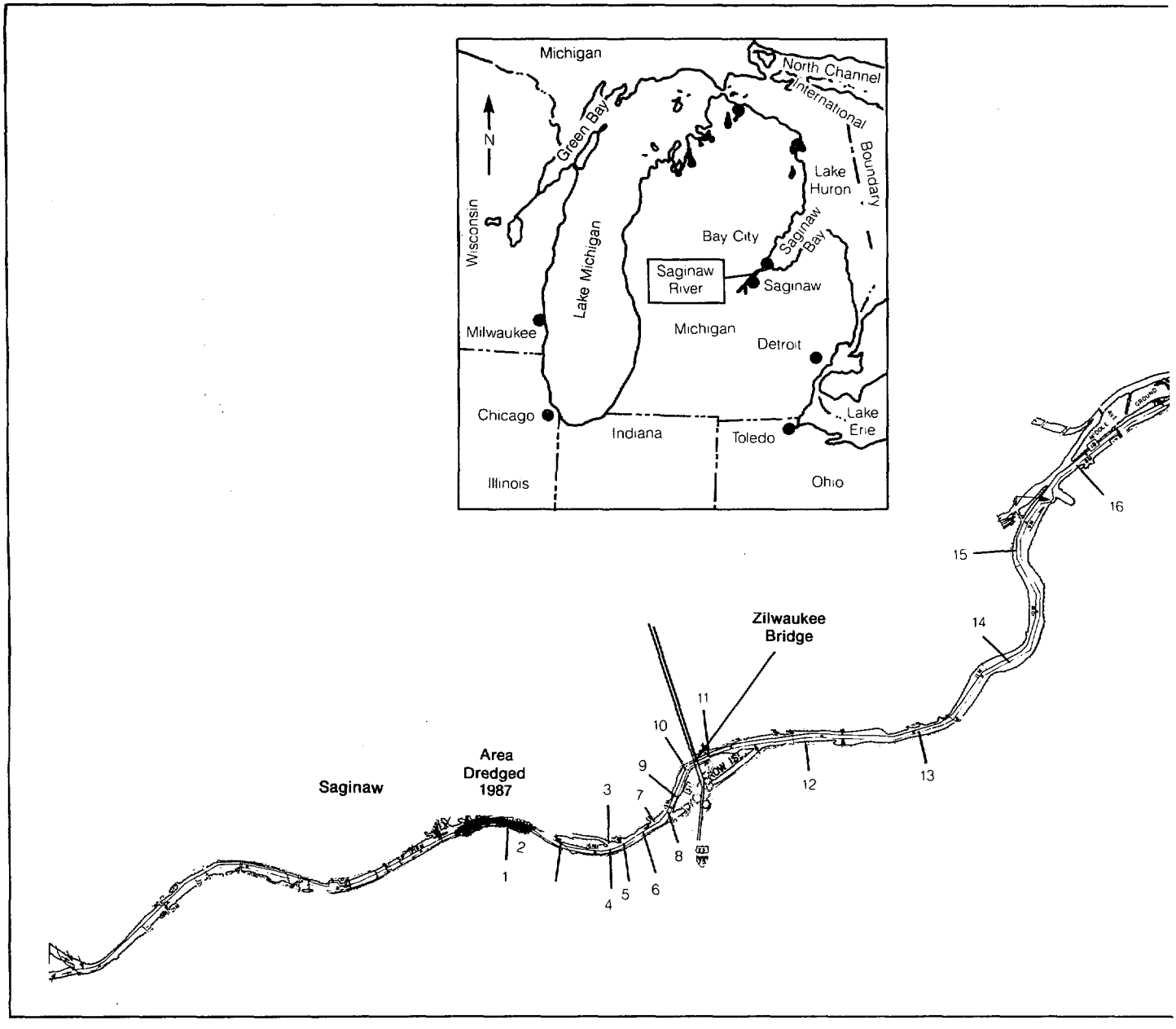
Table 7.1: Contaminants Found in the Areas Dredged in the Saginaw River in 1987 Classified as Moderately to Heavily Polluted

Moderately polluted	Heavily polluted
Iron	Ammonia
	Arsenic
	Chromium
	Copper
	Cyanide
	Lead
	Manganese
	Nickel
	Phosphorus
	Total Kjeldahl nitrogen
	Zinc

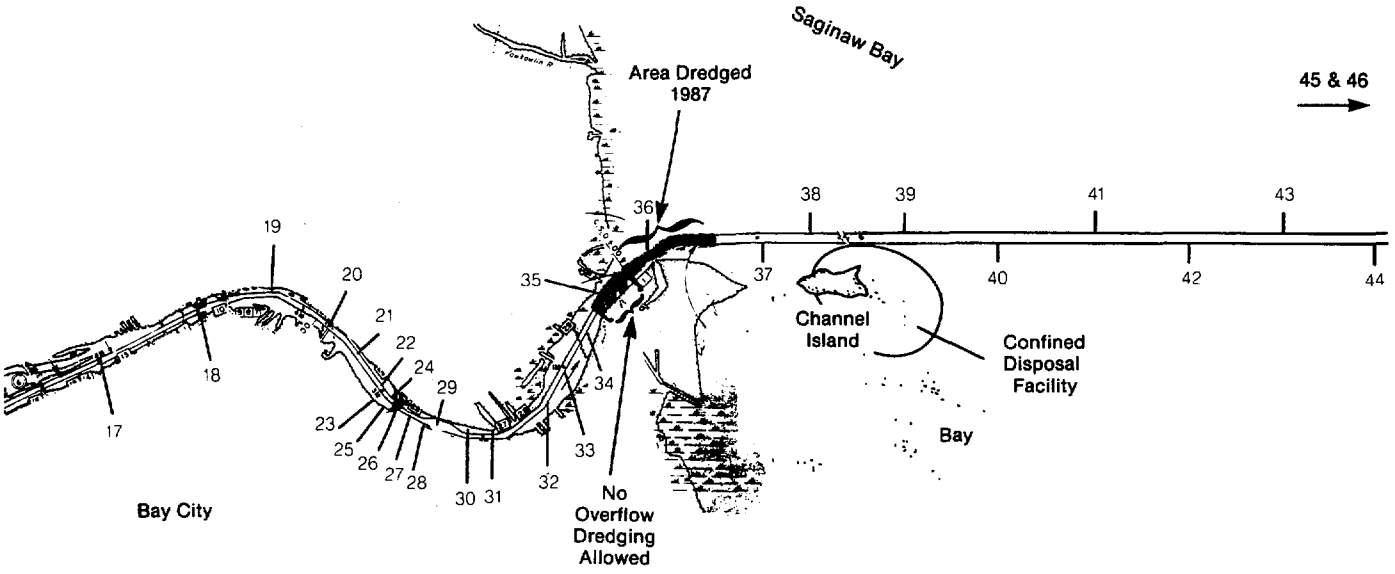
Samples were taken of the channel's bottom sediment at a total of 46 test stations in 1969, 1970, 1972, 1974, 1976, 1977, 1980, 1982, and 1983. Figure 7.1 shows the location of the test stations in 1983, the dredge areas in 1987, the disposal site, and the area where no overflow dredging is allowed. In 1974, the Corps tested the channel primarily for heavy metals, while according to a Corps Detroit District scientist, the 1976 to 1983 tests included PCBs, heavy metals, and other contaminants.

The 1974 and 1975 tests of sediment in the Saginaw River were used by the Corps to prepare an Environmental Impact Statement (EIS) required by the National Environmental Policy Act of 1969. The EIS, which assessed and publicized Corps dredging activities and their possible environmental impacts, stated that sediments from the entire project had been classified as unsuitable for open water disposal and would be placed in a containment facility but that overflow dredging would continue throughout the river channel. The Corps completed the Saginaw River EIS in 1975. EPA and the state of Michigan reviewed and approved the EIS.

Figure 7.1: Location of the Saginaw River in Michigan, the Sediment Sampling Stations, and the Areas Dredged in 1987



Source: U.S. Army Corps of Engineers.



Stations 45 & 46 extend further out into the Bay along the navigation channel.

In July 1976, after publication of the EIS, the East Central Michigan Planning and Development Region, representing 14 counties in the Saginaw River drainage basin, wrote a letter to the Corps indicating concern over contaminants in the Saginaw River sediments, including PCBs. The letter suggested that the river bottom sediment was the source of the PCBs remaining in the water. In response, the Corps and EPA did additional testing of the Saginaw River channel for PCBs and identified two areas in excess of EPA Region V guidelines. On the basis of this information, the Corps and EPA agreed not to allow overflow dredging in all areas of the Saginaw River exceeding the guidelines.

According to Corps' Detroit District Office officials, the district office has modified its dredging plans for the Saginaw River to recognize environmental concerns raised by EPA, Michigan, local communities, and interest groups. As a result of annual meetings held with federal and state agencies, local communities, and interest groups to discuss and coordinate Saginaw River dredging, the district office made a number of changes to its dredging plans to protect the environment, including delaying dredging until after fish in the river had spawned and modifying disposal procedures for dredged materials. District officials told us that they plan to continue holding such meetings in the future.

Question: What are the details of the dredging that took place in 1987?

Response: In 1987, the Corps proposed to dredge two areas of the Saginaw River, one located near the city of Saginaw and the other at the river's mouth. The project was approved by the state, EPA, and FWS. The Corps took underwater surveys in both areas prior to the start of dredging to determine the depth of the channel and the amount of sediment that needed to be removed to return the channel to the congressionally authorized navigation depth. The areas were also surveyed at the conclusion of dredging to determine the quantity of sediment actually removed.

The city of Saginaw area, located 18.5 miles from the disposal site, was not originally scheduled to be dredged in 1987. However, according to Corps officials, heavy flooding in 1986 caused a large volume of sand to accumulate in the river. The Corps did not sample the sediment prior to dredging because it considered the dredging to be an emergency measure and because there was insufficient time to sample and test the sediment. Also, according to Detroit District officials, there was no reason to believe the sediment was contaminated because contaminants do not readily attach to sand and no sources of PCBs or mercury were upstream of the site. The Michigan Department of Natural Resources agreed with the Corps' assessment.

The second area, in the mouth of the river, consisted of moderately to heavily polluted silt based on 1983 sampling results

and 1977 EPA Region V guidelines for open water disposal. One of four test sites contained PCBs at levels exceeding EPA guidelines while the other three had only trace amounts. In addition, test results from all four areas showed moderately to heavily polluted levels of arsenic, phosphorus, lead, and iron. The Corps did not allow the contractor to overflow dredge in the area where tests showed PCB levels were above EPA guidelines but allowed it to overflow dredge in the rest of the area.

A Corps' Detroit District official told us that a Saginaw field office contracting officer surveyed the work of the contractor about twice a week during the 25-day operation to ensure contract compliance. However, Corps district officials told us that they could not establish the extent that overflow dredging occurred because its field office did not have enough staff for continuous on-site inspection during the 24-hour, 7-days-a-week operation, and the Corps did not require the contractor to maintain records showing when overflow dredging occurred. Nevertheless, according to a Corps scientist, Michigan Department of Natural Resources officials, and an engineer on the contractor's dredge, overflow dredging in the river mouth area was not economical because sediment did not settle quickly in the hopper and the disposal site was only 1.5 miles away. Moreover, they were aware of the local citizens' concerns about the use of overflow dredging. A Corps district engineer and Michigan Department of Natural Resources officials told us that the contractor overflow dredged in the river mouth area three times--twice to take samples for an overflow dredging study and once during our visit. Further, a spokesman for the local conservation groups and concerned citizens told us that the amount of overflow dredging in the river mouth area in 1987 was less than in past years.

MAJOR CONTRIBUTORS TO THIS REPORT

RESOURCES, COMMUNITY, AND ECONOMIC DEVELOPMENT DIVISION, WASHINGTON, D.C.

James Duffus III, Associate Director (202) 275-7756
Leo E. Ganster, Group Director

DETROIT REGIONAL OFFICE

Francis L. Reynolds, Evaluator-in-Charge
Robert R. Readler, Site Senior
Dea M. Crittenden, Evaluator

(140826)

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