



CONFERENCE ON THE REMEDIATION OF SEDIMENTS

**NOVEMBER 17-18, 1992
EAST BRUNSWICK, NEW JERSEY**

SUMMARY DOCUMENT

SPONSORED BY THE

**INSTITUTE OF MARINE AND COASTAL SCIENCES AT
RUTGERS - THE STATE UNIVERSITY OF NEW JERSEY**

AND THE

**MARINE SCIENCES RESEARCH CENTER AT
THE STATE UNIVERSITY OF NEW YORK AT STONY BROOK**

AND

THE PORT AUTHORITY OF NEW YORK/NEW JERSEY

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**THE STATE UNIVERSITY OF NEW JERSEY
RUTGERS**

Conference on the Remediation of Sediments

**November 17-18, 1992
East Brunswick, New Jersey**

Summary Document

On November 17-18, 1992, a conference was held at the Ramada Renaissance Hotel in East Brunswick, New Jersey to assess the current state of physical and chemical remediation of sediments, undersea pit design and engineering, and the sediment dynamics of the New York harbor area. The conference was organized by the Institute of Marine and Coastal Sciences (Rutgers University) and the Marine Sciences Research Center (State University of New York) at the request of The Port Authority of New York and New Jersey. The Port Authority is interested in establishing a federal pilot project to demonstrate the feasibility of making contaminated sediments cleaner and safer through remediation.

More than 60 scientists, engineers, managers and environmentalists attended the conference (list of attendees and conference agenda enclosed). Formal presentations from experts in three thematic areas -- physical and chemical remediation technology, undersea pit design and engineering, and sediment dynamics -- highlighted current research and demonstration programs in the U.S and Europe. Speakers represented a variety of U.S. research institutions and agencies as well as organizations in the United Kingdom, Germany, Belgium, and the Netherlands. In combination with an earlier conference on the bioremediation of sediments (May 1992), a broad range of remediation approaches were presented and evaluated.

Both the bioremediation and sediment remediation conferences showed that a fine-scale characterization of sediment texture, metal and organic contaminants distribution and flux is required for the New York harbor region. This is necessary to determine which sediments and what quantity of dredged material warrant remediation. For the vast bulk of dredged material (Class I which does not require remediation), open ocean disposal remains a suitable disposal practice. For Class II and III dredged material, confined disposal facilities (CDFs) and possibly undersea pits represent a viable short-term strategy as long-term solutions are pursued -- especially source reduction of contaminants to sediments and the remediation of "hot spots" such as the Passaic River.

After a series of formal presentations, two groups of conference participants developed recommendations on future research requirements and the most promising pilot-scale approaches to remediation, undersea pit design and engineering, and research on sediment dynamics. A summary of these discussions and list of recommendations is provided below.

I. Remediation Discussion

The remediation group discussion was chaired by Stephen D. Garbaciak, an Environmental Engineer with the Great Lakes National Program Office of the Environmental Protection Agency. For the purpose of this discussion and where used in this document, the term remediation refers to physical and chemical treatment techniques and does not include bioremediation.

Presently, there are many remediation projects being conducted at the demonstration scale but only one full-scale separation treatment facility. Most of the U.S. remediation projects are being sponsored by the Environmental Protection Agency through the Assessment and Remediation of Contaminated Sediments (ARCS) program. This program involves bench-scale tests of solvent extraction, thermal desorption, and wet-air oxidation techniques with contaminated sediments from the Grand Calumet River/Indiana harbor and canal, Ashtabula River, Buffalo River and Saginaw Bay. These projects focus primarily on polychlorinated biphenyls and polynuclear aromatic hydrocarbons.

In Europe, a variety of institutions have been developing methods to remediate contaminated sediments over the past ten years. These have led to several small-scale pilot facilities and one full-scale separation facility. Principal methods for remediation involve mechanical separation to separate sand from silt. Other physical separation techniques such as flotation may be effective and, along with heap-leaching techniques, should be investigated further.

It should be noted that the full-scale separation program in Germany requires that a substantial fraction of the initial dredged material (at least 50%) consist of sand. A fine-grained fraction containing from 10-15% sand is produced-- an amount critical to the effectiveness of a subsequent dewatering process. New York harbor material however, only contains 5-15% sand at the outset and may not be amenable to the same treatment.

One particularly innovative approach is being pursued in Great Britain where microorganisms are used to immobilize and localize metal ions from solution which are then separated with a high gradient magnetic separation (HGMS) technique. This approach may also be effective with polar organic compounds and is worthy of further exploration.

Although many of the sediment remediation strategies in Europe parallel those being pursued in the U.S., differences in political systems and the relationships between private industry, government and public/environmental groups have enabled some European nations to produce a long-range strategy with short-term tradeoffs. This strategy uses specially-designed, undersea, confined disposal facilities as near-term solutions to manage dredged material while other relocation/remediation alternatives are pursued in the long-

term. The common practice in the Netherlands is to reduce the amount of contaminated material to a minimum by physical separation of particles and to confine the most contaminated dredged materials in double-lined land containment areas or undersea CDFs, with the more contaminated materials receiving greater levels of protection. The same is essentially true for Belgium and Germany, with greater emphasis on heavy metal levels in Belgium.

The group discussion also addressed issues concerning the cost of treatment technology and criteria for sediment classification. With respect to cost, the following estimates were provided:

- o In Belgium, a cost of \$30/m³ was estimated for the application of a flotation process (just the process cost itself).
- o In the Netherlands, costs ranged from \$50-\$200/ton of dry, coarse-grained material and up to \$1500/ton of fine-grained material.
- o In Germany, estimates were \$140/ton of dry material for the particle separation and "silthill" disposal program at Hamburg. One note about the Hamburg facility was that the material was not being "treated", but rather separated with all sediment fractions disposed in a landfill-type facility.

Unlike Germany, Belgium and the Netherlands do not treat large quantities of dredged material regularly. Similarly, treatment projects in the U.S. have only been conducted at the demonstration scale with one exception. The Waukegan Harbor Superfund site did remediate 8,000 cubic yards of contaminated sediments with the use of thermal desorption technology.

II. Undersea Pit Design and Engineering

This discussion was chaired by R. Lawrence Swanson, Director of the Waste Management Institute of the Marine Sciences Research Center at the State University of New York at Stony Brook.

Undersea borrow pits have been suggested for use on an experimental basis as an alternative for the disposal of contaminated sediments. This approach presumes that contaminated sediments will be isolated and contained by a clean sand cap and the pit walls and bottom.

Data collected from capped disposal mounds as part of the Dredge Area Monitoring System (DAMOS) project indicate that no detectable mobilization of trace metals has occurred over a 7-11 year period. Although some mixing of contaminated and cap material was observed, cores showed a distinct boundary between the two materials. Even with consolidation, the two sediments remained geochemically distinct. There is a need for improved methods of emplacement of sediments and methods of monitoring disposal mounds. Attention must be paid to the effects of natural processes (storms, bioturbation) and human disturbance (fishing) on the cap. As a result of bathymetric surveys conducted at the mud dump site in November 1992, January 1993 and February 1993, two areas of apparent material loss were detected. The loss could be attributed to storm activity, erosion or poor operational control with scow loads being deposited over a wide area. Bathymetry data require further evaluation to understand the apparent loss of material.

Several speakers emphasized the importance of proper pit design and construction to the effectiveness of this approach. Knowledge of the characteristics and strengths of base materials used in pit construction, along with depth and the impact of material disposed on the seafloor is necessary to account for settlement of the disposed material and compression of the base material. Regardless of the type of pit construction, the cap must prevent biological and physical disturbance of the underlying dredged material to ensure that contaminants are not remobilized.

Despite the apparent promise of appropriately designed borrow pits, the siting of these pits remains a contentious issue. Another concern is sediment dispersal during dredging and disposal operations. An initial loss of 3-5% of the volume occurs in the water column during pit disposal. Improvements in dredging procedures need to be considered. A more comprehensive long-term monitoring program is needed to ensure that pit stability is maintained and any long-term diffusion of contaminants is detected.

The group regards the use of containment structures for disposal of dredged material as an intermediate measure as long-term solutions are pursued to make sediments cleaner. These solutions must include source reduction and pretreatment programs.

III. Sediment Dynamics in the New York Harbor Area

This session was chaired by Keith Stolzenbach of the University of California at Los Angeles.

Dennis Suszkowski (Hudson River Foundation) provided an overview of sediment dynamics in New York Harbor. The harbor was described as a complex series of large embayments, tidal straits and rivers with many diverse hydrodynamic environments. Most of the approximately one million metric tons of fine-grained sediments that enter the harbor annually are brought there by tributaries (i.e., Hudson, Passaic and Raritan Rivers) and easily account for more than 90% of the harbor's annual sedimentation rate.

The group identified and discussed the primary mechanisms and properties governing sediment dynamics in New York harbor. These are:

- o Sediment textural patterns are complex and reflect varying hydrodynamic conditions.
- o A majority of the sediment inputs are from tributaries.
- o The ocean, wastewater and biological production also are important sources of sediments.
- o Sedimentation rates are very site-specific.
- o Estuarine circulation is responsible both for trapping and resuspending sediments.
- o Resuspension is a critical component of any analysis of sediment transport.
- o Sediment dynamics must be studied on appropriate time-scales (e.g., over a tidal cycle) under various flow conditions, and the effect of intense, episodic events (e.g., storms) need to be quantified.
- o Visco-elastic response of sediments to forcing.
- o Aggregation of fine particles at the sediment-water interface.

Other factors which influence sediment dynamics and must be investigated include episodic resuspension of sediments by waves, velocity of sediment deposition, recycling of thin interfacial sediment layer, surface sediments, plastic deformation, "behavior" of fine sediments (including disaggregation) and not just aggregation, spatial variability, biogeochemistry of contaminants, regional sediment balances and related contaminant transport, biogenic particle effects on the water column and sediments.

As with the earlier conference on bioremediation, considerable discussion centered on the lack of an adequate characterization of sediment pollutant loads, distribution and transport processes for New York harbor. This is necessary to determine which sediments and what quantity of dredged material warrant remediation. Effective decisions concerning treatment technology cannot be made without this information. A detailed characterization of sediments could be used to focus treatment alternatives on sediment sources and depositional areas in the estuary. One useful technique for conducting this characterization is sidescan sonar. This technology, in conjunction with some sampling and direct characterization of sediments, provides information on seafloor characteristics such as bottom roughness and sediment texture at meter scales. Sidescan sonar has been used successfully at other port areas to provide essential information for the design of research and monitoring programs.

In addition to sidescan sonar and direct sampling, the group suggested a number of other techniques to obtain a detailed characterization of sediments for the harbor. Current meter moorings that can provide measures of bottom shear stress are needed to understand resuspension processes. Acoustic methods might be used to study particles in the water column and fluorescent particles could be used to study sediment transport. Flux and turnover of sediment particles and pore water should be studied with radio-chemical tracers. Sediment transport and the sediment profile camera might be useful in specific instances. Mechanical properties of sediments should also be measured. Predictions concerning sediment dynamics should be tested using flumes including conventional straight flumes, sea flumes and rotating annular flumes.

IV. Recommendations

On November 18, 1993, most of the Steering Committee met to develop recommendations to guide Port Authority interest in a pilot-scale remediation project. Members of this committee are listed in the Appendix.

A great deal of regional discussion and public interest in dredging and disposal practices has focused on dioxin. Contaminated sediments from the Passaic River and possibly from other sources

accumulate in areas that require dredging. One approach would be to combine a short-range strategy to clean up the dioxin "hot spot" with intermediate and long-range strategies that address the vast bulk of dredged material. Ultimately, the goal should be to dispose only Class I material into the ocean.

An orderly phase-out of current practices to manage dredged material can be conducted as alternative solutions are pursued and set in place. Several European nations have adopted this approach to manage disposal of contaminated sediments. In view of the current need to dredge Port Newark/Port Elizabeth and the lack of adequate and affordable treatment techniques, existing disposal alternatives should be considered. None of the existing alternatives (capping, upland containment, existing borrow pits) are ideally suited to resolve the current dredging issue. However, the agencies responsible for protecting the public interest should be given some latitude to reach a compromise within the current regulatory framework.

Short-Range Strategy

While remediation and bioremediation approaches are being developed it will be necessary to construct specially-designed containment facilities to store contaminated sediments (Class II and III dredged material) as we pursue a long-range effort to treat and dispose of this material. Specially designed confined disposal facilities, such as subaqueous borrow pits, disposal islands, land-based containment areas and floating storage vessels should be considered. At present subaqueous borrow pits appear to be most promising.

Long-Range Strategy

As we focus initially on one or several contaminants, we must develop a long-term strategy for the treatment and/or disposal of all dredged material. Considerable emphasis should be placed on reduction of contamination at the source and to pretreatments as mitigation techniques. In addition, precise determination of the distribution of contaminants should be part of our long-term efforts to reduce the volume of sediments which have to be treated prior to disposal. Without a detailed characterization of sediment content and distribution, we cannot accurately locate "hot spot" areas for remediation.

Remediation technology requires years of further development, demonstration and pilot-scale testing to become practical and successful. We must begin now to support those techniques with the most promise. Now is the time to commence a long-term effort to remediate sediments and begin efforts to reduce contaminants at their source. Only with a long-term commitment to remediation and source reduction can we attain what should be our long-term goal: to dispose only Class I material in the ocean. To help attain this

goal, the Steering Committee made a number of specific recommendations:

Remediation Technology

1. Establish a bistate policy committee to guide decisions on dredged material management for New York harbor and to develop a long-range plan to improve the quality of sediments dredged and disposed. This committee would coordinate regional research activities (e.g., a detailed sediment characterization), determine treatment and disposal sites, and establish chemical-based standards for the classification of dredged material, among other duties. The committee should include representatives of:

N.J. Department of Environmental Protection and Energy
N.Y. Department of Environmental Conservation
Representatives of public environmental organizations
U.S. Army Corps of Engineers
Representatives from industries (port-related, fishing, tourism)
U.S. Environmental Protection Agency
Rutgers - the State University of New Jersey
State University of New York at Stony Brook
The Port Authority of New York/New Jersey

2. Establish a peer review panel and process to solicit proposals to evaluate techniques to remediate contaminated sediments at the bench-scale level. This process could be modeled after that developed by EPA for its ARCS program.
3. Fund a research competition to select promising bench-scale techniques for pilot-scale remediation tests on dioxin-laden sediments. This is a short-term development program.
4. Fund a research competition to conduct pilot-scale demonstrations of the most promising remediation techniques for typical contaminants found in New York harbor sediments. This is a long-term development program.
5. Permit the continued disposal of Class I dredged material in the open ocean until containment facilities are available. Conduct a pilot disposal program using undersea borrow pits and investigate sites and structures to be used for other methods of containment for other sediments (Class II and III) as studies proceed to develop the best technology to remediate harbor sediments and control sources of contamination.

6. Emphasize source reduction and pretreatment as part of the long-term strategy to improve sediment quality. A waste prevention audit is needed to identify sources of contamination and opportunities for eliminating or reducing contamination.
7. Public participation is required throughout the decision-making process.

Undersea Pit Design and Engineering

1. Develop a thorough understanding of sediment properties and the effects of disturbance on contaminated sediments.
2. Evaluate new techniques for placing dredged material in pits or on the seafloor. All future dredging and ocean disposal of dredged material should use the best available technology to mitigate sediment dispersion. The Port Authority should convene another conference on this theme.
3. Use of undersea pits for dredged material disposal must be accompanied by a long-term monitoring program to detect physical, chemical and biological changes in and around the pit.
4. Pit disposal appears to be an effective technology that warrants further engineering studies and a pilot-scale test while long-term solutions are pursued.
5. Public participation in discussions on the use and siting of the test pit or pits is a must.

Sediment Dynamics

1. Support a fine-scale characterization of sediments in the New York harbor area with funding from the federal and state governments. Ideally, the survey should include sidescan sonar, high resolution profiling, bottom sampling and bottom photography. Spatial resolution should be on the order of 0.5 m.
2. In most cases, pollutants in New York harbor are present in complex mixtures. A spatially intensive characterization of contaminants in areas to be dredged and potential source areas (hot spots) is required.

3. Sediment dynamics must be studied over appropriate time scales (e.g., a tidal cycle) and under various flow conditions, and the effect of episodic events should be quantified.
4. Develop regional sediment balances in relation to contaminant transport.

Summary

In summary, remediation will not be effective unless efforts are made to control sources of contamination. Source control, along with pretreatment efforts, constitute key elements of a long-term strategy that must be developed to mitigate the need for remediation. By reducing the amount of sediments which have to be treated prior to future disposal, remediation becomes a better treatment alternative. This approach mandates public participation at the earliest stages of the decision-making process.

Agenda

**Conference on the Remediation of Sediments
November 17 & 18, 1992**

**Ramada Renaissance Hotel
East Brunswick, New Jersey**

**Sponsored by the Institute of Marine and Coastal Sciences
at Rutgers University and
the Waste Management Institute of the Marine Sciences Research Center
at the State University of New York at Stony Brook**

Tuesday, November 17, 1992

8:00 AM	Welcome and Introduction Conference mandate	F. Grassle, Chair L. Liburdi
8:15	"OVERVIEW OF SEDIMENT DYNAMICS IN THE NEW YORK HARBOR AREA"	D. Suszkowski
8:45	FORMAL PRESENTATIONS <u>Chemical & Physical Remediation</u> "BENCH-SCALE TESTING OF SELECTED REMEDIATION ALTERNATIVES FOR CONTAMINATED SEDIMENTS"	S. Garbaciak, Chair S. Garbaciak
9:15	"LABORATORY LEACHING STUDIES OF SOLIDIFIED/STABILIZED POLLUTED SEDIMENTS"	T. Myers
9:45	"MINERAL PROCESSING PRETREATMENT OF CONTAMINATED SEDIMENT"	T.. Phillips
10:15	BREAK	
10:30	"TREATMENT TECHNOLOGIES FOR CONTAMINATED SEDIMENTS"	J. Ludwig
11:00	"THE REMOVAL OF HEAVY METALS AND ORGANIC COMPOUNDS FROM ANAEROBIC SLUDGES"	J.H.P. Watson
11:30	"SANITATION AND REVALORIZATION OF DREDGING SILT, A RESEARCH PROJECT ON THE RIVER LYS/FLANDERS"	G. Cockaerts
12:00	LUNCH	
1:30	"FACILITIES FOR THE TREATMENT AND DEPOSIT OF DREDGED MATERIAL FROM THE HAMBURG HARBOUR"	H.-D. Detzner

Tuesday, November 17, 1992 (continued)

2:00	"SEDIMENT REMEDIATION - DEVELOPMENTS IN THE NETHERLANDS"	W.A. Bruggeman
2:30	"THE EFFECTIVENESS OF GRAIN SIZE SEPARATION/SOIL WASHING AS A VOLUME REDUCTION TECHNIQUE FOR MILDLY CONTAMINATED SAGINAW RIVER SEDIMENTS"	F. Snitz
3:00	"PILOT SCALE DEMONSTRATION OF A SOLVENT EXTRACTION PROCESS AT THE GRAND CALUMET RIVER, INDIANA	L. Diez
3:30	BREAK	
3:45	CONCURRENT SESSIONS BEGIN	
	<u>SEDIMENT DYNAMICS</u> Keith Stolzenbach, Chair	<u>PIT DESIGN AND CONSTRUCTION</u> Larry Swanson, Chair
	"USE OF FLUORESCENT TRACERS TO STUDY THE TRANSPORT AND DEPOSITION OF CONTAMINATED SEDIMENTS", K. Stolzenbach	"RELOCATION OF DREDGED MATERIAL IN THE PORT OF ROTTERDAM", T. Vellinga
4:15	"UEGS STUDIES ON THE COMPO- SITION, DISTRIBUTION, AND TRANSPORT OF CONTAMINATED SEDIMENTS IN MASSACHUSETTS BAY", B. Butman	"SHAPING PITS FOR DISPOSAL SITES IN NEW YORK HARBOR", M. Bokuniewicz
4:45	"PHYSICAL FACTORS AFFECTING THE DISPERSAL OF DREDGED MATERIALS IN COASTAL WATERS: MANAGEMENT CONSIDERATIONS", P. Bohlen	"MONITORING DEPOSIT CONDITIONS", W. van Kesteren
5:15	"FLOW FIELD OBSERVATIONS IN A ROTATING ANNULAR FLUME", P. Visser	"GEOTECHNICAL ANALYSIS AND CONSOLIDATION SETTLEMENT OF DREDGE-SEDIMENT MOUNDS", A. Silva
5:45	RECESS	
6:30	CASH BAR AT RUTGERS FACULTY CLUB	
7:30	DINNER AT RUTGERS FACULTY CLUB	

Wednesday, November 18, 1992

8:00 AM	<u>Sediment Dynamics (continued)</u> "MECHANICAL BEHAVIOUR OF COHESIVE SEDIMENTS" W. van Kesteren
8:30	"ROLE OF COASTAL BOTTOM MUD IN WAVE ENERGY ABSORPTION" A. Mehta
9:00	<u>Pit Design and Construction (continued)</u> "MONITORING OF CAPPED DREDGED MATERIAL DISPOSAL SITES" T. Fredette
9:30	"A DECADE OF CAPPING: GEOCHEMICAL PERSPECTIVES" D. Carey
10:00	BREAK
10:15	PANEL DISCUSSIONS
11:30	BREAK
11:45	PLENARY SESSION - SUMMARY - Chairs, 15 minutes each
12:30 PM	ADJOURN
12:30	STEERING COMMITTEE LUNCH
1:30	STEERING COMMITTEE DISCUSSION
3:30	ADJOURN

ABSTRACTS
for the
CONFERENCE
ON THE
REMEDIATION
OF SEDIMENTS
Nov. 17-18, 1992

OVERVIEW OF SEDIMENT DYNAMICS IN NEW YORK HARBOR

by Dennis J. Suszkowski and John Floberg

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New York Harbor is a complex series of large embayments, tidal straits, and rivers with many diverse hydrodynamic environments. The textural distribution of bottom sediments reflects this diversity. Sediments range from sands near the entrance to the Harbor in the Lower Bay, to fine-grained muds in channels, mud flats and other quiescent parts of the estuary. Most of the approximately one million metric tons of fine-grained sediments that enter the Harbor each year are brought there by several tributaries, including the Hudson, Passaic and Raritan Rivers. Municipal wastewater treatment plants and CSOs, along with biological production of phytoplankton are significant contributors to the total suspended sediment load to the Harbor. Based upon dredging records and estimates of off-channel sedimentation rates coupled with sediment input data, the total fine-grained sediment load to the Harbor from landward sources can easily account for over 90% of the Harbor's annual sedimentation rate. Estuarine circulation is responsible for the trapping of large quantities of sediment entering the Harbor. This is particularly true in Newark Bay and the lower Hudson River where the estuarine circulation also promotes resuspension of sediments and the formation of turbidity maxima.

**BENCH-SCALE TESTING OF SELECTED REMEDIATION ALTERNATIVES
FOR CONTAMINATED SEDIMENTS**

by Dennis Timberlake, U.S. EPA, Risk Reduction Engineering
Laboratory, Cincinnati, OH 45268

and

Steve Garbaciak, U.S. EPA, Great Lakes National Program
Office, Chicago, IL 60604

The Assessment and Remediation of Contaminated Sediments Program within the U.S. Environmental Protection Agency's Great Lakes National program Office contains a component for the demonstration and evaluation of sediment remediation technologies. Towards this end, bench-scale tests of solvent extraction, thermal desorption, and wet-air oxidation technologies were conducted. Contaminated sediments from Indiana Harbor, Indiana; Buffalo River, New York; and Saginaw Bay, Michigan were tested. The primary contaminants of concern in these sediments were polychlorinated biphenyls and polynuclear aromatic hydrocarbons. The solvent extraction tests were conducted with sediments from all three sites. The thermal desorption studies were conducted with Indiana Harbor and Buffalo River sediments. The wet-air oxidation testing was performed with Indiana Harbor sediment. This paper will present the results of the bench-scale testing for each technology and will present a comparison of the effectiveness of the various technologies.

MINERAL PROCESSING PRETREATMENT OF CONTAMINATED SEDIMENT

**Presented by Tom Phillips for
J. P. Allen and I.G. Torres
Salt Lake City Research Center, Bureau of Mines
U.S. Department of the Interior
Salt Lake City, UT 84108**

Savings in the overall cost of environmental remediation can be expected when low-cost mineral processing techniques are used to reduce the volume of contaminated material requiring expensive contaminant destruction or controlled disposal. Mineral processing methods do not destroy contaminants, but they can concentrate the pollutants in a smaller volume of materials. This volume reduction can make a subsequent destruction technology more efficient or economical, or reduce the cost of disposing of the sediment in a controlled facility.

The Bureau of Mines, U.S. Department of the Interior, in cooperation with the Great Lakes National Program Office, U.S. Environmental Protection Agency, has conducted a study of mineral processing methods for remediation of contaminated sediment. The sediments, from rivers and harbors on the Great Lakes in the United States, contained varying, but relatively low, levels of heavy metal contamination, along with organic contamination such as polychlorinated biphenyls (PCB's). The Bureau conducted investigations in size classification, magnetic separation, gravity separation, and froth flotation to concentrate contaminants. The most effective application of mineral processing technology on Saginaw River sediment, was the use of size classification to isolate metal and organic contaminants. Froth flotation was also found to be effective on organic contaminants.

TREATMENT TECHNOLOGIES FOR CONTAMINATED SEDIMENTS

by John R. Ludwig
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The Coleraine Minerals Research Laboratory (CMRL) of the National Resources Research Institute (NRRI) is applying mineral processing techniques to the treatment of Great Lakes contaminated sediments. The partition of fine sediments by combinations of various size and density classification techniques and extractive mineral processing unit operations has the potential to isolate the most heavily contaminated fractions from the bulk of the material and in some cases detoxify selected fractions. The ultimate objective is to reduce the cost of remediation by isolating materials which can be returned to the environment and to decrease the volume of material that would require either rigorous treatment for detoxification or permanent impoundment.

This research program encompasses three phases: progressing though, (1) the initial characterization of selected sediment samples and small-scale laboratory beneficiation tests, Phase I; (2) continuous integrated pilot-plant operations to generate basic engineering design data, Phase II; and (3) providing the final flowsheet and equipment specifications for a full-scale on-site field demonstration unit, Phase III. The research program is being carried out under a Cooperative Agreement between NRRI and the U.S. EPA Environmental Research laboratory in Duluth, Minnesota.

Sediment samples utilized in the first phase of the project were obtained from seven of the Areas of Concern (AOC) identified by the U.S./Canada International Joint Commission's Great Lakes Water Quality Board. These AOC sites included:

Indiana Harbor
Saginaw Bay
Buffalo River
Manistique River

Duluth-Superior Harbor
Rouge River
Presque Isle Bay

The major contaminants in these sediments are heavy metals, polycyclic aromatic hydrocarbons (PAHs), and polychlorinated biphenyls (PCBs).