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Type of Organization: College or University

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Project Title: Phase II Assessment of Sediment Contamination in White Lake

Project Category: Contaminated Sediments

Rank by Organization (if applicable): 1

Total Funding Requested (\$): 115,638 **Project Duration:** 1.5 Years

Abstract:

White Lake was designated an Area of Concern (AOC) in 1985 by the International Joint Commission because of historical discharges of heavy metals and organic chemicals. Recent and historical studies have identified extensive sediment contamination with chromium, arsenic and mercury in the area near the former outfall of Whitehall Leather called Tannery Bay. Sediments from Tannery Bay were found to be toxic to amphipods and subject to export by water currents. While we know that high levels of chromium are present in the near surface zone in many areas of eastern White Lake, the toxicity of these sediments is unknown. In addition, sediments contaminated with chlorinated hydrocarbons were identified in the discharge area of Occidental Chemical and in a deep depositional zone near Dowies Point. Contaminant profiles and toxicity evaluations have not been performed in the western half of White Lake from Dowies Point to the Lake Michigan channel. The proposed investigation will build on historical data and fill critical data gaps related to the distribution of chlorinated hydrocarbons and heavy metals in the western half of White Lake and the toxicity of sediments outside of Tannery Bay. The investigative sampling will focus on regions of sediment contamination in near shore areas and in deeper deposition zones. A series of 10 sediment cores and 20 Ponar samples will be analyzed for heavy metals, semivolatiles, PCBs, and physical characteristics. Ponar samples will be analyzed for benthic macroinvertebrates and sediment toxicity. Chromium levels in the benthic macroinvertebrates will also be assessed. In addition, 3-4 cores from deposition zones will be dated using ²¹⁰Pb and ¹³⁷Cs. These cores will be analyzed for chromium and radionuclides to determine the depositional patterns and contaminant flux in the lake. This information will be important for the development of remediation plans and the assessment ecological effects of contaminated sediments.

Geographic Areas Affected by the Project

States:

- | | |
|--|---------------------------------------|
| <input type="checkbox"/> Illinois | <input type="checkbox"/> New York |
| <input type="checkbox"/> Indiana | <input type="checkbox"/> Pennsylvania |
| <input checked="" type="checkbox"/> Michigan | <input type="checkbox"/> Wisconsin |
| <input type="checkbox"/> Minnesota | <input type="checkbox"/> Ohio |

Lakes:

- | | |
|--|------------------------------------|
| <input type="checkbox"/> Superior | <input type="checkbox"/> Erie |
| <input type="checkbox"/> Huron | <input type="checkbox"/> Ontario |
| <input checked="" type="checkbox"/> Michigan | <input type="checkbox"/> All Lakes |

Geographic Initiatives:

- | | | | | |
|--|----------------------------------|-------------------------------------|--------------------------------------|---|
| <input type="checkbox"/> Greater Chicago | <input type="checkbox"/> NE Ohio | <input type="checkbox"/> NW Indiana | <input type="checkbox"/> SE Michigan | <input type="checkbox"/> Lake St. Clair |
|--|----------------------------------|-------------------------------------|--------------------------------------|---|

Primary Affected Area of Concern: White Lake, MI

Other Affected Areas of Concern:

For Habitat Projects Only:

Primary Affected Biodiversity Investment Area: Not Applicable

Other Affected Biodiversity Investment Areas:

Problem Statement:

White Lake is a 2,571 acre, drowned-rivermouth lake located on the eastern shore of Lake Michigan in Muskegon County. The lake was designated an Area of Concern (AOC) in 1985 by the International Joint Commission because of historical discharges of heavy metals and organic chemicals. A preliminary investigation of sediment contamination by NOAA/GVSU in 1997 determined that the sediments in Tannery Bay were highly contaminated with chromium, arsenic, and mercury and were toxic to amphipods in laboratory bioassays. The highest level of toxicity was observed in an isolated cove located to the northeast of Tannery Bay. In addition, the sediments in Tannery Bay were found to be subject to erosion and transport by wave action and wind induced currents. It was postulated that the high levels of chromium found in the near surface zone sediments of a depositional zone 1.5 miles from the bay were the result of the movement of contaminated sediments in the system. Chlorinated hydrocarbons were also found in a deeper strata from the same area which was located near the old Occidental Chemical outfall. Recently, the MDEQ and the USACE have conducted additional studies of the Tannery Bay sediments to determine detailed contaminant profiles and volumetric estimates for remediation. A further investigation of the area near the Occidental Chemical outfall was also conducted by a consultant pursuant to a RCRA assessment. These results have confirmed the presence of chlorinated dienes and PCBs in the area of the old outfall.

The current extent of sediment contamination in western half of White Lake is unknown with respect to spatial and vertical distribution. Even though the direct discharge of tannery and process chemical effluents was discontinued in the mid 1970s, the previous data suggests that the river and lake currents may be sufficient to resuspend and transport contaminated sediments to other areas of the lake. Without more information on sediment stability and accumulation rates, it is difficult to determine the fate of contaminants in the system. Whether historical levels of metals and chlorinated hydrocarbons are being covered by less contaminated material or being resuspended by physical events are critical questions that need to be answered before evaluating remediation options. We also know very little about the toxicity and the ecological effects of contaminated sediments outside of Tannery Bay. It is important that we investigate the nature and extent of the area of high sediment toxicity in the cove adjacent to Tannery Bay. Similarly, we need to determine if the sediments outside of Tannery Bay are toxic and have an adverse ecological effect on the benthic community. The proposed Phase II Assessment of Sediment Contamination in White Lake will address the above issues and provide information that is critical to the development of restoration plans for the AOC. Future dredging, marina development, and macrophyte control programs may also affect the mobility of contaminated sediments in the system. It is therefore important that areas of contaminated sediment are identified so that proposed maintenance and development activities do not impact the lake.

Proposed Work Outcome:

To determine the nature and extent of sediment contamination in western White Lake, we propose to collect 10 core samples from locations that have been impacted by anthropogenic activity. Four cores will be taken from deep depositional zones near Dowies Point, Long Point, Sylvan Beach, and Indian Bay. Six additional cores will be collected from shallow areas along the south shore (2), down gradient from Occidental Chemical (2), and the DuPont ground water plume (2). These core samples will be analyzed for heavy metals (arsenic, chromium, lead, and mercury), semivolatile organics, PCBs, and physical characteristics (grain size distribution, TOC, bulk density, and percent solids). Ponar samples will also be collected at the same locations and analyzed for chemistry, sediment toxicity, and benthic macroinvertebrates. An additional group of 10 Ponars will be collected to examine the toxicity of sediments in areas of eastern White Lake. Four Ponars will be collected from the cove area between Whitehall Leather and the White Lake Marina. This location had the highest level of amphipod toxicity in the NOAA/GVSU investigation. Six additional Ponar samples will be collected from control sites (2) and locations outside of the Tannery Bay remediation area (4). These locations will correspond to Stations E-5, E-6, E-7, and E-9 in the NOAA/GVSU report. High levels of chromium were found in the near surface zone sediments at these locations. While we know that chromium contaminated sediments have been exported from Tannery Bay, information on their toxicity is unknown. We propose to analyze this series of Ponars for the above parameters and organic chromium (Walsh and O'Holloran, 1996). Organic chromium complexes have been identified in sediments contaminated with tannery wastes and may have a higher toxicity than inorganic chromium. In addition, a second set of benthic macroinvertebrate samples will be collected and analyzed for total chromium to assess the potential for bioaccumulation. The final location of the core and Ponar samples will be determined in cooperation with the MDEQ and USEPA. Core samples at the above locations will be collected by VibraCore techniques using the R/V Mudpuppy. This part of the project will provide historical current and information related to the nature and extent of sediment contamination in White Lake. The benthic macroinvertebrate and toxicity evaluations will support this information and will be used for evaluating ecological effects and prioritizing areas for remediation.

In addition to the above scope of work, an investigation of sediment deposition and stability will be conducted using radiodating and detailed stratigraphy. Radiodating profiles will help define annual deposition rates and directly reflect sediment stability. In consideration of the effluent diversions that occurred in early 1970s, heavy metal flux into White Lake has changed dramatically over the last 25 years. If the sediments are stable and not subject to resuspension, lower levels of heavy metals should be encountered in the surface strata. To help assess the stability and deposition of sediments in White Lake, 3 - 4 piston cores will be collected and dated using ²¹⁰Pb and ¹³⁷Cs. The locations of these samples will be determined after reviewing the initial sediment chemistry data. Each core will be analyzed for chromium at 2 cm intervals in order to develop a detailed stratigraphic profile. The information from the piston cores will determine if significant levels of heavy metals are still mobile in the lake from the effects of wave action and from currents related to the drowned river mouth system. These data along with the biological and toxicological studies discussed above will provide a technically sound basis for the development of remediation alternatives and restoration plans for White Lake.

Project Milestones:	Dates:
Project Start	10/2000
Sample Collection and Start Analyses	11/2000
Complete Initial Analyses	04/2001
Collection of Cores for Radiodating	05/2001
Complete Radiodating and Stratigraphy	09/2001
Review and Analyze Project Data	10/2001
Begin Final Report	11/2001
Complete Final Report	03/2002

Project Addresses Environmental Justice

If So, Description of How:

Project Addresses Education/Outreach

If So, Description of How:

In order to address community concerns and to build public support for issues related to contaminated sediments, the Annis Water Resources Institute and the Muskegon County Soil Conservation District (MCSCD) will conduct an outreach education program as part of this project. The outreach education activities will include:

1. The production and distribution articles in the PAC's newsletter concerning the purpose and anticipated outcome of the project, the available information on the sites selected for investigation, the beneficial use impairments related to contaminated sediments, and how the information can be used for community decision making.
2. Development of a display board for the White Lake AOC that will address contaminated sediment issues. The display will include photographs of project activities, maps, data summaries, and information concerning the ecological significance of contaminated sediments.
3. Coordination and hosting of a Public Meeting designed to disseminate the project results and solicit community input. The MCSCD will provide the necessary advertising and publicity for the meeting, develop the agenda, and cover the costs for the room and food service.

Where appropriate, information and materials developed by the Lake Michigan Federation for their Contaminated Sediment Education Program Grant will be incorporated into the project outreach activities. The principal investigator will also make three presentations to the White Lake PAC during the project to provide updates and answer questions. These presentations will be made during regularly scheduled PAC meetings.

Project Budget:

	Federal Share Requested (\$)	Applicant's Share (\$)
Personnel:	39,140	0
Fringe:	8,756	0
Travel:	1,500	0
Equipment:	0	0
Supplies:	7,000	0
Contracts:	42,000	0
Construction:	0	0
Other:	0	0
Total Direct Costs:	98,396	0
Indirect Costs:	17,242	5,782
Total:	115,638	5,782
Projected Income:	0	0

Funding by Other Organizations (Names, Amounts, Description of Commitments):

None

Description of Collaboration/Community Based Support:

This project will be performed in collaboration with the following scientists and organizations as co-investigators and contractors:

- Dr. Peter G. Meier, University of Michigan. Benthic Macroinvertebrate Ecology
- Dr. Graham Peaslee, Hope College. Radiodating
- Muskegon County Soil Conservation District, Outreach Education.

Additional partners for this project will include the White Lake PAC, the Lake Michigan Federation, MDEQ, and the US Army Corps of Engineers. Project information will be important to the White Lake PAC for the purposes of updating the RAP and developing a further understanding of the effects of contaminated sediments on the aquatic ecosystem. We will also work closely with the Lake Michigan Federation with respect to the transfer of relevant information and utilize their educational materials where appropriate. The MDEQ and the US Army Corps of Engineers have identified the proposed work as a priority project to support their ongoing assessment of sediment contamination in White Lake.