

Using the Weight of Evidence Approach for Making Sediment Management Decisions

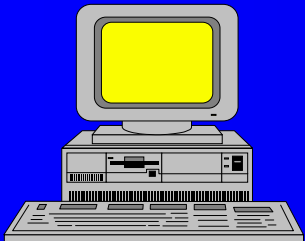
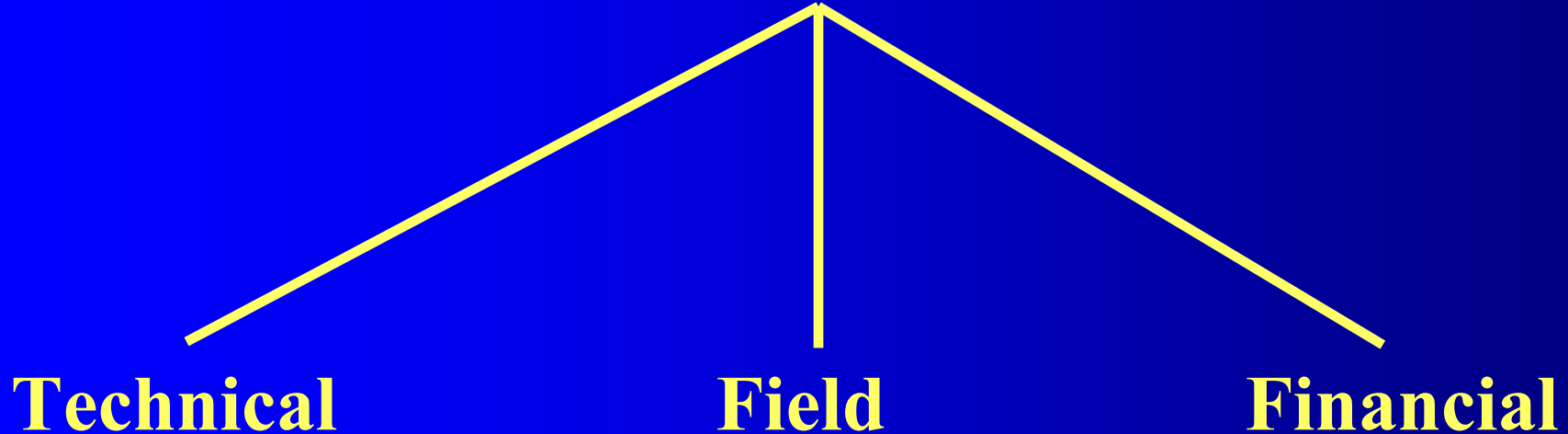
Scott Cieniawski
USEPA-GLNPO

GLNPO Sediments Web Page:

WWW.EPA.GOV/GLNPO/SEDIMENTS.HTML

The GLNPO Sediment Assessment and Remediation Team

Supporting Contaminated Sediment Work In Great Lakes AOCs



For Technical Assistance or to Schedule R/V Mudpuppy Support

- Contact:

Scott Cieniawski

312-353-9184

or

Marc Tuchman

312-353-1369

For More Information on the GLNPO Grants Program

- Visit the GLNPO Web Page at:

www.epa.gov/glnpo

Next Request for Proposal Expected to be
Announced December 2002/January 2003

Sediment Assessment References

- *ARCS – Assessment Guidance Document*, EPA-905-B94-002.
- Great Lakes Dredge Material Testing and Evaluation Manual.
- A Guidance Manual to Support the Assessment of Contaminated Sediments in Freshwater Ecosystems (Volumes 1 through 3)

The Weight of Evidence Approach

Multiple Lines of Evidence to Support Decision Making

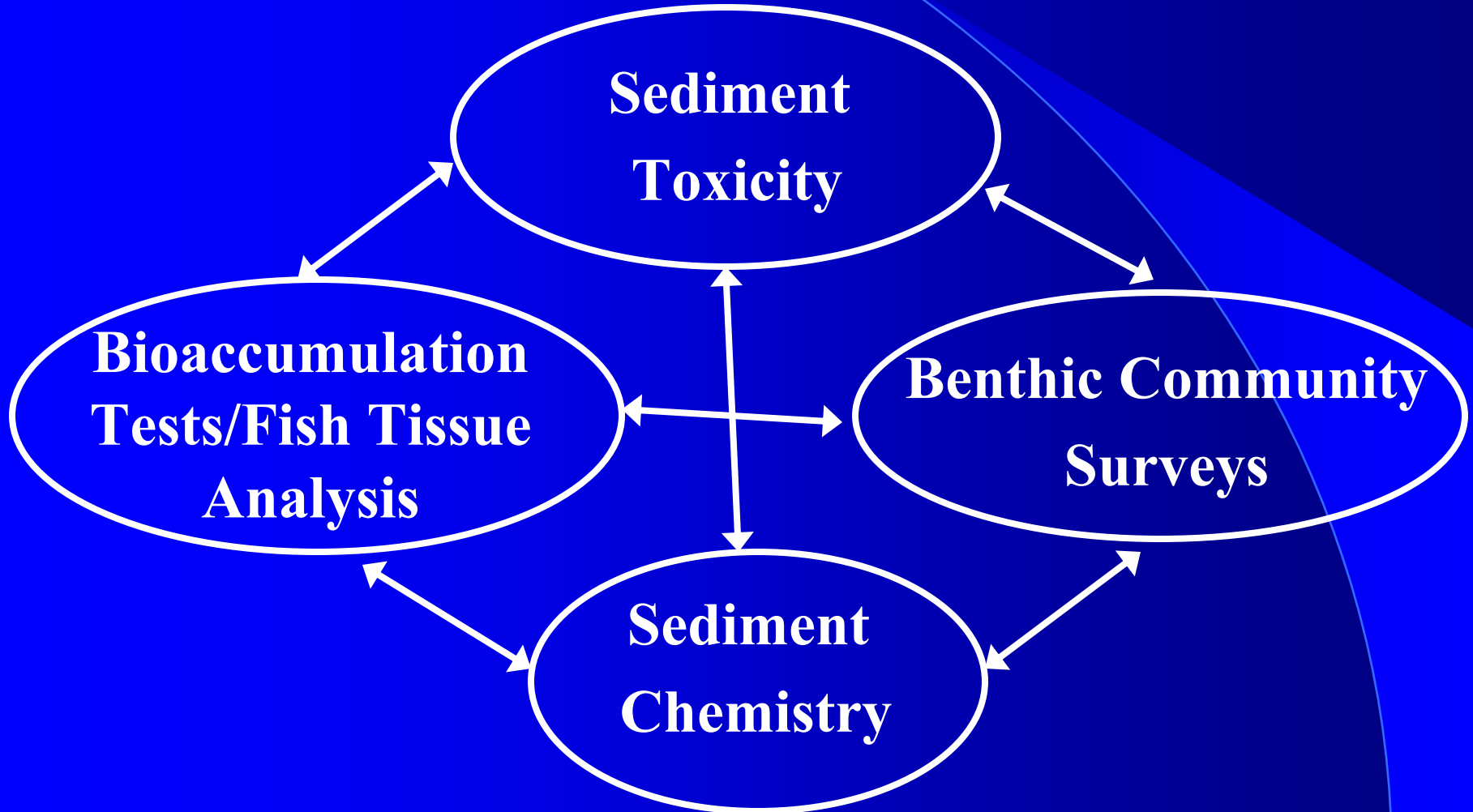
No Single Line of Evidence Should Drive Decision Making

- Some lines of evidence weighted more heavily than others
- Increasingly complex evaluations only when needed
- Weight of Evidence Collected should be proportional to the weight of the decision being made.
- Multiple lines of evidence are necessary since there is no clear consensus on how incorporate uncertainties or relate measurement endpoints

Planning a Sediment Assessment Survey

- Identify Sediment Quality Issues and Concerns
- Evaluate Existing Sediment Quality Data
- Develop a QAPP and Implement a Sampling Plan
Preliminary Site Investigation (Goals: Identify Priority Sites for Further Investigation)
- Develop a QAPP and Implement a Sampling Plan
for a Detailed Site Investigation (Goals: Determine Magnitude and Extent of Contamination and Delineation)
- Make Decisions Regarding the Need for Remediation

THE SEDIMENT QUALITY “QUADRAD”



Evaluation of Sediment Chemistry Results

- Analysis of Chemical Concentrations in Sediment and Pore Water
- Comparison to Sediment Quality Guidelines (Screening Purposes Only)
- Comparison to Regulatory Guidelines
- Use in Human Health and Ecological Risk Assessments
- Simultaneously Extracted Metals (SEM) minus Acid Volatile Sulfide (AVS) Analysis

Sediment Chemistry - Advantages

- Provides direct information on presence of contaminants of concern
- Standard Methods available for many chemicals
- Useful in tracking down and eliminating source of contamination

Sediment Chemistry - Disadvantages

- Does NOT provide direct information regarding impacts and effects of contaminated sediments.
- Can be fairly expensive
- Matrix interferences may impact detection limits and usability of data
- Lack of Standard Methods for Emerging Chemicals
- Important chemicals may be missed/No information on effect of mixtures

Whole Sediment Toxicity Tests

- Exposure of benthic organisms to sediment samples in the laboratory and response endpoints are evaluated
- 2 different species (e.g., *Hyallea*, *Chironomus*, *Daphnia*, etc) and two different endpoint (e.g., growth, survival, reproduction, etc.) are recommended
- Comparison of results to reference site or control sediments

Sediment Toxicity - Advantages

- Direct indication of impact and effects on aquatic organisms
- Standard methods and evaluation procedures available
- Sensitivity to impact of mixtures and/or unmeasured chemicals

Sediment Toxicity - Disadvantages

- Field collected sediments are manipulated which may impact their integrity and toxicity
- Results may be less relevant than in situ type tests
- Can't discriminate impacts of individual chemicals (causality)
- Organism sensitivity varies on organism and contaminant class
- Long-term and inter-generational effect tests can be expensive
- Results influenced by physical properties of sediments in addition to chemical composition

Benthic Community Assessments

- An evaluation of the number and diversity of sediment-dwelling organisms
- Test sites compared to reference sites
- Evaluation of the identity, abundance, and distribution of species present in a sediment sample
- Variety of metrics are available for evaluation data from these assessments

Benthic Community Assessments - Advantages

- Direct evaluation of in situ effects of contaminated sediments
- Benthic Organisms are “continuous monitors” of sediment health
- Assessments focus on indigenous populations with direct impact to overall health of the aquatic ecosystem

Benthic Community Assessments -Disadvantages

- Lack of standardized methods for collecting and processing samples
- Benthic Communities are influenced by of chemical, physical, and hydrologic properties of the sediments and sampling site
- High variance in samples requires large number of samples and large volumes to be collected
- Can't discriminate impacts of individual chemicals (causality)
- Numerous metrics available, which makes interpretation of data complex

Bioaccumulation Assessments

- In-situ and/or Ex-situ tests to determine contaminant uptake by organisms (benthic organisms, fish, birds, etc.)
- Used at sites where contamination by bioaccumulative chemicals (PAHs, PCBs, mercury, dioxins/furans, etc.)
- Used in conjunction with sediment chemistry and bioaccumulation models
- Results compared to reference sites and/or regulatory benchmarks

Bioaccumulation Assessments - Advantages

- Availability of standard methods
- Measurement of contaminants uptake by organisms.
- Can include in situ and/or ex-situ tests
- Can target site-specific contaminants
- Useful in tracking down and eliminating source of contamination

Bioaccumulation Assessments

Disadvantages

- Very Expensive
- Collection of required mass of tissue from in-situ organisms is cumbersome
- Field collected sediments for laboratory tests are manipulated which may impact their integrity and bioaccumulation potential
- Few benchmarks exist for decision making based on tissue concentrations

Drawing Conclusions

<u>Chem</u>	<u>Tox</u>	<u>Ben</u>	<u>Bio</u>	Potential Conclusions
+	+	+	+	Sediment contamination present and contributing to toxicity, benthic impairment, and bioaccumulation
-	-	-	+	Bioaccumulation has potential to impact higher trophic levels, but not impacting benthic community. Source of contamination undetermined.
+	-	-	+	Bioaccumulation has potential to impact higher trophic levels, but not impacting benthic community. Sediment likely the source.
-	+	-	+	Bioaccumulation has potential to impact higher trophic levels. Unmeasured factors influencing toxicity. Source of contamination undetermined.

Summary

- Recommend Use of Multiple Lines of Evidence for Sediment Assessment
- Make Use of Technical Guidance Manuals that are Available
- Decision-Making is a Complex Process, but can be Simplified by Collecting the Right Information