A GIS solution to evaluating remedial alternatives in sediment remediation and recovery

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Sediment Cleanup – Recovery and Remediation

• Objectives

• Where does GIS help?

• Scenario Modeling – Tools and applied example
Sediment Cleanup Overview

Primary Objectives

• Determine whether existing conditions are compliant with proposed sediment cleanup levels (SCLs) for hazardous substances. *(COCs)*

• Must attain SCL within reasonable timeframe

• Combination of active remediation and natural recovery
How can GIS-based models help?

- What is the spatial extent of the ‘site’?
- Will cleanup levels be met through natural recovery?
- What is the optimized remediation to comply with regulations?
- What are the outcomes of different management decisions?

Dredging

Capping
Spatial Data Modeling Scenarios

- Need a way to model multiple scenarios to help in management decisions
- Model parameters are COC dependent
- Becomes a data management problem

Customized Toolbox
1. Natural Recovery
2. Active Remediation
3. Integrated Remediation With Recovery
Scenario Modeling – Dioxin/Furan Example

Initial Concentration

Dioxin/Furan TEQ
(μg/Kg)
0.5 - 2.0
2.01 - 5.0
5.01 - 10.0
10.01 - 50.0
50.01 - 70.0
Sediment Cleanup Unit
sample location

0 500 1,000 2,000 Feet
How much time will it take for the system to recover on its own?

Natural Recovery Model

<table>
<thead>
<tr>
<th>Time</th>
<th>Sediment Cleanup Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>SWAC Model Parameters</td>
<td></td>
</tr>
<tr>
<td>• Chemical Loading ($C_d$)</td>
<td></td>
</tr>
<tr>
<td>• Bioturbation ($B$)</td>
<td></td>
</tr>
<tr>
<td>• Sedimentation Rate ($R$)</td>
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</tbody>
</table>

1. Depositing solids and solids in the mixed layer have the same density
2. No diffusion/degradation of COC

SEDTCAM (Jacobs, Barrick, and Ginn – 1988)

$$C_t = C_d \cdot \left[ 1 - e^{\frac{-Rt}{B}} \right] + C_i \cdot e^{\frac{-Rt}{B}}$$
Scenario Modeling – Natural Recovery

30 Year Recovery Result

Active Remediation?
Active Remediation Model

Replace hot spots with “clean” sediment

Cleanup to Regional Background

What’s the area of remediation required to meet cleanup level?

5 acres
50 acres
100 acres

Sediment Cleanup Level
Integrated Remediation and Recovery

After remediation, how much time to meet the sediment cleanup level?

- Model variables frequently vary depending on management decisions
- Can reevaluate using toolset
Scenario Modeling – Optimal Dioxin/Furan Remediation

Site Average Sediment Cleanup Level

Graph showing average concentration over time with a line for Site Average and a dashed line for Sediment Cleanup Level.

Map showing concentrations of Dioxin/Furan TEQ in different colored regions.
Scenario Modeling – Optimal Site-Wide Remediation

- Represents a maximal extent of remediation
- Model does not optimize the remediation for multiple COC
Summary

- Local Sediment Cleanup Standard have become more complex
- GIS-based models allow for scenario evaluation
- What is the optimized remediation to comply with regulations?
Questions?
Reference