Guidelines for Performing Modeling at Contaminated Sediment Sites

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Engineer Research and Development Center

Don Hayes, Paul Schroeder, Earl Hayter, and Todd Bridges

Environmental Laboratory

Joe Gailani

Coastal & Hydraulics Laboratory

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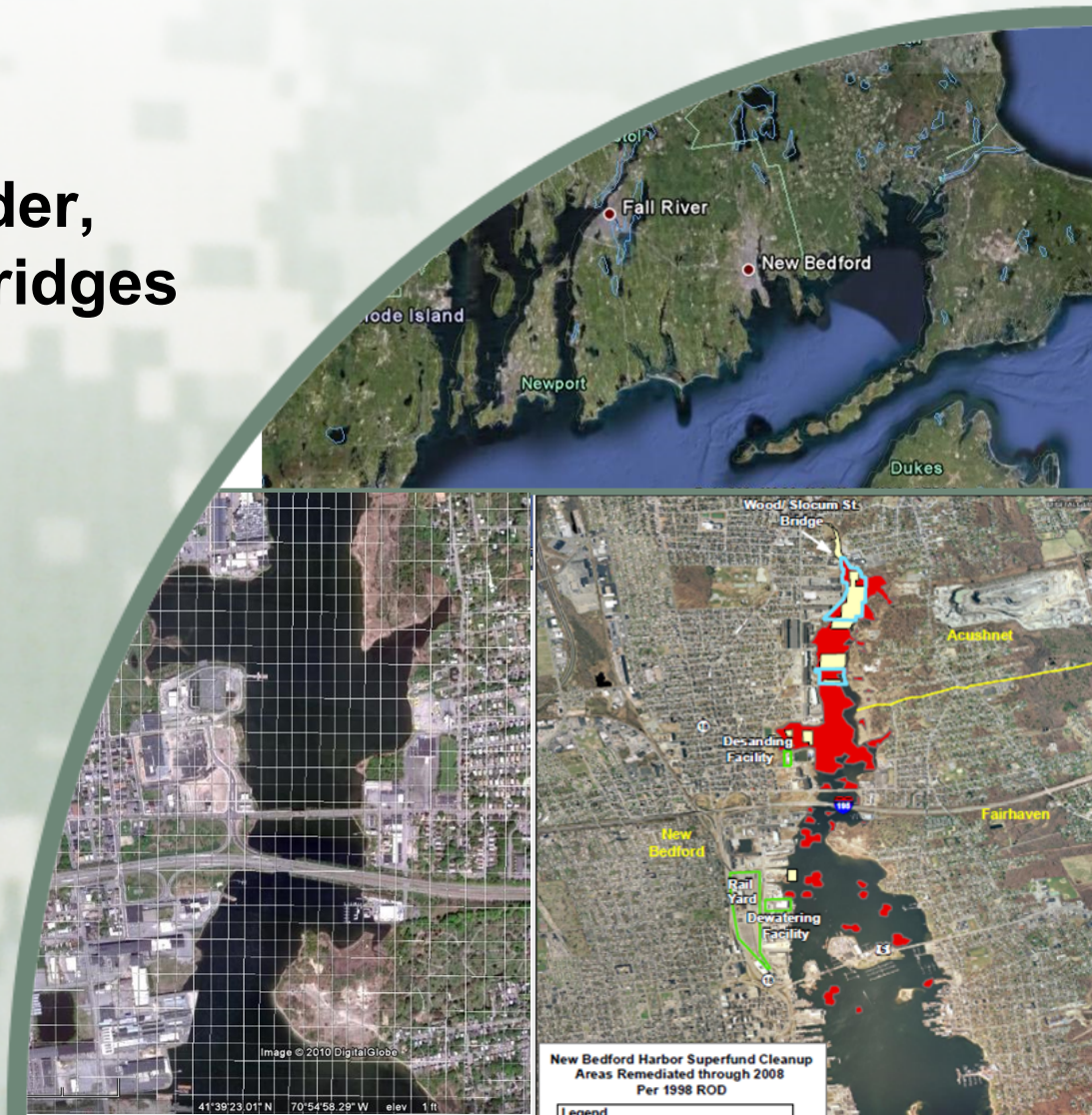

Questions that Drive Modeling?

- Does the contaminant pose unacceptable risk now or in the future?
- Is there a complete conceptual site model?
- What is the spatial and temporal extent of the risk?
- Is the contamination spreading?
- Is recovery occurring? If so, is the rate of recovery acceptable?
- Is a proposed remedy protective under extreme hydrologic events?
- Is groundwater releasing contaminants to the water column?
- What losses would occur during remediation?
- Would a cap be stable based on slope, seismic and erosive forces?
- Would infrastructure be stable if sediment were removed?
- What is the projected long-term performance of the remedy?

What Level of Analysis is Needed at a Site?

- Level of analysis refers to the degree of quantitative analyses to be performed on historic and new data.
- At relatively small, homogeneous sites, simple extrapolation from empirical data may be sufficient to understand the system and support decision-making.
- At sites where the sediment and COPC properties are only marginally heterogeneous, limited modeling efforts, possibly using simple models to address narrow questions, may be necessary to understand system processes and make technically sound decisions.

What Level of Analysis is Needed at a Site?

- At sites where the contamination is wide spread and sediment properties are very heterogeneous in both the horizontal and vertical dimensions, a more advanced tool such as a numerical model may need to be used.

- Numerical modeling is more likely needed when contamination is being left in place, groundwater discharges are considerable, on-going sources and background contamination exists, and stability is questionable.

“All Models Are Wrong But Some Are Useful”

This is the title of a section of the paper Box, G.E.P. (1979) "Robustness in the strategy of scientific model building" in Robustness in Statistics (R.L. Launer and G.N. Wilkinson, Eds.), Academic Press.

“All geophysical-chemical-biological models are gross simplifications of natural processes. Some of these models are useful when appropriately applied, but a lot of modelers are ignorant about the 'inner workings' of models and do not know how to appropriately apply them.”

Uses of Models

- Direct data collection efforts
- Perform hypothesis testing and refine the CSM
- Act as prognostic tools for predicting future behavior of the system
- Support remedy evaluation and selection
- Support remedy design
- Help understand post-remedy monitoring data

Top 10 List of Modeling Related Issues

1. Model selection is critical. Use existing, proven models. Proprietary codes should not be used. A collaborative approach to model development and use between EPA and the PRP(s) is preferred.
2. Modeling team selection is as important as model selection. Extensive modeling experience in similar environments can avoid unpleasant surprises and excessive costs.
3. A phased modeling approach should be used where complexity is added as needed to address specific objectives and reduce uncertainty.

Top 10 List of Modeling Related Issues

4. Uncertainty or inability to represent key driving forces should be considered when deciding if a modeling study should be performed or not.
5. Modeling team must be familiar with how the chosen model represents processes. Ability to run a model is insufficient - modeler must be familiar with how it simulates each process and the corresponding assumptions and limitations.
6. Modeling team should be able to modify code to represent site-specific conditions - they must also be able to validate modified code.

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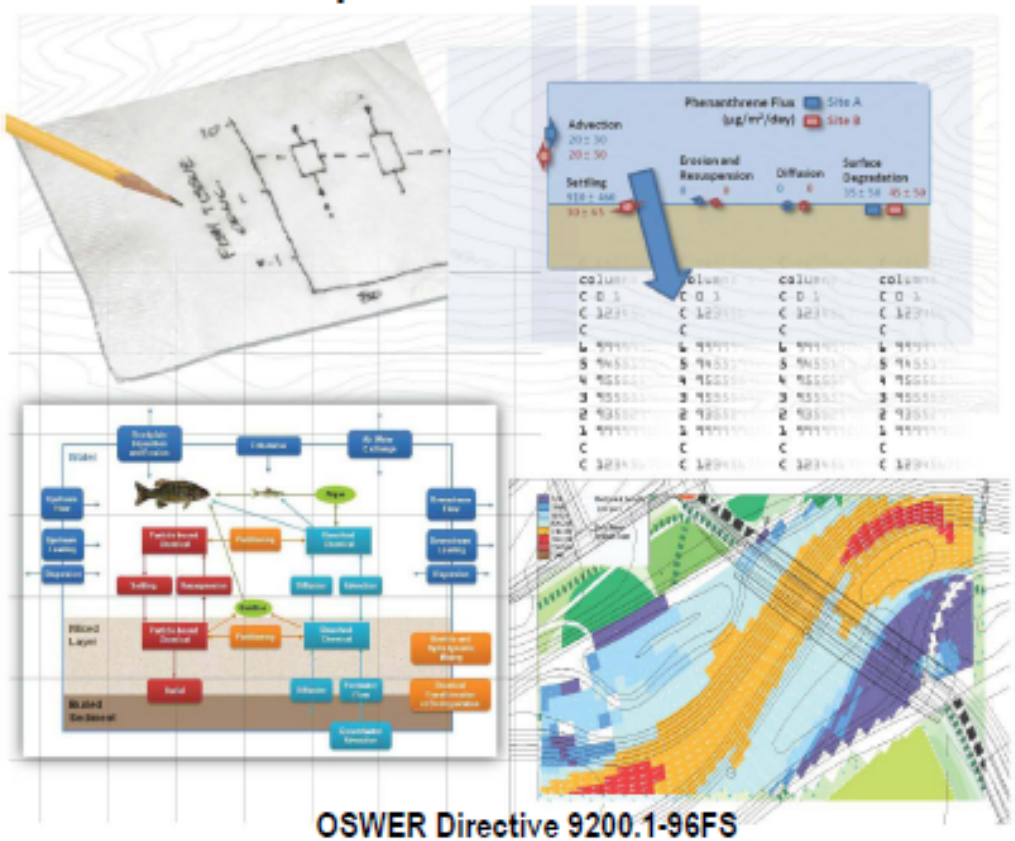
Top 10 List of Modeling Related Issues

7. Modelers should be part of the team evaluating alternatives and familiar with the outcomes required for decision-making.
8. Never be satisfied with one answer - model sensitivity and bracketing of solution are critical. Uncertainty should be quantified.
9. Site-specific sediment and contaminant partitioning characteristics are critical to model calibration and reducing uncertainty.
10. Modeling and data collection costs should be less than the differences in costs of remedial alternatives.

Office of Superfund Remediation and Technology Innovation

Sediment Assessment and Monitoring Sheet (SAMS) #2

Understanding the Use of Models in Predicting the Effectiveness of Proposed Remedial Actions at Superfund Sediment Sites



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Questions?

USACE Panel

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