Actionable Science for Communities

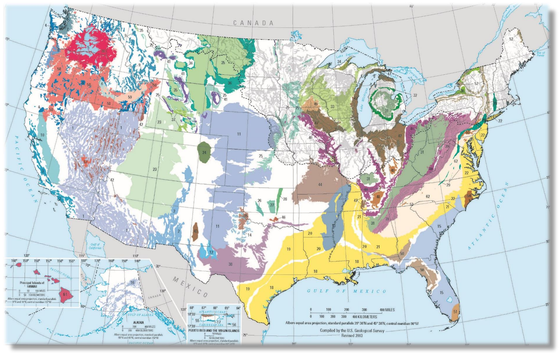
SHC Task 3.61.5 – Tools for Evaluating Spatio-Temporal Impacts of Contaminated Sites on the Environment

David Burden, Task Lead, National Risk Management Research Lab (NRMRL)

United States Environmental Protection Agency

Problem Summary & Decision Context

- The purpose of this task is produce applied research products that will focus on the temporal and spatial changes in groundwater, vapor intrusion and/or contaminated sediments coupled with social and economic factors related to community water supplies addressing Superfund, Brownfields, and/or Environmental Justice concerns.
- Over 80 percent of the most serious hazardous waste sites in the U.S. have adversely impacted the quality of nearby groundwater. Just as the groundwater cleanup process is complex, so are the issues behind the methods and techniques used to determine the best approach for each site.
- Groundwater accounts for more than 95 percent of the nation's available freshwater resources, and is the drinking water source for half the people in the United States. Many households, towns, cities, farms, and industries use groundwater every day, or depend on lakes and rivers that receive part of their water supplies from groundwater.
- Groundwater wells near Superfund sites supply public and private drinking water wells, irrigation, and other agricultural needs, and commercial and industrial businesses. There is no single way to characterize communities that are located near hazardous waste sites, but a recent EPA study found that approximately 49 million people live within 3 miles of Superfund sites or proposed NPL sites.
- It is the intention of ORD to focus its efforts on the development of models and/or decision support tools which are both spatially and temporally based.



Aquifers of the U.S. compiled by the U.S. Geological Survey, 2003.

Task Overview

With population increases and increased frequency of extreme weather events due to climate change, there are stresses on aquifer-based water supplies, and the impacts of contaminated sites may constrain community decisions on water supplies.

- At the decision-making level environmental considerations (SHC Project 3.61 – Tasks 1, 2, 3, and 4) are augmented by social and economic factors.
- One of the most challenging aspects of site remediation is the selection of a suitable contaminated site management strategy that incorporates both technical and economical feasibilities of available alternatives that include social variables and site reuse considerations.
- Research is needed to develop a knowledge base and decision tools to assess and predict temporal and spatial changes in aquifer based water supplies related to community water supplies.
- Task 5 emphasizes decision support tools, models, and software applications that scientists, technical staff, and communities can use to evaluate the temporal and spatial impacts that contaminated sites may have on the environment.

Accomplishments

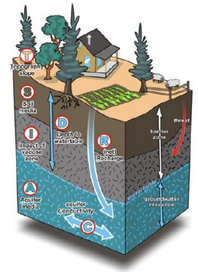
- Funding for this task was **delayed until FY16**, because of resource reductions limiting research activities on the project, there are several proposed products for this task in the coming years (see “Future Directions”).
- For the past several decades Geographic Information Systems (GIS) has been under continuous development and more recently coupling this technology with Decision Support Systems (DSS). The application of DSS have become widely used and have become integral elements of information technology applications in a wide variety of domains.
- A readily available suite of GIS-based analytical and modeling tools will help scientists, engineers, planners, and policy makers make better determinations and decisions about the environment. Moreover, spatial decision support systems (SDSS) combine analytical tools with functions available in GIS as well as models for evaluating various options.
- SDSS approaches for both detailed and screening impacts of contaminated sites are needed, as are mapping-based evaluation of locations and impacts to private drinking water wells in the context of aquifer vulnerability.

Future Directions

Proposed products for this task include:

The spatial assessment of contaminated groundwater at hazardous waste sites near vulnerable drinking water supplies;

- Using existing spatial data on the location of hazardous waste sites and toxic release sites, and current information on public drinking water supplies, produce GIS layers which could be incorporated into existing spatial decision support tools such as EnviroAtlas, EnviroMapper, and/or MyEnvironment. The research will focus on conducting a GIS-based statistical analysis and/or developing a vulnerability index for the most vulnerable public drinking water sources in proximity of hazardous waste sites with groundwater contamination. For public drinking water supplies the focus will be on producing data layers of public and private wells utilized for drinking water, irrigation, and other agricultural needs, and commercial and industrial businesses.



An example of using the DRASTIC method to map intrinsic aquifer vulnerability of groundwater in British Columbia. Intrinsic aquifer vulnerability can vary from qualitative indexing methods to process-based quantitative hydrogeologic assessments with numerical modeling (Liggett et al. , 2011).

A graphical user interface (GUI) for simulating the transport of volatile organic compounds in the vadose zone;

- Develop a graphic user interface for using a group of analytical solutions simulating the transport of volatile organic compounds in the vadose zone incorporating mass exchange through the water table. The analytical model will take into account different transport mechanisms that appear in subsurface domains. In the vadose, the model will simulate diffusion, mass transfer and first order decay of volatile organic compound. In the saturated zone, the model will simulate convection, dispersion, rate-limited adsorption and first order decay of dissolved volatile organic compounds. The tool will assist in evaluating temporal and spatial impacts of volatile organic contaminants on the subsurface environment.

Other products planned include cross-collaboration with researchers in SHC Project 2.63 (Community Well-Being: Public Health & Ecosystems Goods and Services):

- GIS-Mapping and Statistical Analyses to Identify Communities and Populations Disproportionately Impacted by Climate Change-Vulnerable Contaminated Sites.
- Key Factors, and Exposure Assessment Case Study of a Community Disproportionately Impacted by Climate-Vulnerable Contaminated Sites.