Clean-Up Isn't the End in Sediment Remediation

New NESDI Web Site Provides Assistance with Long-Term Monitoring

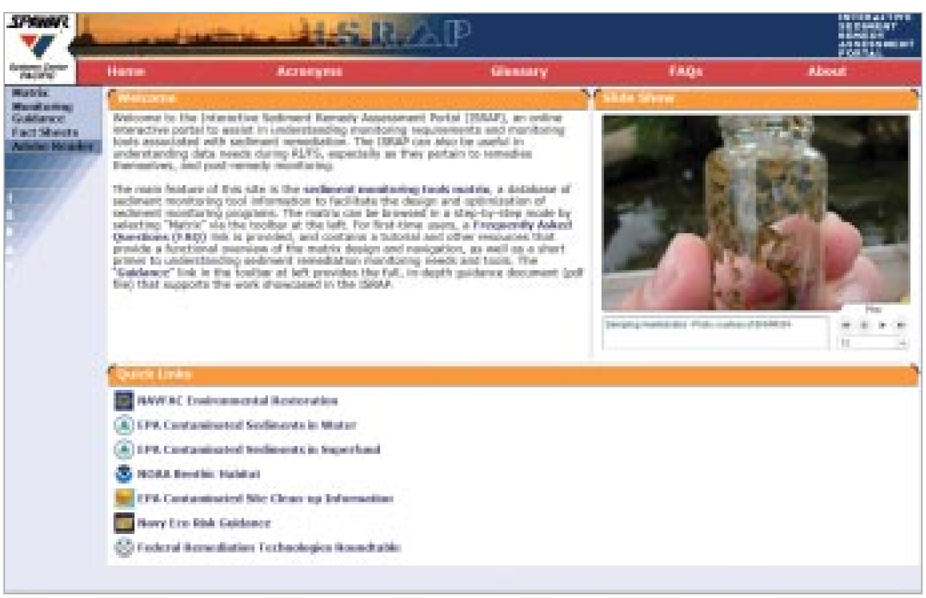
CONTAMINATED SEDIMENT IS an ongoing problem on military bases around the world, and the effort to clean it up has been anything but clear-cut. But, thanks to the Navy Environmental Sustainability Development to Integration (NESDI) program, a new web site is about to make the process a little easier. The Interactive Sediment Remedy Assessment Portal (ISRAP) is now available to help site managers select an appropriate remediation and monitoring plan for sites that have been identified as contaminated.

Background

Over the last several years, increased environmental scrutiny has led to the identification of numerous contaminated sediment sites in coastal areas of the United States. The Navy and other Services have been faced with the challenge of safely remediating these sites.

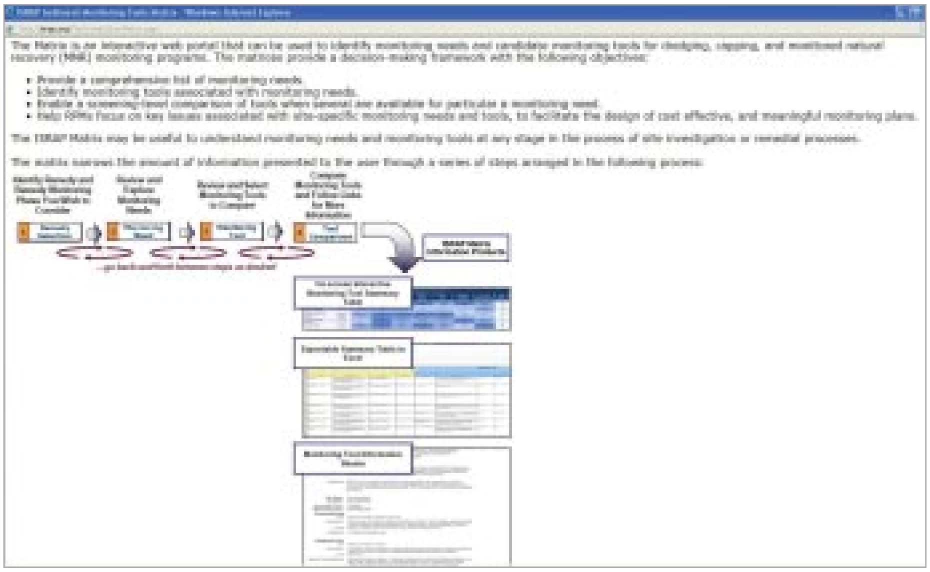
Based on more than 200 identified sites on Navy property, the estimated cost to complete remediation of the contaminated sediments is more than one billion dollars—and this does not include the costs associated with post-remediation monitoring efforts.

Post-remediation monitoring is necessary because little is known about the long-term effectiveness of most of the remediation methods used. However, site owners that have spent millions of dollars on sediment remedies are reluctant to spend even more money on a monitoring program that may last decades longer. Of the relatively few sites where remedies have been implemented, the limited monitoring data gathered has provided little information regarding the long-term effectiveness of the method or methods used. Even among U.S. Environmental Protection Agency (EPA) Superfund sites that have undergone remedy implementation, short- and long-term monitoring data are often insufficient to fully evaluate the effectiveness of the remedy in meeting the remedial action objectives (EPA,



ISRAP is now accessible to anyone at www.israp.org.

2003a). In addition, the cost of monitoring at these sites varies widely due to differences in scope, magnitude, and duration of monitoring plans, thereby making it difficult to project potential costs at other sites.



With the ISRAP Matrix, users can identify the monitoring needs and associated tools that best suit their needs.

Selecting an appropriate containment strategy and monitoring its effectiveness is a complicated task in the marine environment. For instance, one of the most frequent containment strategies is capping, or placing a layer of clean material over the contaminated sediment. In the marine environment, capped sediments can be disrupted by currents, tides, and winds. This initiates concerns about a method's long-term effectiveness. Standard sediment and water sampling techniques are inadequate for this type of monitoring, as they pose the risk of disturbing the integrity of the cap. In addition, conditions such as erosion, future hydrodynamic events, changes to site use and various background factors can impact the remedy.

Working Toward a Solution

Because remedy performance, monitoring requirements and risk reduction are not well understood, and because long-term monitoring can be a major financial burden, the NESDI program identified a need for better monitoring strategies and sensors. Working with input from the EPA, the U.S. Army and industry, the NESDI program sponsored the development of a set of standardized assessment and monitoring protocols to validate the effectiveness of remedial technologies.

Personnel from the Space and Naval Warfare Command—Systems Center Pacific were tasked with providing guidance on this issue. Working in partnership with Environ International Corporation, they developed an interactive solution now known as ISRAP. This portal provides a general framework for sediment remedy modeling, constructed and populated with a variety of possible monitoring needs and tools to address those needs.

At the heart of the ISRAP site is the matrix, an interactive tool designed to assist Remedial Project Managers (RPM) in selecting appropriate remediation methods, understanding monitoring requirements, and pairing them with effective monitoring tools. The matrices build on the first four steps of EPA's Monitoring Framework Steps (EPA, 2004). By using the matrix to identify monitoring needs and investigate monitoring tools associated with those needs, RPMs can more easily identify monitoring plan objectives and appropriate monitoring tools.

Macroinvertebrate sampling is one way to evaluate remediation effectiveness.

Environ

The process of coring is used to obtain a vertical sediment profile. Coring is used to determine whether there has been any chemical movement through a cap.

The matrices provide a decision-making framework with the following objectives:

- Provide a comprehensive list of monitoring needs
- Identify monitoring tools associated with each monitoring need
- Enable a screening-level comparison of tools when several are available for a particular monitoring need
- Help RPMs focus on key issues associated with site-specific monitoring needs and tools, to facilitate the design of cost-effective and meaningful monitoring plans.

ISRAP can also be useful in understanding data needs during Remedial Investigation and Feasibility Studies, especially as they pertain to remedies themselves, and post-remedy monitoring.

Types of Remediation

In addition to controlling the source of contaminants, there are three common forms of remediation: dredging relies on mass removal of sediment to achieve risk reduction; capping involves burial and creation of a clean sediment surface; and Monitored Natural Recovery (MNR) relies on natural physical, biological and chemical processes to remove or reduce risk. MNR is often chosen in cases where immediate risk factors are relatively low—however, it may also be chosen in instances where active remedies will further disturb the sediment; exposing workers, the community and the environment to even greater risk.

Remediation Monitoring

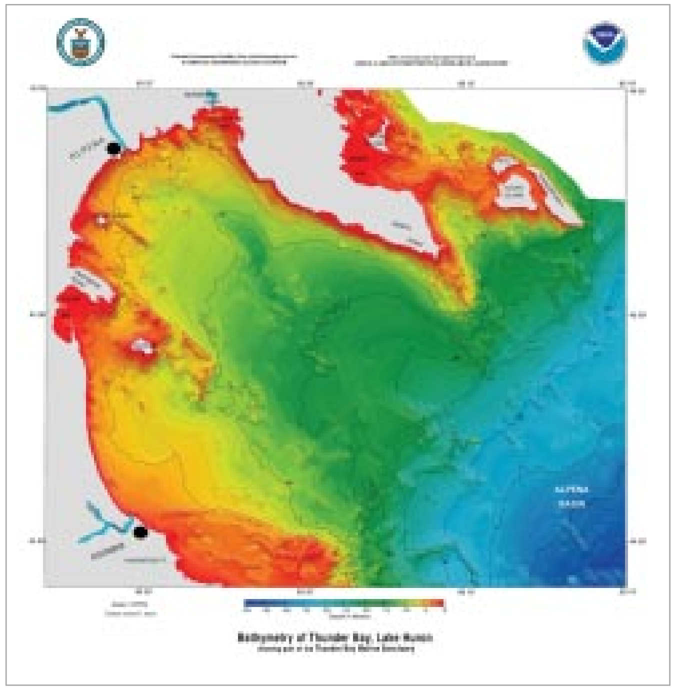
While currently there are only three major remedies for managing risk from contaminated sediments, there are significantly more approaches to remediation monitoring. While monitoring methods can be broadly categorized as physical, chemical or biological measurements, many different types of testing and monitoring fall under these umbrella terms. For example, physical testing may include measurements of sediment erosion or deposition, ground water advection, surface water flow, and physical characteristics of the sediment (e.g., particle size distribution, porosity, organic carbon content), and sediment heterogeneity. The RPM must decide which data he or she needs and how best to go about getting them.

Using the Matrix

The ISRAP web site provides some basic information on various remediation techniques. Once a technique has been chosen, the RPM can use the matrix for assistance in formulating a monitoring plan. The user first inputs the chosen remediation method, then selects one of three monitoring phases: construction, performance or remedial goal.

The construction phase deals with attainment of design criteria and assessment of construction and operations activities. The performance phase attempts to answer the question: Is the remedy mechanism performing as designed? The remedial goal phase addresses whether the remedy achieved its goal of risk reduction.

If a manager selects dredging, for example, and wants to explore the construction phase, he or she is presented with ten monitoring needs, along with a description of each, a discussion of the timing and frequency required. Each monitoring need will have one or more monitoring tools associated with it. For instance, in the dredging example, downstream deposition is one of the monitoring needs. This can be achieved through current velocity measurement, sediment chemical analysis, sediment profile imaging, and/or sediment traps. In most cases, not all of these tools will be required to satisfy each need. The matrix describes each tool and provides information on special considerations to enhance the decision-making process. For each tool selected, information is also provided on factors such as spatial and temporal complexity, the level of expertise required to provide and interpret data. In this way, users can compare tools and select those most appropriate for their purposes.



Bathymetry modeling is used to evaluate sediment stability over time, navigable depths, bottom surfaces for remedy design, and post-remediation bottom elevations.

National Oceanographic and Atmospheric Administration

A Case Study

The Puget Sound Naval Shipyard (PSNS) in Bremerton, Washington is a 1,350-acre site that serves as a home port for Navy vessels, including aircraft carriers. In 2000, PSNS was identified as a site in need of remediation due to high levels of polychlorinated biphenyls (PCB) and mercury in fish tissue in near-shore waters. This posed an unacceptable risk to human health.

Remediation at PSNS was accomplished through a combination of dredging, capping and MNR.

Approximately 200,000 cubic yards of sediment containing PCBs was dredged and disposed of in confined aquatic disposal (CAD) cells, located on Navy-owned submerged land. These sediments had PCB concentrations which exceeded the EPA's remedial action objectives. Capping remedies were applied to isolate impacted sediments in a 13-acre area and in the submerged CAD cells. For intact sediments, both thick and thin layer caps were used. Thin layer caps (a minimum of 20 centimeters) provided a layer of clean sediment to mix with underlying sedi-

The Basics About the NESDI Program

THE MISSION OF the NESDI program is to provide solutions by demonstrating, validating and integrating innovative technologies, processes, and materials; and filling knowledge gaps to minimize operational environmental risks, constraints and costs while ensuring Fleet readiness. The program seeks to accomplish this mission through the evaluation of cost-effective technologies, processes, materials and knowledge that enhance environmental readiness of naval shore activities and ensure they can be integrated into weapons system acquisition programs. The NESDI technology demonstration and validation program is sponsored by the Chief of Naval Operations Energy and Environmental Readiness Division and managed by the Naval Facilities Engineering Command. For more information, visit the program's web site at www.nesdi.navy.mil.

ments, thereby facilitating natural recovery. In some areas, a three-foot-thick cap was placed first, and combined with a thin-layer cap to help promote natural recovery. A thick-layer cap was added as needed to isolate sediment, withstand erosion, and provide a clean surface for improved ecological habitat. The CAD cells containing dredged material were capped with a thick layer of clean import material.

Natural recovery was assumed to be a key remedial strategy in thin-layer capping. In addition, full MNR was selected in other locations—the goal being the natural chemical transformation (mineralization) of PCBs rather than physical isolation.

Rating the Remedy

The ISRAP matrices were not yet available for use at PSNS, but a retrospective comparison of identified monitoring needs and tools provided useful information. The actual monitoring plan was compared against a hypothetical plan constructed with the help of the matrix. While in many cases, the tools chosen by the matrix were the same as those successfully employed at PSNS, there were other instances where needs or tools identified on the ISRAP site had not been addressed at PSNS. For example, during the dredging construction phase, one of the identified monitoring needs was ecotoxicological risk monitoring. Of the six monitoring tools associated with this risk, only water column monitoring was chosen. This form of simple chemical analysis usually overestimates toxicological risks. It was later determined that toxicity testing would have been useful in evaluating ecotoxicological risk. This method uses water column and/or sediment samples to assess chemical effects on growth, survival and/or reproduction in representative pelagic and benthic species.

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Expert Input

The current version of ISRAP represents reviews of ten technical peer reviewers and five potential end users. Experts from the EPA, Navy, industry and U.S. Army Corps of Engineers provided written comments on specific technical issues. The ISRAP was also presented at numerous venues during 2007-2009 and additional verbal comments affected the development of the site. Going forward, ISRAP will be updated as needed with technical information.

ISRAP is currently available and accessible to anyone at www.israp.org. In addition to the matrix, the site contains the full guidance document providing an overview on remediation techniques as well as their associated monitoring tools plus links to related documents and web sites. ⚓

The tool comparison function of the ISRAP web site aids the decision-making process by offering a quick side-by-side comparison of selected monitoring tools.

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