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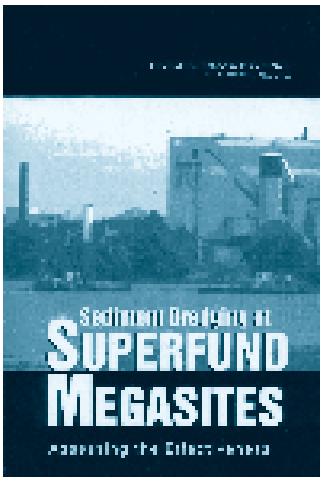

Sediment Dredging at Superfund Megasites: Assessing the Effectiveness
NATIONAL RESEARCH COUNCIL
Published by the National Academies Press, Washington DC. 2007. 316 pages.

The U.S. National Research Council (NRC) published its report on *"Assessing the Effectiveness of Dredging Superfund Megasites"* in 2007, which summarises the findings of an NRC committee charged with conducting an independent evaluation of the effectiveness of dredging contaminated sediments at large Superfund sites. In general, the report does a good job of providing a concise overview of the various aspects of remedial dredging projects and presents some useful conclusions and guidelines. The report tries to provide an objective analysis of the data available from major contaminated sites in the United States, acknowledging that most sites are data limited in that either data was never collected or made available to the public.

The summary at the beginning of the book provides a well-founded set of conclusions and recommendations that are useful for regulators and responsible parties contemplating remedial dredging. The rest of the report is organised as follows: Chapter 1 provides a good review of the issues surrounding contaminated sediment sites. Chapter 2 outlines overall concepts of sediment management at Superfund sites (including a discussion of the Superfund process, an evaluation of risks in contaminated sediments, and an impression of remedial dredging, its effectiveness and the technical challenges). Chapters 3 and 4 discuss the evaluation framework (for remedial dredging projects) and the lessons learned from these sites. Chapter 5 presents an objective analysis of monitoring approaches and practices, and suggests approaches to improve monitoring. Finally, Chapter 6 provides some recommendations on improving future decision-making aspects of contaminated sediment dredging projects in a Superfund context. Appendix C of the report is a useful compendium of major sediment sites and lists Remedial Action Objectives (RAOs), clean up levels (Numerical Remedial Goals) and their overall effectiveness/performance at those sites.

The committee evaluated "megasites" or sites where the total clean up cost is expected to exceed US$50 million. Accordingly, the committee considered eleven NPL (National Priorities List) sites and three Non-NPL sites. The committee concluded that while dredging is a good tool for mass removal, it appears that it has encountered systematic difficulties in achieving specified clean up levels. Long-term monitoring data appear to be generally lacking for any meaningful long-term trends analysis.
A powerful method would have been to evaluate long term-system recovery trends in the absence of dredging and compare it to the case post-dredging. Interestingly, not many sites have even contemplated such a systems-wide approach to evaluating remedial effectiveness. One recommendation of the report is that the US Environmental Protection Agency (EPA) take steps to ensure that adequate monitoring is conducted at all contaminated sediment sites to evaluate remedial effectiveness. This would be a valuable tool to plan future sediment management decision-making processes.

The committee noted that remedies should be designed to meet long-term risk-reduction goals, and not necessarily focus on other criteria not strictly related to risk, such as mass removal. Since most dredging projects are aimed at achieving mass reduction in some sense or other, the dilemma and debate about whether mass removal is an appropriate target continues. The committee's evaluation of surface concentrations prior to and following dredging was somewhat inconclusive, i.e., some sites showed increases, some showed decreases and some had no significant changes. However, the committee did find that dredging alone achieved the desired clean up goals in only a few of the 26 projects it evaluated: At most sites, capping or a post-dredge cover was needed to bring the surface concentrations in compliance with the clean up goals. Further, the committee noted that environmental conditions that limit the effectiveness of dredging should be fully evaluated before a decision to dredge

is made. This makes sense as some of the most inefficient remedial dredging projects have occurred under conditions that are not ideally suited for dredging to begin with – such as hard rock and shale beds, fluid bed layers, sediment interlaid with debris and high flow/current conditions.

One limitation of the report is that it only considers dredging as a stand-alone remedy, with mass removal apparently being the objective. The value of the report would have been increased tremendously had the committee ventured to provide analyses and summaries pertaining to efficiencies of dredging:
a) as related to other remedies such as Monitored Natural Recovery (MNR) and capping; and
b) addressing the effectiveness of dredging as part of a hybrid remedy scenario (i.e., one or two passes of dredging followed by a sand cover or an engineered cover). While that was no doubt beyond the charge of the committee, it leaves the decision process somewhat muddled as no clear-cut analyses on such scenarios have been performed by a national body with the stature of the NRC.

Another aspect where the report could have provided useful direction was in the remedial action monitoring area. An effective monitoring process should aim to determine if the assumed relationship between the clean up levels in the Record of Decision (ROD) and the remedial action objectives (RAOs) have been achieved. While such data may not determine remedy effectiveness, it would help verify the underlying assumptions of the clean up level-exposure relationships, and thus help inform the long-term monitoring and review/re-opener scenarios during USEPA process, as well as help in developing future sediment management decisions.

The committee concluded that dredging, in the context of mass removal, may be effective, but it may present surface contamination issues that will need to be handled some other way – such as through a post-dredging cover or cap. The committee seems to advocate the use of pilot studies where possible for identifying adverse site conditions and logistic problems. However, a pilot study should be undertaken with appropriate conditions that are either comparable to full scale application, or can be easily scalable to the full-scale application. Otherwise, it would not be a true "pilot" and thus will be unable to replicate the same process-related choke points. Several recommendations are provided for future management of sediment sites, including carefully planned pre-remedial baseline monitoring in order to facilitate comparisons with post-remedial data; during and post project monitoring to evaluate effectiveness; planning, evaluation and adaptive management based on monitoring data; and research to develop rapid field monitoring techniques to make real-time adjustments as needed. Perhaps the committee's most useful observation is that contaminated sites should be evaluated using the principles of adaptive management – particularly for sites where there is a large degree of uncertainty regarding contaminant distribution and the effectiveness of remedial technologies. This includes a tiered remedial approach, where the least conservative (yet, environmentally effective) remedy is implemented first, followed by a robust monitoring programme, with triggers that may move it towards a more conservative remedy if certain threshold effectiveness criteria are not met through monitoring.

Another aspect the report notes is the increasing popularity and utility of hybrid remedies – a concept where dredging is typically undertaken to address hot spots (or areas with higher chemical concentrations) or other specific needs (such as navigation or habitat restoration), followed by backfilling, capping or habitat creation or restoration.

The report advocates a risk-based clean up decision-making process, with due consideration of the 4Rs of dredging – ie., residuals, resuspension, releases and risks. While the report intended to review only "megasites", they also reviewed several smaller projects (mainly because of the volume of sediment remediation resulting in multiple years of dredging). The report rightfully concludes that a "basin-wide" cleanup goal is essential to effective environmental remediation. This approach, plus the adaptive management concept mentioned earlier, makes a phased remedial approach ideal for remediation of such contaminated megasites. That way, lessons learned from the initial years can be applied painlessly to future years of remedy implementation.

The report is a good summary of publicly available information from a wide range of projects and a good reference for academics, site managers, practitioners and regulators alike.

DR. RAM MOHAN, PE
ANCHOR ENVIRONMENTAL, LLC.