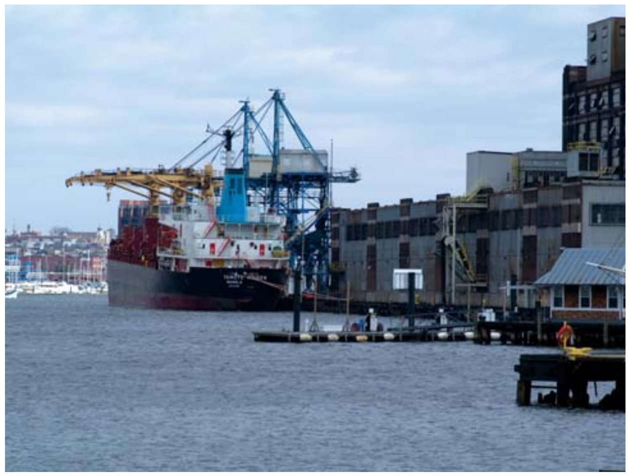
SEDIMENT IN BALTIMORE HARBOR

SUMMARY OF AN INDEPENDENT REVIEW • A TECHNICAL BRIEF



Ocean-going ships bound for Baltimore need as much as fifty feet to stay afloat. This can be a challenge in the shallow Chesapeake, where sediments regularly settle into channels. Without constant dredging, all the channels approaching and within Baltimore harbor would fill, and deep-draft ships would run aground.

For many decades, it's been important to keep those channels open. A maritime hub since Colonial times, the Port of Baltimore in 2008 moved approximately 33 million tons of freight cargo through its public and private marine terminals — cargo valued at more than $45 billion. The port produces $1.9 billion in business revenue annually and spins off about $400 million a year in state, county, and municipal tax revenues. All the jobs and revenue generated by the Port provide a powerful motivation to keep the shipping channels open.

To do this, every year the Maryland Port Administration oversees the dredging of some 4.5 million cubic yards of sediment. About 1.5 million cubic yards come from harbor channels inside the Patapsco. If that were concrete, those 1.5 million cubic yards could form an 8-foot wide, 4-inch thick driveway from Baltimore to San Francisco. Every year.

New Uses for Dredged Materials

Deciding what to do with all that sediment has proven a tough challenge. Concerned with potential impacts on water quality in the Chesapeake Bay, in 2001 the Maryland legislature passed the Dredged Materials Management Act — a law that prohibits the disposal of sediment dredged from Baltimore harbor into the Bay's open waters.
The law defines harbor sediment by drawing a line across the mouth of the Patapsco, from North Point (near Fort Howard Park) south to Rock Point (near Fort Smallwood Park). Anything inside that line must be handled in a special manner, deposited, for example, in a contained area such as the Hart-Miller Island containment facility. The law also calls for closing the Hart-Miller Island facility by the end of 2009, creating a sense of urgency for devising new ways to handle harbor sediment.

In a progressive move, the law places more emphasis on beneficial and innovative uses of dredged material. These include such innovative products as commercial building materials and lightweight aggregates. This policy challenges managers to view dredged materials as a resource and not simply as a disposal problem.

But different uses for dredged sediment call for varying levels of environmental safety. Some commercial applications allow for the use of dredged materials that contain defined levels of metals and organic compounds — since some manufacturing processes can reduce or destroy these contaminants. Other applications, such as the use of dredged materials for land reclamation or agricultural soil amendment, require more stringent safety criteria.

The question is, which sediments are contaminated, and to what degree? To answer such questions, the Maryland Port Administration launched a new process to explore the best path for dredging the harbor and for handling all that dredged material.

A Plan for Baltimore Harbor

In 2003 the Maryland Port Administration's Dredged Materials Management Program — a collaborative effort linking state, federal, and community stakeholders — convened a Harbor Team to consider options for the harbor acceptable to the surrounding communities. This group recommended some type of innovative recycling for one third of the 1.5 million cubic yards of sediment dredged each year from Baltimore harbor.

Following this recommendation, in 2006 the Executive Committee of the Dredged Materials Management Program directed MPA to create a special committee to investigate the potential uses of sediment in beneficial and innovative ways. Called the Innovative Reuse Committee, this group of 20 community and industry volunteers spent 14 months devising a set of recommendations, including the evaluation

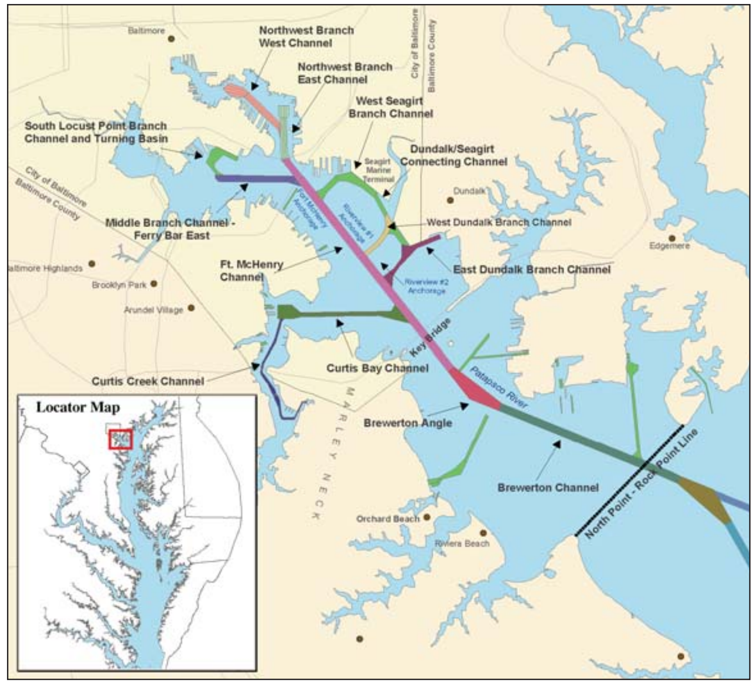
of 12 innovative technologies for sediment reuse. One of their recommendations was to commission a neutral technical review of harbor sediments to determine the suitability of dredged materials from the harbor's shipping channels and surrounding areas for these innovative reuse options.

In response to this recommendation, in 2008 the Maryland Port Administration engaged Maryland Sea Grant and the Chesapeake Research Consortium to organize and facilitate a review of the issues surrounding sediment quality in Baltimore Harbor. Each of these organizations has a long history of science management and technical expertise, and they in turn tapped top experts from around the country to form an Independent Technical Review Team. Comprised of seven scientists and engineers, the team brought extensive expertise in biogeochemistry, sediment contaminants, regulatory criteria, risk assessment, and port operations.

Independent Review of Harbor Sediments

The independent review team took on a series of linked tasks to develop a better understanding of the suitability of harbor sediments for reuse options. Their report, *Sediment in Baltimore Harbor: Quality and Suitability for Innovative Reuse*, provides a foundation for understanding where Maryland fits in the broad picture of sediment management nationwide and a clear picture of potential uses of sediments based on available data. It also provides guidance for future decision making.

To start, the team evaluated how Maryland currently defines acceptable levels for various chemicals in the environment and compared these standards to criteria used around the country. They focused on 20 metals and over 100 organic chemicals currently regulated with respect to exposure — to humans, to wildlife, and to the environment.



Inner Harbor Channels. Map from the "Dredged Material Management Plan" (U.S. Army Corps of Engineers, 2006).

They coupled this review with a detailed analysis of possible risks associated with each reuse option. By tracing the pathways from initial dredging operations, to transport of the dredged material, to processing and final placement, the team identified the "who, what, and where" for risk of contaminant exposure.

Taken together, these analyses enabled the team to develop a screening protocol for evaluating harbor sediments and for determining their suitability for reuse options under consideration. They found that, in most cases, the State of Maryland's criteria were consistent and appropriate for this type of assessment. The exception was for a few metal contaminants (for instance the metalloid, arsenic) where Maryland standards are set below naturally occurring geological background, and for a number of organic contaminants where national standards apply.

The team's screening protocol therefore reflects Maryland Department of the Environment soil classifications. The protocol defines four categories, listed below in order from more to less stringent criteria:

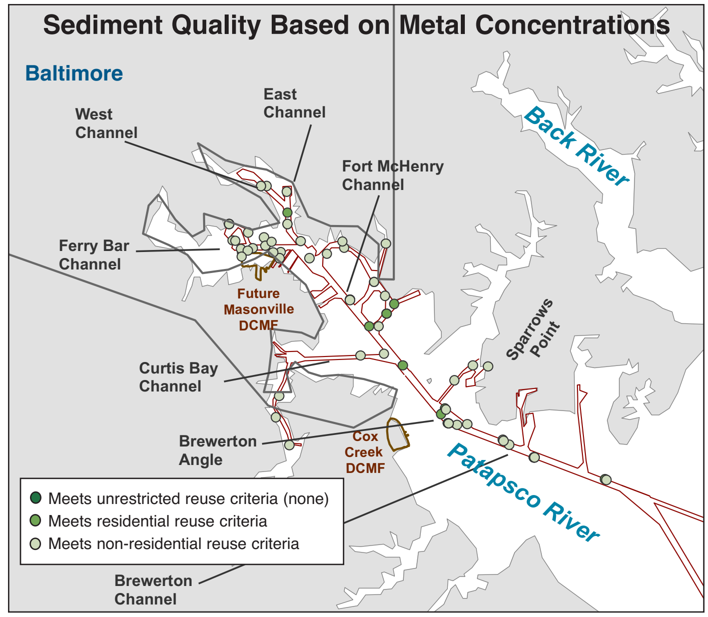
- Unrestricted upland reuse (e.g., agricultural land amendment)
- Residential reuse (e.g., manufactured topsoil)
- Non-residential reuse (e.g., fill for reclaiming industrial mines or pits)
- Material unsuitable for non-residential reuse, or should not be dredged at all

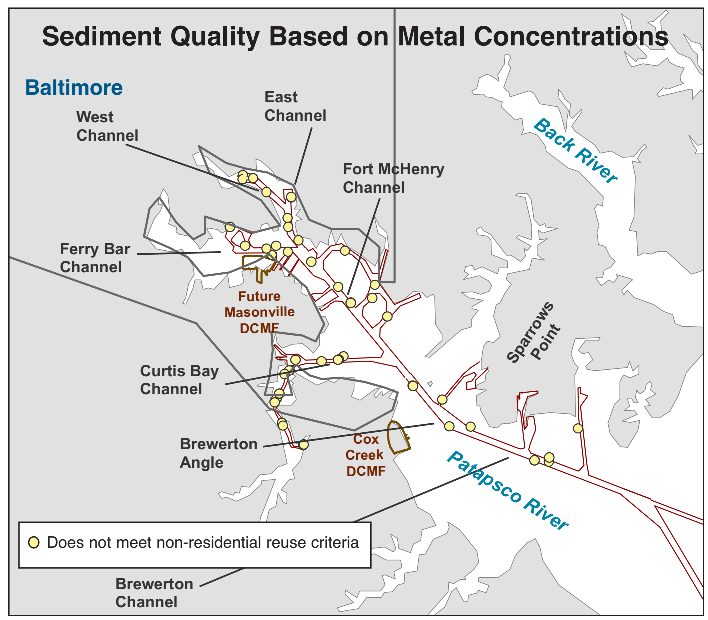
With this template in hand, the team compiled and examined historical datasets obtained from studies of contaminants in harbor sediments. These studies were conducted over a long timeframe by government agencies, the U.S. Army Corps of Engineers, and the academic community. Because analytical technology and project design varied among the studies examined, the team focused on datasets that employed up-to-date techniques and demonstrated sufficient quality control to provide a technically rigorous evaluation. They concluded that there was sufficient data to perform a baseline screening of sediment quality — one that would characterize the potential for innovative reuse from the harbor, the approach channels, and areas adjacent to the channels.

To assess sediment quality, the team examined available metal and organic contaminant data for each location where samples were taken — both inside and outside currently maintained channels. Some sample sites had data for only metals or only organic contaminants, while other sites had both. Based on these data, the team identified which contaminant was present at the highest level, and they used this value to determine the category for each sample site. This information was then displayed on a series of maps to reveal general patterns of contaminant levels in harbor channels and surrounding areas. Since assessments were based on historical data, these patterns represent the potential contaminant status for each location. As managers consider specific locations for sediment reuse options, they must first undertake targeted monitoring and analysis, especially since there can be considerable variability even among nearby sample sites.

Looking to the Future

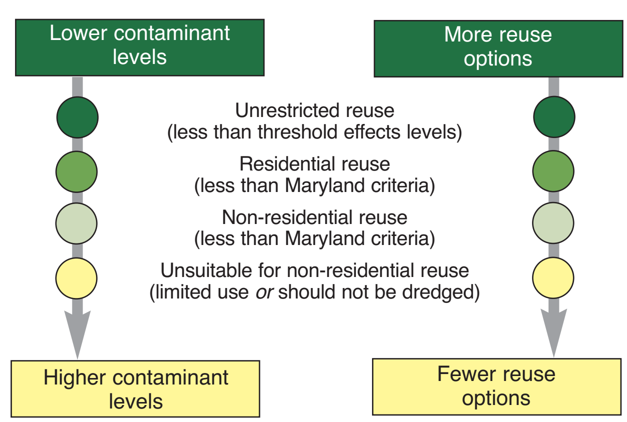
The screening assessment completed by the team provides a foundation for understanding the potential uses of sediments from harbor channels and surrounding areas. Recognizing the limitations of using historical data and the fact that sediment quality can vary over time and from location to location — even over relatively short distances — it is essential to have a clear process for evaluating future dredged material. With this in mind, the team developed a step-by-step protocol to help determine the reuse options available for given dredging projects. The recommended guidance includes consistent application of the team's criteria applied in the context of understanding and minimizing risk. This protocol should provide managers with a durable process for assessing options for innovative reuse — an approach that will create greater value while recycling sediments in environmentally acceptable ways. The report's guidance should help address pressing environmental and economic issues and aid ongoing efforts to maintain a sustainable port for Baltimore.





These maps are examples of the maps generated in this study showing sediment quality in harbor channel locations.

Map Color Key for Dredged Material Reuse Criteria



Findings and Implications

Based on the historical data available for this study, the team concluded that sediments in Baltimore Harbor vary with respect to contaminant levels — the sediment quality in the harbor is not homogeneous. Recognizing that variability can be significant — over short distances and among different locations in shipping channels and around the harbor — the team drew the following conclusions:

- Based on the available data the team found that sediment taken from locations in currently dredged channels is of sufficient quality for a variety of innovative reuse options as specified by the Innovative Reuse Committee. Some sediments in locations outside the channels are contaminated to the point that consideration should be given to leaving them in place.
- The screening protocol developed by the team revealed varying suitability for two types of innovative reuse: residential (e.g., manufactured topsoil) and non-residential (e.g., industrial). Based on the data examined, the team did not find locations that were suitable for unrestricted land amendment (e.g., agricultural).
- Many of the locations sampled met Maryland criteria for non-residential reuse options. These uses include, for example, fill for mines and for sand and gravel pits, and as components in cement filler and lightweight aggregate materials.
- A limited number of locations had sediment quality that met Maryland criteria for residential reuse (e.g., manufactured topsoil, not meant for cropland).
- The team determined that none of the locations sampled met the most stringent criteria for unrestricted upland reuse options (e.g., agricultural land amendment). The review team therefore did not consider land amendment a viable option, both because of contaminants and because of inherent characteristics of estuarine sediments that can impact the integrity and productivity of soils.
- The team found that numbers of locations did not meet criteria for either residential or non-residential reuse. This was especially true for locations outside actively dredged harbor channels.
- These findings have implications for the management of sediments in the future and emphasize the importance of active engagement of all parties as managers consider innovative reuses.

In most cases, Maryland's current soil criteria are sufficient to assess sediment quality. The team noted that in some cases — arsenic is an example — background levels in the environment are often higher than the state's regulatory limits. These limits therefore make it difficult to meet the criteria, thus restricting reuse options. Addressing this regulatory issue will require consultations between the Innovative Reuse Committee and the Maryland Department of the Environment.

Acceptable uses in the residential and non-residential categories cover 10of the options under consideration by the Innovative Reuse Committee. Further feasibility assessments for innovate reuse are therefore clearly warranted.

Variability in sediment quality is an important factor, and managers must carefully consider specific conditions before undertaking channel widening or other projects that would yield material for innovative reuse. Before decisions are made regarding dredging and innovative reuse, any location will require case-by-case, site-by-site testing, risk assessment, and monitoring.

Authors

This technical brief was written by Jonathan G. Kramer and Jack Greer, Maryland Sea Grant.

Acknowledgments

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