Innovative Reuse of Dredged Material

Report to the Executive Committee of Maryland’s Dredged Material Management Program

April 2007
April 12, 2007

To: Executive Committee, DMMP
From: Members of the Innovative Reuse Committee

It is our pleasure to convey to you the report of our analysis, conducted over the past 13 months, of the potential for innovative reuse to become a sustainable part of Maryland’s Dredged Material Management Program.

We recognize the critical importance of finding creative means of managing the sediment dredged every year from Maryland’s shipping channels. We believe our analysis has yielded some useful alternatives that ought to be further explored. We think that opportunities exist now to conduct pilot efforts and we urge you to support doing that. We also believe that as a long-term strategy, innovative reuse makes sense as part of the overall DMMP. We recognize the added costs of innovative reuse but believe that over time increased costs of other options and perhaps, increased efficiencies of reuse options will make innovative reuse costs more competitive. We also believe that Maryland needs to take a fresh look at what strategies are available to reclaim contaminated sediments and to distinguish them from those sediments which are not contaminated. Our report offers recommendations on how to proceed on all these points.

It has been gratifying to us to work on this issue for the past year and we trust that our findings and recommendations will be useful in expanding the options available and improving the Dredged Material Management Program which is essential to keep the Port of Baltimore competitive and thriving.

Robin B. Davidson
George Hanman
Douglas Ditchett
Paul A. Kelly
William C. Morse
Paul P. Severance
Andrew Parker
John E. McKee
Steve W. Sanders

[Signatures]
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EXECUTIVE SUMMARY

After 13 months of study, analysis and discussion, the Innovative Reuse Committee has concluded that there is significant potential to make innovative reuse of dredged material a sustainable part of Maryland’s long range Dredged Material Management Program.

The Committee evaluated twelve potential technologies based on capacity, cost and public and political acceptability. These technologies included:

- Daily cover
- Manufactured topsoil
- Land amendment
- Mines – deep and surface
- Sand and gravel pits
- Brownfields
- Base material
- Bricks
- Compressed blocks
- Lightweight aggregate
- Cement filler
- Flowable fill

This report presents the results of that evaluation and recommends strategic next steps. The Committee makes three policy recommendations as well as implementation recommendations for each of the policy recommendations. Based on the evaluation criteria the Committee engaged in a ranking exercise that selected mines, flowable fill, sand and gravel pits, and land amendment as the most highly favored technologies for implementation.

The three policy recommendations are:

1. The MPA and its DMMP partners should consider implementing at least one pilot or demonstration project within the next 12-24 months, taking into consideration targets of opportunity for available technologies.

2. The MPA and its DMMP partners should develop an implementation strategy, consistent with existing dredging plans, for the innovative reuse of dredged material from public and private dredging projects.

3. The State of Maryland should conduct a broad review of its policies and regulations affecting dredging.

The report, which follows, summarizes the technologies currently available for reuse of dredged material. It provides an assessment of the applicability of each technology in Maryland and describes some of the constraints which presently exist. It suggests specific avenues for further investigation and encourages all the partners in the State’s Dredged Material Management Program to move forward carefully but expeditiously to make innovative reuse a reality in Maryland in the near future.
Chapter One: INNOVATIVE REUSE & BALTIMORE HARBOR

Commercial maritime Baltimore Harbor forms the hub of the Port of Baltimore. The 50 foot southern approach channel runs up the Bay into the Patapsco River and the Port, allowing for deep draft access to the Port’s many terminals. Both public and private terminals exist side by side in the harbor and depend on continual channel maintenance dredging performed by the Corps of Engineers. The Port is irreplaceable to the economy of Maryland.

The Maryland Port Administration (MPA) estimates that on average 1.5 million cubic yards of material needs to be removed each year from harbor channels, anchorages, and berths (Box 1-1). Since 1984 that material has been deposited at Hart Miller Island (HMI), owned and operated by the MPA. When it is filled in 2009, HMI will contain approximately 100 million cubic yards of dredged material. The MPA in the meantime is developing plans for facilities that can replace HMI. A new facility at Masonville is slated to begin receiving material in calendar year 2009, and along with the existing Cox Creek Dredged Material Containment Facility (DMCF) will provide near-term placement capacity for the MPA and the Corps. Other placement sites are being studied for future utilization.

Over the long term, however, it has become apparent that Maryland needs to find more creative ways to manage the sediment dredged from its shipping channels. Regarding this material as a recyclable resource and looking for ways to reuse it for a beneficial purpose has become a high priority for Maryland’s Dredged Material Management Program (DMMP).

In 2004 MPA sponsored a forum on innovative reuse technologies. This forum brought together business people with ideas about how to address problems related to managing dredged sediment, and it highlighted case studies of previous attempts to implement innovative reuse. One of the recommendations of the forum was a call to create a committee charged to look in depth at the opportunities and issues from a Maryland perspective.

The Executive Committee directed the MPA to appoint a Committee on Innovative Reuse to address challenges facing the implementation of innovative reuse of dredged material in Maryland (Box 1-2). This directive stemmed from the 2003 recommendation of a committee called the Harbor Team that the State should aim to manage 500,000 cubic yards (cy) of Baltimore Harbor dredged material through innovative reuse by 2023.

The Harbor Team suggested specific innovative reuse possibilities including mines and quarries, reclamation, innovative reuse at the Cox Creek facility, landfill usage, use in aggregates, bricks for construction and walkways, and agricultural use. The Innovative Reuse Committee has evaluated all these technologies.
Box 1-1 Baltimore Harbor Channels, Anchorages and Terminals
Box 1-2 Committee Members

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<tr>
<th>Name</th>
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<tr>
<td>Bob Agee</td>
<td>Maryland Aggregates Association</td>
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<td>Torrey Brown</td>
<td>Intralytix, Inc.</td>
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<tr>
<td>Lee Connor</td>
<td>John S. Connor, Inc.</td>
</tr>
<tr>
<td>Robin Davidov</td>
<td>Northeast Maryland Waste Disposal Authority</td>
</tr>
<tr>
<td>Joe DiCara</td>
<td>Dept. of Business and Economic Development</td>
</tr>
<tr>
<td>Betty Dixon</td>
<td>Anne Arundel County Government</td>
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<td>Heather Hamilton</td>
<td>Chamber of Commerce</td>
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<td>George Harman</td>
<td>Department of the Environment</td>
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<td>J. B. Jennings</td>
<td>House of Delegates</td>
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<td>Carolyn Jones</td>
<td>Greater Dundalk Alliance</td>
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<tr>
<td>Paul Kelly</td>
<td>Den-El Transfer, Inc.</td>
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<tr>
<td>Bill Kilby</td>
<td>Cecil Land Trust</td>
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<td>Steve Landess</td>
<td>Rukert Terminals</td>
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<tr>
<td>Mary Marsh</td>
<td>Maryland Conservation Council</td>
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<td>Jeffrey McKee</td>
<td>US Army Corps of Engineers, Baltimore District</td>
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<td>Karen Montgomery</td>
<td>House of Delegates</td>
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<tr>
<td>William Muir</td>
<td>U. S. Environmental Protection Agency, Region III</td>
</tr>
<tr>
<td>Andrew Parker</td>
<td>Engineering Consultant</td>
</tr>
<tr>
<td>Paul Petzrick</td>
<td>Department of Natural Resources</td>
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<td>Doug Scott</td>
<td>Department of Agriculture</td>
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<td>Paul Swensen</td>
<td>Moran Towing</td>
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<td>Mary Roe Walkup</td>
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<td>Robert Yarlott</td>
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MPA has also pursued the Harbor Team’s recommendations to further study three potential Baltimore Harbor placement sites including BP Fairfield, Sparrows Point, and Masonville, the site selected first for construction. In considering Masonville, federal and state regulatory agencies have indicated that future DMCFs likely will not be permitted if the construction plans include the filling of significant areas of open water. This means evaluation of innovative reuse of dredged material from the Baltimore Harbor channels has become a more urgent priority.
The Innovative Reuse Committee’s tasks were to address technical feasibility of implementing known technologies in Maryland; and to examine transportation issues, community concerns, environmental issues, available markets, funding sources, and potential implementation models. Additionally, the Committee was asked to develop consensus-based decisions and recommendations regarding innovative reuse opportunities for MPA to pursue; and provide this advice within one year to the MPA. In order to accomplish these tasks, the Committee met regularly between March 2006 and April 2007. Information from each of these meetings including meeting summaries and presentations is available in Appendix A.

The Committee began its work with briefings on innovative reuse technologies. The wide range of perspectives and experience represented on the Committee led to valuable and thoughtful dialogue. The Committee gained perspectives from a variety of experts who talked about important aspects of developing an innovative reuse program. It studied how other states have handled dredged material and looked for models that may have applicability in Maryland. It considered how the implementation of innovative reuse would potentially affect various stakeholder groups as well as the communities in which sites may be located. It compared the estimated costs of innovative reuse with the actual costs of present dredged material management options. Finally the Committee considered the long-range implications for the Port of Baltimore if current placement sites are exhausted and no new sites or management techniques are developed to replace them.

This report describes what the committee accomplished in its first year of work, and suggests a direction for the MPA and its DMMP partners in order to move the concept of innovative reuse closer to implementation.

**Sediment Quality and Environmental Concerns**

All of the innovative reuse technologies the Committee studied raised questions about the quality of sediments being dredged from Baltimore Harbor. For some technologies only clean sediments are acceptable for the intended use. For others, proper conditioning and/or processing would make them acceptable.

The Maryland Department of the Environment (MDE) has monitored both ambient water quality and sediment quality in the harbor for years, and has noted elevated levels of a variety of potentially harmful chemicals as well as nutrients in both the water column and in sediments. In fact, TMDL’s (Total Daily Maximum Loads), a requirement of the Clean Water Act for water bodies considered impaired by one or more pollutants, have either been developed or proposed for various pollutants in the harbor. MDE has produced maps of its data indicating locations and relative levels of various substances known to impair either sediment or water quality. These maps can be found in Appendix B.

While there is no doubt that areas of the harbor are impaired, monitoring conducted by MDE, MPA, and the Corps of Engineers definitively and repeatedly show that maintenance material
dredged from the Harbor navigation channels have levels of contaminants that are often similar to those of the open Chesapeake Bay. This has been partially explained as a function of years of continuous dredging which has long since removed many of the legacy contaminants. The relatively benign nature of channel maintenance material can also be partially explained by the three-tiered or layered pattern of water flow at the mouth of the Harbor that is established by the temperature and salinity gradients. Typically, water flows into the Harbor at both the top and bottom and out through an intermediate layer. Both the top layer containing sediments from the Susquehanna River inflow and the bottom containing sediment from the Bay contribute material that tends to accumulate in the channels. Other areas of the harbor and its tributaries that are not routinely dredged or flushed remain degraded with persistent contaminants. When the occasion arises for these areas to be dredged, greater care is required in managing the use or placement of the sediments.

Because of the general public’s perception that all sediments in Baltimore Harbor are contaminated, the Maryland General Assembly, in 1975, established in law that any material dredged from the harbor westward of a line extending from Rock Point to North Point must, in essence, be deposited in a contained facility like HMI. This law provided comfort to those concerned about contamination in harbor sediments. It also posed no particular problem to the MPA as long as the site at HMI was available. Now that HMI is nearing the end of its operational life for dredged material placement (end of 2009), the MPA is under tremendous pressure to find new ways to manage harbor sediments.

Many of the categories of end uses that the Committee has evaluated can only be implemented if sediment quality is acceptable for the intended use. So the issue of whether the channel sediments routinely dredged from Baltimore harbor are “contaminated” has become critical. If the sediments are in fact relatively clean, as MDE, MPA, and Corps of Engineers data appear to demonstrate, many options become available and costs for implementation can be greatly reduced. The Committee believes that this issue needs to be resolved with further detailed scientific evaluation, and that an outreach and education effort needs to be mounted with the public to discuss the results of the evaluation and assess potential policy and legislative changes that may be warranted.

**Costs and Capacity**

Most ports, including the Port of Baltimore, have historically depended on relatively low cost placement options – for example, open water placement or construction of large containment facilities. Combined dredging and placement costs were always less than $10 per cubic yard (cy) and frequently less than $5 per cy. As environmental concerns about loss of open water and effects of excessive sedimentation and so forth have grown, acceptable placement options have become more difficult to site and develop, and much more expensive to construct and operate. The Port of New York New Jersey, for example, has been spending over $50 per cy to process and dispose of its dredged material for at least the past decade. The Committee, in reviewing potential ways to reuse dredged material, was cognizant of the added cost and concerned about
the economic burden this would place on taxpayers who support the Corps of Engineers and MPA dredging projects, and on private terminal operators who are responsible for their own maintenance dredging.

The Committee was also concerned about finding options that provide adequate material placement capacity, realizing that the most cost-effective options likely are going to be those that have the capacity to handle large quantities of dredged material over a period of many years. The Committee also recognized that there may be opportunities to handle the larger volumes of dredged material by combining several small volume technologies.

Both federal and state Dredged Material Management Plans require that capacity be available to handle dredged material for 20 years into the future. This future capacity is critical to the shipping industry, which desires to establish long-term relationships with preferred ports, and will not do that unless ports can guarantee access channels will be maintained.
Chapter Two: TECHNOLOGIES AND METHODS

The Committee began its work by considering all known and proposed methods to reuse dredged material. It eliminated those that had never been attempted or demonstrated anywhere, and investigated those with a demonstrated track record. The Committee’s objective was to learn how technologies that had been tested elsewhere might be applied to Baltimore Harbor sediments. The Committee also recognized that new applications are likely to emerge in the future, and encourages MPA to be vigilant about new ideas that may lower the cost, provide additional benefits or handle greater quantities of material. Meanwhile, in the short term, the innovative reuse methods likely will be drawn from the list of technologies the Committee reviewed.

**Dewatering**

The first step in processing material for innovative reuse is generally dewatering of the dredged material. Most of the innovative reuse technologies evaluated will require dewatering of material during some stage of processing or placement. This step can add significantly to cost and requires space and facilities, so it became an important consideration in the Committee’s deliberations. The volume will be reduced as moisture is separated from the material and thus reduce transportation costs. Options involving truck or rail transportation will demand dewatering prior to loading and shipment. Options involving barge transportation from the point of dredging to the final placement site will not require dewatering prior to transport. Presently, the Cox Creek DMCF is the proposed site for a processing facility for dewatering and stockpiling dredged materials for innovative reuse. Cox Creek presents distinct advantages to MPA for these reasons: the facility is owned by MPA; land is available to stockpile and process material; and operating permits are in hand and modifications can be obtained. A technical study group has evaluated several different alternatives and site modifications for processing and stockpiling dewatered dredged material at the Cox Creek DMCF. Depending on how much material MPA ultimately decides to recycle, it is possible that another facility in addition to Cox Creek would be needed in the future. But for the short term, Cox Creek provides placement space to dry, recover, and process the dredged material, and transport the end use product. Cox Creek also has the advantage of CSX rail spurs onsite as well as being located immediately adjacent to harbor channels.

**Categories of Technologies**

Six general categories of innovative reuse that included fourteen specific technologies were selected for evaluation. Two technologies, landfill liners and tree farms, were eliminated after initial review because of limitations related to material suitability and capacity. The six categories of innovative reuse and technologies that were assessed and compared by the Committee are these:
1. Landfilling
   - Daily cover
   - Landfill liners and caps (eliminated by committee)

2. Landscaping
   - Manufactured topsoil

3. Agricultural Use
   - Land amendment
   - Tree farms (eliminated by committee)

4. Reclamation
   - Mines – deep and surface
   - Sand and gravel pits
   - Brownfields

5. Engineering Fill
   - Flowable fill
   - Base material

6. Building Materials
   - Bricks
   - Compressed blocks
   - Lightweight aggregate
   - Cement filler

The Committee reviewed information from the literature, from industry and from experts. Fact sheets and presentations were prepared for each technology from the information gathered. A summary is presented below for each technology organized by category, describing briefly the “state of the art” and highlighting the potential applicability of each technology in Maryland.

Category #1: Landfilling

Dredged material can be used as a construction material in a landfill operation for liners, daily cover, and capping. It is used as a replacement for common standard construction materials. The technology “landfill liners and caps” was eliminated from further consideration due to a lack of suitability. Landfill liners and caps require very low hydraulic conductivity and thus liners are generally constructed of clay soil or synthetic material. Dredged material generated by MPA projects does not have sufficient clay and thus is generally not suitable for use as liner material.
Technology: Daily Cover

Dredged material can be used as a raw material for producing daily cover for use at landfills. Traditionally, daily cover material is obtained from site excavations completed to provide additional fill space at a particular landfill operation. Dredged material requires conditioning for use as daily cover including screening to remove debris greater than 2 to 3 inches in diameter and dewatering so that the material passes the standard paint filter test to allow both for placement in the landfill and transportation by rail or truck. Portland cement or pozzolanic reagents may be required to dry the dredged material, provide additional strength, and lower the hydraulic conductivity. Furthermore, daily cover is used sparingly to preserve the capacity of the landfill. Therefore, use of dredged material as daily cover has relatively minimal demand. The Committee’s survey of Maryland landfills found that most stockpile their own material for daily cover; therefore this technology appears to have very little capacity to use dredged material unless MPA looks at out-of-state landfills.

Category #2: Landscaping

Dredged material can be processed into topsoil for use in landscaping. The processed dredged material is used as a replacement for natural topsoil, for which there is generally a high demand.

Technology: Manufactured Topsoil

Dredged material can be incorporated as a raw material for producing manufactured topsoil, but it requires significant conditioning and processing for production of topsoil. Screening is required to remove debris greater than one inch in diameter and in some cases smaller. Dewatering is required to minimize spillage during rail or truck transport to the processing facility. The dredged material must generally be amended with additives such as organic matter (yard waste, wastepaper, wood chips, etc.) and biosolids (sewage sludge or animal manure) and composted. Composting provides for the degradation of complex organics and produces a rich soil. Manufactured topsoil in Maryland is generally in demand and it appeared to the Committee that there might be potential to expand the market to include topsoil manufactured with dredged material. Sediment quality would need to meet Maryland environmental standards for use as topsoil. Another area where topsoil may have potential is in highway construction.

Category #3: Agricultural Use

Agricultural use of dredged material is a method of amending poor agricultural soils. The processed dredged material is used to supply organic content and nutrients to deficient soils to increase productivity. Dredged material with the proper amount of fine material can also be beneficial in reducing the percolation rate of rainwater, thus promoting the retention of soil moisture needed by the crops.
**Technology: Land Amendment**

Dredged material can be incorporated as a land amendment to improve the productivity of low organic soils. Dredged material must be conditioned prior to use as a land amendment. Screening is required to remove debris greater than one inch in diameter. Dewatering is required to minimize spillage during rail or truck transport to the placement site. In practice, conditioned dredged material is transported to the site, spread, and incorporated into the soil by rototilling or plowing. Alkalinity (generally agricultural lime) must generally be incorporated in the soil mixture to buffer acid production. On Maryland’s Eastern Shore, a demonstration project on a small scale successfully produced high yields. Much of Maryland’s agricultural land, especially on the Eastern Shore, is sandy and depleted of topsoil, so there is potential to amend it with dredged material. Sediment quality is critical for any land application where food crops will be grown, and public perception will likely be a big hurdle.

**Category #4: Reclamation**

Dredged material can be used during the repairing or reclaiming of land disturbed and/or contaminated by industrial activities. The goal of the process is to restore and/or develop a land area to make it suitable for other uses. Reclamation returns it to a more natural condition, and/or minimizes the potential for contaminant migration. Reclamation technologies evaluated included restoration of mines (coal and hard rock), sand & gravel pits, and brownfields.

**Technology: Mines**

Dredged material can be used as fill material to reclaim mining sites including both underground and surface mines. These are primarily coal mines, but could include mines for metals and other minerals. In practice, dredged material is transported by rail, truck, or possibly part-way by barge from its point of generation to a mine site for placement. For rail or truck transport, the dredged material must be conditioned or treated to remove free water to minimize spillage during transport. The material must generally be screened to remove debris greater than 2 to 3 inches in diameter. The dredged material generally requires further treatment with an alkaline reagent (i.e., Portland cement, kiln dust, fly ash, etc.) to dry the material, provide additional strength, immobilize heavy metals, and buffer acid production from the material or associated with the mine site. The treatment can be conducted prior to transport or after delivery to the mine site. After placement, the treated material generally requires spreading, grading, and compaction. The dredged material is often covered with a layer of topsoil to promote vegetative growth. Demonstration projects have been conducted at mines in Pennsylvania and experimental work has been done at mines in Western Maryland. There is potentially very large capacity and the possibility of mitigating environmental problems such as acid mine drainage is attractive. The cost of transporting large quantities of dredged material to mines far from the Harbor could be an economic impediment, but could potentially be offset by cost-sharing because of the reclamation benefit of the dredged material.
Technology: Sand and Gravel Pits

Dredged material has also been used as fill material to reclaim depleted sand and gravel pits. In practice, dredged material is transported by rail, truck, or barge from its point of generation to a sand or gravel pit. For rail or truck transport, the dredged material must be conditioned or treated to remove free water to minimize spillage during transport. The material must generally be screened to remove debris greater than 2 to 3 inches in diameter. The dredged material generally requires further treatment with an alkaline reagent (i.e., Portland cement, kiln dust, fly ash, etc.) to dry the material, provide additional strength, immobilize heavy metals, and buffer acid production from the material. The treatment can be conducted prior to transport or after delivery to the sand or gravel pit. After placement, the treated material generally requires spreading, grading, and compaction. The dredged material is often covered with a layer of topsoil to promote vegetative growth. A large demonstration project at the Shirley Plantation in Virginia took 600,000 cubic yards of dredged material from the Woodrow Wilson bridge project. Quarries have been identified throughout Maryland with potential to accept dredged material. Capacity seems to be large. Transportation poses a challenge depending on location. Environmental issues include potential for groundwater contamination.

Technology: Brownfields

Brownfield reclamation incorporates the use of dredged material as fill and/or capping material to reclaim historic landfills and other industrial properties. These properties generally have contamination and contaminant migration issues. In practice, dredged material is transported by rail, truck, or barge from its point of generation to the brownfield site. Barge transport is desirable for very large projects to minimize costs. For rail or truck transport, the dredged material must be conditioned or treated to remove free water to minimize spillage during transport. The material must generally be screened to remove debris greater than 2 to 3 inches in diameter. The dredged material must be further treated with an alkaline reagent (i.e., Portland cement, kiln dust, fly ash, etc.) to dry the material, provide additional strength, immobilize heavy metals, and buffer acid production from the material. The treatment can be conducted prior to transport or after delivery to the brownfield site. After placement, the treated material requires spreading, curing, grading, and compaction. The dredged material is often covered with a layer of topsoil to promote vegetative growth or clean structural fill to provide for facility construction. New Jersey has been reclaiming brownfields with dredged material successfully for more than a decade. In Maryland, it appears that the number of known brownfields creates a very limited capacity. However, there may be some private development sites that could serve as targets of opportunities in the future.

Category #5: Engineering Fill

Dredged material is processed and used as fill material in many construction applications. In these technologies, dredged material is used as a replacement for common natural fill materials and thus competes with traditional products. Examples of engineering fill are flowable fill and base material.
**Technology: Flowable Fill**

This technology incorporates the use of dredged material as a raw material for producing flowable fill for use in general construction. It is used primarily as a backfill material around pipes, in trenches cut through roads, under buildings, and other applications where potential subsidence of backfill creates problems. Flowable fill is traditionally produced by mixing a fine aggregate such as sand or fly ash with cement and water. The principal advantage of flowable fill in backfilling is that it does not require compaction and exhibits low shrinkage. Dredged material processed for use in flowable fill is screened to remove debris greater than 0.25 to 0.5 inches in diameter and dewatered sufficiently to allow transportation by rail or truck. It is processed into flowable fill by mixing with sand or fly ash, cement, and water in a conventional truck-mounted rotary mixer that is also used for transport and placement of the fill at the construction site. The total market for flowable fill in Maryland has been averaging about 50,000 cy per year according to the Maryland Ready-Mix Association. At 10% admixture, this would equate to about 5,000 cy of dredged material annually.

**Technology: Base Material**

This technology incorporates the use of dredged material as a raw material for producing base/fill material for use in highway construction. Base/fill material for highway construction is generally obtained from borrow areas in close proximity to the construction site. Natural materials are often used in highway construction without extensive conditioning. They are often spread, moistened by applying water, and compacted. Dredged material requires significant conditioning for use as a base/fill material including screening to remove debris greater than 0.25 to 0.5 inches in diameter and dewatering to produce a soil-like material. Portland cement or pozzolanic reagents are often added to dry the dredged material and provide additional strength. The MD State Highway Administration is currently examining the use of recycled materials, including dredged material, in a number of highway construction applications.

**Category #6: Building Materials**

Dredged material can be processed and used as a raw material for manufacturing end-use building materials such as bricks, compressed blocks, and lightweight aggregate or as an intermediate-use product such as cement filler. In these technologies, dredged material is used as a replacement for common standard raw materials. The manufactured products are sold in the same markets and compete with traditional products.

**Technology: Bricks**

Dredged material has been substituted as a raw material for manufacturing fired bricks for use in construction of buildings and other structures. In practice, dredged material is processed to remove water and screened to remove debris greater than 0.25 inches in diameter. The dredged material is then transported by rail or truck to a brick manufacturing facility where it is further dried and blended with clay/shale (30% to 80%) and then passed through an extruder to form and shape the bricks. The bricks are then dried in a drying oven and finally fired in a kiln. They are
then stored in preparation for distribution. The use of dredged material for manufacturing of fired bricks has been demonstrated on a commercial scale at the Port of Hamburg in Germany, but the cost of the bricks and lack of public acceptance were reasons that the joint venture failed. Brick production in Maryland during 2004 was approximately 228 million standard brick equivalents (SBEs). If this supply were produced using dredged material it would require 305,000 cy of material (cut volume). Manufacturing of bricks from dredged material would saturate and possibly displace the existing market. Also, there is a potential issue with public acceptance of the bricks.

Technology: Compressed Block

This technology incorporates the use of dredged material as a raw material for manufacturing compressed earth blocks for use in construction. Compressed blocks have been used for centuries, often manufactured by hand, and are still used predominantly in rural areas in developing countries. In practice, dredged material is conditioned to remove free water and screened to remove debris greater than 0.25 inches in diameter. The dredged material is then transported by truck to the site where the compressed blocks are manufactured. It generally must be blended with sand and clay, and then a binder (lime and/or Portland cement) is added. The mixture is then processed using an extruder to form and shape the blocks. The blocks are then allowed to dry and harden. Since they are typically air dried, the manufacturing process is more compatible with an arid environment. There is probably no market in Maryland for compressed blocks made from dredged material. Public and environmental acceptance would be difficult to obtain.

Technology: Lightweight Aggregate

This technology incorporates the use of dredged material as a raw material for manufacturing lightweight aggregate for use in manufacturing building products such as concrete and concrete masonry, and in geotechnical applications such as a fill material. In practice, dredged material is screened to remove debris greater than 0.25 to 0.5 inches in diameter. Next, it is dewatered using polymer addition and filter pressing to produce a filter cake. The dredged material is then transported by rail or truck to a lightweight aggregate manufacturing plant where it is further dried (<5% moisture), ground, mixed with up to 30% ground shale and bloating agents in a pug mill, processed into pellets (0.5 inches in diameter and 1 inch in length) using an extruder, and fired in a kiln at 1922° to 2012°F. Demand for LWA exists in construction. However, markets in Maryland would have to be established and the particular type of LWA that would be produced from the dredged material would need to be evaluated for compatibility with construction methods.

Technology: Cement Filler

Dredged material can be substituted as a raw material for manufacturing Portland cement. The use of dredged material in the manufacture of cement has been proposed using two techniques. The first process technique involves firing of processed dredged material in a specially designed process kiln to produce clinker (Cement-Lock Ecomelt). The clinker is then ground to produce a powder that is mixed with cement as filler. The second process technique involves the
introduction of processed dredged material as a raw material along with other traditional raw materials into a traditional kiln at a conventional cement manufacturing plant to produce a combined clinker. The combined clinker is then ground to produce cement. Both techniques require screening of the dredged material to remove debris greater than 0.25 inches in diameter. The dredged material must be dewatered generally using polymer addition and filter pressing to produce a filter cake. The cake may require further drying before it is fired in a kiln. The dredged material would require some dewatering prior to shipment by rail or truck to either a specialty kiln or a conventional cement kiln. In the Cement-Lock process, proprietary additives are mixed with dredged material prior to kiln firing. Demand for high quality cement exists in construction. Four cement kilns are within 50 miles of Baltimore. However, the capability to blend (substitute) dredged material into a Maryland cement production facility would need to be established.

**Technology Database**

Before the Committee began its review, it agreed to specific evaluation factors for use in assessing each technology. Three major evaluation factor categories were identified including Technical/Engineering, Economic, and Regulatory/Political. Technical/engineering factors address: the degree of development of the technology; compatibility with the physical and chemical characteristics of the dredged material; and the conditioning, additives, equipment, and facilities required to process the dredged material to produce a useable product. Economic factors include: capital costs, production costs, transportation/delivery costs, and potential revenue or other cost offsets associated with producing and marketing a useable product. Regulatory/political factors address: environmental and potential public health impacts associated with the reuse of dredged material; permit requirements for processing and use; and the potential for public acceptance of a particular technology product. The specific evaluation factors used in the review of the technologies are presented in Appendix B grouped by category and subcategory. Information and data concerning these factors were presented to the Committee at each meeting and became part of the technology database, which was the Committee’s primary tool for ranking the 12 technologies. Handouts and presentations addressing these factors for each technology are found in Appendix B.

**Technology Cost Analysis**

Some of the technologies under consideration had not been attempted other than at the demonstration scale and most have never been attempted in the Baltimore area. Many options exist for applying each of them and some of them differ significantly with respect to location and logistical, transport, engineering, and marketing approaches. As a result, there is a significant range of possible costs associated with each technology.

For purposes of comparing costs across technologies, the incremental cost associated with each stage of operation of a "typical" application of each technology was estimated and the sum of
those incremental costs was used to represent "typical" costs for that technology. The stages of
operation for a technology always included some combination of dredging, transport, and either
placement or processing. Technologies that included processing dredged material into usable
products (e.g., bricks) involved additional transport costs after processing (e.g., delivering bricks
to market). Technologies that included only the placement of dredged material (e.g., mine
placement) involved other types of additional costs (e.g., groundwater testing and site
management). The Committee was presented with information about the assumptions used for
estimating costs and the likely range of error around cost estimates associated with each
technology.

**Cost Estimates**

Box 2-1 presents a flow chart illustrating how the total cost for each technology was estimated
using the sum of incremental cost estimates for each stage of operation. Cost estimates for the
different technologies range from $27 per cubic yard to $58 per cubic yard or from about $13
million to $29 million per year for the baseline annual volume of 500,000 cy.

Back-up tables showing how the costs presented in Box 2-1 were generated and spreadsheets that
summarize the assumptions that were used to characterize "typical" logistical, design, and
capacity characteristics at each stage of operations to generate total cost estimates for each
technology can be found in Appendix B.

**Incremental/Cumulative Cost Profile: Brownfield Capping**

<table>
<thead>
<tr>
<th>Stage</th>
<th>Incremental $/CY</th>
<th>Cumulative $/CY</th>
<th>Total Cost:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Stage Cost</td>
<td>Cumulative Total</td>
<td>Cumulative Total</td>
</tr>
<tr>
<td>1. Dredging</td>
<td>$3</td>
<td>$3</td>
<td>$1,500,000</td>
</tr>
<tr>
<td>2. Transport to DMCF</td>
<td>$5</td>
<td>$5</td>
<td>$2,500,000</td>
</tr>
<tr>
<td>3. Placement</td>
<td>$2</td>
<td>$10</td>
<td>$1,000,000</td>
</tr>
<tr>
<td>4. Water Discharge</td>
<td>$1</td>
<td>$11</td>
<td>$500,000</td>
</tr>
<tr>
<td>5. Crust Management</td>
<td>$2</td>
<td>$13</td>
<td>$1,000,000</td>
</tr>
<tr>
<td>6. Material Retrieval and Treatment</td>
<td>$7</td>
<td>$26</td>
<td>$3,500,000</td>
</tr>
<tr>
<td>7. Stockpiling</td>
<td>$1</td>
<td>$21</td>
<td>$500,000</td>
</tr>
<tr>
<td>8. Transport</td>
<td>$15</td>
<td>$38</td>
<td>$7,500,000</td>
</tr>
<tr>
<td>9. Processing</td>
<td>$13</td>
<td>$49</td>
<td>$9,500,000</td>
</tr>
<tr>
<td>10. Stockpile and Placement</td>
<td>$8</td>
<td>$57</td>
<td>$4,000,000</td>
</tr>
</tbody>
</table>

*Note: Chemical & physical analytical testing of materials will be required at various stages and analytical costs are not included in this analysis.

* Incremental costs for all stages are all multiplied by total cut volume of dredged material (500,000 cy) to calculate the Total Stage Cost.

**Box 2-1 Example of Technology Cost Flowchart**
Standardization of Cost Estimates
The actual volume of material handled at each stage of operation can differ significantly from one technology to another because of differences in the amount of dewatering needed (which reduces volume) and the amount of amendments added, which increases volume. While it is necessary to use actual throughput volumes at each stage of operation to measure costs, the volume throughput at each stage of operation was tracked in terms of both the actual material throughput and also in terms of what is known as the "cut" volume - the equivalent volume of dredged material measured at the time of dredging. The cost per unit "cut" volume was used as a standard unit measure to compare costs across technologies.

Sensitivity of Cost Estimates
Because information was not available to estimate costs for specific applications of each technology, the Committee viewed the cost estimates that were provided as "screening level" cost estimates only. The Committee believes that these cost estimates provide a reasonable basis for making preliminary cost comparisons across technologies. However, the Committee expects that when more precise cost information is generated about specific applications of technologies at specific sites the results could be significantly different from these screening level cost estimates.

Approaches to Regulation
The Committee was very aware and concerned about the potential permit issues inherent in all the innovative reuse categories investigated. Several meetings and briefings with MDE staff were held to examine permit issues. A full description of meetings with MDE staff and an analysis of how the administrations within MDE might view the various categories are located in Appendix D.

The Committee investigated the approach the New Jersey Department of Environmental Protection (NJDEP) developed a decade ago for regulating dredged material to determine whether any elements of it could serve as a model for Maryland. Currently, Maryland’s approach to the management of dredged material from Baltimore Harbor is governed by a previous legislative assumption that all of this material is contaminated, which subsequent analysis of sediment quality has shown not to be the case. This legislative approach has serious implications both in terms of the negative public perception it creates as well as for the potential success of innovative reuse. In contrast, New Jersey has established a regulatory framework for managing dredging projects in which reuse of dredged material is generally promoted and where the management of dredged material for reuse is science-based. New Jersey’s management involves strict monitoring of the level of contaminants in dredged material, comparison of the contaminant levels to regulatory contamination criteria, and subsequent determination of the appropriate methods for reuse.
In addition, while Maryland’s Dredged Material Management Act of 2001 established innovative reuse of dredged material as a preferred option for the end use of dredged material, this recommendation was not accompanied by any administrative or regulatory mechanism to facilitate innovative reuse as an end use of dredged material from Baltimore Harbor.

Several aspects of the Maryland and New Jersey approaches to the regulation of dredged material are compared in Box 2-2. This analysis is of interest in part because the Committee learned that material dredged from the New York/New Jersey Harbor is significantly more contaminated than Baltimore Harbor sediment.

NJDEP has determined that dredged material derived from statewide dredging projects is not to be considered a solid waste. This determination found that dredged material should not be regulated under the New Jersey Solid Waste Management Act but should continue to be regulated by the relevant statutes listed above.

Maryland legislation geographically defines contaminated material and regulates the placement of this sediment as described in the above box. That means that regulatory decisions are made based on placement of the dredged material and the potential impact that placement may have. It appears that all three MDE administrations – Air, Water and Waste Management – will have an interest in all 12 of the technologies the IRC reviewed. In many cases that interest will likely be minor, and there appears to be a high likelihood that MDE will issue relevant permits after technical review. Some technologies present more significant permitting issues. For example, the potential use of dredged material for agricultural application, reclamation of mines, sand and gravel operations and brownfields, as well as engineered fill applications, will require careful examination of issues related to applicable cleanup standards, groundwater, wetlands and other concerns. Similarly, if a new containment facility were to be needed to dry dredged material in preparation for further processing for innovative reuse there would be major permit issues, which would need to be addressed by MPA and MDE. Finally, the Air Management Administration would become involved if a new processing facility were to be built or if the transportation of dredged material by truck, train or barge increased air emissions in non-attainment areas. Knowledge of permit issues is important to the Committee’s ranking process discussed in Chapter 3.

Pursuant to New Jersey statutes, NJDEP produced a technical manual in 1997 to define dredging and discuss management and permitting of dredged material in the state. As explained in this manual, New Jersey has implemented an Acceptable Use Determination (AUD) process in order to manage and reuse dredged material. If the dredged material meets contaminant criteria for a potential reuse project, the NJDEP is authorized to issue an AUD in conjunction with a Waterfront Development Permit to both the dredging project and the facility responsible for conditioning the material prior to final placement. The dredged material can then be reused for a variety of projects including remediation projects such as surface cover material at brownfields. In such cases the AUD is issued for remediation and establishes onsite operating control and reporting requirements.
### Box 2-2 Maryland and New Jersey State Statutes Regulating Dredged Material

<table>
<thead>
<tr>
<th>Regulatory Authority</th>
<th>MDE</th>
<th>NJDEP</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>State Statute</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Management of Dredged Material:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Title 5, Section 5-1101</td>
<td></td>
<td>Section 12:5-3 Waterfront Development Law</td>
</tr>
<tr>
<td>• Baltimore Harbor is defined as the Patapsco tidal waterways westward of Rock Point/North Point</td>
<td>• Defines requirements for waterfront development permit needed for dredging and placement of material within 500 ft. of shoreline</td>
<td></td>
</tr>
<tr>
<td>Title 5, Section 5-1102</td>
<td></td>
<td>Section 7:7 Rules on Coastal Zone Management</td>
</tr>
<tr>
<td>• Harbor dredged material may not be deposited in an unconfined manner outside of the Harbor</td>
<td>• Regulates siting of the upland confined disposal facilities</td>
<td></td>
</tr>
<tr>
<td>• Material may not be placed in Chesapeake Bay waters or bottomland within 5 miles of Hart-Miller Island*</td>
<td>Section 58:10A Water Pollution Control Act</td>
<td></td>
</tr>
<tr>
<td>Title 9</td>
<td></td>
<td>• Regulates discharge from upland dredged material containment facilities</td>
</tr>
<tr>
<td>• Maryland regulates discharges of water from contained facilities through state discharge permits or through the Water Quality Certification process</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Permitting Responsibility for Innovative Use:**

- None

**Acceptable Use Determination**

- Waterfront Development Permit
- Remedial Action Work Plan Approval

*Exception was granted for redeposition of dredged material on the Chesapeake Bay bottom at the Pooles Island sites.*
In comparison, Maryland does have a variety of statutory authorities to regulate various operations relating to the handling and disposal of dredged material. These include Environmental Article, Title 2 (Air Pollution Control), Title 5 (general dredging activities), Title 7 (brownfields), Title 9 (landfills and biosolids), Title 15 (mine reclamation), and Title 16 (wetland activities and waterway construction). Furthermore, the Board of Public Works has oversight in the issuance of Tidal Wetlands Licenses for any activities that encroach upon, or otherwise use public waters or bottomlands of the State. The key point is that Maryland does not have a focused program relating to dredged material utilization. The Committee believes that New Jersey’s approach and similar approaches being used elsewhere in the U.S. warrant further review to determine if Maryland’s approach puts the Port of Baltimore at a competitive disadvantage and imposes unnecessary costs on taxpayers and Port facility operators.
Chapter Three: RANKING AND PRIORITIZATION

In preparation for ranking the twelve technologies various techniques for conducting the ranking process and interpreting and recording results were considered. It was decided that the ranking process should be simple and concise. It was also determined that the process should provide sufficient detail so that the technologies could be grouped as to overall potential for successful implementation by MPA and prioritized for further evaluation and assessment. The technology assessment metrics (Technical/Engineering, Economic, and Regulatory/Political) used by the Committee to characterize each technology include the following:

- **Technical/engineering metric.** Information developed during the course of the technology presentations and discussions indicated that all the technologies were technically feasible. Each of the technologies or the component processes on which they depend had been demonstrated previously at some scale. As a result, the decisive factor with respect to the technical metric was "end use capacity."

- **Economics metric.** The various costs for implementing each technology were combined to develop a single cost estimate, average dollar cost per cubic yard, which was based on processing 500,000 cy per year. Cost estimates were based on in-place (in the channel) volumes and Maryland-based technology applications to provide a standard basis for making cost comparisons among technologies.

- **Regulatory/political metric.** The MDE indicated that all the technologies, in principle, were feasible from a permitting perspective. As a result, this metric was represented by a general acceptance criterion that included assessments of the difficulty in obtaining the necessary permits, the potential for public acceptance of the technology, the potential for legal challenges, the potential for positive environmental impacts or advantages, and public support or opposition associated with implementation. It was acknowledged that the basis for the committee's ranking of technologies based on acceptance would be more qualitative than its ranking of technologies based on the other two criteria.

The technology assessment metrics were combined into three major ranking criteria including Capacity, Cost, and Acceptance shown in Box 3-1.
Results of the Ranking Process

The results of the ranking process and the total aggregate scores for Capacity, Cost, and Acceptance are presented in Boxes 3-2 thru 3-4, respectively. The Committee used a number system ranging from “1” (poor) to “5” (good). The “Totals” row in each spreadsheet represents the sum of the ranking scores for each criterion by the seventeen Committee members who voted.

To further illustrate the ranking results, a table was developed that shows the technologies sorted according to their ranking with respect to each criterion. This table is presented in Box 3-5. The technologies are listed in order of ranking from highest (i.e. best) to lowest in each column.

Overall Results

The final prioritized list of technologies is presented in Box 3-6. Those technologies rated with a higher priority have been determined by the Committee to exhibit a greater potential for successful implementation, and thus should receive the most emphasis regarding further evaluation and assessment. Those technologies rated with a lower priority should be retained for additional consideration because they could be useful under some circumstances and may appear more promising in the future; however, they should receive less emphasis during the next phase of evaluation and assessment. In the future, changes in technologies, markets, costs, or evolving opportunities regarding sites or cost offsets could result in some lower priority technologies being elevated to higher status priority.
The higher priority technologies should be further investigated to define:

- Specific products and markets and associated end use capacities and acceptability;
- Availability of existing commercial processing facilities, potential interest in the use of dredged material as a raw material, and material conditioning requirements;
- Requirements, specifications, and construction and operating costs for necessary dredged material conditioning/storage/processing facilities;
- Detailed costs associated with various logistical and engineering designs and degrees of conditioning and processing or tipping fees;
- Impact of permitting requirements on processing facilities and operations; and
- Identification of environmental benefits and potential environmental or other public issues.
Box 3-2. Capacity Ranking Statistics of the Dredged Material Innovative Reuse Committee

<table>
<thead>
<tr>
<th>Ranking</th>
<th>Landfilling</th>
<th>Landscaping</th>
<th>Agricultural Reclamation</th>
<th>Engineering Fill</th>
<th>Building Materials</th>
</tr>
</thead>
<tbody>
<tr>
<td>Totals</td>
<td>28</td>
<td>43</td>
<td>55</td>
<td>74</td>
<td>51</td>
</tr>
<tr>
<td></td>
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<td></td>
<td>36</td>
<td>39</td>
</tr>
<tr>
<td>Totals</td>
<td>29</td>
<td>35</td>
<td>65</td>
<td>35</td>
<td>62</td>
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<tr>
<td></td>
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<td></td>
<td></td>
<td>48</td>
<td>30</td>
<td>47</td>
</tr>
</tbody>
</table>

Note: A higher number represents a better ranking.

Box 3-3. Cost Ranking Statistics of the Dredged Material Innovative Reuse Committee

<table>
<thead>
<tr>
<th>Ranking Statistic</th>
<th>Landfilling</th>
<th>Landscaping</th>
<th>Agricultural Reclamation</th>
<th>Engineering Fill</th>
<th>Building Materials</th>
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<tbody>
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<td></td>
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<td>30</td>
<td>47</td>
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</tbody>
</table>

Note: A higher number represents a better ranking.

Box 3-4. Acceptance Ranking Statistics of the Dredged Material Innovative Reuse Committee

<table>
<thead>
<tr>
<th>Ranking Statistic</th>
<th>Landfilling</th>
<th>Landscaping</th>
<th>Agricultural Reclamation</th>
<th>Engineering Fill</th>
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<td></td>
<td></td>
<td></td>
<td>48</td>
<td>47</td>
<td>47</td>
</tr>
</tbody>
</table>

Note: A higher number represents a better ranking.
In addition to evaluation and assessment of the various technologies, specific projects identified as targets of opportunity for the innovative reuse of dredged material should be evaluated for immediate implementation if proven feasible. Where conditions seem favorable, in terms of capacity, cost, and acceptability, targets of opportunity should be pursued even for applications of technologies that in the absence of any specific option were deemed by the Committee to be low priority. Finally, there may be combinations of technologies that could be implemented together to provide short term and/or long-term solutions.

**Committee Rankings versus Numerical Estimates of Cost and Capacity**

The Committee reviewed estimates of cost and capacity for each technology. By themselves, these estimates could have been used to rank options in terms of these two criteria. However, the
Committee reviewed significant amounts of ancillary information, which enabled it to consider many additional factors when ranking technologies in terms of cost and capacity.

With respect to costs, for example, the Committee was provided with and considered information about: 1) differences in the level of uncertainty about cost estimates for each technology; 2) possible contingency costs associated with each technology; 3) the likelihood that assumed transport distances for some technologies might be too high or too low; 4) whether there might be cost offsets associated with some technologies (e.g., mining company payments or brick sales) that would reduce actual MPA costs; and, 5) whether future investments in specialized equipment and infrastructure or economies of scale might lower costs for some technologies.

With respect to capacity, the Committee considered that the capacity figures that were provided for some technologies had enormous ranges of potential error (e.g., agricultural amendments) while capacity estimates for other technologies either had far less error (e.g., brownfield capping) or were so high that any expected error around the exact number was unimportant. (e.g., Western Maryland mines). Because the committee’s ranking in terms of cost and capacity was based on judgments about many related factors, they are considered far more reliable than any ranking that could have been based solely on direct estimates of cost and capacity.

**Sensitivity of Results to Changing Information**

The technical and economic information that was available to the Committee was very preliminary and reflected what the technical support team determined to be "typical" applications within each of the twelve categories of technologies. Some specific applications within each of these categories can be expected to exhibit cost, capacity, and acceptability characteristics that are much more or less favorable than those associated with typical or average applications within each category. As more specific information about particular technologies and specific sites becomes available, the ranking of a particular technology could change considerably. Technologies that were determined to be lower priority now may, in the future, exhibit sufficient promise to be ranked higher priority, and vice versa.

This has three important implications in terms of the recommendations provided by the Committee. First, all of the technologies, whether they are ranked lower or higher priority, should be considered further because there could be promising specific projects involving any of the technologies. Second, Maryland’s Dredged Material Management Program should remain open to "targets of opportunity" and further examine technologies that are proposed under favorable conditions regardless of their rankings here in terms of high or low priority. Third, in order to determine if new information about a particular technology within each category is likely to have any effect on its prioritization, MPA should identify and further examine all new information as it becomes available. If the most favorable option within the low priority technologies does not appear promising, that technology should be put aside; and if the least favorable option within a high priority technology appears promising, that technology should be targeted for more attention.
Chapter Four: WHAT HAPPENS NEXT: RECOMMENDATIONS

The Committee has concluded that a significant potential exists to accomplish innovative reuse of dredged material in Maryland within the 20-year timeframe (by 2023) set by the Harbor Team and adopted by the DMMP Executive Committee. The Committee also envisions that some technologies might be implemented in the near future on a pilot or demonstration basis. More detailed analysis will be required to develop existing or emerging innovative reuse technologies to the point where they can become part of a viable and sustainable long-term strategy. Detailed analyses should include assessments of location-specific sediment characteristics; sediment quality requirements for specific technology applications and processing operations; opportunities to combine options; potential processing sites; transportation modes; costs; potential to be permitted; community acceptance; and other sociopolitical factors.

To date, the work of the Committee represents a very comprehensive examination of the range of possibilities for establishing a viable, integrated role for innovative reuse as part of Maryland’s long-term dredged material management strategy. Although the Committee feels that significant progress has been made during this initial step, much remains to be accomplished before innovative reuse of dredged material can become part of a practical DMMP strategy for the management of dredged material.

Looking ahead, the Committee offers three recommendations and a series of implementation steps for each. The Committee suggests that the MPA and its DMMP partners begin to expeditiously implement these recommendations with the goal of reporting progress to the Executive Committee within 12 months of the issuance of this report.

**Recommendation 1:** The MPA and its DMMP partners should consider implementing at least one pilot or demonstration project within the next 12-24 months, taking into consideration targets of opportunity for available technologies.

- **Execute one or more pilot or demonstration projects.** Several potential pilot projects are available for project demonstration. MPA should task its support team to prepare implementation plans so at least one of these projects can be recommended by the Committee for implementation within the next 12-24 months.

- **Investigate additional technology options.** MPA should task its support team to identify specific potential use sites for high priority technologies to allow for development of more detailed costs, community input to be solicited, permit requirements to be assessed, and potential funding sources to be identified.
Prepare Cox Creek to serve as processing facility. Cox Creek has potential capacity to serve as a dewatering and stockpiling area for a portion of the targeted 500,000 cubic yard annual processing goal. MPA should initiate plan preparation and request funding for development of a dredged material processing area at Cox Creek.

Recommendation 2: The MPA and its DMMP partners should develop an implementation strategy, consistent with existing dredging plans, for the innovative reuse of dredged material from public and private dredging projects.

- Seek information and/or proposals. The MPA should issue either a “request for information” or an open-ended broad announcement “request for proposals” to initiate dialogue with potential technology developers, brokers and end users.

- Develop partnerships and seek new funding sources. The MPA should explore partnerships with utilities, the Maryland State Highway Administration, the Maryland Power Plant Research Program, the MDE Mining Program, private landowners, transportation companies and any others who may have an interest in the recycling of dredged material. The DMMP, through the Department of Business and Economic Development (DBED) and MPA, should explore economic development concepts for funding innovative reuse. The legislature should be engaged to provide funding and encourage state agencies and others to participate in innovative reuse of dredged material.

- Seek economic development options and incentives. The DMMP partners should examine economic incentives and alternative approaches to encourage the use of dredged material for mitigation. Creative ideas such as tipping fees for landowners who have an acceptable use for suitable dredged material should be explored.

- Develop and implement an outreach strategy. The MPA should develop and implement an outreach strategy that includes briefings for key groups within and outside of government. The outreach strategy should identify community and stakeholder groups appropriate to the process and implement a plan to involve them.
Recommendation 3: The State of Maryland should conduct a broad review of its policies and regulations affecting dredging.

- **Evaluate potential for legal and policy changes.** MDE and MPA, in partnership with state policymakers and stakeholders, should evaluate the potential for fundamental legal and/or policy changes that may facilitate the development of a sustainable dredged material management program, including innovative reuse and environmentally beneficial uses of dredged material at an affordable cost.

- **Consolidate and review sediment data.** MDE and MPA should use the best scientific expertise available to examine the issue of sediment quality in the Port’s shipping channels and conduct a comparison of sediment quality in the harbor and sediment quality in the main Bay channels. This review should include historic and recent monitoring data and sampling protocols, comparison of sediment quality to EPA and MDE criteria and standards, and analysis of the impacts of current legal restrictions on the management of dredged materials. The review should recommend a scientific protocol to identify and categorize dredged material to be either processed so it can be reused innovatively or handled in a confined facility if it were deemed unsuitable for innovative reuse.

- **Evaluate the merit of New Jersey’s consolidated permit approach.** Evaluate the merit of New Jersey's consolidated permit approach. The Executive Committee should request that MDE investigate the potential merits of New Jersey's regulation, including their "Acceptable Use Determination" approach to evaluation of suitable placement sites and end uses for dredged sediment. Also, they should continue to research other regulatory frameworks or regulations for dredged material placement and reuse and report their findings and recommendations to the Executive Committee.

- **Conduct policy dialogue.** The DMMP partners should engage in dialogue with key policymakers and stakeholders to explore the possibility of creating a new dredged material management strategy for Maryland based on the sediment quality characteristics of the material and dedicated to reusing it as a natural resource whenever practicable.