Beneficial Use Options and Considerations for Dredged Material in Coastal Virginia

Prepared for Commonwealth of Virginia Marine Resources Commission

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Cover Photograph: Tidal marsh in Mobjack Bay, Virginia (photograph by Anchor QEA)

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FOREWORD

Aligned Beneficial Advancement

In December 2024, Virginia Governor Glenn Youngkin issued Executive Directive 10 acknowledging the critical role that Virginia plays in efforts to restore the Chesapeake Bay. The Directive proactively focuses on “evaluating investments, executing targeted implementation of Bay programs and initiatives, operating under realistic strategies, and exploring innovative ideas” in coastal restoration.

Beneficial use of dredged material (BUDM) is one strategy for restoring degraded shorelines and coastal habitats. BUDM projects use material dredged from navigation channels beneficially to enhance or improve estuarine habitats and coastal resiliency. Virginia has long followed a state policy mandating the use of sandy dredged material (DM) to nourish eroding beaches (Virginia §28.2-103). Identifying opportunities to use more-finely grained DM for other beneficial uses is needed.

A myriad of elements—including design, permitting, construction, ecological and socioeconomic considerations, and financing-must align on the dredging and the restoration sides of a proposed BUDM project to coordinate and implement it properly. This document attempts to identify ways DM might be used beneficially in Virginia necessary to avoid the adverse impacts associated with the traditional measures of overboard disposal.

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TABLE OF CONTENTS

Foreword i
Aligned Beneficial Advancement i
Figures and Tables v
Acronyms vi
Introduction vii

Part 1

1 Background and Context 2
2 Evolution of Beneficial Use of Dredge Material 4
3 Beneficial Uses of Dredge Material 5
3.1 Habitat Development 5
3.1.1 Marsh Habitats 5
3.1. Upland Habitats 6
3.1.3 Island Habitats 7
3.1. Aquatic Habitats 8
3.1.5 Beaches and Beach Nourishment 8
3.2 Parks and Recreation 10
3.3 Agriculture, Horticulture, Forestry, and Aquaculture 10
3.4 Strip Mine Reclamation, Solid Waste Landfill, and Alternative Uses 10
3.5 Multipurpose Uses and Other Land Use Concepts 11
3.6 Construction and Industrial/Commercial Uses 12
3.6.1 Manufactured Products 12
3.6.2 Dikes and Levees 12
3.6.3 Roads 12
3.7 Mineral Extraction 13
4 Beneficial Use of Dredged Material Project Development 14
4.1 Life Cycle of a Beneficial Use of Dredged Material Project 14
4.2 Planning Tools 15

Part 2

5 Planning 17
5.1 Conceptualize the Project 17
5.2 Project Funding 17
5.2.1 Grants 17
5.2.2 USACE Navigation Dredging 18
5.2.3 Virginia Port Authority 19
5.2. Special Tax Districts 19
5.2.5 Tax Increment Financing 19
5.2.6 Loans 20
5.3 Stakeholder and Regulatory Involvement 20
5.3.1 Stakeholder Engagement 20
5.3.2 Jurisdictional Considerations 22

5.4 Scientific Advisors 22
5.5 Baseline Monitoring Studies and Preliminary Beneficial Use Placement Investigations for Habitat Restoration 23
6 Engineering Considerations 25
6.1 Physical Characteristics 25
6.2 Chemical Characteristics 26
6.2.1 Contaminated Dredged Material 26
6.2.2 Risk Assessment for COCs 27
6.3 Biological Considerations for COCs 28
6.4 Water Quality Considerations 28
7 Logistical Considerations 30
7.1 Dewatering 30
7.2 Transport, Handling, and Storage 30
7.3 Cost Analysis for Dewatering, Storage, and Transport 31

Part 3
8 Permitting 34
9 Design 37
9.1 Conceptual and Preliminary Design 37
9.2 Intermediate Design 38
9.3 Final Design 39
10 Implementation 40
10.1 Means and Methods 40
10.1.1 Methods 40
10.1.2 Equipment 41
10.2 Project Financial Management 41
10.3 Project Procurement 42
10.3.1 Public Projects 43
10.3.2 Private Projects 43
10.4 Construction Monitoring 43
11 Long-Term Monitoring 45

Part 4
12 Project Documentation 47
13 Recommendations 48
13.1 Strategies in Nearby States 48
13.1.1 Maryland 48
13.1.2 Delaware 49
13.1.3 North Carolina 49
14.1.4 New Jersey 50

15 References 51

Appendix A: Virginia Beneficial Use of Dredged Material Workshop Summary **A-1**

Attachment 1: Workshop Agenda **A-11**

Attachment 2: Summary Slides **A-14**

Attachment 3: List of Attendees **A-47**

Appendix B: Industry Follow-Up Interview Participants and Document Stakeholder Reviewers **B-1**

Appendix C: Case Studies **C-1**

Past (Completed) **C-2**

Virginia Beach and sandbridge Beach Nourishment *C-3*

Blackwater National Wildlife Refuge Thin-Layer Placement *C-4*

Present (Ongoing) **C-5**

Paul S. Sarbanes Ecosystem Restoration Project at Poplar Island *C-6*

Weanack Land (Historic Shirley) *C-7*

Langley-Eustis Nature-Based Solutions *C-8*

Chincoteague National Wildlife Refuge Tidal Wetland Restoration *C-9*

Future (Planned) **C-10**

Cedar Island *C-11*

Hampton Roads Beneficial Use of Dredged Material *C-12*

Guinea Marsh *C-13*

Catlett Islands *C-14*

FIGURES AND TABLES

Figures

Figure 1-1: Relative Sea Level Rise Rates at Sewells Point, Virginia, Since 1929 **2**
Figure 3-1: Beach Nourishment Site Identification **10**
Figure 4-1: Process Flowchart for BUDM Projects **15**
Figure 5-1: Stakeholder Engagement Process **21**
Figure 8-1: Regulatory Process Flowchart **35**
Figure 8-2: Joint Permit Application: Review Agencies and Jurisdictional Boundaries **36**

Tables

Table 5-1: Potential BUDM Project Stakeholders in Virginia **21**
Table 6-1: Common Physical Testing and Test Methods for Dredging and Placement Operations **25**
Table 10-1: Cost Estimates for BUDM Project Design Phases **42**
Table B-1: Industry Follow-Up Interview Participants **B-2**
Table B-2: Document Stakeholder Review Participants **B-2**

ACRONYMS

ASTM	American Society for Testing and Materials International
BMP	best management practice
BU	beneficial use
BUDM	beneficial use of dredged material
CEC	cation exchange capacity
COC	contaminant of concern
CZM	Coastal Zone Management Program
DCR	Virginia Department of Conservation and Recreation
DEQ	Virginia Department of Environmental Quality
DHR	Virginia Department of Historic Resources
DM	dredged material
DMCF	dredged material confinement facility
DMMA	dredged material management area
DNREC	Delaware Department of Natural Resources and Environmental Conservation
DWR	Virginia Department of Wildlife Resources
IRBU	innovative reuse and beneficial use
JPA	Joint Permit Application
MEE	Marsh Elevation Enhancement
MPPDC	Middle Peninsula Planning District Commission
NOAA	National Oceanic and Atmospheric Administration
NWR	National Wildlife Refuge
PDC	Planning District Commission
RSLR	relative sea level rise
SAV	submerged aquatic vegetation
SLR	sea level rise
SSD	special service district
T&E	threatened and endangered
TLP	thin-layer placement
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
VDACS	Virginia Department of Agriculture and Consumer Services
VDH	Virginia Department of Health
VIMS	Virginia Institute of Marine Science
VMRC	Virginia Marine Resources Commission
WPP	Wetland Program Plan

INTRODUCTION

The economic security and environmental resilience of coastal Virginia depends on efficient, navigable channels and healthy shorelines. The beneficial use of dredge material (BUDM) from the maintenance dredging of navigation channels in a sustainable and productive manner may result in additional economic and environmental benefits for the Commonwealth.

Historically, DM has been discarded—often permanently—in dredged material management areas (DMMAs) or disposed of overboard into the Chesapeake Bay and its tributaries. Overboard disposal of dredge material has long been recognized as having pronounced adverse environmental impacts on marine and estuarine subaqueous beds/bottomlands. Key adverse impacts include:

- Increased localized turbidity which adversely affects shellfish populations, submerged aquatic vegetation beds and other marine aquatic flora and fauna.
- Burial of existing benthic communities that play an integral role in the Bay's ecological services (i.e., nutrient recycling, carbon sequestration, feeding grounds, etc.).
- Resuspension of pollutants/contaminants and nutrients, which can degrade water quality and lead to localized decreased oxygen concentrations through increased biological and chemical oxygen demand (BOD & COD).
- Reduced biological diversity of high food quality benthic prey organisms resulting from overboard placement of fine-grained material (fine to medium sand, silts, clays). An example of habitat loss or degradation resulting from overboard disposal is reflected in the burial (loss or reduction) of the larger, deeper-bodied benthic marine annelids (clam worms, etc.) that feed drum fishes and other finfish species. These benthic species are lost, soon after spoil placement, resulting from the invasion of opportunistic, smaller-bodied infauna with less value as a food source for many fish species.

Over the past few decades, DM increasingly has been recognized as a valuable resource with the potential to combat coastal land loss when kept within the coastal system. The United States Army Corps of Engineers (USACE) recently set a goal of beneficially using 70% of DM by the year 2030. This goal is commonly referred to by industry practitioners as the "70/30" goal and has resulted in a national movement to implement more BUDM.

Federal and state agencies involved in BUDM in Virginia include the Virginia Marine Resources Commission (VMRC), USACE, the Department of Defense (DOD), the Virginia Department of Environmental Quality (DEQ), the Virginia Department of Wildlife Resources (DWR), the Virginia Department of Conservation and Recreation (DCR), and the Virginia Department of Health (VDH). Virginia DEQ is the lead agency in the Virginia CZM network, which is a consortium of state agencies implementing laws, regulations, and policies that protect coastal resources and support sustainable development in Virginia's coastal zone. The Virginia CZM network's Coastal Policy Team comprises representatives from each member state agency and from each of the eight coastal Planning District Commissions (PDCs) with the aim of discussing and resolving coastal management issues (DEQ 2024a). In Virginia, institutions like the Virginia Institute of Marine Science (VIMS) function as key scientific advisors to state agencies that may often weigh in on this process.

Part 1 of this document explores the potential for BUDM in Virginia. Part 2 covers project planning, including funding, stakeholder engagement, regulatory involvement, monitoring, engineering considerations, and logistics. Part 3 covers project execution, including permitting, design, implementation, and long-term monitoring. Part 4 provides recommendations for the future of BUDM in Virginia informed by existing directives, challenges, and successful strategies from nearby states.

PART 1

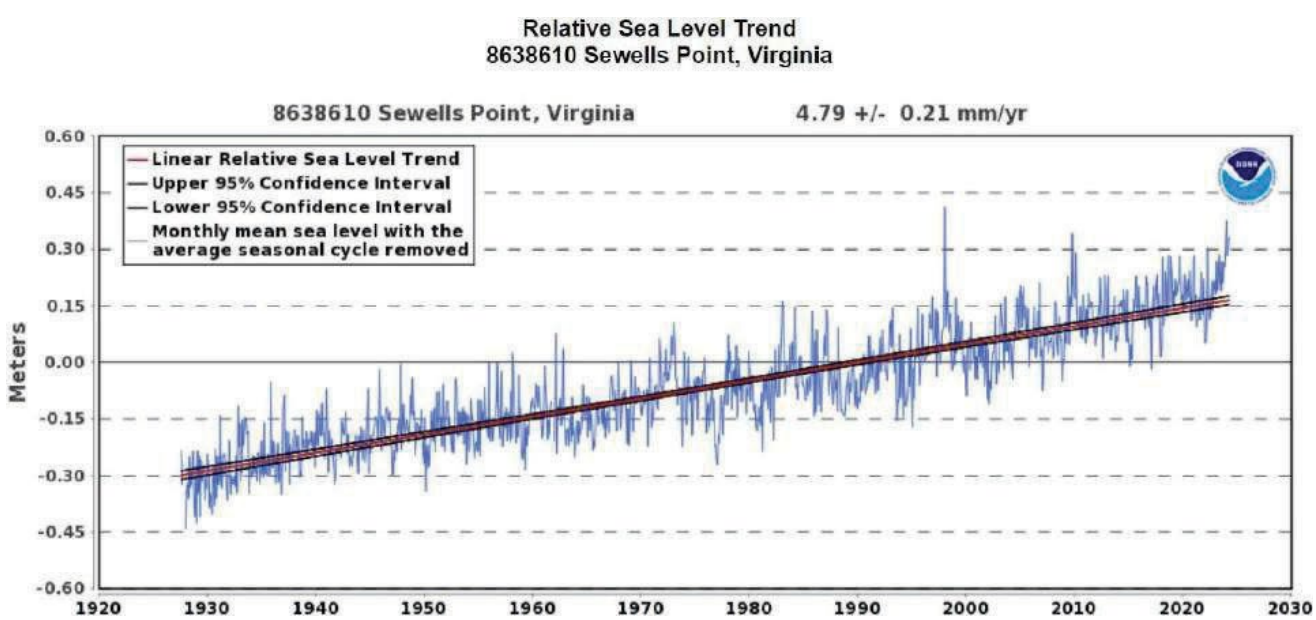
Dredged Material As a Resource

1 BACKGROUND AND CONTEXT

When treated as resource rather than a waste product, DM can enhance local economies and mitigate the impacts of coastal hazards such as storm surge, recurrent flooding, and erosion. BUDM may not always be the most cost-effective placement option for DM in the short term but may lead to long-term benefits to ecosystems and communities.

BUDM is one strategy to help Virginia keep pace with the accelerating rate of sea level rise (SLR), which threatens low-lying coastal communities and habitats (Phillips 2024). Relative sea level rise (RSLR) in Virginia is influenced by regional factors such as land subsidence, postglacial isostatic adjustment, erosion, and other geological processes. Together, these factors have resulted in an RSLR of approximately 14 inches since 1950, with an observed rate of increase of 0.15 to 0.25 inches per year—the highest along the Eastern Seaboard in the past 95 years (Figure 1-1). The frequency of flooding and intense rainfall in Virginia has also increased since the 1950s, and the number of intense category 4 or 5 tropical cyclones on the Atlantic Coast is expected to nearly double by 2100 (VASEM 2021). Six of the 10 most extreme storm surges recorded in Virginia over the past century occurred between 2000 and 2020 (VASEM 2021).

Figure 1-1: Relative Sea Level Rise Rates at Sewells Point, Virginia, Since 1929



Source: NOAA Tides and Currents Database (2025)

The impacts of RSLR include the retreat of marshes and the loss of beaches and dunes (Von Holle et al. 2019). Projects to keep sediment in the system and reduce erosion can help mitigate several coastal hazards (NOAA NCCOS 2025, n.d.). Where marsh migration corridors are not available or desirable (depending on site specific factors), BU projects can mitigate coastal erosion by replacing lost sediment to keep pace with the rate of SLR (ERDC 2023).

Impacts are not only ecological but also economic: 80,000 jobs and $6.1 billion in wages in Virginia are expected to be vulnerable to flooding from 100-year storms projected to occur by 2050 (DCR 2021). By 2080, annual damages of nearly $6 billion are projected for the approximately 341,000 buildings in Virginia exposed to extreme coastal flooding (DCR 2021). Virginia localities have already spent millions of dollars on infrastructure improvements to counter the effects of coastal hazards (VASEM 2021).

Dredging is the excavation of sediment (i.e., DM) from the seabed to deepen, maintain, or restore working depths of navigable waterways. Tidewater Virginia has more than 5,000 miles of shoreline and an estimated 2,300 square miles (1,472,000 acres) of tidally influenced submerged lands (VMRC 2023). Of this, VMRC “assumes that all perennial streams with a drainage basin of greater than 5 square miles, or a mean annual flow greater than 5 cubic feet per second, are navigable” (VMRC 2023). These channels are maintained by their respective jurisdictions to support industry, commerce, and recreational boating.

Dredging in Virginia occurs in deep-draft channels (i.e., deeper than 14 feet), shallow-draft channels (i.e., up to 14 feet deep), federally maintained channels such as those approaching and moving up the Chesapeake Bay, and shallow channels in tributaries that may be maintained federally or non- federally at the state or local level. Funding for the maintenance dredging of navigation channels is managed through the USACE navigation program, the Virginia Port Authority (now VMRC per legislation passed by the 2025 General Assembly), or special tax districts. Dredging in Virginia is also carried out by the U.S. Navy to maintain access to various installations in the region such as Fort Eustis. Much of the resulting DM is placed in upland DMMAs, but the Navy is exploring opportunities for beneficial use of the material to restore shorelines and use natural infrastructure for mission resilience (Siegel 2022).

Dredging in Virginia goes back into the nineteenth century (UVA 2008). Historically, most dredged sediment was disposed of in open-water or upland disposal facilities known as DMMAs. Through the twentieth century, DM from Norfolk Harbor and adjacent waters was placed in the Craney Island DMMA, which was authorized in 1946 and completed in 1957 (USACE 2003). Placement at Craney Island and other small upland disposal locations continues today; however, traditional placement in upland DMMAs removes sediment from the system, decreasing available sediment supply that may enhance coastal erosion.

As the vulnerability of our coastal areas increase in the future (due to rising water levels, frequency and intensity of storms, etc.), it is imperative to find more long-term placement options for DM that keep good quality sediment in the system, thus increasing coastal resiliency and promoting sustainable management of this important public natural resource.

Many navigation channels once federally maintained, particularly shallow-draft channels, are no longer adequately maintained because of the lack of adequate congressional funding for USACE’s Shallow Draft Navigation Program (Middle Peninsula Chesapeake Bay Public Access Authority, 2021). The Virginia General Assembly created the Virginia Waterway Maintenance Fund grant program in 2018 to bridge this funding gap for shallow-draft channels throughout the Commonwealth.

2 EVOLUTION OF BENEFICIAL USE OF DREDGE MATERIAL

The need for alternative placement of DM has become increasingly apparent as the remaining DMMA capacity has decreased. More than 95% of the material dredged annually by USACE satisfies the criteria for use in BUDM projects, if carefully matched with a variety of possible uses (USACE 2015). USACE recognized the value and benefits of DM as early as 1987, noting that “dredged material disposal provides opportunities for a number of environmental, economic, and aesthetic beneficial uses" (USACE 1987). As the benefits of BUDM are increasingly understood and the value of DM is recognized, regulatory shifts in favor of BUDM practices are becoming more frequent.

The USACE Chief’s 2023 BUDM Command Philosophy Notice challenged USACE Districts nationwide to beneficially use 70% of all DM by 2030. Announcement of the 70/30 goal, which had been anticipated by the Districts, was followed by an increase in BUDM: since 2022, almost 60% of DM has been used beneficially nationwide (USACE RSM Sediment Placement Data Viewer 2024a), considerably more than the 23% of DM that was beneficially used between 1998 and 2021 (USACE RSM Sediment Placement Data Viewer 2024b). But increasing BUDM in Virginia has been challenging; only 17% of the DM excavated by the USACE, Norfolk District from 2022 to December 2024 has been beneficially used (USACE RSM Sediment Data Viewer 2024a).

Some of the challenges Virginia faces with BU involve the large numbers of stakeholders and regulators involved in BUDM projects. Additional challenges facing Virginia are echoed at the national scale. Many frequently dredged navigational channels contain fine-grained sediments, which are challenging to use in BUDM projects. Generally, there is high demand for beach-quality DM for beach nourishment and other projects using BU, but low demand for the silts and clays that make up the majority of available DM. In addition, BUDM projects must balance potential benefits to the receiving site with potential costs, and trade-offs like impacts to wetlands, submerged aquatic vegetation (SAV), and essential fish habitat can make projects logistically challenging.

Because of the various agencies and institutions involved in BUDM in Virginia, considerable information is available for characterizing placement areas, defining BU types, navigating permitting processes, and more. Several web tools provide significant geospatial data for the Virginia coast and cover topics relevant to BUDM such as erosion, topography, socioeconomic considerations, and habitat needs.

The added economic benefits of using DM that would otherwise be disposed of as waste should be considered. In other states, particularly those along the Gulf Coast, a sustainable and readily available supply of sediment is critical to natural land-forming processes (e.g., the Mississippi River Delta and coastal barrier islands) and human-driven natural infrastructure resilience projects. If sediments can be managed and reused instead of lost, the benefits of dredging and BUDM applications together may offset the higher costs of complex BUDM projects compared to traditional disposal. See section 5.2 for additional information about project funding.

3 BENEFICIAL USES OF DREDGE MATERIAL

3.1 Habitat Development

Developing or restoring degraded habitat is a primary BU of DM (USACE 2003). Habitat restoration with BU should benefit the receiving site, and an action's short- and long-term implications for the entire area—and not just the habitat being built or restored—should be considered (Correll et al. 2024). The VMRC Subaqueous Guidelines allow fill material to be used for habitat restoration when a project can be shown to have positive aquatic resource benefits. Projects should be planned to restore the stochastic and nonuniform ecosystem functions at a site, some of which may not be intuitive or considered in initial plans.

Notably, the scope of habitat restoration projects that use DM is restricted by the maximum scope and volume of nearby dredging work. The success of BU habitat restoration projects often depends on coordination with ongoing dredging, and BU may be just one part of multitiered projects to improve and restore coastal ecosystems.

Almost all habitat restoration options involve trade-offs: restoration of eroded islands removes habitat for fish, SAV, and benthic organisms; restoration of wetlands may result in temporal loss of vegetation, etc. Although BUDM protects and enhances some habitat types, existing habitat may be degraded over the short term or lost permanently. Trade-offs must be carefully considered during project development and impacts to sensitive habitats such as NOAA-designated essential fish habitat, oyster reefs, and SAV beds should be minimized and, if possible, avoided. For almost all BUDM projects, impacts to existing aquatic habitat can occur. An impact survey prior to construction is one of the most critical assessments needed for habitat protection during BUDM projects. Dredging and BU placement can physically damage sensitive habitats. Dredging equipment, boat groundings, propeller scars, anchors, scouring, sloughing, and sediment accumulation are some of the impacts that should be observed and noted in an impact assessment survey.

3.1.1 Marsh Habitats

Virginia's almost 200,000 acres of tidal marsh amounts to more than 6,000 miles of wetland shoreline (VIMS WetCAT 2024). But Virginia's coastal marshes in the Chesapeake Bay are subject to rates of RSLR more than double the global mean, and the rate is accelerating because of coastal storm impacts and subsidence. Although some of Virginia's existing wetlands may be lost to SLR (Buchanan et al. 2022), Virginia may also gain wetland area as marshes migrate inland, potentially compensating for those losses (Molino et al. 2022).

Nationally, wetlands can be affected by RSLR through multiple pathways: drowning, where open water covers low-lying wetlands with no place to retreat, such as marsh island habitat; edge retreat, where erosion pulls soil away from the wetland's edges in a continuous, progressive manner; and ponding and collapse, where open water fills wetland ponds and causes edge retreat from the interior of the wetland (Mariotti 2016). In all cases, increased flood duration results in loss of vegetation, accelerating sediment loss. Specific rates of wetland loss depends on the capacity of a wetland to accrete sediment as water levels rise and on the wetland's capacity for marsh migration, which is heavily dependent on slope and upland land use. Where coastal wetlands are backed by steep topography or urban and developed landscapes, upland migration of marsh is limited, and other methods of marsh area conservation may be necessary to maintain marsh ecosystems (Osland et al. 2022; Molino et al. 2022). In these cases, BUDM is one potential tool that may be useful for supporting marshes.

Blackwater National Wildlife Refuge

In 2002, Blackwater NWR in Maryland was the site of the first thin-layer placement (TLP) project using DM in the Chesapeake Bay region. A second TLP application was carried out there in 2017, and the refuge received over 950 cubic yards of DM spread over 40 acres, raising elevations 3 to 6 inches. Sites at Blackwater NWR that received TLP applications have recovered and continue to be well vegetated.

Photo credit: Dave Harp

See **Appendix D** for more information on this project.

Wetland creation and restoration may be considered as a BU option when DM is compatible with native sediments and suitable for the application. NOAA's marsh migration tool can be used to determine where placement provides the most value as a resilience strategy (NOAA Office of Coastal Management 2024). Unlike many types of BU that require coarse-grained DM, wetland habitat development can use finely grained material such as silt and consolidated clay (USEPA and USACE 2007a; Maher et al. 2018). But the feasibility of using finely grained material depends on site conditions and such material can be difficult or impossible to use at sites with high wave or current energy (Maher et al. 2018).

BUDM for wetland restoration typically involves placing material on an existing wetland, typically in locations that have been eroded or damaged. Wetland restoration or enhancement often relies on a process known as thin-layer placement (TLP) or marsh elevation enhancement (MEE), where a shallow layer of sediment is placed on the existing habitat to achieve a target elevation (ERDC 2023; Mohan et al. 2021; Raposa et al. 2020). MEE projects have been carried out in the Chesapeake Bay at Deal Island Wildlife Management Area and Blackwater National Wildlife Refuge in Maryland (see Appendix C).

Wetland creation involves placing DM where there are no wetlands. Such projects aim to establish wetlands that provide natural protection to upland coasts vulnerable to inundation and strong waves. To enhance the success of wetland creation, vegetation similar to the surrounding native species should be planted. The selection of plant species should consider not only the constructed elevations but also the anticipated future elevations. This approach will ensure that the created wetland meets classification standards and supports future wildlife habitats.

The disturbance of existing vegetation by heavy equipment and material placement during implementation has the potential to create hospitable conditions for invasive species, but that can be controlled through careful monitoring and intensive planting of native species shortly after sediment placement (Correll et al. 2024).

3.1.2 Upland Habitats

BUDM on upland habitat may occur in upland forests, riparian wetlands, grasslands, or other valuable habitat (Keil et al. 2022). In Virginia, upland habitats, or land above the elevation at which tidal flooding typically occurs, are found on the landward side of tidal wetlands and support diverse vegetative and terrestrial species. Considerations specific to upland habitat development include determining site elevations, slope orientation, configuration, and area and volume; compatibility of material type; public appeal; proximity to a dredged waterway; project funding; and future maintenance.

In 1978, the Dredged Material Research Program (DMRP) released the Upland Habitat Development with Dredged Material: Engineering and Plant Propagation (Hunt et al. 1978). This report provides guidance on two opportunities for upland habitat development using DM: 1) reclaiming or increasing value on an existing disposal area; and 2) placing DM on a selected site to meet a specific habitat goal (Hunt et al. 1978). Planning alternative placement of DM to create upland habitat proceeds with one (or both) of these goals in mind: 1) improving conditions for selected wildlife species or communities; and 2) providing recreation facilities and opportunities by increasing aesthetic value, controlling soil erosion, or improving soil quality.

Examples of improving conditions at Mid-Atlantic dredged material containment facilities (DMCFs) can be seen at Hart-Miller Island (HMI) in Maryland (MDOT MPA 2023). The relationship between HMI and DM has evolved over the decades, with more-recent efforts focusing on upland habitat remediation. In response to a diminishing footprint because of severe erosion, in 1970 HMI was proposed as a placement site for DM from Baltimore Harbor Shipping Channels in hopes of restoring the island's original footprint. But because of public concern and in recognition of its environmental value, HMI was closed as an active DMCF in 2009 and transitioned to wildlife habitat through the planting of native grasses, shrubs, and trees (Brainard 2016). Now managed by the Maryland Department of Natural Resources, HMI is a state park that receives tens of thousands of visitors annually and is home to approximately 300 bird species. With the reconsideration of material management at traditional upland placement sites, habitat and environmental diversity was returned to the area and aesthetic value improved.

In 1979, DMRP released An Introduction to Habitat Development on Dredged Material, which highlighted planning and design specifics once upland habitat has been selected as a disposal alternative (Smith 1978). Together, DMRP's 1978 and 1979 reports provide initial information, lessons learned, and advantages and disadvantages to account for when considering upland habitat as a DM placement alternative. Updated, modern USACE guidance on upland habitat development is in development.

3.1.3 Island Habitats

Another type of habitat-related BU is the creation or restoration of historically eroded islands through BUDM. DM can and has been used to create new islands, often as a placement alternative to relieve upland DMMAs nearing capacity. This activity usually occurs near maintained channels and waterways, offering an alternative placement option for future DM. However, island creation often involves an analysis of the trade-off between loss of existing aquatic bottom and associated habitat versus the ecological value of habitats provided by the newly created island - which can include both upland as well as nearshore benefits. Island restoration or creation can involve similar techniques to marsh restoration and creation, but differs in that, depending on the size and scope of the island, projects may include multiple habitat types: upland areas, tidal wetlands, mudflats, and more. Island projects also face challenges in terms of trade-offs: conversion of submerged lands to island habitat may remove existing habitat for fish and may impact SAV, reef-forming bivalves, and other benthic organisms.

Functions of island creation beyond a placement alternative should be considered, including habitat creation, coastal protection, and aquatic resource benefits. Depending on the geographical placement and orientation, a newly created island can protect landward coastlines by buffering direct wind and wave action and reducing erosional consequences that follow. DM can also be used in the creation of islands designed to provide nesting habitat for various seabird species. In addition, islands can provide recreational spaces for boaters, anglers, and birdwatchers. Islands may also block fetch from inland locations, preventing erosion on important shorelines, and when placed in erosive environments may serve as sediment sources for upstream shorelines.

BUDM for island restoration involves placing material on an existing island. Restoration objectives can include, but are not limited to, environmental enhancement, erosion mitigation, elevation increases, and the restoration of the island's morphological features.

Island restoration is common elsewhere in the Chesapeake Bay. The original footprint of Maryland's Poplar Island, in the upper Chesapeake Bay, was more than 1,000 acres, and the island supported a small community. By 1996, it had been reduced to less than 4 acres. The restoration of Poplar Island using DM is ongoing and will cover 1,715 acres of upland area and tidal wetlands that include low and high marsh, bird nesting islands, and open-water ponds (MES 2024). And HMI, near Baltimore, Maryland, was a DM placement area at the former site of three eroding islands and has been restored to form a 1,100-acre state park (MDOT MPA 2024). Future island restorations include the deteriorating James and Barren Islands in Mid-Bay, which are set to receive DM from the Maryland Chesapeake Bay approach channels in 2030 (Anchor QEA 2021). This project will restore 2,072 acres of James Island and 72 acres of Barren Island.

Similar opportunities for island habitat development exist in Virginia. In the lower Chesapeake, USACE has recently begun planning the Hampton Roads Beneficial Use of Dredged Material project, which aims to use DM to develop a 5-acre seabird nesting habitat island at Hampton Bar (USACE, Norfolk District 2024). On the Atlantic Coast, the restoration of Cedar Island's back-barrier marsh islands is using material sourced from a subaqueous bottom area to raise the marsh platform is slated to begin in 2027 (USACE, Norfolk District 2019). While not directly a BUDM project, the project will provide knowledge transferable to BUDM projects. Both projects are discussed further in Appendix C.

3.1.4 Aquatic Habitats

Models predict that SAV habitat will migrate shoreward into shallower water as sea levels rise (Saunders et al. 2013). Developed shorelines may restrict shoreward migration and cause an overall loss of SAV habitat (Russ et al. 2023).

3.1.5 Beaches and Beach Nourishment

Coastal beaches and sand dunes serve ecological and economic functions. They serve as protective barriers to inundation, wind, and wave-generated erosion; host numerous recreational activities; and provide crucial habitat for wildlife such as birds, turtles, and the endangered northeast beach tiger beetle. In Virginia, erosion of beaches is an immediate threat, and some Virginia shorelines are experiencing “historic erosion rates of up to 30 feet per year” (DCR 2024a).

Beach nourishment is the process of adding sandy sediment on or directly adjacent to eroding shorelines to widen the beach or increase the sediment budget. Beaches where sediment is depleted are vulnerable to increased rates of berm erosion, greater inundation, upland infrastructure damage, and possible reductions in economic value tied to aesthetics and recreation.

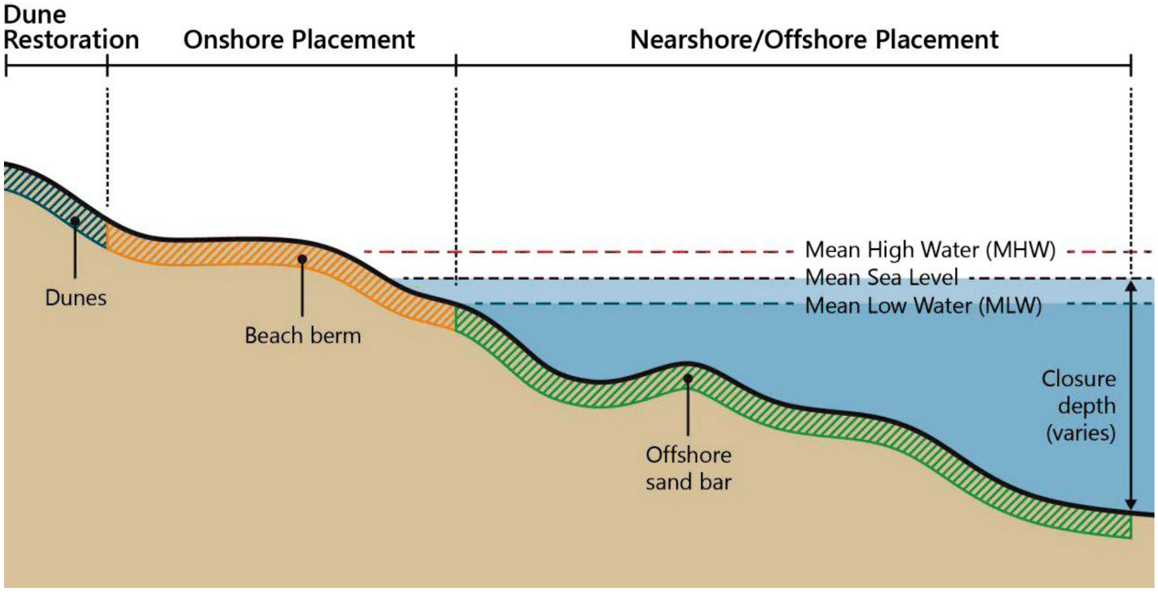
State beaches have priority when it comes to beach nourishment. As Section III of Virginia’s Subaqueous Guidelines states, “In accordance with § 10.1-704 of the Code of Virginia, the beaches of the Commonwealth shall be given priority consideration as sites for the disposal of that portion of dredged material determined to be suitable for beach nourishment. Recent research suggests that some borrow areas with sediment that may appear too fine-grained for use in beach nourishment projects may actually be considered because the process of dredging and placement reduces the quantity of fine-grained sediments by as much as 87% (Smith et al. 2019), with the remainder being of sufficient granular composition for beach placement.

Dune construction and restoration are often part of beach nourishment projects to establish or restore habitat lost to erosion and provide upland flood protection (FEMA 2021). BUDM has been successful in nourishment projects and continues to be a preferred alternative to DMMA placement.

For more about the “Criteria for the Placement of Sandy Dredged Material along Beaches in the Commonwealth,” visit Regulation: Placement of Sandy Dredged Material Along Beaches.

Onshore beach nourishment is the placement of DM on an existing beach (Figure 3-1) to improve beach access, increase recreational opportunities, restore ecological habitat, or fortify the area against oncoming waves.

Figure 3-1: Beach Nourishment Site Identification



To ensure an onshore placement project will meet its objectives, the beach profile and hydrodynamic conditions expected at the placement site should be well understood. Inevitably, some of the material placed on the beach berm will "gradually move offshore to the DoC [depth of closure] as the nourished profile adjusts to changes in water level and to wave action" (Wise 1998). Understanding to where the placed material may travel gives project affiliates and engineers a clearer picture of where the material may have the most impact on the beach and nearshore system.

3.2 Parks and Recreation

The range of BUDM in the parks and recreation sector, for example as fill and foundations for recreational facilities, varies in complexity. The transformation of DMMAs to address the public's demand for water-oriented recreation is one of the biggest land uses in terms of acreage (USACE 2015). Parks and recreation sites created from DM are often located near active dredging areas and include beaches, trails, campgrounds, and playgrounds. Although recreation is one of the more popular BUDM, it is "heavily dependent on financial backing at the local level" (USACE 2015) and suitability of material. Transparency of material composition is needed to inform community engagement for local land use decisions such as DMMA conversion to public recreational spaces.

3.3 Agriculture, Horticulture, Forestry, and Aquaculture

In Virginia and other states, DM can be applied on agricultural land to replace eroded topsoil or as an amendment to existing marginal soils (MDOT MPA 2020). DM is typically higher in micro- and macronutrients than are marginal agriculture soils, which may or may not support plant growth unamended due to nutrient limitations or to drainage issues especially in flood-prone areas (USACE 2015). However, to ensure crop growth and protect groundwater supplies, the salinity of the DM must be taken into account because marine and brackish sediments are high in sodium, chloride, sulfate, and other ions, and DM may need to be treated before use (USACE 2015). DM has also been used to develop livestock pasture and new cropland. For example, a former DM placement facility in South Carolina was converted to a successful farm in the late 1990s (USACE 2015). DM used to create new pasture for livestock typically requires no development beyond facilitating natural colonization by grasses (USACE 2015). The use of BUDM in agriculture is an avenue for additional research and study.

3.4 Strip Mine Reclamation, Solid Waste Landfill, and Alternative Uses

DM can be used to fill and reclaim abandoned strip mines, an application that has "exclusively positive environmental benefits" (NY/NJ COAST and PaDEP 2004). Dredged sediment can be mixed with lime kiln or other fill materials to obtain desired chemical and physical characteristics. DM has been used to fill abandoned strip mines in the Mid-Atlantic region since as early as the 1970s (Perrier et al. 1980).

DM has been used to cap and reclaim solid waste landfills (Mohan et al. 1997) to prevent contaminants from reaching wildlife or humans through natural processes like wind, precipitation runoff, and gas releases (Solanki et al. 2023). Depending on material conditions, DM can be used as an impermeable layer at the base of a landfill to prevent contaminants from leaching into surrounding soils (Solanki et al. 2023). Clay and sand-dominant DM both have been successfully used for these purposes. In Virginia, DM collected from federal maintenance dredging of Oyster Channel was historically used as daily cover for the Northampton County Landfill, which was designated for closure in 2011 (TRC, 2023).

DM may also be used in remediation projects that require engineered caps to isolate chemically and physically underlying contamination or contamination from adjacent upland locations that cannot be removed by dredging. Such caps typically comprise the following three layers of placed material (Palermo et al. 1996):

1. Contaminant attenuation or isolation material (e.g., sand, possibly amended with absorptive material such as organic matter)
2. Filter material (e.g., a sand and gravel mix)
3. Armor material (e.g., rock)

Depending on material type, site sensitivities, and project objectives, DM is typically used in the first or second layers. Additional design evaluations such as contaminant mobility and erosion protection evaluation (e.g., wind wave, vessel propeller wash [propwash], currents erosion) are standard to capping projects, particularly those that use DM (Palermo et al. 1996).

3.5 Multipurpose Uses and Other Land Use Concepts

DM has been used to fill geotextile tubes, weather-resistant bags used to form artificial, typically temporary, coastal structures like breakwaters, dunes, and levees, often as part of living shoreline projects (NOAA 2015). Geotextile tubes often require addition of flocculants or polymers, to enhance DM settling within the tubes and also to improve the effluent water quality. It is critical to ensure that the polymers/flocculants do not cause adverse impacts to the receiving water body, which can be done via a review of their Material Safety Data Sheets (MSDS). There are several additives that do not cause adverse impacts to the water bodies; however, it requires site specific analysis.

DM, in combination with other materials, has also been used in to manufacture bricks for construction (USACE 2015). For these and many other purposes, DM is typically moved to an upland processing facility where it is dried and processed, incurring additional costs and extending project timelines (USACE 2015).

3.6 Construction and Industrial/Commercial Uses

DM is useful for construction projects. Stabilized DM has been used to fill geotextile tubes and to create construction materials such as aggregates and “mudcrete” (mud or DM stabilized with cement) to build dikes, levees, seawalls, roads, and embankments (CEDA 2019).

3.6.1 Manufactured Products

The use of DM in manufacturing products for construction, agriculture, and industry is a rapidly growing application typically termed innovative reuse or innovative reuse/beneficial use (IRBU; MDOT MPA 2025). Maryland’s IRBU program funds considerable efforts to incorporate DM in manufacturing with a goal to “make long-term, sustainable reuse of dredged material a widely used tool for managing dredged sediments to promote capacity recovery in upland containment facilitates and support the continued viability of the Port of Baltimore” (MDOT MPA 2025b).

Maryland’s IRBU products include ceramic bricks and permeable pavers made with a blend of DM and other construction products; sod rolls created with dredged sediment-amended soils; concrete traffic barriers created with DM; modular shoreline protection structures; bricks; lightweight aggregates; and berms (MD DMMP, n.d.). Tests suggest that pavers made of 100% DM pass the Maryland Department of the Environment criteria for residential unrestricted use soil and fill material and meet or exceed the ASTM International (ASTM) performance criteria for traditional clay/shale pavers.

Fine-grained DM can be blended with clay, compost, fertilizer, and other materials to improve soil chemistry and hydrological quality and promote crop growth (Lake et al. 2024). DM may also be applied wholesale to farms as a replacement for topsoil fertilizer (Sequeira et al. 2024).

3.6.2 Dikes and Levees

DM can be used in the construction of upland dikes, levees, seawalls, and other structures. The sediment is typically stabilized with Portland cement or other additives to increase strength, minimize postplacement particle segregation, and reduce water content and permeability prior to construction (CEDA 2019). In Virginia, the USACE Norfolk District uses suitable DM from the Craney Island Dredged Material Management Area to maintain and construct containment dikes for DM Placement capacity.

3.6.3 Roads

DM can be used in road construction and maintenance (USEPA and USACE 2007b), most commonly as road infill and sub-base material and in embankments and other structural components (Sadat Associates 2001). DM has been used in road construction in Wisconsin, Texas, Minnesota, and Illinois and in countries other than the United States (USACE 2015; Loudini et al. 2020; Solanki et al. 2023). DM was used for structural-grade and highway embankment fill in a pilot project in the Baltimore region (Schnabel Engineering 2014); the material was combined with steel slag and 2% Portland cement was added to immobilize residual metals in the DM. Tests showed that the fabricated material was suitable for typical highway embankment construction. Initial reports indicated that the DM blends were “comparable or superior to conventional soils used for embankment construction” (Francingues et al. 2011). DM has also been used as fill for new parking lots (USACE, New York District 2025).

3.7 Mineral Extraction

Some BU projects provide opportunities for mineral extraction, including beach nourishment projects that use sand taken offshore along Virginia's Atlantic coastline. Offshore sediment sampled in areas with beach-quality sand averaged 2.7% total heavy minerals, and 41% of that fraction comprised heavy minerals, such as titanium, zirconium, and uranium, that can be economically valuable. The potential value of extractable minerals in a cubic yard of dredged sand with average total heavy mineral content was estimated at $10.80 in 2022 (Hawkins and Lassetter, 2022). Much of that content is in the fine-grained fraction (silt or clay) of the DM, which is often of limited use in BUDM projects. But combining BU and total heavy mineral extraction may make these sediments more attractive logistically and economically (Hawkins and Lassetter 2022).

4 BENEFICIAL USE OF DREDGED MATERIAL PROJECT DEVELOPMENT

4.1 Life Cycle of a Beneficial Use of Dredged Material Project

BUDM projects may take several years from conception to implementation. Projects begin with initial planning, which involves conceptualizing the project and identifying possible sites. Concepts may begin with problems whose solution provides a good opportunity for BUDM, such as a degrading shoreline that needs additional sediment to prevent habitat loss or a shoaled-in navigational channel that requires dredging. Once possible sites are identified, success criteria should be determined based on site needs and stakeholder engagement and project goals, objectives, and constraints should be established. Once a project is fully conceptualized, managers may begin to evaluate funding opportunities. Sometimes, project design may occur prior to construction funding, with the design phase and construction phase funded through different avenues. The benefit of this is to have a project with some level of design ready to go when a dredging opportunity arises that aligns with the project geographically and temporally. This involves establishing baseline conditions at the site, which may include sediment characterization, securing the necessary permits, and preparing preliminary, intermediate, and final designs, which are discussed in detail in Part 3. After the design is complete, project implementation can begin, starting with bidding and contractor selection. Implementation also involves establishing project means and method, accessing equipment, monitoring construction, and establishing a long-term monitoring plan. Adaptive management following construction can help determine whether the project achieved the set goals and what future management actions may be required at the site. Each step is shown in Figure 4-1 and discussed in detail in Parts 2, 3, and 4 of this document.

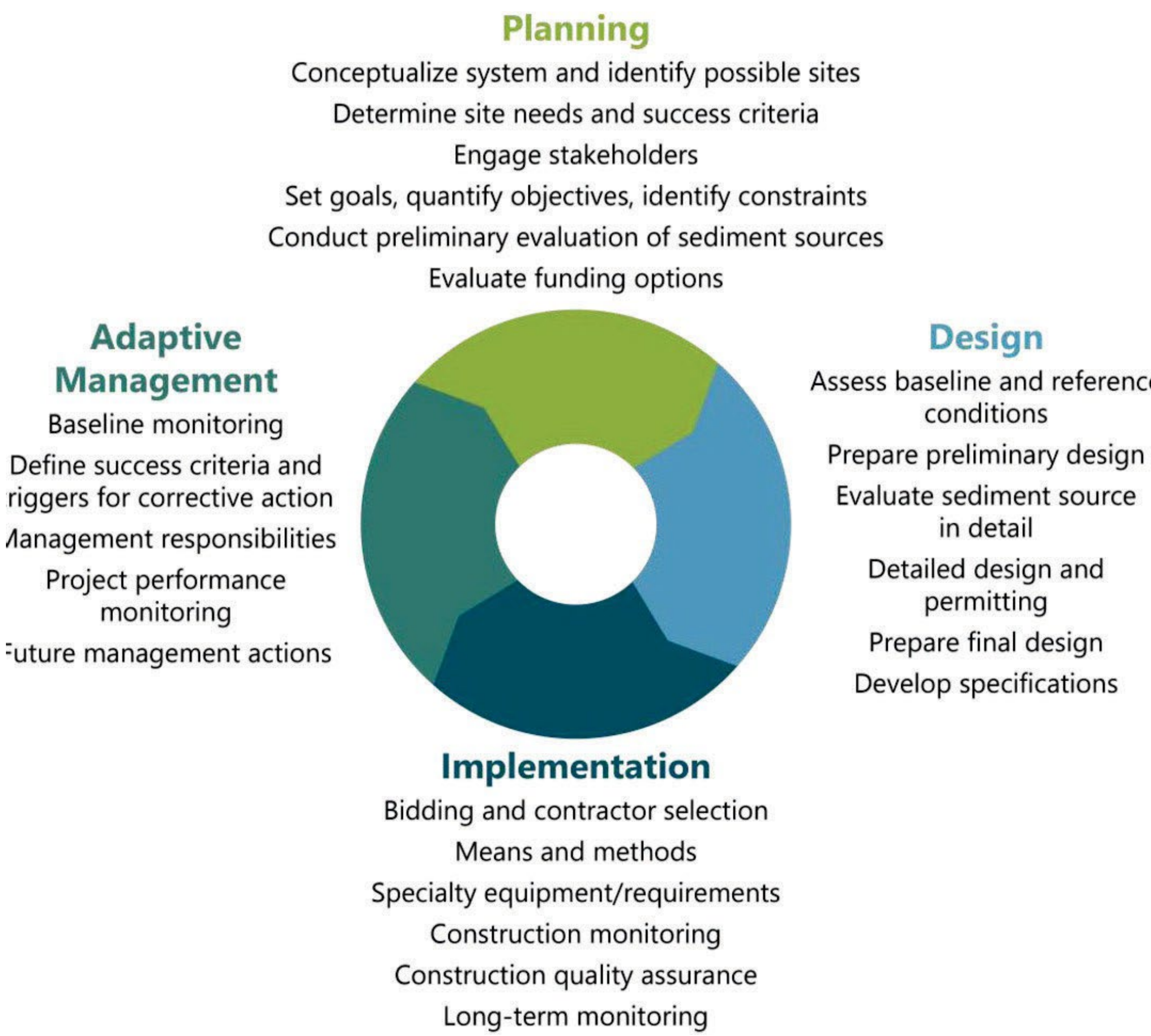
Paul S. Sarbanes Ecosystem Restoration Project at Poplar Island

Heavily eroded Poplar Island in Maryland, once more than 1,100 acres in size, and eroded down to approximately 4 acres by 1990, is being rebuilt with DM. Ongoing placement of DM began in 2001 and is expected to end in 2043. Habitat restoration a key component of each completed area. The island is designed to hold 71.1 million cubic yards of DM, expanding capacity for dredging in the region. Poplar Island supports various habitats, including tidal wetlands, open water ponds, bird nesting islands, and rock reefs.

Photo credit: USACE

There is a need for long-term BUDM sites, particularly for USACE navigation projects, which require long-term (typically 20 years) DM capacity. BU projects may be constructed incrementally over 20 years, with sediment added whenever the navigation channel needs dredging. Planning for such long-term projects should consider the dredging frequency, estimated volume dredged in each cycle, funding constraints, and construction cost escalation over time. Example projects may include large-scale island development or restoration and identification of at-risk marshes that may benefit from recurrent applications of DM by MEE.

Figure 4-1: Process Flowchart for BUDM Projects



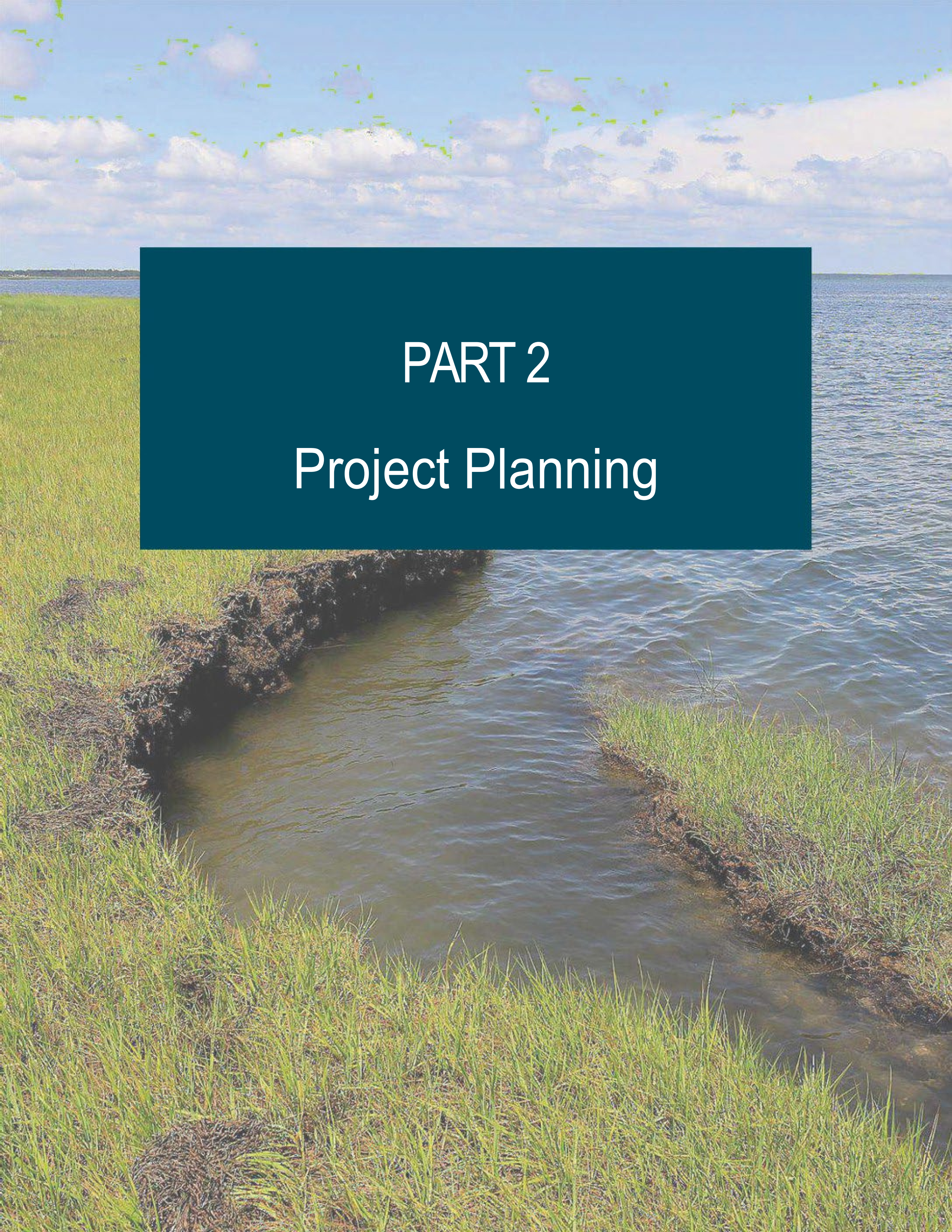
Source: Modified from Piercy and Mohan (2023)

4.2 Planning Tools

Various resource agencies and scientific advisors in Virginia and at the local, regional, and national levels host tools that are useful for planning BUDM projects. Many of the tools are based on geographic information systems (GIS). They provide spatial information and data relevant to BUDM and may support informed decision-making at each stage of a BUDM project's life cycle.

PART 2

Project Planning



5 PLANNING

The planning of a BUDM project should be done well in advance of—and often can begin before-a nearby dredging operation to provide DM is identified. Planning approaches will depend on stakeholder engagement, site needs, success criteria, and project goals and objectives. In some cases, a restoration project evaluating BUDM will need a sediment source. In others, a dredging project will be seeking an opportunity for BU of the sediment it dredges. Stakeholder engagement and preliminary assessment data from both the dredging and the BUDM project will need to be considered to inform the overall project approach.

5.1 Conceptualize the Project

Approaching a project starts with a need, such as a restoration challenge or a navigation priority, that stakeholder groups can identify. The project starts with an initial site assessment and a feasibility assessment. Stakeholder engagement is critical to the success of BUDM projects, especially MEE efforts, and should occur frequently from early planning through postconstruction monitoring and adaptive management.

Various tools are available to identify and screen potential project parameters. (See the Natural Infrastructure Opportunities Tool [NIOT] by ERDC [2025], the Coastal Resiliency Evaluation and Siting Tool by NFWF [2025], the Virginia Coastal Resources Tool by VIMS [2025], and the Coastal Geospatial and Educational Mapping System by Virginia CZM [2025].) DM-BUMT, a GIS-based BUDM management tool developed in conjunction with this document, compiles various data sources to centralize information, connect people and stakeholders, and engage users. These tools should be used to assemble stakeholder groups, develop goals and objectives for MEE locations, and identify potential sediment sources, available data, and data gaps. The dredging and BUDM project sites' proximity to cultural or historic resources should also be assessed during the early planning stages.

5.2 Project Funding

5.2.1 Grants

Grants from local, state, federal, and nongovernmental organizations are available for projects that involve BU, both on the dredging side to fulfill a navigational need and on the BUDM side to promote habitat restoration or innovation and resilience.

Potential grant sponsors for habitat restoration using BU in Virginia include Virginia DEQ, the Coastal Virginia Adaptation and Resilience Consortium, MPPDC's Fight the Flood Program, Virginia Sea Grant, the Virginia Department of Emergency Management, and cities and towns in the state. Virginia DEQ manages the Virginia Clean Water Revolving Loan Fund, which funds the acquisition or permanent conservation of land that contributes to water quality in the state (DCR 2024b). At the federal level, grants for BUDM may be available through NOAA, the U.S. Fish and Wildlife Service (USFWS), DOD, U.S. Environmental Protection Agency (USEPA), USACE, and other agencies. USFWS administers several grants, including the National Coastal Wetlands Conservation Grant and the North American Wetland Conservation Act, that may be relevant to BUDM projects to restore habitat (DCR 2024b).

5.2.2 USACE Navigation Dredging

USACE can cover a portion of the costs for dredging new or existing federally maintained navigation channels, with the balance paid by the local sponsor or nonfederal interest (state or locality). Each entity's share of the cost depends on the project size, volume of sediment, and whether the project is new or the deepening, widening, or maintenance and operation of an existing channel. For new projects, USACE will cover 10% of the construction costs for dredging depths up to 20 feet, 25% of the cost for projects between 20 and 45 feet deep, and 50% of the cost for projects more than 45 feet deep, with an additional 10% of construction costs allocated for the next 30 years of maintenance for each size category (USEPA and USACE 2007a). The federal share of operational and maintenance dredging costs for existing shallow-draft federally maintained channels is 100%-unless the harbors are deeper than 45 feet, in which case the federal share is 50% of the costs beyond those that would be incurred for a project with a shallower depth. USACE also allocates some funds for the construction of disposal facilities; the size of the federal share depends on the depth of the project. Operation and maintenance costs of existing disposal facilities are covered by USACE (USEPA and USACE 2007a).

The amount of funding USACE can provide for BUDM projects associated with federally maintained channels depends on the Federal Standard, or base plan, which is the "least costly alternative that is consistent with sound engineering practices and meets all federal environmental requirements" (USEPA and USACE 2007a). Efforts have been undertaken recently to expand the Federal Standard to include environmental and social impacts as well as economic costs and benefits when considering alternatives for dredged material placement (USACE Comprehensive Documentation of Benefits in Decisions Document, 2021). When performance of BUDM work outside of an established model cost share agreement is being considered, the general cost share rule is that all costs for transportation and placement of DM beyond that of the Federal Standard will be the responsibility of the local sponsor or nonfederal interest. The cost share requirements for BUDM work performed using a model agreement can be found at https://www.usace.army.mil/Missions/Civil-Works/Project- Partnership-Agreements/. When BUDM is selected, cost sharing by USACE depends on whether or not the project is the Federal Standard option. If the project is not the Federal Standard, USACE will cover 65% to 75% of the costs provided the project improves the quality of the environment; protects, restores, or creates aquatic and related habitats; places DM on beaches; or achieves environmental benefits (USEPA and USACE 2007a). Actual cost share amounts will depend on the USACE agreement with the project's local sponsor or nonfederal interest. Note that these cost share values are generalized, and actual numbers may be project specific. For the most updated estimates of USACE cost share values, see the USACE Civil Works guidance documents and cost share agreements at https://www.usace.army.mil/Missions/Civil-Works/Project-Partnership-Agreements/.

As outlined in the Comprehensive Documentation of Benefits in Decision Document policy directive of 2021, USACE has begun to incorporate, in addition to economic benefits, the value of ecosystem services and social benefits in benefit-cost assessments when determining DM placement plans; this move may support increased BUDM, particularly for purposes such as habitat restoration (ASACW 2021). Similarly, finding beneficial uses for locally sourced DM instead of materials from distant locations provides economic value to the local community while reducing the environmental impacts of material transport.

5.2.3 Virginia Port Authority

At the time of this publication's drafting, the Virginia Port Authority administers the Virginia Waterway Maintenance Fund, which provides financial assistance for shallow-draft dredging projects with or without a federal interest. Funds may be used to cover various aspects of BUDM projects, including feasibility, pre-project planning, and sediment analysis, the nonfederal portion of a project with partial federal funding, state maintenance of shallow-draft channels, and BU for environmental restoration. Application requirements include a statement of need and urgency; project costs, timelines, and phases; feasibility assessments; capabilities of the project managers; description of potential BUDM; beneficial impacts to affected communities; and total funds requested (Virginia Port Authority 2018). Special consideration is given to dredging projects that support waterway enhancement in rural areas but lack federal funding and for which rural localities provide evidence of economic or commercial need for the project (Virginia Port Authority 2018). However, in 2025 HB 134 was approved which transfers the Virginia Waterway Maintenance Grant Program and Fund to the Virginia Marine Resources Commission from the Virginia Port Authority. It also required the Commission to utilize the existing Municipal Dredging Operating Program and Municipal Dredging Operating Agreement adopted by the Middle Peninsula Chesapeake Bay Public Access Authority for the administration of the Municipal Dredge Pilot Program.

5.2.4 Special Tax Districts

Virginia allows localities to create special tax districts, also known as special service districts (SSDs), to facilitate additional, more complete, or more timely services than previously existed, including navigational dredging (§ 15.2-2400. Creation of service districts). These districts levy taxes on residents to fund desired projects (§ 15.2-2403. Powers of service districts). By law, SSDs have the power to conduct dredging as well as beach and shoreline restoration (§ 15.2-2403. Powers of service districts). The Nassawadox Creek Service District, for example, was created to expedite dredging of the severely shoaled-in creek to support local water-based economies and to facilitate environmentally beneficial placement of the DM on eroding shorelines in the area (§ 33.011 NASSAWADOX CREEK SERVICE DISTRICT.). The City of Virginia Beach administers a Navigational Neighborhood Dredging SSD program (https://pw.virginiabeach.gov/coastal- waterways/neighborhood-dredging-ssd) established in 2011 for the maintenance of existing community channels only; individual waterfront property owners are required to cover the full cost of additional dredging to connect their boat basin(s) to the neighborhood channel.

5.2.5 Tax Increment Financing

Article 4.1 of the Code of Virginia (§ 58.1-3245.2 et seq.) provides the legal framework for Tax Increment Financing (TIF), allowing local governments to fund public infrastructure and development projects using anticipated increases in property tax revenue. Localities can establish designated development project areas through an ordinance adopted after a public hearing, with required public notice. Once established, the increase in property tax revenue—known as the tax increment— is allocated to a special Tax Increment Financing Fund. These funds can be used to finance project costs, including the issuance of bonds or other financial obligations. Any unused funds at the end of a tax year, if not pledged to financial commitments, may be transferred to the locality's general fund. When all obligations have been met, the locality may dissolve the TIF district and revert property assessments and revenues to their standard allocation.

TIF can be used to fund dredging and dredged material management when these activities support economic development within a designated TIF district—typically a waterfront or port area where improved navigability and access are expected to boost property values and commercial activity. By establishing a TIF district that includes properties benefiting from dredging, such as marinas, waterfront businesses, or industrial zones, a locality can capture the resulting increase in property tax revenues driven by enhanced land use and business development. These future revenues can then be used to repay bonds and loans or directly fund the upfront costs of dredging projects.

5.2.6 Loans

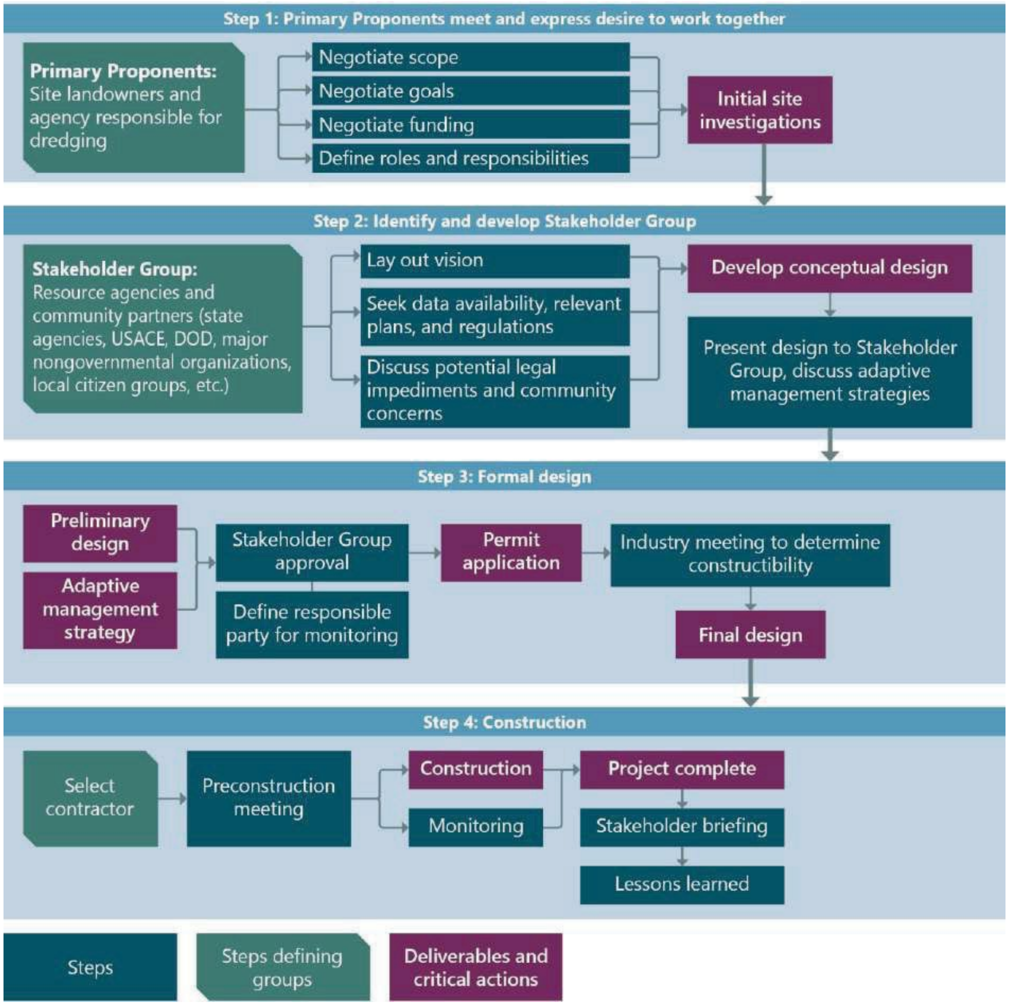
Low-interest loans for dredging and dredged material management projects are available to local governments through the Virginia Resources Authority. These financing options were authorized by a 2018 amendment to § 62.1-199 of the Code of Virginia. The program helps support the planning, design, and implementation of dredging projects.

5.3 Stakeholder and Regulatory Involvement

5.3.1 Stakeholder Engagement

While the permitting process for projects often stipulates regulatory agency coordination and consultation, project planning should include early and significant engagement with key stakeholders. Ideally, such outreach should focus on team building and consensus development on important project aspects, such as goals and objectives, constraints, and success criteria. Meeting with relevant parties early in the planning process is strongly encouraged because BUDM projects typically involve groups with distinct, and occasionally different, project goals. Early communication of goals and processes to stakeholders will promote collaboration and goodwill and may significantly reduce delays that could occur later on due to a perceived lack of engagement felt by other interested parties. Engaging with stakeholders is not a one-size-fits-all activity, and engagement with regulatory partners, nongovernmental organizations, and community advocates should differ in approach because all parties have different goals and concerns surrounding BU. Some parties may request engagement sooner in the process, while others may prefer engaging later, when project plans are more developed. Communications should balance updating and receiving input from all parties and set reasonable expectations throughout the project. Figure 5-1 summarizes the engagement process.

Figure 5-1: Stakeholder Engagement Process



Source: Modified from Piercy et al. (2023) - originally developed by Scott Douglas, former NJDOT.

Table 5-1 lists potential stakeholders for BUDM projects in the Commonwealth. The stakeholder list for each project should be reviewed and updated as necessary throughout the life of the project to ensure a transparent planning process and to communicate proposed changes as adaptive management needs arise.

Table 5-1: Potential BUDM Project Stakeholders in Virginia

VMRC	Virginia DEQ
VIMS	DWR
USACE, Norfolk District	NOAA Fisheries Service
Department of Defense	NASA Wallops Island
Local tribes (e.g. Chickahominy Indian Tribe, Patawomeck Indian Tribe of Virginia)	Local PDCs
DCR	Local Wetlands Boards
Nongovernmental organizations engaging in resilience and habitat restoration work	Cities, Towns, and Counties
Contractors	Engineering firms
Virginia Security Corridor Sentinel Landscapes (partnership between DOD, agencies, and Commonwealth)	USFWS

Note: This list is not all inclusive and should be reviewed and updated with each BUDM project.

5.3.2 *Jurisdictional Considerations*

Multiple state, local, and federal entities are involved in regulating BUDM projects. VMRC upholds the Public Trust Doctrine and, consequently, regulates subaqueous lands below mean low water (Code of Virigina 28.2-1202). Virginia DEQ is the lead agency for Virginia CZM's network, a consortium of agencies involved in coastal work including VMRC, VIMS, the Virginia Department of Energy (Virginia Energy), Virginia Department of Forestry (DOF), Virginia Department of Historic Resources (DHR), Virginia Department of Agriculture and Consumer Services (VDACS), DCR, DWR, and VDH. Virginia CZM network agencies administer enforceable laws, regulations, and advisory policies governing coastal resources (DEQ 2024c). Virginia DEQ, in collaboration with USACE and VMRC, administers some of the major permits required for BUDM projects. (The permitting process is described in more detail in Chapter 8.) A list of regulatory contacts at the USACE Norfolk District is maintained online at https://www.nao.usace.army.mil/Missions/Regulatory/Contacts.aspx.

Data used in the BUDM process in Virginia may come from various state or federal regulatory agencies, depending on the legally mandated or de facto responsibilities of the agency (DCR 2024b). DCR collects a wide range of data that may be relevant to BU projects, including the presence of threatened and endangered (T&E) species, floodplain mapping, riparian buffer areas, topography, shoreline erosion rates, conservation easements, zoning and subdivision regulations, nonpoint pollutant sources, and recreational and historic sites. DEQ collects data on water chemistry, biological monitoring, habitat classifications and management, water flow, and pollutant and point source discharges. DWR collects wildlife and fish data from around the Commonwealth, including information about the location of and habitats occupied by T&E species and other imperiled animals, information provided by hunters and anglers, and data collected by DWR's Scientific Collections Permittees. DWR uses these data to designate unique habitats, inform land use, and prioritize conservation efforts. USFWS collects data on the presence of T&E species and can provide recommendations on surveys and conservation measures during the planning stages that would be beneficial during the permitting stage. VMRC collects much of the same data, as well as wetlands and channel and navigation data. The full breakdown of agencies collecting various BU-related data (including VDH, Virginia Department of Transportation [VDOT], VDACS, DOF, and Virginia Energy) can be found in DCR's Community Water Quality Approach report (DCR 2024b). Additional data may be acquired from federal agencies such as the USEPA, U.S. Department of Agriculture, the DOD, U.S. Geological Survey (USGS), and PDCs and from soil and water conservation districts, local governments, and colleges and universities.

5.4 Scientific Advisors

The Commonwealth of Virginia relies on the academic and scientific community for the best available information on science to inform policy and regulation development. VIMS is codified into law to support and expand research on estuarine marine systems and to advise on marine and coastal issues. VIMS has published a wealth of information and data on estuarine systems, wetland and habitat health, and shoreline erosion for consideration when planning, designing, implementing, and monitoring BUDM projects. Other academic and research institutions have also been engaged to inform how policies and regulations could be adjusted to accommodate the shift to sustainable practices such as beneficial use and nature-based solutions. Based on support from the various scientific advisors, the Virginia General Assembly enacted in 2018 a law stating that "the Marine Resources Commission […] shall adopt regulations to establish and implement a fast-track permitting program that authorizes the selection and use of appropriate sites in Tidewater Virginia […] for the disposal of material dredged in such region" (General Assembly of Virginia 2018 Uncodified Act, Chapter 449 [HB1096]). The academic and scientific community will need to continue to be engaged in BUDM projects to inform the regulatory process and necessary iterative changes for a successful regulatory framework supporting MEE for coastal resilience.

5.5 Baseline Monitoring Studies and Preliminary Beneficial Use Placement Investigations for Habitat Restoration

Once a placement site is identified, its ambient conditions should be characterized and understood so that impacts after placement can be fully determined (ERDC 2022).

A conceptual understanding of the waterway and wetland system is required during the initial planning of BUDM projects. The project team should have a firm understanding of the placement site location and nearby habitat functions and should consider the physical, ecological, engineered, and combined physical and ecological systems and the cultural and regulatory context for each. Initial investigations should consider oyster leases in the area, current elevations, local tidal ranges, and comparison of the physical and chemical characteristics of the material to be dredged to the native receiving sediment.

Monitoring the proposed site before placement is a critical step in understanding local behaviors and the general feasibility of BUDM in the area. Preconstruction monitoring provides a baseline or initial assessment of conditions at the placement site. Data gathered during and after construction can be compared to the initial conditions to determine the success of placement and the impact of DM on benthic habitat. Placement site monitoring may also identify possible obstructions to placement such as hydrodynamics at the site.

Baseline review of the placement site should also account for ecological information such as native soil and sediment properties, the presence of invasive species like the common reed (*Phragmites australis)* or green crabs (*Carcinus maenas*), and the abundance and diversity of T&E species (sea turtles, tiger beetles, and shorebirds). The review should also account for use of the site by wildlife for sensitive activities like mating or nesting and the presence of oysters or other reef-forming bivalves. USFWS and VCR have data concerning additional T&E species in the Commonwealth. SAV density, cover, and aboveground and belowground biomass should also be considered. Current vegetation assemblages, if applicable, should be monitored to determine whether they are healthy or stressed prior to material placement.

The presence of SAV, reef-forming bivalves, or T&E species at the site may require protective action such as silt fences, mitigation in the form of restoring habitat elsewhere, time-of-year restrictions or considerations, or the selection of an alternative site to minimize impacts to sensitive species or habitat. If invasive species are present, their removal may be carried out as part of the project, and project teams should implement strategies to prevent their spread due to increased disturbance at the site during construction (Correll et al. 2024).

Initial ecological assessments for DM placement at the site level may consider the environmental benefits and costs of placement at that location. With island habitat creation, for example, planners must consider whether benefits to upland organisms like birds outweigh habitat losses for fishes and SAV. Costly mitigation may be necessary to replace sensitive habitat such as seagrass meadows or bivalve reefs, making other nearby sites more attractive as placement options. The DWR State Wildlife Action Plan can be consulted for strategies to improve and maintain natural habitat and conserve wildlife for 883 species in decline in Virginia.

Site assessments should also characterize cultural resources, such as historical and archaeological sites, indigenous landscapes, and shipwrecks. DHR encourages stewardship and preservation of Virginia's cultural and historic resources. The department's guidelines for conducting cultural resource surveys and inventorying identified cultural resources in Virginia can be found at https://www.dhr.virginia.gov/.

6 ENGINEERING CONSIDERATIONS

Depending on the type of BUDM being considered, additional tests on the DM may be necessary to ensure standards for habitat quality, public health, and upland uses are met so the necessary permits can be obtained. Testing needs vary based on project scope, site history, and intended BU type. If testing is warranted, samples typically will be taken from the channel prior to dredging. Additional information on testing is available in USACE Engineer Manual 1110-2-5025 (USACE 2015).

DM to be used in manufactured products may require testing different from that required for DM used in typical BU projects.

6.1 Physical Characteristics

The physical characteristics of DM affect operational controls during dredging and placement, can significantly affect the potential end uses of DM, and may also affect the water quality controls required during construction. Early assessment of in situ material will help refine the project and determine the necessary potential assessments.

It may be important to determine whether the source DM is homogeneous throughout the navigation channel or borrow area, or whether there is high spatial heterogeneity of the material in terms of physical characteristics. Homogeneity or heterogeneity of the material may be determined by environmental energy levels at the site and by whether the site is an environment favorable to the shoaling of fine-grained materials or a protected harbor or basin that serves as a depositional area for silts and clays. Different materials will behave differently throughout dredging operations, and material may self-sort during placement, with sands immediately settling out while silts and clays stay in suspension longer. This hydraulic sorting process may provide beneficial habitat components for the BUDM site and may benefit various species depending on the BU application. Common tests for the physical characteristics of DM are listed in Table 6-1. The tests performed for a given project should be based on its site-specific needs or characteristics and the specific needs for making decisions about BUDM (i.e., site selection or suitability of DM). Physical testing considerations for different end uses are summarized in later sections of this document. The testing required for dredging may be different from those required for BUDM determination, and the metrics for each should be considered in project planning.

Table 6-1: Common Physical Testing and Test Methods for Dredging and Placement Operations

Test Method	Test Method Description
ASTM D6913	Particle Size Distribution Analysis
ASTM D7928	Hydrometer Analysis
ASTM D2487	Unified Soil Classification System
ASTM D4318	Atterberg Limits
ASTM D792	Specific Gravity
ASTM D2216	Moisture Content
ASTM D1586	Standard Penetration Test

6.2 Chemical Characteristics

DM may be chemically characterized prior to placement if there is reason to believe, based on a Tier 1 analysis, it contains contaminants (USEPA n.d.). A Tier 1 analysis assesses the results of prior analyses and scientific research at the site, the site's history of spills and pollution, and its particle size and wave energy. If the Tier 1 analysis indicates the material is coarse grained and in a high-energy location, and previous research and history do not suggest the presence of contaminants, DM can be exempted from further testing (USEPA n.d.). Details on Tier 1 analyses and chemical characterization can be found in the Inland Testing Manual (USEPA and USACE 1998).

Chemically characterizing DM before it is used can extend project timelines and increase costs, potentially making smaller BU projects infeasible. Four impacts should be considered to determine whether the DM can be used in BU: 1) plant toxicity; 2) animal toxicity; 3) surface water contamination; and 4) groundwater contamination (USACE 2015). The cation exchange capacity (CEC) of the material governs the sorption of nitrogen, potassium, heavy metals, and some pesticides to DM particles; generally, fine-grained material has a higher CEC and is more likely to contain contaminants. In addition to CEC, DM may be tested for nitrogen content, particularly ammonium. Solid-phase sulfur in DM may also be assessed because drying DM results in the oxidation of iron- and manganese-sulfide compounds-which are stable in anoxic sediment—to sulfate, dramatically reducing soil pH.

DM may also be tested for heavy metals, which are often found in marine, estuarine, and lacustrine sediment due to industrial and sewage discharges, urban and highway runoff, and snow removal using salts. Heavy metals of concern include zinc, copper, nickel, cadmium, boron, lead, mercury, and chromium. They are often bound in mineral form with sulfide in anoxic submerged DM and may become mobile due to the dissolution of metal-sulfide minerals during extraction and drying.

Sediments in Virginia may be naturally high in some compounds, including arsenic, and as such, may exceed federal threshold values developed based on national averages. It is recommended that Virginia DEQ's Management and Reuse of Contaminated Media Guidance be consulted for the most regionally appropriate guidance for reuse of DM containing heavy metals and other compounds.

6.2.1 Contaminated Dredged Material

When potentially mobile contaminants of concern (COCs) are identified in DM, additional testing is required to ensure proper placement and environmental risk management. DM that is mostly clay and silt contains particulates that have a greater affinity for COCs than does sand (USEPA and USACE 1998). Although more than 300 million cubic yards of sediment are dredged annually for domestic navigational purposes, only 5% to 10% of the total volume is deemed unsuitable for traditional open-water disposal because of contaminants (ERDC 2003). Alternative placements must be identified for that material.

Five potential contamination pathways must be evaluated when making such determinations:

1. Effluent discharge to surface water during filling operations and subsequent settling and dewatering;
2. Precipitation and surface runoff;

3. Leachate into groundwater;
4. Volatilization to the atmosphere; and
5. Direct uptake by plants and animals living on the DM and the subsequent cycling of the contaminants through plant and animal food webs (USACE 2003).

DMMAs are the most common alternative placement. The presence or concentration of certain COCs differs among different DM types. A toxic and persistent chemical will always be evaluated and tested as a COC, and its impacts on a potential placement area must be understood to fully understand the scope of risk and appropriate management actions. The initial extraction site must be examined to determine where and when the potential contamination may have occurred (USEPA 2022). Permitting authorities may require physical, chemical, and biological evaluations if the sediment and COC presence differ between the dredging and placement locations.

6.2.2 Risk Assessment for COCs

Specific risk assessment criteria depend on the type of BU. Risk assessments for BUDM typically consider the physical and chemical characteristics of the material and may consider other parameters depending on the application (NOAA n.d.). Before deciding to use DM beneficially, consideration must be given to the acute and chronic hazards posed by the material, the economic feasibility of using or treating the material for use, and the potential effectiveness of the treatment methods (NOAA n.d.). The steps in BUDM project risk assessments are described in detail in ERDC/EL TR-22-9 (ERDC 2022).

Risk assessments for BU projects must consider all the possible routes by which humans and biota may be exposed to identified or potential COCs after placement of the DM. Routes of possible human exposure include direct dermal contact, inhalation, and ingestion of game or drinking water (ERDC 2022). Biota may be exposed through ingestion or bioaccumulation influenced by plant toxicity, volatilization of material, fugitive dust, runoff, leaching and infiltration, groundwater discharge, and plant and animal uptake (Great Lakes Commission 2004).

Which exposure routes predominate depend on the type of BUDM. With beach nourishment, for example, humans have direct contact with the material and potential exposure pathways include dermal exposure, ingestion, and inhalation. Material may also be ingested by and bioaccumulate in shorebirds, fish, benthic infauna, and other biota. Other DM uses have other considerations. When using DM in a landfill a cap, for example, managers must consider possible exposure through volatilization, dust, runoff, and leachate (Great Lakes Commission 2004).

Tests performed for certain exposure routes may include direct assessments of COC bioaccumulation in cultured fish or aquatic or terrestrial macroinvertebrates under controlled laboratory conditions.

When laboratory tests are carried out for risk assessments, planners must carefully extrapolate the results from the controlled environment to the more complicated physical and chemical conditions in the field (ERDC 2022).

Specific risk criteria may depend on conditions at the placement site. Sensitive ecological or cultural resources, public health, water quality, and receptors of concern at the site may be considered.

Because risks vary, early site characterization should broadly determine a variety of parameters:

1. The type of site (e.g., aquatic, wetland, agricultural, industrial, urban);
2. The size and circulation of any adjacent waterbodies;
3. Groundwater under the site and its potential use for irrigation or drinking water;
4. The history of site use;
5. Land use in the watershed and in the area surrounding the project;
6. Ambient contamination;
7. Potential continuing sources of contamination that may affect the project; and
8. The environmental, zoning, and local regulatory controls that may affect future land use and development (ERDC 2022).

6.3 Biological Considerations for COCs

Biological conditions related to the DM or at the placement site may preclude the implementation of a BUDM project. DM that contains heavy metals, fertilizers, sewer wastes, pesticides, or petroleum products that exceed maximum acceptable levels set by the USEPA may be too harmful to use in habitat restoration (USACE 2015). The types of animals and plants on site, their tolerance to potential pollutants, and their capacity to take up potential pollutants should also be considered. Biomagnification is a concern when plant, invertebrate, and microbial uptake leads to pollutant bioaccumulation up the food chain into animals or humans. In some cases, little information is available on the biomagnification capacity of pollutants found in DM. Pesticides are known to hamper avian reproduction through eggshell thinning, particularly in seabirds that consume small feeder fishes that have bioaccumulated pollutants through their consumption of benthic infauna.

Many wetland plants and SAV transport certain materials and gases between their belowground and aboveground tissues (Armstrong and Armstrong 2013). Where on-site pollution is a concern, habitat restoration can prioritize bird species that feed on fishes off site rather than consume on-site vegetation. Contaminated sites may also be managed by capping the DM with 2 feet (0.6 meter) of clean material and selecting plant species whose roots will not extend below the cap.

In addition to ecological data, the environmental review should consider the impact that physical conditions at the site, like high wind or wave action, may have on the potential placement of DM. Strong erosive forces on an island creation project, for example, may spread the DM away from the project site, necessitating an assessment of either the potential biological and human health impacts over a larger area or the need to include coastal armoring in the project design.

6.4 Water Quality Considerations

The impacts of BUDM projects on water quality can be challenging to predict because of the complicated interplay between hydrodynamic, physical, chemical, and biological conditions at a site. Heavy metals, chlorinated hydrocarbons, pesticides, nutrients, and oil and grease are

not very soluble in water; they typically attach to suspended particles, settle to the bottom, and concentrate in the sediment. Disturbing these sediments during dredging and placement temporarily resuspends the contaminants. How long until the contaminants return to a stable state in the sediment depends on the physiochemical conditions at the site and the quantity of contaminants in suspension
(USACE 2015).

Turbidity caused by DM discharges will vary greatly between projects and will depend on the grain size of DM used. When anoxic sediments are resuspended into oxygenated surface water, formerly stable contaminants may oxidize and become more mobile (USACE 2015). Water quality conditions such as total suspended solids and turbidity may require monitoring before, during, and after construction to assess impacts on the dredging and placement sites and the potential impacts to nearby habitats and organisms. Monitoring at the discharge point and the placement site will be necessary if comparisons to baseline water qualities will be made, especially during construction.

Although there is no universal correlation between turbidity and total suspended solids in the water column, USACE studies have shown that turbidity plumes from DM discharges are localized, temporary, and quickly dissipate to background levels (USACE 2015); however, this depends greatly on hydrodynamic conditions at the site and material characteristics. Although Virginia does not have a legal, numerical turbidity standard, turbidity testing and monitoring may proceed and the standards of nearby states considered. State-specific sediment-related Criteria for Surface Water Quality are listed in *Developing Water Quality Criteria for Suspended and Bedded Sediments (SAB)*, *Appendix 3: Sediment Related Criteria for Surface Water Quality* (USEPA 2003). It should be noted that, as this BUDM guidance was being written, the Virginia Water Control Board was amending 9VAC25-260, the state's Water Quality Standards, to regulate turbidity using numerical criteria (VAR 2021).

7 LOGISTICAL CONSIDERATIONS

7.1 Dewatering

During DM stabilization for construction or upland uses, and for some habitat development uses, dewatering is necessary to reduce permeability (CEDA 2019). DM may be combined with cement, fly ash, slag, or other industrial byproducts to achieve desired physical characteristics. Mechanical dewatering often involves drying with heat, evaporation, and draining the material (U.S. Aqua Services 2024). To increase the efficiency of the dewatering process, flocculants and coagulant polymers are sometimes added to the DM slurry to hasten the separation of solids from liquid (Clearwater Industries 2021). Drainage trenches also can hasten passive drying of DM slurry (USACE 2015).

7.2 Transport, Handling, and Storage

Depending on the placement site location, transporting DM from the dredging location to the placement site may be logistically challenging. For some BU applications, such as wetland restoration in which sediment is pumped directly from the dredge to an eroding wetland nearby, transport may be minimal and DM storage not needed. But in other applications, such as the use of DM in manufacturing and industry, considerable planning is required to determine how and where DM will be handled, staged, prepared, and stored.

Planners of BUDM projects typically have five transport options to choose from:

1. Hydraulic pipeline;
2. Rail haul;
3. Barge/scow transport;
4. Truck haul; and
5. Belt conveyor movement.

Most existing BU sites use hydraulic pipelines, barge transport, and truck haul. When selecting a transport route, managers should first use maps and site investigations to identify available routes before classifying the nature of the material to be moved (i.e., wet or dry), determining the volume of DM and the duration of the project, estimating the cost of each transport alternative, and identifying and evaluating technical, environmental, legal, and federal agency regulations (USACE 2015).

If the DM is a slurry, a hydraulic pipeline is the best choice and may be economically feasible for distances up to several miles. Density and flow should be carefully controlled, and a secondary rehandling dredge should be designated to process and move the DM into the pipeline. The DM is typically pumped out of the pipe into a containment area at the target site, avoiding the need to unload the material, as is the case with other transport modes. When deciding to transport material by hydraulic pipeline, managers should consider the need to acquire right-of-way access to the desired route and the potential need for confining dikes at the placement site, which may be costly.

If hydraulic dredging is used, the slurried DM may be piped directly to the BUDM site. This is typically the most economical means. Dredges may vary in pumping distance capability. For distances further than the dredge’s capability, booster pumps may be required to convey the DM. Incorporation of booster pump(s) will result in project cost escalation. If BUDM sites are beyond economic pumping distances, hydraulic dredges may pump the slurried DM into scows for transport to the BUDM site. BUDM site evaluations should consider whether the water is deep enough to accommodate fully loaded scows and the required pumping distances for a hydraulic offloading operation to convey the DM from the scow and to the BUDM site. Pipeline routing should consider sensitive resources to avoid or the need to acquire right-of-way access for the pipeline. Depending on the BUDM application and surrounding site conditions, containment of the slurry may be considered. Confinement of the DM slurry may result in project cost escalation if determined to be appropriate for the BUDM application.

Barge transport may be an economically competitive option depending on the volume of material being moved. Loading and unloading facilities are needed near both the dredging and the placement sites, and roads may be necessary to get material from the barge to the placement site. In addition, bathymetric and navigational information about the waterway must be available to the barge captain, and climatic conditions may affect operational schedules (USACE 2015).

Similarly, truck haul requires loading and unloading DM into a truck bed, and roadways are necessary to get the material to the placement site. Managers considering truck haul of DM should take into account local ordinances that may prohibit trucks on some roads, set noise standards, or specify weight limits on small bridges and roads (USACE 2015).

Other transport methods typically less used in BU projects are described in detail in Section 5.9 of USACE’s Dredging and Dredged Material Management Engineering Manual (USACE 2015).

Regardless of transport method, moving DM over wetlands or soft ground may form ruts and damage vegetation. If DM must be transported over sensitive areas, timber construction mats can be used to help prevent damage (USACE, New England District 2016). Temporary impacts to wetlands also should be considered, and best management practices (BMPs) to prevent damage should be proposed for any permit application involving wetlands.

7.3 Cost Analysis for Dewatering, Storage, and Transport

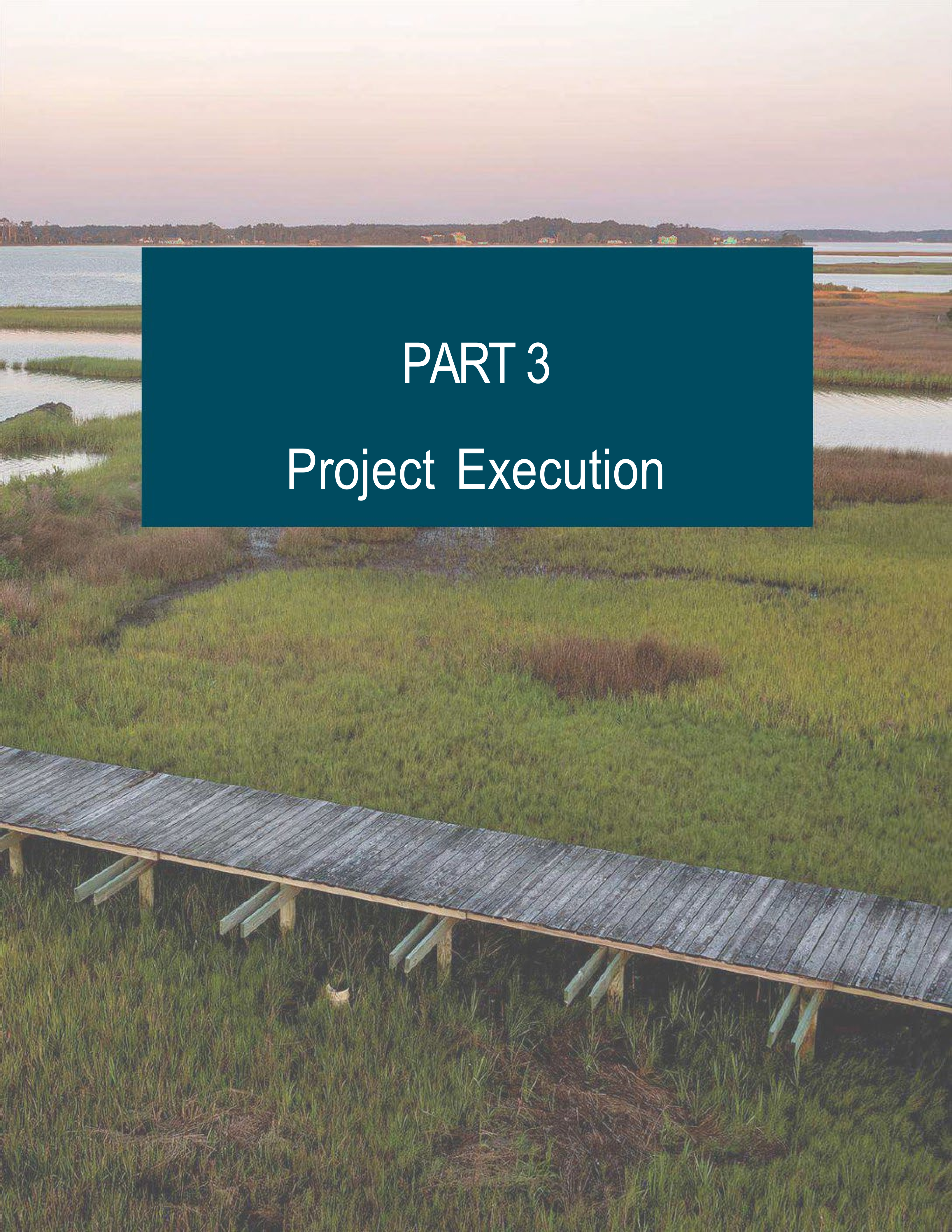
Dewatering, transporting, and handling DM are costly, and project budgets should include them. The final cost will depend on the degree of manipulation (trenching or coagulation) required to dry the DM and the type of heavy equipment used to do that (USACE 2015). The costs of trenching can be very site specific, depending on the size of the placement area and the ease of access for machinery.

Transport costs may account for as much as 90% of the total land improvement budget for some projects. Cost estimates depend on the selected mode of transport, and the differential costs of various modes should be considered when selecting a method for transporting DM in BU projects. The volume of material to be moved and the transport distance should be considered when estimating transport costs. Depending on distances for moving the DM and the terrain, various methods of transport may be considered. Hydraulic pipeline is typically most cost-effective for small quantities of material over short distances on most terrain. Barge transport may be preferred in some situations, such when moving DM from a channel across open water to a site (USACE 2015).

Local costs should be considered, compiled, and assessed as projects are executed.

PART 3

Project Execution

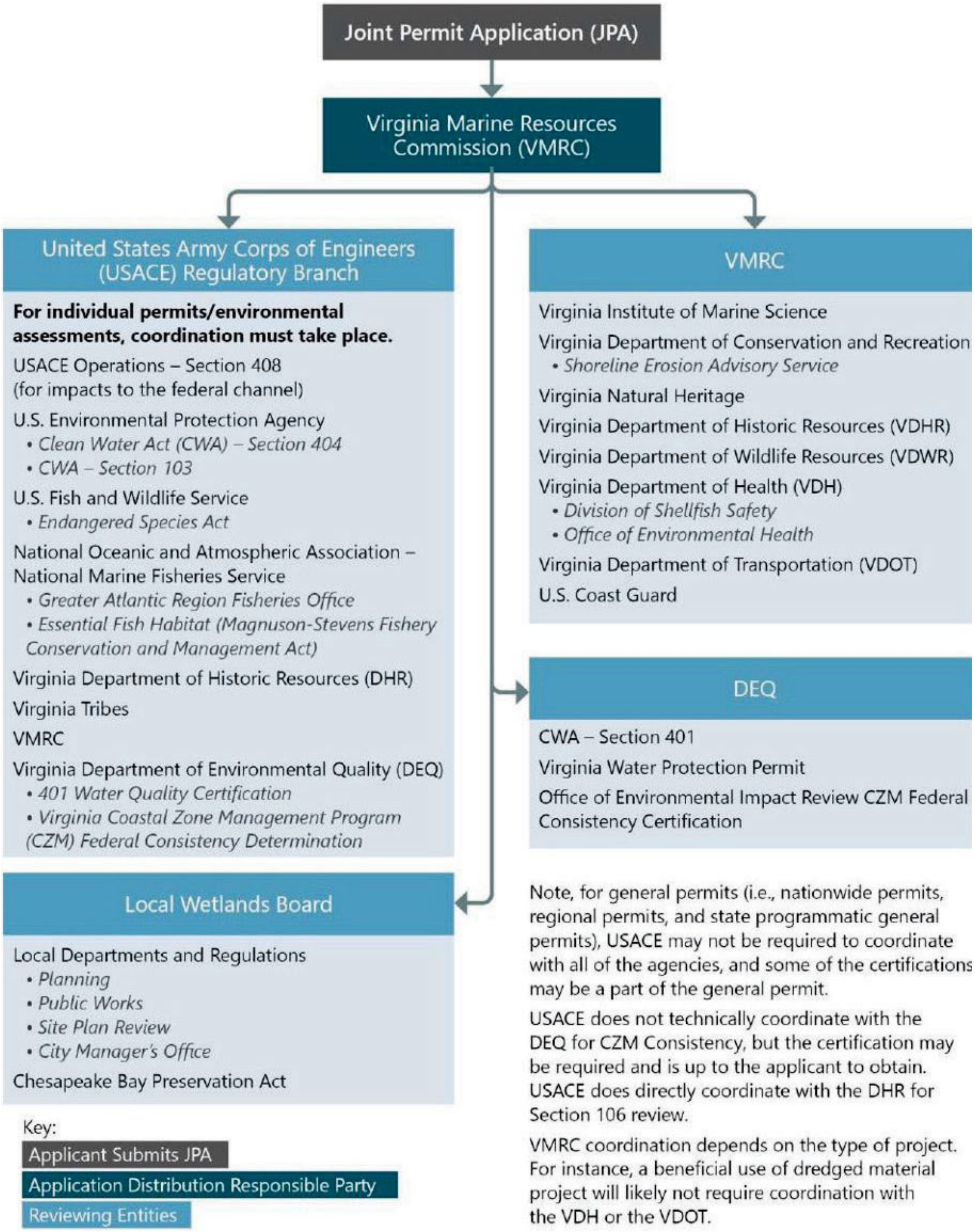


8 PERMITTING

DEQ administers the Virginia Water Protection permit program and regulates impacts to surface waters. Permits go through a stepwise process that includes reviews by interested and affected state and local agencies (potentially including DWR, VMRC, VDH, and any city or county wetland board) and a public notice and comment period. In Virginia, scientific advisors including VIMS function as state agencies that may weigh in on this process. USACE has a similar stepwise permitting process that involves consulting with federal agencies, including USFWS and NOAA's National Marine Fisheries Service, at each step to carry out environmental assessments and ensure compliance with the Fish and Wildlife Coordination Act, Coastal Barrier Resources Act, Magnuson-Stevens Fishery Conservation and Management Act, Endangered Species Act, and other legislation (Gregory et al. 2024). Federal agencies regularly coordinate on issues surrounding BUDM, as evidenced by USFWS and NOAA's joint guidance document, Coastal Marsh Restoration: An Ecosystem Approach for the Mid-Atlantic (Correll et al. 2024). VMRC has regulatory authority over placement and impacts of materials in Virginia's subaqueous waters.

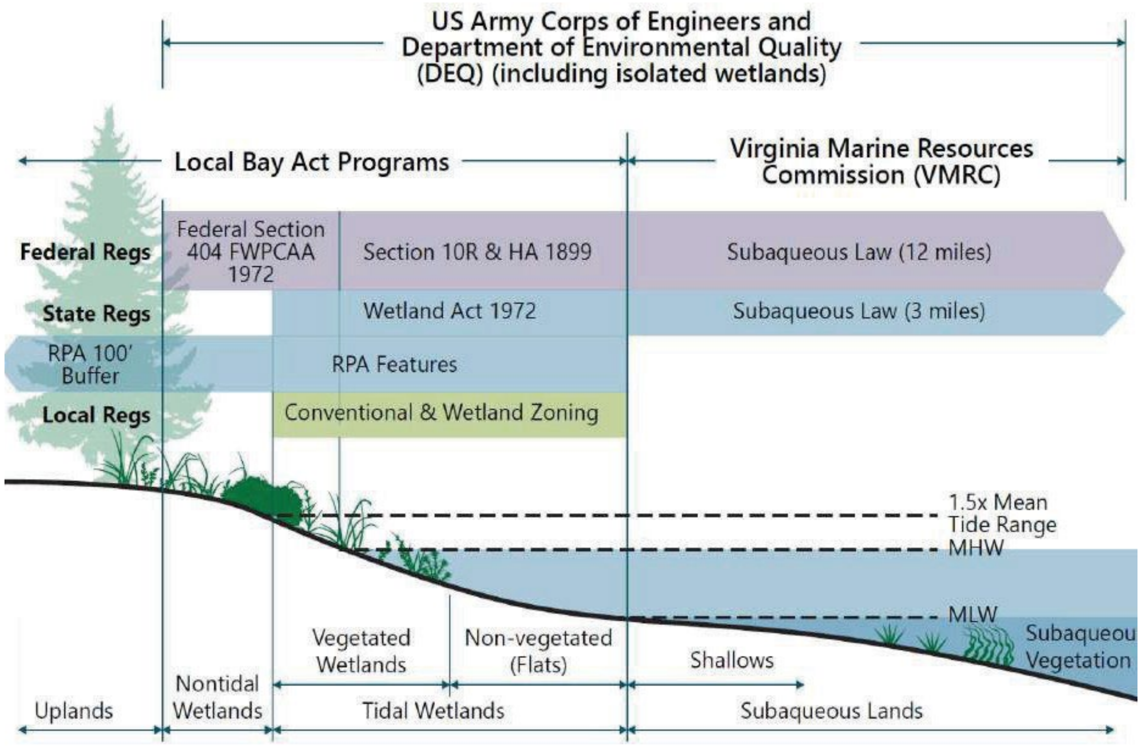
The Joint Permit Application (JPA), available on the VMRC website, is designed to help applicants navigate review and authorization from VMRC; DEQ; the USACE, Norfolk District; and other supporting entities. The JPA is a single, streamlined application used to obtain multiple environmental permits for activities affecting Commonwealth-owned subaqueous bottomlands, streams, wetlands, and other waters. Available information from the USACE Norfolk District, such as the Regional Permit 17 Certificate of Compliance Form (Appendix B), aims to help practitioners ensure they have all information needed to fill out the JPA. The completed JPA is sent to VMRC, which transmits it to the USACE, Norfolk District and Virginia DEQ, as illustrated in Figure 8-1. This review and authorization process aims to minimize impacts to subaqueous bottom and valuable habitat, determine any necessary mitigation measures, and establish a monitoring plan.

Figure 8-1: Regulatory Process Flowchart



Virginia has a framework for the “Fast-Track Permitting Program for Disposal of Dredged Material” (https://mrc.virginia.gov/regulations/FR1340.shtm). The fast-track option for JPAs submitted by local governments in Tidewater Virginia for dredging projects and associated DM disposal sites involving state-owned submerged lands is enacted when “shoreline or open water placement of dredged material is preferable for habitat creation or development of living shoreline features or to enhance coastal resilience” (https://mrc.virginia.gov/regulations/FR1340.shtm). Decision-makers should consult VMRC Regulation 4VAC20-1340-10 et seq. for a comprehensive list of applicability and procedures to ensure they are submitting the correct projects for fast-track consideration.

Figure 8-2: Joint Permit Application: Review Agencies and Jurisdictional Boundaries



Regs = Regulations, RPA = Resource Protection Area

When considering the life cycle of a project, the permitting requirements for dredging, transportation, storage, placement, and restoration also need to be considered. Placing DM in a confined disposal facility is often more straightforward when the receiving facility is already authorized by permit. For example, MEE projects are more aligned with restoration projects and so are generally more complicated to permit and authorize to receive DM. The project team and stakeholders should determine whether the dredging and MEE portions of the project should be permitted as one project, or the MEE portion of the project should be permitted and prepared beforehand until a dredging project that meets the requirements of the MEE project becomes available. The completion date for construction of permitted projects is normally 3 years from the date of approval. Maintenance dredging permits may be granted for up to 5 years. Restoration projects may have a permit timeline of more than 200 days.

9 DESIGN

The following section provides recommendations for typical projects that involve habitat enhancement (section 3.1 of this document). Recommendations may also be relevant to other land use-type BUDM projects. Other project types, such as manufactured products and use of DM as fill or at landfills, mines, etc., will have different design considerations that may be highly specific to the individual project and use. Future efforts should compile the existing science for habitat projects as well as other BUDM opportunities to identify data gaps, determine path forward to expand the state of the science, and develop the process for implementation.

9.1 Conceptual and Preliminary Design

Conceptual design includes project formulation, baseline data collection, and development of the project to the 10% to 15% level. Identifying the baseline conditions (discussed in Section 5) through desktop analysis and preliminary site investigations helps to formulate the project's objectives and goals and identify project constraints, including private and public leases; ecological resources such as SAV, oysters, mussels, or wetlands; infrastructure such as roads, culverts, and navigation channels; and cultural resources that may be present at the site. Project components that could constrain the design in the future should be accounted for and considered to understand their possible impacts on the final design. Financial considerations such as funding options may also affect project phasing and design. Coordination with knowledgeable parties such as VIMS and state agencies as early in the process as possible can help determine scope and priorities.

A major consideration for BU projects is the source of the sediment to be used. Sediment type, possibility of contamination, quantity, and method of conveyance must be compatible with the proposed placement site and BU type. Because sediment properties drive many aspects of project design, the sediment source should be identified early. Often, a nearby dredging project will be the source but, depending on project constraints, the dredging project may also have to identify additional placement capacity for the DM that the BUDM project cannot use.

The preliminary design phase advances the project to approximately the 30% level and includes design features specific to the site itself, such as access from land or water, local hydrology, infrastructure in the area that may need protection, the site's bearing capacity, and other factors necessary to meet the project objectives. Engagement with stakeholders and regulatory agencies, which may have already begun, needs to occur during this phase. Stakeholder priorities often conflict at this point, and when they do a re-examination of each party's goals and objectives can be helpful. Plans and specifications can be performance-based where the final site conditions required for acceptance by the project planner are described, or designs may be highly prescriptive, outlining specific means and methods required to achieve the desired site conditions. Both approaches may be leveraged as appropriate for different elements of the site (i.e. dredging and BUDM). Highly prescriptive designs may result in costs escalation if they prevent flexibility and efficiency in construction means and methods, so projects should seek a balance between the two design approaches to meet objectives and regulatory requirements.

The preliminary design phase should to the maximum extent practicable result in consensus on the overall project layout and approach to meet the desired outcomes and goals. Key project components should be identified, including potential DM sources, placement locations, and logistics of the dredging and placement operations. General logistics should be assessed to advance coordination with regulators. A voluntary pre-application meeting with the permitting agencies is highly recommended to address questions or concerns before a JPA is submitted. Pre-application meetings are important to allow relevant agencies to review BUDM projects more closely and encourage applicants to plan well before DM becomes available. It can take considerable time for projects to go from design to permitting to construction in Virginia, and pre-application meetings may lead to a more efficient process. Meetings with adjacent property owners or community groups to explain, with visual aids, the project are not required but may significantly reduce conflicts and roadblocks later.

Supplementary data should be collected in parallel with the preliminary design, including updated survey information, additional sediment characterization, wetland and water quality assessments, and other information required to finalize the project design and obtain permits. The project team should collaborate on the critical elements of the project, the level of detail each requires, and possible points of contention to ensure all elements are thoroughly assessed and hurdles are identified early.

9.2 Intermediate Design

The intermediate (60%) design phase refines the details developed in the preliminary stages. Shifting from determining how BUDM will meet project objectives to designing the performance-based implementation process is the focus of the intermediate and final phases.

Although the preliminary design may be able to advance based on a desktop assessment of available data and the possible addition of field-verified data, the intermediate design should be based on the most accurate site data feasible to define and refine the project through regulatory coordination. Bathymetry and topography, vegetation density, and any other key data inputs should be comprehensive enough to inform best estimates of construction and biological target elevations and tolerances. If DM from multiple sources will be placed, data from those sources will be needed to inform key placement design criteria, such as channels and volume of material to be dredged, timeline for dredging, and characterization of the sediment. Key design metrics, features, and logistics for placement—including potential containment, the slurry distribution system, access points, and a vegetation enhancement or establishment strategy-will be refined during this phase.

The intermediate phase should culminate in a cost estimate, design plans and specifications, and an implementation schedule at approximately the 60% level. Permit applications may be prepared at this stage, and permitting costs should be considered. As the project is refined through this phase, the procurement and implementation strategy for construction should be considered. The method of engaging a contractor to perform the work (Invitation to Bid, Request for Proposal, Design-Build, etc.) and the various funding sources for construction and long-term monitoring should be determined. These different procurement strategies and funding sources often have variables that inform the design. Additional information on procurement is available in Section 10.2, Project Financial Management.

9.3 Final Design

The final (90% to 100%) design phase is the culmination of all assessment, design, and coordination up to this point. This phase incorporates the findings from all the engineering analyses and the design features such as placement site, sediment source, adaptive management plan, and regulatory coordination. Ideally, permits and authorizations have been obtained, or are imminent, because they often include key constraints that need to be added to procurement packages.

Design plans, specifications, quantity takeoffs, and cost estimates should be updated to the 90% design level and, ultimately, to an accuracy adequate for procurement. Procurement packages should include plans, specifications, bid tabulation, permits and authorizations, and any other contractual requirements for construction.

10 IMPLEMENTATION

This section provides recommendations for typical projects that involve habitat enhancement (section 3.1 of this document). Recommendations may also be relevant to other land use-type BUDM projects. Other project types, such as manufactured products and use of DM as fill or at landfills, mines, etc., will have different, innovative methods that may be highly specific to individual projects.

10.1 Means and Methods

A successful BUDM project requires coordination and cooperation between the owner, the owner's representative, contractors, and stakeholders.

10.1.1 Methods

BUDM projects typically involve pipelines that transport DM from the dredging site to the BU site. The type of pipeline discharge (high pressure or low pressure) and how the pipeline is positioned and repositioned throughout the project have a critical influence on achieving targets and optimizing the engineering characteristics of the placed sediment. In the case of wetland restoration projects, positioning of the pipeline should account for impacts to existing vegetation and shorelines and the formation of ruts in existing soil. If DM must be transported over sensitive areas, timber construction mats can be used to help prevent damage (USACE, New England District 2016).

Low-pressure discharge results in a slower slurry at the inflow point. This allows better control of the inflow point and reduces impacts to the receiving site and the water column. But low-pressure pipelines need to be repositioned frequently to avoid sediment stacking, unless the design considers this stacking and the potential movement of the sediment over time to the desired grades. Low pressure works best for target thicknesses of plus or minus 12 inches of average placement.

High-pressure discharge requires the addition of a contraction section to the end of the pipe to increase slurry velocity and propel sediment much farther from the inflow point. High-pressure discharge can spread DM much more thinly than low-pressure discharge can and requires less frequent repositioning of the pipeline. Disadvantages of high-pressure discharge include scouring of surface sediments at the placement area and production delays caused by objects such as shells, organic material, and debris clogging the nozzle attachment; these materials are commonly excavated from navigation channels and marinas in the Chesapeake Bay and its tributaries.

Hydraulic sorting of coarse-grained and fine-grained sediment tends to occur during both low- and high-pressure discharge, resulting in coarse-grained sediment stacking adjacent to the inflow point and fine-grained sediment migrating farther out.

The method of sediment distribution can be detailed during the design stages or engineered during construction. Ideally, the design will have established the target elevations, range of acceptable thicknesses, areas of impact, and target outcomes in enough detail for a contractor to estimate the price of the project while allowing flexibility in the means and methods of placement, material characteristics, and natural site conditions to minimize impacts and achieve the project's objectives.

10.1.2 Equipment

Cutterhead suction dredges and hopper trailing suction dredges are the most common equipment used to excavate sediment for BUDM projects. Equipment size depends on BU type and region; North Atlantic Coast wetland projects, for example, typically use smaller cutterhead suction dredges and discharge pipelines with inside diameters between 10 and 14 inches. Horizontal auger dredges and mechanical dredges equipped with hydraulic pump systems to create a pumpable slurry can also be used, but they require additional material handling. Amphibious equipment can be fitted with submersible pumps and cutterhead attachments for sediment removal.

DM is pumped in a slurry through a pipeline to the inflow location-unless it is applied directly from the dredge using the "rainbowing" technique. Spreader plates and nozzles can be attached to the end of the pipeline to obtain low-pressure or high-pressure discharges. If there are multiple placement areas, Y-valves or manifold systems can be used for sequential placement or to reduce slurry volume and energy. Perforated discharge pipes may be used to maintain low-energy discharge of material and encourage distribution of the hydraulic slurry throughout the target area.

It is recommended that designers minimize equipment requirements when possible. For example, if high production rates are a concern, consider specifying a range of acceptable flow rates (i.e., gallons per minute) or equipment sizes (e.g., discharge pipe diameter) rather than a specific size of dredge. This may help increase the pool of potential bidders and allow contractors to be innovative with the tools they have.

10.2 Project Financial Management

The cost estimate developed by the project's engineers is used to manage project funding and resources. Estimates should be developed during each phase of the design process based on plan quantities and pricing estimates and should include a contingency for unforeseen costs, risks, events, or changes in scope during the project. There are many unknowns during the conceptual design phase, including site conditions, material prices, and permitting requirements. But as the project team better understands the elements that will be needed for the project, uncertainties and contingencies are reduced and the cost estimate gets more accurate. Table 10-1 summarizes the cost estimate factors and appropriate contingency for each phase of the engineering design.

Table 10-1
Cost Estimates for BUDM Project Design Phases

Design Phase	Construction Cost Estimate Description	Level of Contingency[1]
Planning and Conceptual Design (<15%)	• Feasibility-level project cost estimate • Construction cost estimate meant to be conceptual and basic in nature • Estimated unit rates based on past data may be inaccurate • Magnitudes of quantities and costs understood to lack accuracy	30% to 40%
Preliminary Design (30%)	• Estimate generated near or at complete of data collection • Estimate produced to accompany preliminary design deliverables • Level of accuracy understood to be moderate	20% to 30%
Intermediate Design (60%)	• Estimate advanced to significant level of detail • Magnitudes of quantities, unit rates, and costs estimated with low uncertainty • Level of accuracy understood to be high	15% to 20%
Final Design (95%)	• Magnitudes of estimated quantities, units, and costs understood to have little uncertainty and are incorporated into construction bid schedule • Excluding change orders, construction cost estimate should be highly accurate with respect to final construction cost	10% to 15%

Notes:
1. Adapted from Section 4.3 of the TLP Guidelines. The level of contingency shown is for informational purposes and does not replace the judgment of the design professional.
Source: Piercy et al. (2023)

The engineer's cost estimate should be based on the quantities and pricing for feasible means and methods to achieve the performance-based design of the project. Bids collected from contractors during procurement may be compiled into various combinations of the cost components from the engineer's cost estimate to achieve the performance metrics and goals of the project.

BUDM projects may receive funds from different organizations, grants, loans, or allocated budgets depending on project goals and objectives. For example, the dredging portion of a project may be funded by budgets for navigation dredging, and the placement portion may be funded partially by the navigation dredging budget and partially by funding sources supporting restoration. When considering grant funding, it is important to recognize that not all grant sources operate on annual schedules, and some may make one-time awards. Therefore, additional funding sources for long-term monitoring should be identified during the design phase before the contract package is released to bid and during initial project cost estimating, especially for efforts beyond standard practices discussed during pre-application meetings with regulators.

10.3 Project Procurement

Given the complexity of BUDM work, selecting an experienced contractor is essential. Any procurement method used should include screening to help ensure only experienced and qualified contractors are selected, which helps minimize risk to successfully construct the project. Procurement methods may differ depending on if the project occurs through a public or private entity, which determines whether it is dictated by the Virginia Public Procurement Act (§ 2.2-4300).

10.3.1 Public Projects

Procurement methods for BUDM projects in Virginia using public funds or through public agencies are dictated by the Virginia Public Procurement Act, which states that for "all public contracts with nongovernmental contractors for the purchase or lease of goods, or for the purchase of services, insurance, or construction," procurement should occur through "competitive sealed bidding, or competitive negotiation" (Virginia Public Procurement Act, § 2.2-4300). The Public Procurement Act also states that all public bodies should make online submittal of bids or proposals available digitally through the eVA electronic procurement system. For procurement of construction, competitive sealed bidding is preferred, with allowances for competitive negotiation under special circumstances outlined within the Virginia Public Procurement Act. During emergencies, contracts may be awarded without competitive sealed bidding or competitive negotiation. More details on procurement processes in Virginia, as well as selection processes, can be found within the Virginia Public Procurement Act language, located and maintained at the following link: Virginia Public Procurement Act.

10.3.2 Private Projects

When projects are carried out by non-public entities, more procurement methods are available to practitioners. The following contractor procurement methods are available for BUDM projects:

Low-Bid: This method is typically referred to as Information to Bid with definitive cost components. The low-bid method rates proposals solely on price. Although this method promotes competitive pricing, it potentially sacrifices quality during project execution. If the low-bid method is chosen, potential contractors should be screened ahead of the formal bidding process to help ensure only well-qualified contractors progress to the bidding phase. Pre-evaluations also help streamline the procurement process by minimizing administrative time spent reviewing proposals from unqualified contractors.

Best-Value: The best-value procurement method rates contractors on factors such as quality, expertise, and price to minimize risks during construction. Prospective contractors can be asked for a proposed work plan and approach so the owner and the owner's agent can determine which approach is least risky but can still accomplish the project goals.

Split: The split procurement method divides work between a dredging contractor and a wetlands restoration contractor to promote efficient pricing and specialized experience for the dredging and DM placement portions of the MEE contract. Drawbacks to this method include an increased risk of claims because each contractor's production will be linked to the performance of the other and potentially increased costs associated with multiple design and construction contracts. When considering split procurement contracts, it is important to understand the available equipment fleet proposed to complete work and whether that equipment is owned or leased. Project work, particularly pertaining to permit requirements for operations such as containment, will need to be clearly defined prior to bidding. And all contractors should be screened before the bidding phase, and qualifications should be part of the scoring system for contract award.

10.4 Construction Monitoring

To ensure placement operations do not cause unacceptable impacts to adjacent environmentally sensitive areas, a construction monitoring program needs to be established. The project owner should have a construction quality assurance plan that specifies the activities and measurements to be undertaken by the contractor and the owner's representative during placement. Depending on the project objectives, monitoring can include, but would not be limited to, the elevation or thickness of placed DM, estimated volumes, sediment characterization, and turbidity. Required sampling, analysis, and reporting will vary from project to project.

Turbidity monitoring near MEE sites can help determine whether sediments are leaving the placement area and affecting ecologically sensitive areas such as SAV meadows, oyster beds, or other bivalve reefs. Measures should be taken to prevent sediment escape prior to commencement of construction, using best practices such as silt curtains and confinement. The Commonwealth of Virginia has not set permissible turbidity levels for dredging projects, which can vary among MEE projects. But at the time this guidance was being written, the Commonwealth's Water Control Board was amending 9VAC25-260, the state's Water Quality Standards, to establish numeric criteria to regulate turbidity.

As noted in section 6.4, Water Quality Considerations, monitoring turbidity and total suspended solids in the water column during construction is a BMP to minimize adverse impacts to the surrounding environment. Before construction begins, a turbidity baseline should be established outside the placement site. The monitoring program should be refined during regulatory coordination. Monitoring should occur at an early action and alert distance, set as a range to be protective of the resources and provide greater efficiency for placement operations in the field.

A common way of monitoring turbidity is to attach a submersible sensor to a buoy and measure sediment resuspension in the water column (Fondriest 2014a and 2014b). Multiple sensors can be attached along a line from each buoy to collect data at different depths for real-time transmission by remote telemetry.

11 LONG-TERM MONITORING

Long-term monitoring is critical to project success. It should be included in project design and budgeting from the beginning and should consider the responsibility and ability of various partners to execute this monitoring. Long-term monitoring plans are driven by benchmarks created from the baseline conditions identified in preconstruction monitoring and surveys. The scope of monitoring varies depending on the goals of the monitoring team. Monitoring may be carried out for compliance with regulatory requirements, for adaptive management by the project team, or for scientific research purposes.

Any activity that may modify Virginia's water resources must have a monitoring plan that explicitly defines outcome categories such as success and failure. While success will look different for each project, it is important that success criteria be quantifiable, with a defined period of achievement agreed upon by project team and stakeholders. Case Studies in Appendix C provide examples of success across different project types. In addition to developing pre- and post-construction monitoring plans to evaluate site recovery and enhancement after BUDM, it is necessary that performance be outlined such that it can be measured throughout project stages to be weighed against the developed success criteria (Piercy and Welp 2024). For projects funded in part by USACE, monitoring costs typically are the responsibility of the local sponsor or nonfederal interest, unless USACE has appropriated project funds for monitoring.

The frequency and duration of postplacement monitoring of a site will depend on a number of factors:

1. The project size and scope;
2. Risks;
3. Setting;
4. Budget;
5. Presence of ecological features such as SAV; and
6. Intended end use.

USACE, for example, plans to monitor for 10 years its BU project that built a seabird nesting island in Hampton Roads, but USACE recognizes that further monitoring may be necessary depending on the project outcomes. Federal funds are paying for the monitoring (USACE and DWR 2024). Often, USACE has limited ability to fund monitoring for navigation projects, so the project team should identify responsible parties and funding streams for monitoring.

Specific components of long-term monitoring plans also vary depending on project type and site. For example, creation of a bird island might require the monitoring of marine mammals near the site, while upland habitat creation would not. Long-term monitoring plans should cover all aspects of the environment determined to be at risk because of the project. These can include geology, topography, and bathymetry; benthic resources; potentially hazardous toxic waste; hydrology and tidal processes; air and water quality; groundwater; marine vegetation; fish and essential fish habitat; wildlife, T&E species; navigation; land use; floodplains; cultural and historic resources; and other aspects of the environment (USACE and DWR 2024). As discussed in Part 4, adaptive management is frequently a component of successful long-term monitoring plans.

PART 4

BUDM Looking Forward

12 PROJECT DOCUMENTATION

The list of completed BUDM projects on the Atlantic Coast continues to grow. Distinguished by pre-determined benchmarks and monitoring plans, these projects provide templates and lessons that future projects can reference. Other states, like Maryland, have tools to identify beneficial reuse sites and past projects.

The documentation of BUDM projects can be a valuable resource for future initiatives by providing examples, BMPs, and lessons learned. A comprehensive record can give future decision-makers the knowledge and confidence to advocate for and implement future BUDM initiatives. Detailed documentation of projects will allow BUDM practitioners to apply the lessons they learned to new projects, and distribute knowledge among coastal stakeholders, industry professionals, and other involved parties. Additional information about potential demonstration projects identified at the time this document was developed is available in Appendix C.

13 RECOMMENDATIONS

Establishing clear guidance, documentation, and access to past projects is imperative to advance BUDM at the state and local level in Virginia. Reviews of other BUDM documentation highlight the importance of early and frequent stakeholder engagement and a clear understanding of the permitting and regulatory process.

13.1 Strategies in Nearby States

13.1.1 Maryland

Like the laws of several states including North Carolina, Maryland law states that all land below the mean high-water line is public, but in Virginia, land is public below the low water line. This difference typically gives Maryland greater flexibility in using federal funds for tidal shoreline projects even if they are adjacent to privately owned land. Therefore, Virginia BU projects may have to go through other funding avenues if shoreline is privately owned, although they are several case studies where federal funding was used for Virginia projects, based on a case-by-case analysis.

The Maryland Department of the Environment (MDE) released in 2019 the *Innovative Reuse and Beneficial Use of Dredged Material Guidance Document* (IRBU Guidance Document), which details the policies and procedures for reviewing proposed IRBU projects using DM and covers compiling information required for permits (MDE 2019). This IRBU Guidance Document refers to DM as a resource and lists its authorized uses:

1. Restoration of underwater grasses;
2. Restoration of islands;
3. Stabilization of eroding shorelines;
4. Replenishment of beach areas;
5. Creation or restoration of wetlands; and
6. Creation, restoration, or enhancement of fish or shellfish habitats (MDE 2019).

It also details the testing requirements to characterize material according to these use categories:

- Category 1 – Residential Unrestricted Use Soil and Fill Material
- Category 2 – Nonresidential Restricted Use Soil and Fill Material
- Category 3 – Restricted Use Soil and Fill Material, Cap Required
- Category 4 – Ineligible for Soil and Fill Material

IRBU was added to Maryland's Dredged Material Management Plan to improve the long-term viability of the Port of Baltimore and local DMCFs and to increase transparency and efficiency in the approval process.

Connecting traditional practices to innovative placement opportunities encourages the facilitation and employment of BUDM. The Maryland IRBU Guidance Document provides information for project teams to consider and anticipate when initiating placement of DM, including the following:

- Maryland and Federal USACE Permits
- Maryland and USACE Joint Application process
- Sampling and Analysis Considerations for Beneficial Uses

The Maryland IRBU Guidance Document does not specifically layout how to manage placement of material for habitat development, particularly in tidal waters.

13.1.2 Delaware

Like Virginia, Delaware has recently begun efforts to establish parameters for BUDM as alternative to DM placement. Delaware faces many of the problems found elsewhere in the Mid-Atlantic, including shorelines characterized by low-lying marshes and eroding beaches, where BUDM can be used (USACE, Philadelphia District 2020). The regulatory setting for BUDM projects in Delaware depends in part on whether the project falls within Delaware Bay or on the Atlantic Coast. Like the Chesapeake Bay, Delaware Bay spans multiple states, so Delaware regulatory agencies frequently must collaborate with state agencies in New Jersey, Pennsylvania, and New York during some phases of BUDM planning in Delaware Bay and the Delaware River (Delaware Estuary RSMW 2013). Multiple national, regional, and state agencies are involved in projects related to Delaware Bay, including USACE, the Delaware River Basin Commission, the Partnership for the Delaware Estuary, the New Jersey Department of Environmental Protection, and the Delaware Department of Natural Resources and Environmental Conservation (DNREC). Because of the interplay of multiple states' regulations and laws related to dredging and BU, permitting projects in Delaware Bay can be "enormously complex" (Delaware Estuary RSMW 2013). To address these complexities, the region's 2013 Sediment Management Plan suggested that the various agencies involved in Delaware Bay conservation and dredging planning should develop consistent programs and policies around BUDM and a system-wide approach to BUDM for the region (Delaware Estuary RSMW 2013).

In Delaware, the DNREC is the state authority for many processes related to BUDM projects and is responsible for dredging and maintaining 27 of Delaware's navigable channels—many more are maintained by USACE—producing large volumes of DM throughout the state (DNREC 2024a). DM has been used beneficially in Delaware to restore degrading wetlands (DNREC 2024b), nourish eroding beaches (DNREC 2024c), and to develop resilient shorelines as part of coastal risk management initiatives (USACE, Philadelphia District 2020).

13.1.3 North Carolina

Since 1992, North Carolina state policy has dictated that "material resulting from the excavation or maintenance of navigation channels be used in a beneficial way wherever practicable" (Section 1100). In addition, beach-quality sand in North Carolina must not be removed from the nearshore, beach, or inlet shoal system unless "no practicable alternative exists." North Carolina law specifically encourages research into innovative uses for fine-grained and poorly sorted DM and states that material in public DM disposal sites can be available to anyone proposing a BU project. Much of North Carolina's DM comes from the Atlantic Intercoastal Waterway and is a mix of fine- and coarse-grained material suitable for beach nourishment. But North Carolina has also used more-finely grained sediment dredged from the Atlantic Intercoastal Waterway to build nesting habitat for shorebirds and to restore wetlands and shorelines. Most permitting and regulatory activity involving dredging and BU activities in North Carolina are governed by the North Carolina DEQ, whose Division of Coastal Management and Division of Marine Fisheries maintain policies on impacts of beach dredge-and-fill operations (Myszewski and Alber 2015).

North Carolina's specific laws that govern permitting for shoreline restoration projects include the North Carolina Dredge and Fill law, which requires state agency review and permitting of any project that involves dredging or filling in estuarine waters, tidelands, marshlands, or lakes. State regulatory staff review projects for Dredge and Fill Act compliance simultaneously with other relevant laws, including the Coastal Area Management Act. Implemented by the Division of Coastal Management, the Coastal Area Management Act is designed to be permissive and flexible; and permits are typically granted unless plans are inconsistent with local land use plans, if there are alternatives that would accomplish the project's stated purpose with fewer adverse impacts, or if there is the possibility of irreversible damage to environmental systems (Shudtz 2024).

14.1.4 New Jersey

New Jersey has long been a leader in BUDM and remains an innovator in part due to the Wetland Institute and USACE's Seven-Mile Island Innovation Laboratory (SMIIL), launched in 2019. Seven Mile Island contains confined disposal facilities, historical dredged material placement sites, a mix of sandy and muddy sediments, and other features relevant to BUDM including a section of the New Jersey Intracoastal Waterway (USACE, Philadelphia District n.d.). SMIIL seeks to maintain "safe navigation channels while retaining dredged sediment in the system to benefit natural ecosystems and coastal communities" as well as "enhance the science and engineering that supports dredging and placement practices" (USACE Philadelphia District n.d.). Dozens of projects have been carried out at Seven Mile Island, including several applications of TLP and MEE across various marshes using DM from the Intracoastal Waterway.

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APPENDIX A
VIRGINIA BENEFICIAL USE OF DREDGED MATERIAL WORKSHOP SUMMARY

Attachment 1: Workshop Agenda

Attachment 2: Summary Slides

Attachment 3: List of Attendees

Commonwealth of Virginia: Beneficial Use of Dredged Material Project Advisory Committee

August 20, 2024, Virginia Institute Marine Science, Waterman's Hall Room A/B 1375 Greate Road, Gloucester Point, Virginia 23062

Speakers/Leads

Rachael Peabody	Virginia Marine Resources Commission
Jefferson Flood	Virginia Department of Environmental Quality
Brian R. Davis	University of Virginia
Ram Mohan	Anchor QEA
Christoper Overcash	Anchor QEA
Mindy Strevig	Anchor QEA

Goals and Objectives

This workshop was conducted to facilitate discussion in developing a comprehensive Virginia-specific technical guidance manual for strategic implementation of the beneficial use of dredged material (BUDM) to improve coastal resiliency. Despite the known benefits of reusing dredged material to restore coastal habitats, Virginia does not have a working process or policy to align dredging projects with BUDM. This guidance manual will culminate in the creation of a framework for coordinating, planning, siting, and implementing BUDM in Virginia. General intended outcomes from development of the document and framework are as follows:

- Strengthen stakeholder engagement to advance BUDM in Virginia.
- Develop a framework for advancing BUDM for multiple benefits, including ecosystem services, resilience, water quality, and socioeconomic, while making sure there are minimal adverse impacts to resources, including public trust elements such as subaqueous lands, tidal wetlands, beaches, and water quality.
- Update current resources and provide recommended best management practices.

The workshop assembled the Project Advisory Committee (PAC), a group of regional stakeholders offering a diverse range of perspectives, and garnered their input on the creation of the guidance document and framework using the following objectives:

- Review the existing process for developing BUDM projects, including available guidance, the permitting process, and associated challenges and opportunities.
- Provide an opportunity for subject matter experts to share their ideas and input for planning, designing, permitting, and constructing BUDM projects.
- Work with partners to identify existing and potential BUDM projects under a range of conditions in Virginia.

The workshop also included a report to the PAC of the Virginia-specific BUDM survey, conducted in July 2024. The survey gathered information from key stakeholders and experts in the field on the perceived or real barriers to BUDM and general needs related to beneficial use in Virginia.

Ultimately, the goal of this workshop was to inform stakeholders, get buy-in for the process of developing the framework, and solicit information and input on advancing BUDM in Virginia. The workshop agenda, summary slides, and list of attendees can be found in Attachments 1, 2, and 3, respectively.

Summary of Workshop Activities

Held over the course of 1 day, the plenary session included a variety of speakers, including representatives from federal and state agencies and academia and industry experts. This offered a range of perspectives and providing background information on the state of BUDM in Virginia. As part of the workshop, four breakout sessions were held, each consisting of three small-group discussions and focusing on the following topics: 1) Identifying BUDM Priorities and Current State of the Practice; 2) Identifying Potential BUDM Opportunities; 3) Developing BUDM Opportunities; and 1) Identifying Long-Term Success Criteria for BUDM. Key questions were used to facilitate discussion for each small-group discussion. These questions, overarching themes, and highlights from those sessions are summarized here.

Breakout Session 1: Identifying BUDM Priorities and the Current State of Practice

1. What is our current state of understanding of BUDM principles and practices?
2. What aspect of BUDM do you think requires more emphasis or clarification?
3. What challenges are prohibiting BUDM for wider use, including regulatory, time of year restrictions, mitigation, etc.?
4. What concerns do you have about BUDM implementation, and what can we do to alleviate those concerns?
5. How do we overcome those limitations?

Summary of Key Points

Breakout groups demonstrated that the current understanding of BUDM is evolving, but key challenges remain. These challenges include unclear definitions and the need for standardization, coordination issues between dredging and restoration timelines, regulatory and permitting barriers, the need for technological innovation, and better use of preplanning to ensure timely and effective BUDM projects. Although more work is needed, there is growing recognition of the potential benefits of BUDM, particularly in improving coastal resilience and ecological restoration.

Current State of BUDM: Principles and Goals

- There are challenges with existing processes and ambiguities around coordination.
  - Although BUDM processes exist, they are applied on a case-by-case basis, leading to uncertainty surrounding applicability to new projects, specifically in new areas like Virginia.
  - Communication on alignment between dredging and beneficial use (BU) entities needs to be improved.
- There is a large amount of money in this area; however, there is a need to for a proper framework for implementing them in place.

Clarification and Emphasis Needed

- A Virginia-specific definition of BU is needed.
  - The definition of BU alternatives vary, with confusion on the applicability of Virginia-specific alternatives (i.e., upland disposal).
- Stakeholders need more guidance on handling material types and ecosystem services valuation in cost-benefit analyses.
- More emphasis is needed to align dredging and BU timelines.

Challenges and Concerns in Coordination and Alignment

- Issues include matching sediment types with restoration sites, coordinating dredging and BU timelines, and dealing with fine materials.
- There is a lack of technical knowledge on the restoration side, and better knowledge transfer is needed.
- There are challenges with cost, timing, and scalability of projects.
- There is a lack of flexibility in the permitting process; new permits are required for certain alternatives.
- The Federal Standard, which prioritizes the least-cost option for dredged material disposal, was seen as a limiting factor in expanding BUDM projects.
  - Negotiate the Federal Standard to focus on value, not cost.
  - If federal funds are not involved, the Federal Standard is less of a driver.

Overcoming Challenges

- Restoration projects can be preplanned to align with dredging projects so material can be used for beneficial purposes as sediment sources become available. Preplanning could also expedite timelines to align more with dredging schedules.
  - Conduct pre-application meetings.
- Virginia-specific tools and definitions for BU should be developed to streamline process.
  - Develop improved guidance for permitting.

- Short-term impacts (i.e., temporary marsh loss) and long-term ecological benefits of BUDM need to be balanced.

Breakout Session 2: Identifying Potential BUDM Opportunities

1. How would we integrate BUDM into existing or new projects, and what, if any, limits us?
   a. What BUDM projects known in Virginia or in the general region exist? Or, why was BUDM ruled out for certain projects?
   b. What specific conditions do you seek to improve using BUDM? Are there opportunities for BUDM to combat the local and regional impacts of climate change?
2. Where and how do you see BUDM as most successful, and why?
   a. What unique technologies or strategies would help advance BUDM?
   b. Do you use site location maps to identify new opportunities or key project factors supporting BUDM?

Summary of Key Points

Discussions centered around the challenges that prevented the application of BUDM in the region and identification of new opportunities for incorporating BUDM on a larger scale. However, it was noted that further guidance, resources, innovative technologies beyond BUDM, and a central knowledge base are needed.

Barriers to BUDM

- Primary reasons that have prevented BUDM from being implemented are as follows:
  - Misaligned dredging and restoration timelines
  - Regulatory hurdles, logistical challenges, and cost concerns
  - Environmental concerns
  - Sediment composition and site matching
- There was significant discussion surrounding the following regulatory challenges that limit BUDM opportunities:
  - There is a need for more flexible permitting processes to account for changing materials or project scopes.
  - High standards exist; for example, Water Quality Standards further restrict broader BU applications.

Opportunities for Integrating BUDM

- Coastal resilience projects were highlighted, particularly ecosystem services such as tidal marsh and thin-layer placement (TLP).
- Dredged material can be used to restore/protect wetlands, buffer coastlines, and combat sea level rise (SLR).

- Specific opportunities for BU include expanding projects beyond nourishment and wetland creation to public access and commercial waterfront resilience.
- Integrating BUDM into ongoing projects where it has not been traditionally considered was discussed.

BUDM Opportunities in Virginia and the General Region

- The Saltmarsh Sparrow Habitat Restoration project involves TLP for restoring saltmarsh sparrow. There is a key opportunity to integrate BUDM into the existing coastal resilience project.
- The Beach Nourishment and Wetland Creation project was discussed as a potential BUDM opportunity.
- In Tangier Island, BUDM has been considered for habitat restoration.
  - The project faced challenges due to the logistics of transporting dredged material to the site.

Proposals for Successful BUDM

- Preapplication meetings are needed to streamline permits.
- A BU easement model is needed for the public and private sectors to help project delays.
- Greater coordination is needed between dredging projects.
- The importance of cataloging at-risk wetlands and other potential sites for BUDM to proactively identify opportunities was discussed and reiterated.
  - The creation of a catalog of BU opportunities and sites is needed.
- Discussions were held regarding incentivizing private sector participation to boost momentum behind BUDM projects, recognizing that private industry could help bridge some gaps.

Expanding Beyond Traditional Uses

- Innovative uses discussed are as follows:
  - Public access enhancement (creating new land for recreational use)
  - Resilience infrastructure to combat climate change, such as using dredged material for coastal defenses
  - 3D printing and other technologies for infrastructure projects
  - Reuse of contaminated sediment in specific contexts, such as construction material or abandoned mines, though this is currently limited by regulations
- Light Detection and Ranging and drones can be used for mapping topography and assessing potential BUDM sites.
- AI-based tools can be used to analyze environmental data and optimize site selection and project design.

- Geotextiles can be used for stabilizing dredged material in wetland restoration and coastal defense projects.

Breakout Session 3: Developing BUDM Opportunities

1. How and when should stakeholder engagement begin for potential BUDM projects?
2. How should stakeholders align to advance BUDM projects?
3. What funding opportunities existing for BUDM implementation? At what phases of the project?
4. If time allowed, breakout groups further engaged with the maps around the room to identify potential project sites or dredged material sources.

Summary of Key Points

Discussions centered on stakeholder engagement, funding models, and practical strategies for advancing BUDM projects.

Stakeholder Engagement and Alignment

- Early stakeholder involvement was seen as crucial to the success of BUDM projects. There is a need to include the following interested parties:
  - Landowners, especially in rural and coastal areas, to address potential conflicts and public perception issues regarding the temporary impacts of BUDM (e.g., TLP).
  - Regulatory bodies: to ensure that stakeholders understand the benefits of BUDM and that regulatory hurdles can be navigated smoothly.
- Early public engagement could be key to overcoming potential resistance to BUDM projects to address concerns upfront.
- Public-private partnerships (PPPs) are critical for advancing BUDM.
  - Aligning public funding (e.g., state or federal grants) with private sector investments to address the economic challenges of BUDM projects in which the costs of using dredged material may be higher than traditional disposal methods
  - Explore innovative ways to incentivize private sector participation (i.e., tax incentives or cost-sharing models)
- There needs to be consistent collaboration among stakeholders.
  - Data and resources should be shared to ensure dredged material is matched with appropriate restoration projects.
  - Cross-sector communication ensures project timelines, sediment types, and goals are clearly understood by all parties involved.

Funding Opportunities

- Alternative funding models need to be explored, including the following:
  - Creating PPPs to attract private sector investment into BUDM
    - This is important during the pre-implementation phase to support initial planning, site selection, and technical design of BUDM projects.
  - Incentivizing private industries to participate in BUDM projects by offering cost-sharing or other financial incentives
  - Using existing funds, such as state waterway maintenance funds, for acquiring or leasing properties for dredged material storage or BUDM projects
- The importance of long-term funding was addressed for monitoring and adaptive management purposes and to ensure projects can evolve and succeed over time.

Breakout Session 4: Identifying Long-Term Success Criteria for BUDM

1. What criteria do you use to measure the success of BUDM?
1. How should long-term monitoring and adaptive management be implemented for BUDM projects, and to what extent?
2. How should phasing be considered and addressed for BUDM projects?
3. How is risk managed throughout the life of a BUDM project?

Summary of Key Points

Discussion in this session centered around developing and defining the meaning of a successful project by including a variety of appropriate, project-specific metrics and incorporating long-term monitoring with tailored requirements as a component of a successful project. Risk management during the life of a BUDM project was also a key point of discussion.

Success Criteria of BUDM

- Different BUDM types require tailored success criteria.
- Flexible success criteria were deemed essential, as BUDM projects can vary widely in terms of goals, timelines, and environmental conditions.
  - Success should be specific to the project's goals, such as habitat creation, coastal resilience, or public access. These should also include public perception, recreational opportunities, and overall value of the project to local communities, in addition to reduced flood risk, improved water quality, and enhanced biodiversity.
- Long-term success needs to balance ecological and economic outcomes with flexibility for adaptive management.
  - This may require multiple definitions of success, especially when short-term losses (e.g., temporary marsh function reduction) lead to long-term ecological benefits (e.g., habitat enhancement or improved resilience).

- Multicriteria analysis can be used to evaluate project success.
  - Success should include not just ecological outcomes, but also socioeconomic and community benefits such as improved coastal protection or recreational opportunities.
- Success should be measured not just in terms of immediate project outcomes, but also in the project's ability to adapt to future climate challenges.

Monitoring and Adaptive Management

- Long-term monitoring needs to be included in project plans from the beginning.
  - This is often overlooked due to funding.
  - It was suggested that monitoring funding be built into the initial project budget, ensuring that long-term success of project can be evaluated and managed.
- Long-term monitoring was emphasized as a critical component of success.
  - Ongoing data collection to track the performance of BUDM projects over time, especially in the face of environmental changes like climate change and SLR
  - Adaptive management practices that allow project managers to adjust based on monitoring results, ensuring that the project continues to meet its goals as conditions evolve
- It was highlighted that monitoring requirements should be customized to each project, rather than using a one-size-fits-all approach, to ensure monitoring efforts are focused on the most relevant metrics for each project.

Phasing Considerations for BUDM

- Phasing BUDM projects allow for short-term, medium-term, and long-term success.
  - Manage expectations and ensure projects are evaluated at different stages, rather than waiting years for final outcomes.
  - For example, a project may aim for 70% to 80% vegetation coverage after 5 years as a medium-term goal, with longer term goals focused on ecosystem stability and resilience.

Risk Management Throughout Life of BUDM

- Short-term risks should be assessed against future ecosystem services.
  - There is a potential temporary loss of marsh function when dredged material is placed, with the expectation that long-term restoration benefits would outweigh these losses.
- Incorporating flexibility in permits and engaging the public and private sectors early in the process are critical for managing various risks.
  - There are public perception risk in regard to using contaminated materials in BUDM and concerns about whether the dredged material would impact water quality and habitats.

        - Regulatory constraints help manage this, as they can limit the use of certain materials.
- Miscommunication or lack of early stakeholder engagement can result in greater risks to project timelines and approval processes.
- Pilot projects should include risk assessments and lessons learned from both successful and failed BUDM endeavors.
- Monitoring is a key tool for managing risk.
    - It allows project leads to adjust strategies over time.
    - Adaptive management should be embedded into BUDM projects so risk can be continually assessed and management strategies adapted based on real-time monitoring results.

Key References and Links from the Sessions

The following links and reference came out the workshop:

- New Jersey Coastal Habitat and Aquatic Resource Research and Monitoring Workgroup: https://www.njcoastalresilience.org/workgroup/charrm-workgroup/
- The Virginia Institute of Marine Science and Old Dominion University coal ash balls study.
- Readiness and Environmental Protection Integration Program for funding: https://www.repi.mil/.

Attachment 1: Workshop Agenda

Meeting Agenda

Project Advisory Committee

Virginia Beneficial Use of Dredged Material

August 20, 2024 | 9:00am – 4:00pm

Virginia Institute Marine Science, Waterman's Hall Room A/B

1375 Greate Road, Gloucester Point, Virginia 23062

Workshop Purpose

Despite the known benefits of reusing dredged material to restore coastal habitats, Virginia does not currently have a working process or policy to align dredging projects with the beneficial use of dredged material (BUDM). A myriad of project elements including design, permitting, construction timeline, ecologic and socioeconomic considerations, and funding must align between both the dredging activity and the proposed restoration project to properly coordinate and implement a comprehensive BUDM project. Currently, the Virginia Coastal Zone Management Program (Virginia CZM; https://www.deq.virginia.gov/our-programs/coastal-zone-management) is providing funding (FY2023, Task 10) from the National Oceanic and Atmospheric Administration's Office for Coastal Management (NOAA-OCM; https://coast.noaa.gov/) to the Virginia Marine Resources Commission (VMRC; https://mrc.virginia.gov/) and their contractor, Anchor QEA, (https://www.anchorqea.com/) to develop a guidance manual that will create a framework for coordinating, planning, siting, and implementing BUDM. A project advisory committee (PAC) comprised of regional stakeholders is gathered to provide input on the creation of the document and framework. The PAC is engaged in a workshop to garner input from a diverse range of perspectives throughout this process.

Workshop Outcomes

- Strengthen stakeholder engagement to advance BUDM in Virginia.
- Develop a framework for advancing BUDM for multiple benefits, including ecosystem services, resilience, water quality, and socioeconomic, while making sure there are minimal adverse impacts to resources, including public trust elements, such as subaqueous lands, tidal wetlands, beaches, and water quality.

Workshop Objectives

- Review the existing process for developing BUDM projects, including available guidance, permitting process, and associated challenges and opportunities.
- Provide an opportunity for subject matter experts to share their ideas and input for planning, designing, permitting, and constructing BUDM projects.
- Work with partners to identify existing and potential BUDM projects under a range of conditions in Virginia.

Workshop Agenda

8:30-9:00	Networking *(light coffee/tea/morning snacks will be served)*
9:00-9:50	Workshop Goals/Objectives and Background
9:50-10:00	Arrange into Breakout Groups
10:00-10:45	**Breakout Session 1: Identifying BUDM Priorities and Current State of the Practice**
10:45-11:00	Networking Break
11:00-11:45	**Breakout 2: Identifying Potential BUDM Opportunities**
11:45-12:45	*Lunch (boxed lunch will be available)*
12:45-1:15	Breakout Session 1 and 2 Report Out
1:15-2:00	**Breakout Session 3: Developing BUDM Opportunities**
2:00-2:15	*Break*
2:15-3:00	**Breakout Session 4: Identifying Long-Term Success Criteria for BUDM**
3:00-3:15	Networking Break
3:15-3:45	Breakout Session 3 and 4 Report Out
3:45-4:00	Closing

Attachment 2: Summary Slides

Commonwealth of Virginia: Beneficial Use of Dredged Material

Project Advisory Committee Workshop

August 20, 2024

Facilitated by:

VMRC | Virginia Coastal Zone Management Program | Anchor QEA

With support from:

Elizabeth River Project | VIMS William & Mary Virginia Institute of Marine Science | Waterway Surveys & Engineering, Ltd. | University of Virginia | NOAA

Welcome and Introductory Remarks

by Rachael Peabody

VMRC

Empowering Partners

by Jeff Flood

Advancing Beneficial Use in Virginia

by Mindy Strevig, PE

ANCHOR QEA

Overall Objectives

Provide a framework for beneficial use of dredged material (BUDM) in coastal Virginia

- Provide support to the Commonwealth of Virginia Marine Resources Commission (VMRC) in developing a comprehensive framework aimed at coordinating, planning, siting, and executing for BUDM
- Update resources and recommended best management practices over time

Planning

Siting

Executing

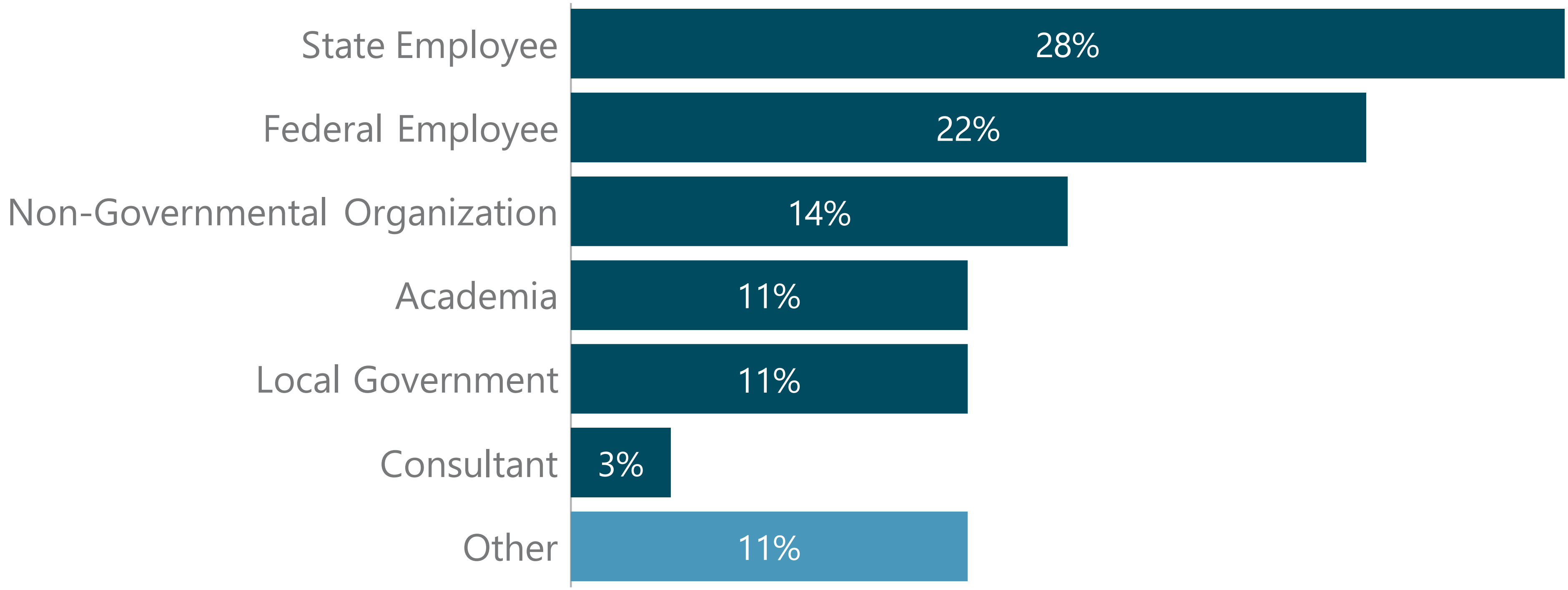
Monitoring

How do we advance BUDM as a resource in Virginia?

- Gather feedback from experts and stakeholders
  - Stakeholder survey
  - Project Advisory Committee Workshop
- Identify perceived or real barriers to the BUDM in Virginia
  - Establish the state of the industry
  - Identify data gaps and needs to advance BUDM in Virginia
- Develop technical document with feasibility decision framework
  - Study project examples
  - Share resources and knowledge
  - Identify advancements necessary

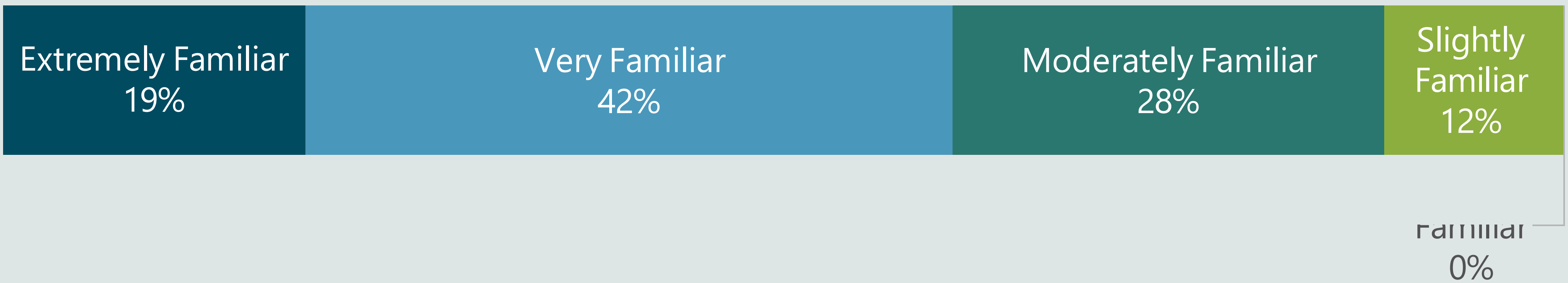
BUDM Survey Results

Industry Recap



Note: The *Other* category includes regional government and planning, Tribal government, and nature-based infrastructure providers.

Respondent’s Familiarity with BUDM



Ranking of Most Important Factors Preventing Widespread Use of BUDM in Virginia

1. Lack of policy requiring BU
2. Unevenly applied regulatory requirements or process
3. Risk perception
(effects on wildlife, maintenance, contaminants, long-term monitoring, etc.)
4. Lack of definition/understanding of BU
5. Incremental cost of placement

Ranking of How We Can Get More People to Consider BU in Virginia

Streamline permitting process to make it less onerous for BU

Clearly communicate benefits associated with BU

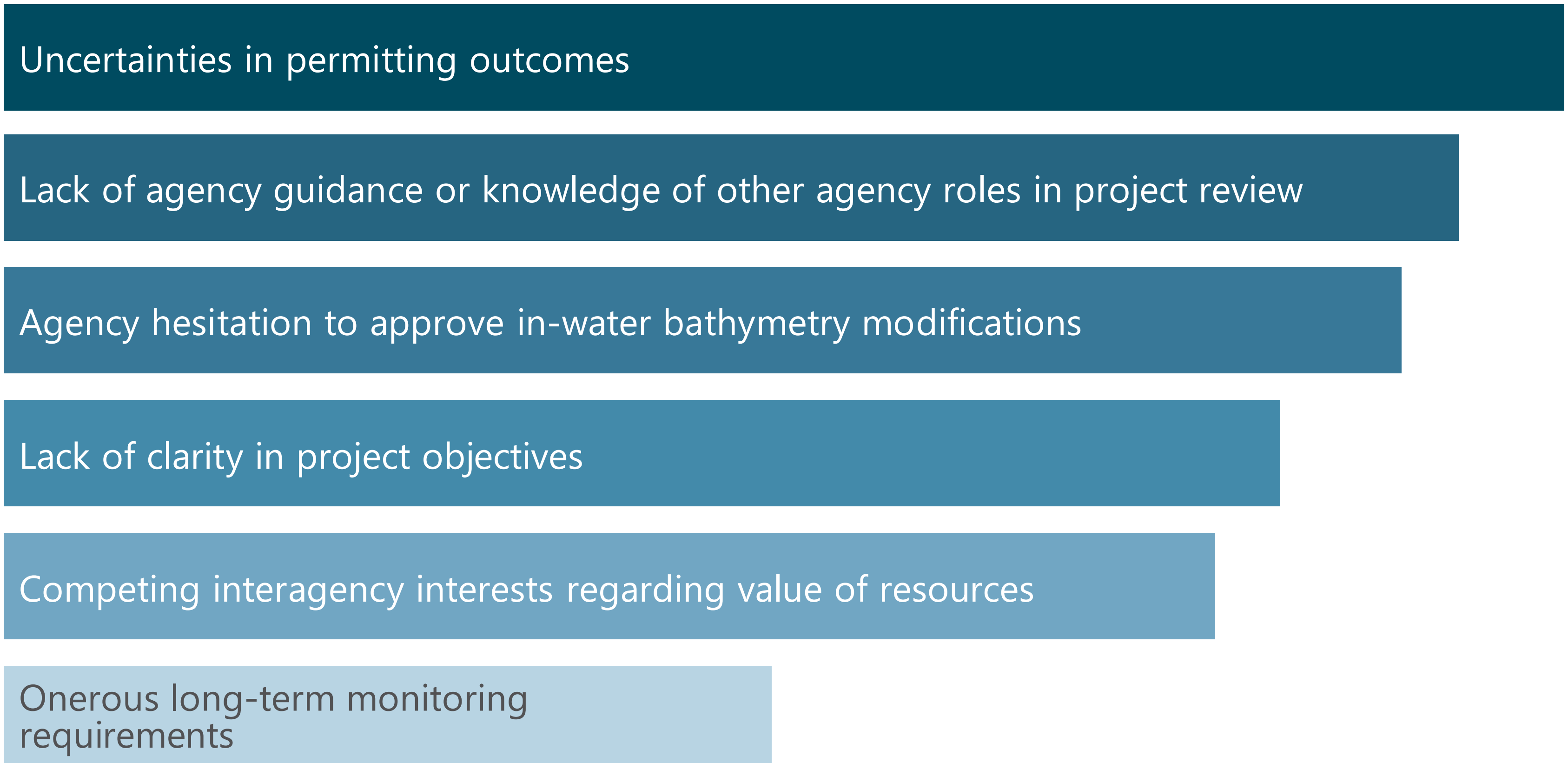
Develop a sediment/BU banking system, where the placement areas are pre-permitted and can be used by local dredging projects

Focus on ecological and coastal resilience benefits as opposed to project costs

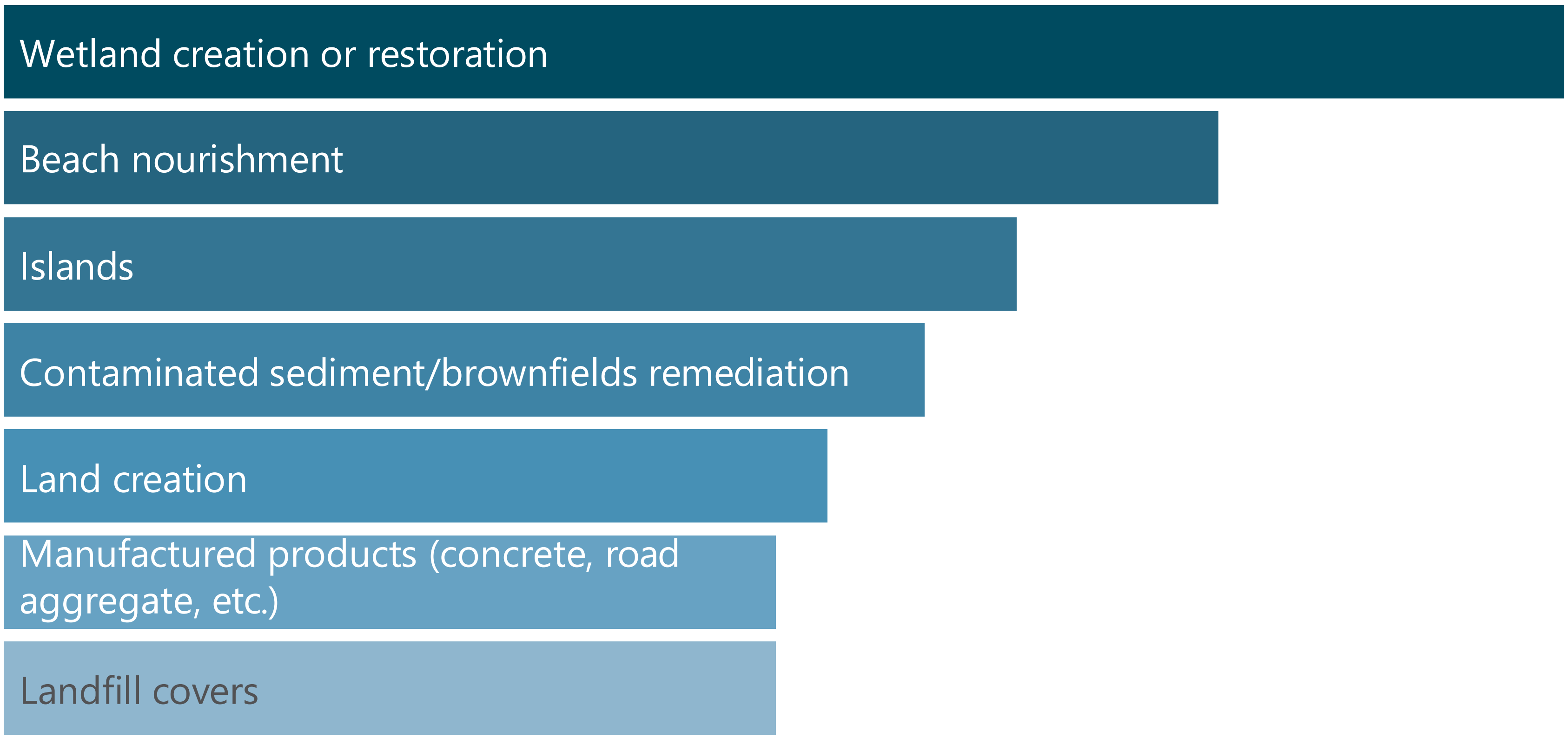
Develop ecosystem restoration credits that owners can use to offset future dredging impacts

Clearly communicate the risk of contaminated sediment and the measures in place to mitigate threats to human and environmental health

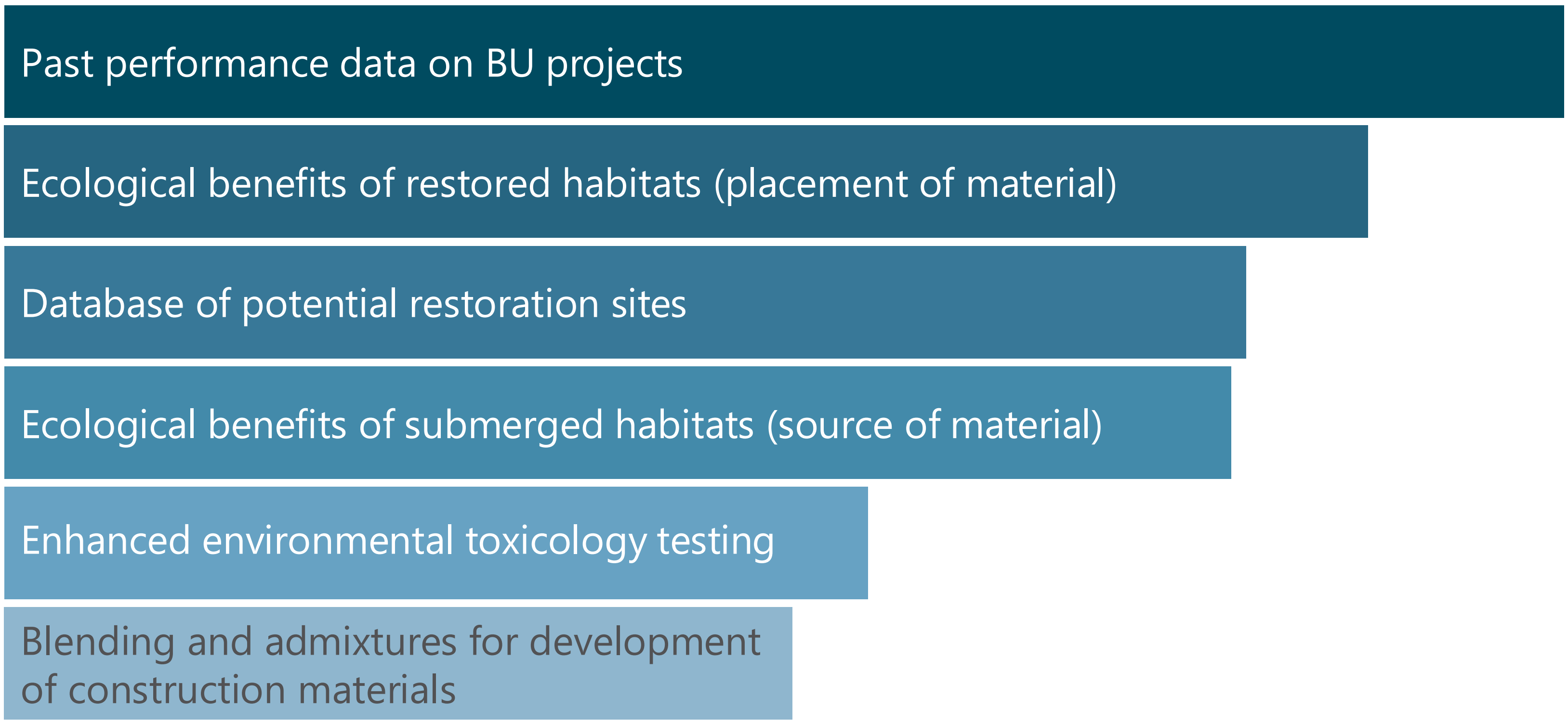
Ranking of Primary Regulatory Hurdles to Permitting Projects in Virginia



Ranking of More Promising Innovative Aspects of BU That Should Be Implemented More Widely in Virginia



Ranking of Research and Data Collection Needs Related to BU in Virginia



Ranking of Guidance and Development Needs Related to BU in Virginia

Engineering and performance standards

Constructing long-term project sites for many different habitats or developments

Placement/distribution equipment for dredged material

Monitoring and adaptive management requirements

Biodegradable containment and design for multiple habitat types

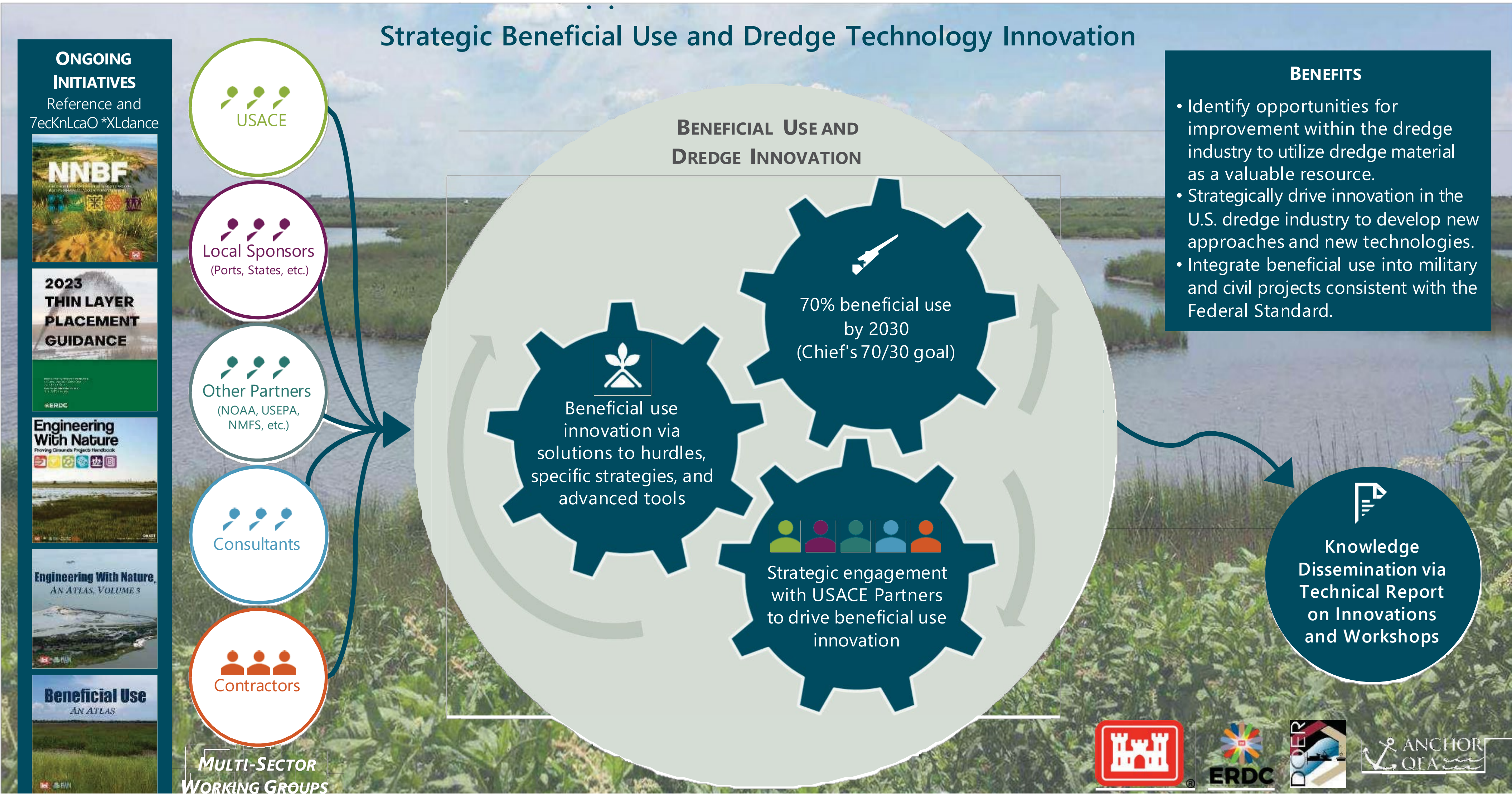
Virginia BUDM Survey Key Takeaways

- Most noted challenges
  - Unknown permitting outcomes and coordination between regulatory entities
- Top potential opportunities
  - Wetland creation and restoration, beach nourishment, island creation
  - Banking system for restoration opportunities
  - Permitted and designed placement sites
- How do we get there?
  - Streamline the regulatory and permitting process
  - Document projects as implemented to better understand performance and benefits

Perspectives on Accelerating BUDM

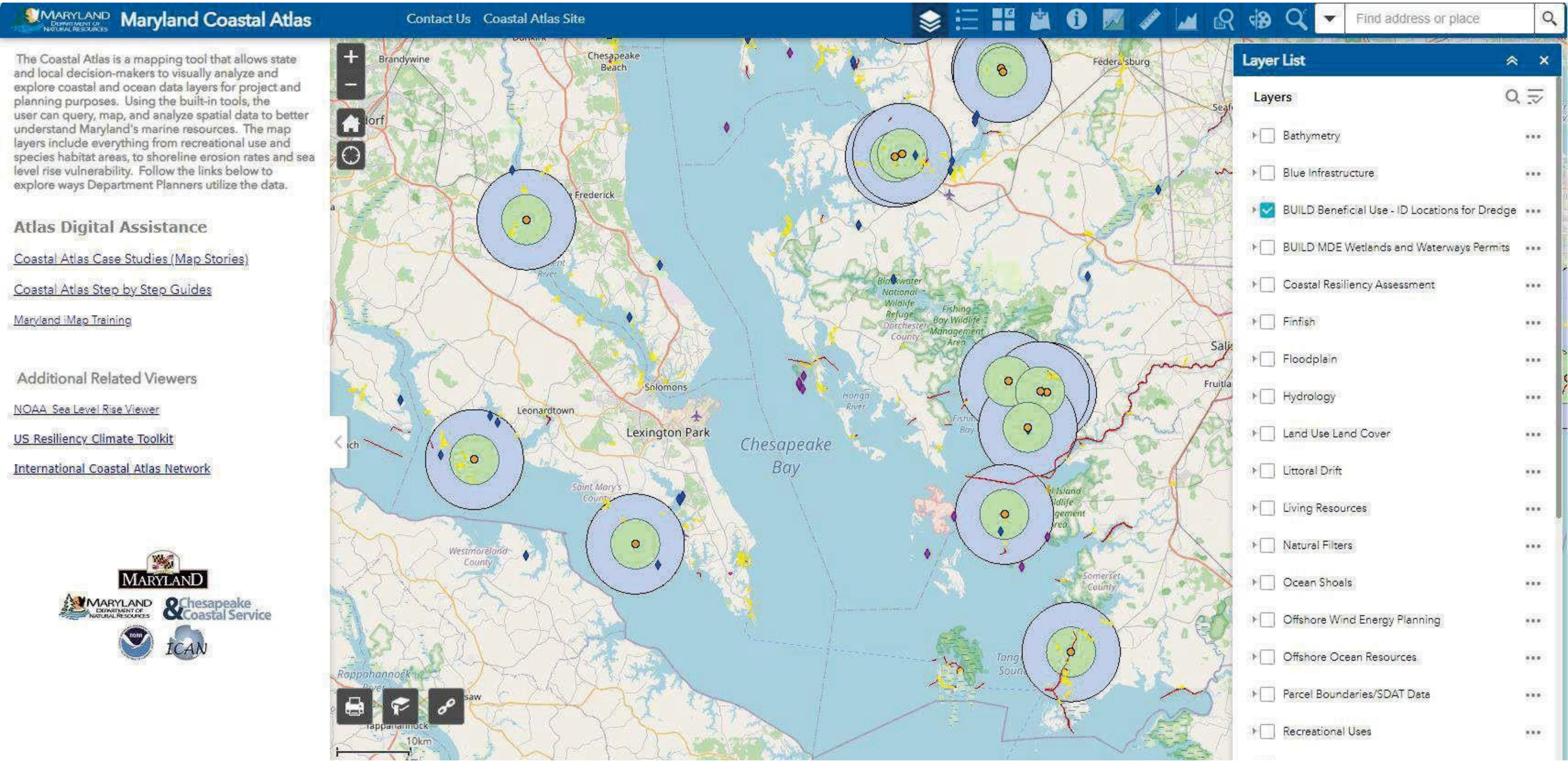
by Ram Mohan, PE, PhD, F.ASCE

ANCHOR QEA



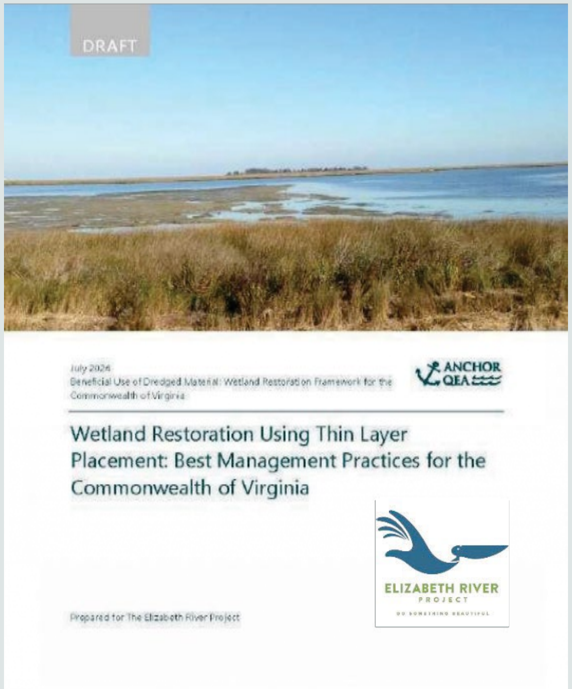
Strategic Beneficial Use and Dredge Technology Innovation
Ongoing Initiatives
Reference and
7ecKnLcaO *XLdance
NNBF
2023 Thin Layer Placement Guidance
Engineering With Nature
Proving Grounds Projects Handbook
Engineering With Nature
An Atlas, Volume 3
Beneficial Use
An Atlas
USACE
Local Sponsors
(Ports, States, etc.)
Other Partners
(NOAA, USEPA, NMFS, etc.)
Consultants
Contractors
Multi-Sector Working Groups
Beneficial Use and Dredge Innovation
Beneficial use innovation via solutions to hurdles, specific strategies, and advanced tools
70% beneficial use by 2030 (Chief's 70/30 goal)
Strategic engagement with USACE Partners to drive beneficial use innovation
Benefits
• Identify opportunities for improvement within the dredge industry to utilize dredge material as a valuable resource.
• Strategically drive innovation in the U.S. dredge industry to develop new approaches and new technologies.
• Integrate beneficial use into military and civil projects consistent with the Federal Standard.
Knowledge Dissemination via Technical Report on Innovations and Workshops
ERDC
DOER
ANCHOR QEA

Beneficial Use Tools: State of Maryland BUILD Tool



Other BUDM Toolbox Kits and Resources

TLP Guidance for Elizabeth River



Comprehensive Virginia-specific, thin-layer placement BMP to encourage and assist future marsh restoration projects

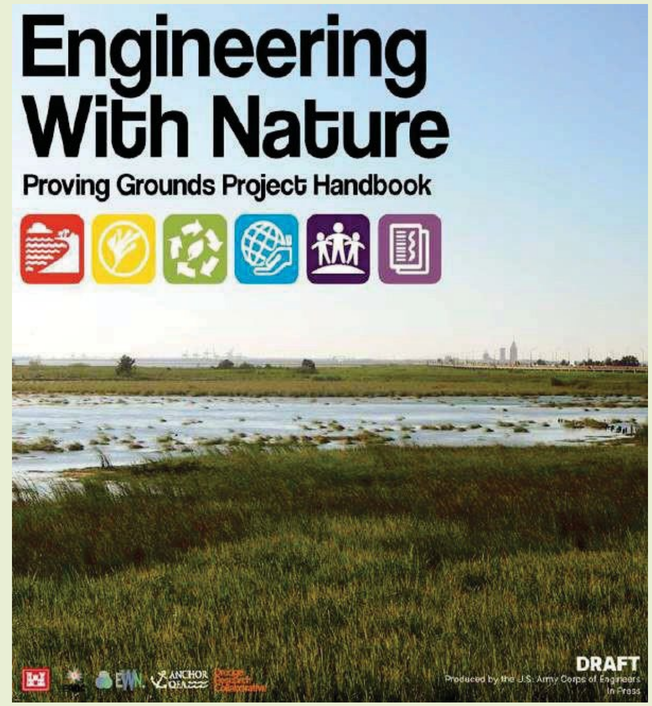
Maryland Beneficial Use Guidance

Category	Use
Category 1	Residential Unrestricted Use Soil and Fill Material: For offsite fill use
Category 2	Non-Residential Restricted Use Soil and Fill Material: Non-residential fill
Category 3	Restricted Use Soil and Fill Material: For managed commercial innovative use
Category 4	Ineligible Soil and Fill Material: Unfit for reuse, requiring containment

- ***2019 Innovative Reuse and Beneficial Use of Dredged Material Guidance Document*** (https://mde.maryland.gov/programs/Marylander/Documents/Dredging/FINAL_IBR_GUIDANCE_12.05.2019_MDE.pdf)
- **Innovative Reuse – Maryland Port Administration** (https://maryland-dmmp.com/innovative-solutions/innovative-reuse/)
- **Maryland Coastal Atlas** (https://dnr.geodata.md.gov/CoastalAtlas/)

Maryland classification system for BUDM according to physical and chemical characteristics

ERDC EWN Handbook



National guidelines on how to use innovative EWN and NBS concepts to advance BUDM and restoration needs

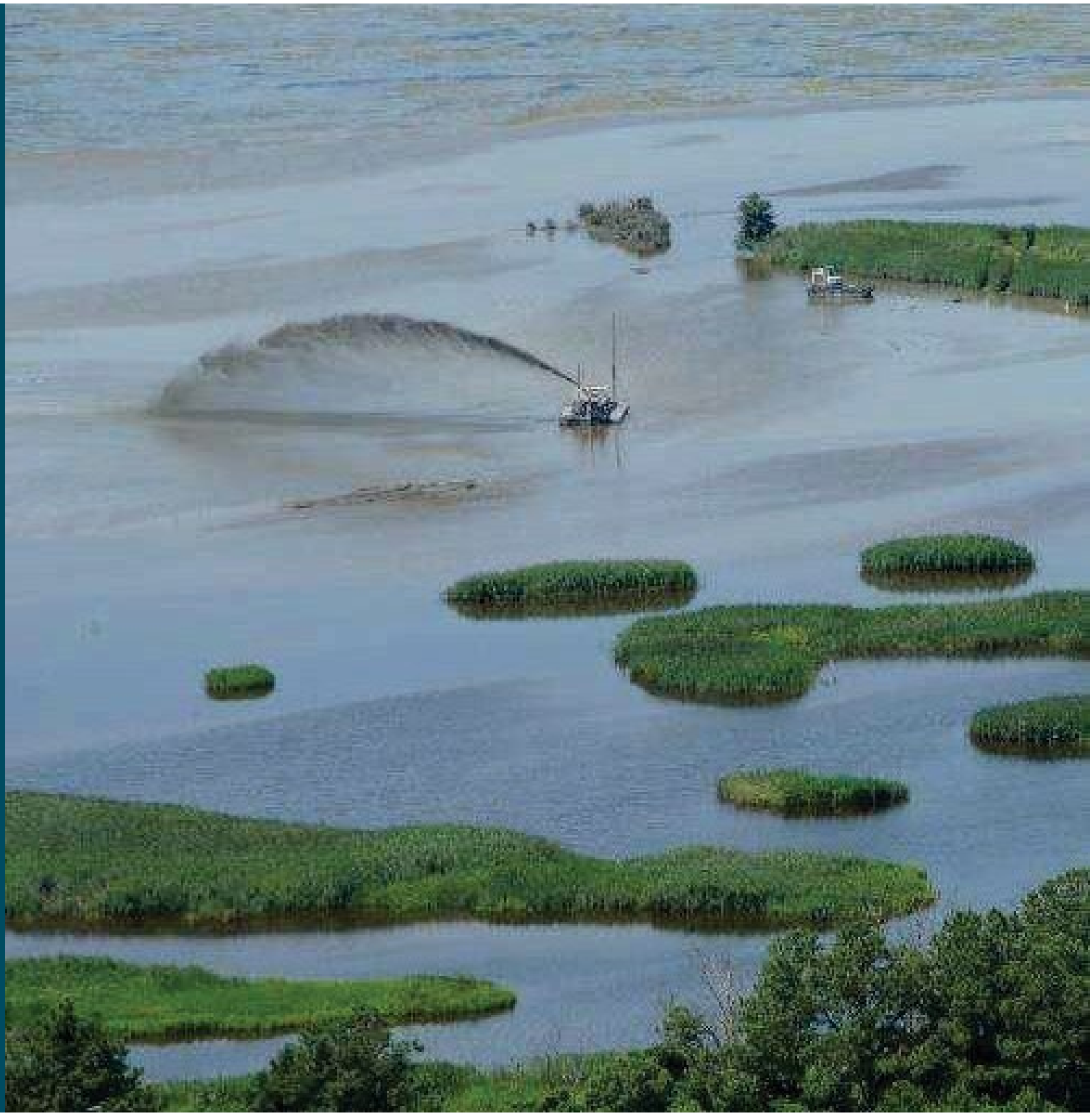
Challenges and Solutions to Advance BUDM

- Short-term impacts vs. long-term benefits
- Assigning value to ecosystem benefits
- Trade-offs in habitats and functions
- Streamlining permitting
- Overcoming Federal Standard?
- Demonstrating proof of concepts (pilot projects)
- Monitoring and adaptive management
- Sharing lessons learned

21

Key Elements of Planning a BU Project

by Chris Overcash, PE, BCEE, ENVSP



Planning

Conceptualize system and identify possible sites

Determine site needs and success criteria

Engage stakeholders

Set goals, quantify objectives, identify constraints

Conduct preliminary evaluation of sediment sources

Evaluate funding options

Adaptive Management

Baseline monitoring

Define success criteria and triggers for corrective action

Management responsibilities

Project performance monitoring

Future management actions

Design

Assess baseline and reference conditions

Prepare preliminary design

Evaluate sediment source in detail

Detailed design and permitting

Prepare final design

Develop specifications

Implementation

Bidding and contractor selection

Means and methods

Specialty equipment/requirements

Construction monitoring

Construction quality assurance

Long-term monitoring

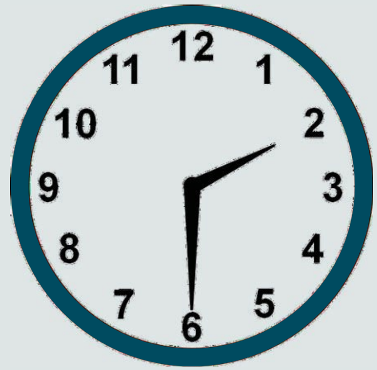
24

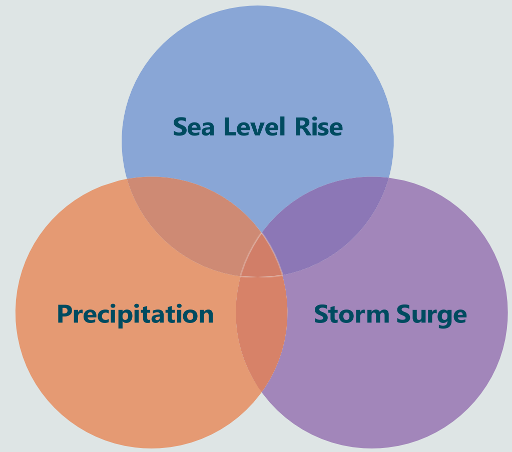
Source: Bridges et al., eds. 2021

VMRC Virginia Coastal Zone MANAGEMENT PROGRAM ANCHOR QEA

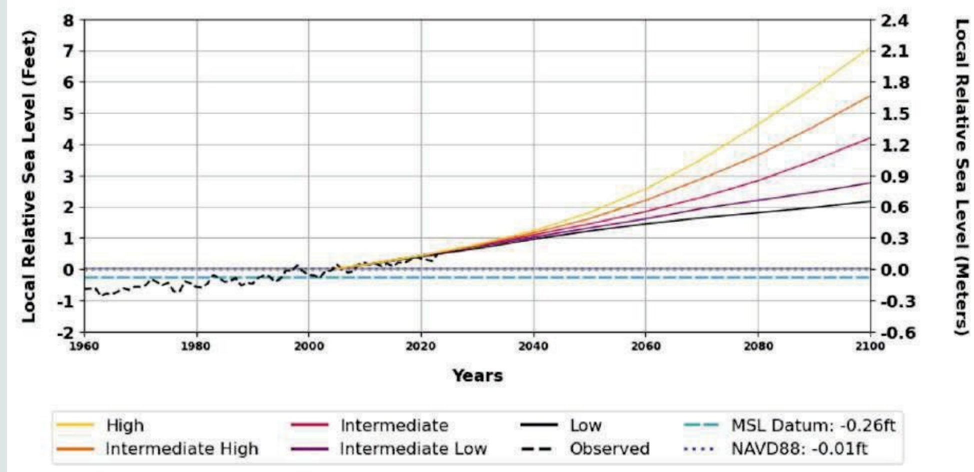
Key Data Needs

- Coordination – dredging projects and placement and timing
- Dredged material characteristics
- Restoration site conditions
- Stakeholder and regulatory preferences
- Budget
- Climate change considerations
  - Sea level rise
  - Compound flooding
  - Subsidence





Annual RSLR Since 1960 and Projections – 8638610 Sewells Point



Overview of the Day and Charge

by Mindy Strevig

Breakout Group Discussions

- Identifying BUDM priorities and current state of the practice
- Identifying potential BUDM opportunities
- Developing BUDM opportunities
- Identifying long-term success criteria for BUDM

Breakout Group Details

- Inform stakeholders
- Get buy-in for process
- Gather information and input on advancing BU in Virginia

Breakout Session Rules

1. Offer constructive feedback (focused on solutions)
2. Provide candid input
3. Think innovatively
4. Be respectful and allow all to contribute

Breakout Groups: Sessions 1 and 2 (Morning)

Breakout Group A		Breakout Group B		Breakout Group C	
Name	**Organization**	**Name**	**Organization**	**Name**	**Organization**
Andrew Button	VMRC	**Brian R. Davis**	UVA	David Hawkins	VA Department of Energy
Andy Dunton		**Christopher Overcash**	Anchor QEA	Elizabeth Andrews	UVA
Barbara Gavin	Ducks Unlimited	David Obrien	NOAA	Josef Rieger	US Navy
Ben Sagara	DWR	Eli Podyma	PlanRVA	Kevin R Du Bois	US Navy
Dan Adams	City of Virginia Beach	Emily Argo	FWS	Mark Mansfield	Shore Consulting
Danielle Weerth	ECOncrete	Erin Reilly	VIMS	Megan Wood	USACE
Ella DiPetto	Elizabeth River Project	George Janek	USACE	Melinda Woodruff	DEQ
Jefferson Flood	DEQ	Josh Priest	Moffatt Nichol	Pam Mason	VIMS
Kellan Singleton	ANPDC	Justin Shafer	City of Norfolk	**Rachael Peabody**	VMRC
Matt Dalon	DCR	Kerby Dobbs	BOEM	**Ram Mohan**	Anchor QEA
Mindy Strevig	Anchor QEA	Lewis Lawrence	Middle Peninsula PDC	Robin Bedenbaugh	RES
Robert Pruhs	USACE	Maor Bezner	ECOncrete	Ruth Boettcher	DWR
Scott Hardaway	VIMS	Randy Owen	VMRC	Ryan Walsh	James River Association
Vincent Orazi	DON	**Rebecca Francese**	Waterway Surveying & Engineering, Ltd.	**Zachary Widgeon**	VMRC

Note: Names in **bold** are group facilitators.

Breakout Groups: Sessions 3 and 4 (Afternoon)

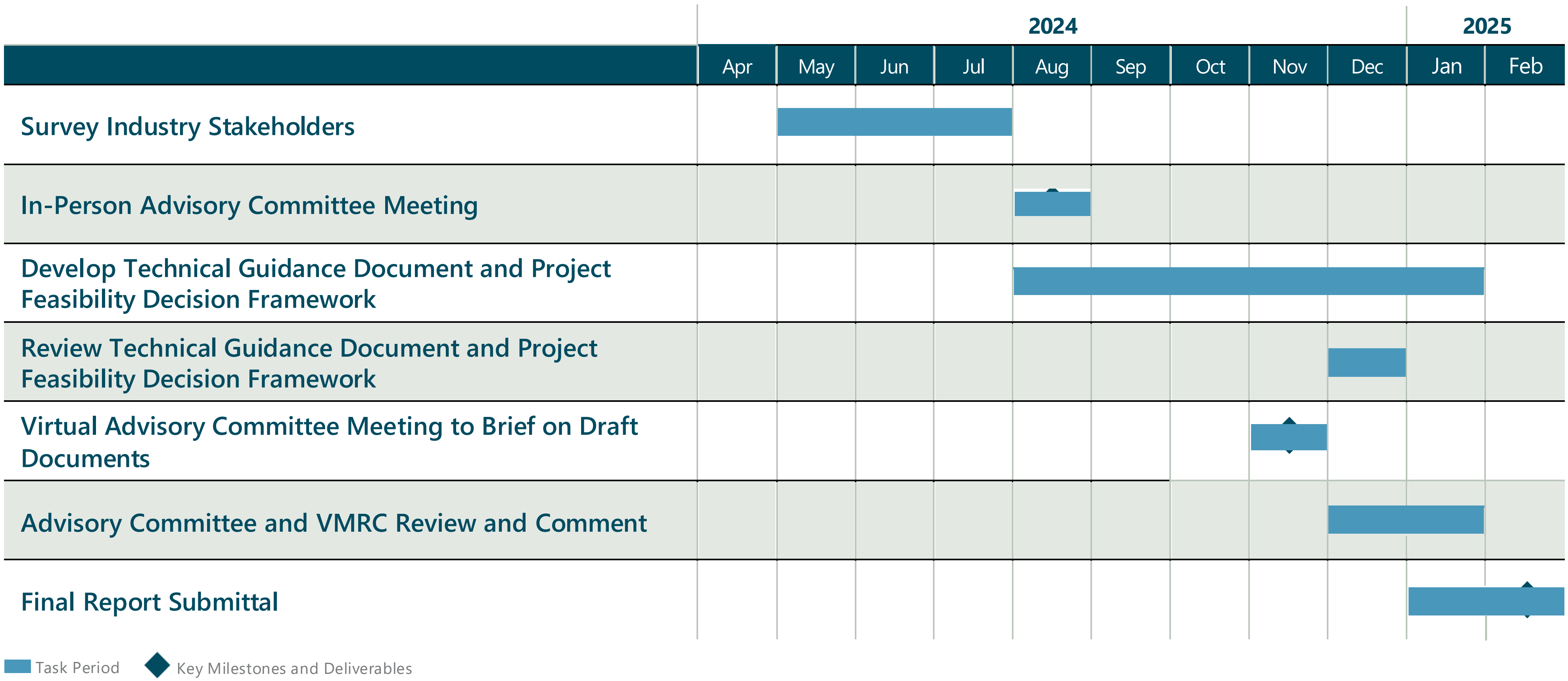
Breakout Group D		Breakout Group E		Breakout Group F	
Name	**Organization**	**Name**	**Organization**	**Name**	**Organization**
David Obrien	NOAA	Ben Sagara	DWR	Christopher Round	Versar
Donna Milligan	VIMS	**Brian R. Davis**	UVA	Craig Nicol	DEQ
Elizabeth Andrews	UVA	**Christopher Overcash**	Anchor QEA	Dan Adams	City of Virginia Beach
Ella DiPetto	Elizabeth River Project	Danielle Weerth	ECOncrete	George Janek	USACE
Erin Reilly	VIMS	David Hawkins	VA Department of Energy	Justin Shafer	City of Norfolk
Jefferson Flood	DEQ	Eli Podyma	PlanRVA	Lewis Lawrence	Middle Peninsula PDC
Josef Rieger	US Navy	Emily Argo	FWS	Lyle Varnell	VIMS
Josh Priest	Moffatt Nichol	KC Filippino	Hampton Roads PDC	Melinda Woodruff	DEQ
Kellan Singleton	ANPDC	Kevin R Du Bois	US Navy	Pam Mason	VIMS
Mindy Strevig	Anchor QEA	Mark Mansfield	Shore Consulting	**Rachael Peabody**	VMRC
Randy Owen	VMRC	**Rebecca Francese**	Waterway Surveying & Engineering, Ltd.	**Ram Mohan**	Anchor QEA
Robin Bedenbaugh	RES	Scott Hardaway	VIMS	Robert Pruhs	USACE
Ruth Boettcher	DWR	Vincent Orazi	DON		

Note: Names in **bold** are group facilitators.

Summary of the Day

by Mindy Strevig

What is the plan?



32

Thank You for a Productive Day!

VMRC Virginia Coastal Zone MANAGEMENT PROGRAM ANCHOR QEA

Attachment 3: List of Attendees

Name	Affiliation
Ben Sagara	DWR
Brian R. Davis	UVA
Christopher Overcash	Anchor QEA
Craig Nicol	DEQ
Curt Smith	Middle Peninsula PDC
Dan Adams	City of Virginia Beach
Danielle Weerth	ECOncrete
David Hawkins	Virginia Department of Energy
David Obrien	NOAA
Donna Milligan	VIMS
Eli Podyma	PlanRVA
Elizabeth Andrews	UVA
Ella DiPetto	Elizabeth River Project
Emily Argo	USFWS
Erin Reilly	VIMS
George Janek	USACE
Jefferson Flood	DEQ
Josef Rieger	U.S. Navy
Josh Priest	Moffat and Nichol
Justin Shafer	City of Norfolk

Name	Affiliation
KC Filippino	Hampton Roads PDC
Kellan Singleton	ANPDC
Kevin R Du Bois	U.S. Navy
Lewis Lawrence	Middle Peninsula PDC
Lucas Manweiler	Virginia CZM
Lyle Varnell	VIMS
Mark Mansfield	Shore Consulting
Matt Dalon	DCR
Megan Wood	USACE
Melinda Woodruff	DEQ
Mindy Strevig	Anchor QEA
Rachael Peabody	VMRC
Ram Mohan	Anchor QEA
Randy Owen	VMRC
Rebecca Francese	Waterway Surveying and Engineering, Ltd.
Robert Pruhs	USACE
Robin Bedenbaugh	RES
Ruth Boettcher	DWR
Scott Hardaway	VIMS
Vincent Orazi	U.S. Navy

Note:
ANPDC: Accomack-Northampton Planning District Commission
CZM: Coastal Zone Management Program
DCR: Virginia Department of Conservation and Recreation DEQ: Department of Environmental Quality
DWR: Virginia Department of Wildlife Resources
NOAA: National Oceanic and Atmospheric Administration PDC: Planning District Commission
RES: Resource Environmental Solutions, LLC
USACE: U.S. Army Corps of Engineers
USFWS: U.S. Fish and Wildlife Service
UVA: University of Virginia
VIMS: Virginia Institute of Marine Science

APPENDIX B
INDUSTRY FOLLOW-UP INTERVIEW PARTICIPANTS AND DOCUMENT STAKEHOLDER REVIEWERS

Table B-1
Industry Follow-Up Interview Participants

Name	Affiliation
Andrew Larkin	NOAA
Bob Kerr	Wetland Studies & Solutions
Brad Hatch	Patawomeck Indian Tribe of Virginia
Brent Huntsinger	Friends of Rappahannock
Dana Adkins	Chickahominy Indian Tribe
Joe Rieger	U.S. Navy
Kati Booth	The Nature Conservancy
Kerby Dobbs	Bureau of Ocean Energy Management
Kevin Dubois	Department of Defense
Maggie Cavey	Maryland Department of Natural Resources
Mary Andrews	NOAA
Stephanie Jacobs	EPA Region 3

Notes:
EPA: U.S. Environmental Protection Agency
NOAA: National Oceanic and Atmospheric Administration

Table B-2
Document Stakeholder Review Participants

Name	Affiliation
Amy Martin	DWR
Anonymous VIMS reviewers	VIMS
Ashby Scott	DEQ
Charles Carter	Weanack Land, LLC
E. Argo	USFWS
Erin Reilly	CBNERR
G. Janek	USACE
J. Stanhope	USFWS
Kevin Dubois	U.S. Navy
Lyle Varnell	VIMS
M. Anderson	USACE
M. Wood	USACE
Mark Mansfield	Shore Consulting Group
R. Pruhs	USACE
Randy Owen	VMRC
Robin Bedenbaugh	RES
W. Lee Daniels	Virginia Tech
Will Fidew	Virginia Maritime Association

APPENDIX C
CASE STUDIES

PAST (COMPLETED)

- VIRGINIA BEACH AND SANDBRIDGE BEACH NOURISHMENT PROJECTS
- BLACKWATER NATIONAL WILDLIFE REFUGE TLP

VIRGINIA BEACH AND SANDBRIDGE BEACH NOURISHMENT

A beach nourishment project underway at Virginia Beach in 2013. (Source: USACE)

Virginia Beach and the surrounding communities have a long and ongoing history of beach nourishment using material dredged from offshore. The Sandbridge Beach Coastal Storm Damage Reduction Project's 2020 renourishment cycle, for example, was carried out from April 8 to May 23 and followed similar efforts in 2003, 2007, and 2013.[1] Nourishment involved dredging and placement of 1.7 million cubic yards of sand onto Sandbridge Beach.[1]

Beach nourishment using dredged material (DM) is a common practice in the Virginia area and represents the most common beneficial use of DM in Virginia and in the United States as a whole.[2]

[1]Allmond, A., 2020. "Sandbridge Beach Renourishment Work Underway." *U.S. Army Corps of Engineers, Norfolk District: News Stories*. Last modified April 22, 2020; accessed January 10, 2025. Available at: https://www.nao.usace.army.mil/Media/News- Stories/Article/2159967/sandbridge-beach-renourishment-work-underway/.
[2] McGill, S.P., R.L. Bain, and D.M. Robinson, 2024. "Surf Zone Hazards Before and After a Beach Nourishment in Virginia, USA." *Ocean & Coastal Management* 258:107367. DOI: 10.1016/j.ocecoaman.2024.107367.

BLACKWATER NATIONAL WILDLIFE REFUGE THIN-LAYER PLACE-

MENT

DM is sprayed onto flooded low marsh at Blackwater NWR. (Source: Dave Harp)

The 28,000-acre Blackwater National Wildlife Refuge (NWR) near Cambridge, Maryland, is approximately one-third wetland, one-third forested upland, and one-third open water. Since 1940, Blackwater NWR has lost more than 7,000 acres of tidal wetland to rising sea, erosion, hydrologic changes, and damages by invasive nutria, which were eradicated in 2022.[3] In 2002, Blackwater NWR was the site of the first thin-layer placement (TLP) project using dredged material (DM) aimed at increasing wetland elevations in the Chesapeake Bay region.[3,4] A subsequent TLP application was carried out in 2017 at Blackwater NWR, and the refuge received 950 cubic yards of DM spread over 40 acres, raising elevations 3 to 6 inches.[4] Sites at Blackwater NWR that received previous TLP applications have recovered and continue to be well vegetated.[3] The 2017 TLP project at Blackwater NWR was a runner-up for the American Society of Adaptation Professionals Prize for Progress in Adapting to Climate Change.[4]

[3] USACE (U.S. Army Corps of Engineers), Baltimore District, 2024. *Draft Supplemental Environmental Impact Statement – Mid-Chesapeake Bay Island Ecosystem Restoration Project: James Island*. March 2024.

[4] Buxton, L., 2024. *Marsh Migration and Thin-Layer Placement on Blackwater National Wildlife Refuge*. August 29, 2024

[5] Gross, S., 2017. “Baltimore District Offers Dredging Expertise for Award-Winning Climate Adaptation Project on Eastern Shore.” *U.S. Army Corps of Engineers, Norfolk District: News Stories*. Last modified August 8, 2017; accessed January 17, 2024. Available at: https://www.nab.usace.army.mil/Media/News-Stories/Article/1271819/baltimore-district-offers-dredging-expertise-for-award- winning-climate-adaptati/.

PRESENT (ONGOING)

- PAUL S. SARBANES ECOSYSTEM RESTORATION PROJECT AT POPLAR ISLAND
- HOG ISLAND
- WEANACK LAND (HISTORIC SHIRLEY)
- LANGLEY-EUSTIS NATURE-BASED SOLUTIONS
- CHINCOTEAGUE NATIONAL WILDLIFE REFUGE

PAUL S. SARBANES ECOSYSTEM RESTORATION PROJECT AT POPLAR ISLAND

View of Poplar Island showing containment cells and marsh. (Source: MES)

Poplar Island, once a 1,100-plus acre island that hosted a small community of almost 100 people, was subject to extensive erosion that reduced it to just 4 acres by 1990. The island remnants consisted of tidal flats and low marsh. An interagency partnership led by the U.S. Army Corps of Engineers (USACE) and Maryland Department of Transportation Maryland Ports Authority began placing DM on the remnants of the island in 2001 with the goal of restoring Poplar Island to its 1847 extent of 1,400 acres.[1]

Construction consisted first of building 35,000 feet of containment dikes, creating a series of individual cells for DM placement. Poplar Island receives 2 million cubic yards of DM per year.[2] The island is designed to contain 71.1 million cubic yards of DM, expanding capacity for dredging in the region. The habitat developed on Poplar Island so far consists of 776 acres of tidal wetlands, including both low and high marsh habitats, nesting islands for birds, and open-water ponds. Poplar Island also has an 110-acre open-water embayment with a depth of 12 feet to support benthic habitat. It has large rock reefs and the potential for SAV restoration. More than 800 acres of upland habitat are currently in development, and the project team plans to develop a range of habitat types, including scrub-shrub, forest, and meadow. Testing is underway to determine best practices for using DM for upland habitat because of the limited number of projects that have done that in the past.[1] Poplar Island ecosystems are extensively monitored during restoration by the Poplar Island Working Group, which consists of scientists from federal, state, and local agencies and researchers from the University of Maryland Center for Environmental Sciences.[3]

[1] MES (Maryland Environmental Service), 2024. "About Poplar Island." *Poplar Island Restoration*. Accessed December 20, 2024. Available at: http://www.poplarislandrestoration.com/Home/About.

[2] Maryland DMMP, 2024. "Poplar Island Ecosystem Restoration Project". Accessed March 13, 2025. Available at: https://maryland- dmmp.com/wp-content/uploads/2024/12/PI_FACT_SHEET_11_24.pdf

[3] UMCES, n.d. Poplar Island: A Story of Successful Restoration. Accessed March 13, 2025. Available at: https://www.umces.edu/research-highlights/poplar-island-a-story-of-successful-restoration

WEANACK LAND (HISTORIC SHIRLEY)

Bird's eye view of Port Tobacco. (Source: Weanack Land)

Weanack Land, LLC (Weanack Land) runs Port Tobacco, formerly part of the Historic Shirley estate (aka Shirley Plantation). Weanack Land is a 280-acre tract of land on the James River aimed to facilitate restoration and agricultural productivity. The land was formerly mined for sand and gravel, and the pits left behind were used as DM containment basins. Weanack Land now supports a modern dock built using DM as structural fill and business geared toward land reclamation using DM, particularly focusing on the use of DM to support degraded farmland and row cropping. At Weanack Land, DM has been used to create an 18-acre pecan orchard.[4]

DM processed at Weanack Land is tested to ensure it meets regulatory standards and to determine its agronomic utility. Approved DM can be used as topsoil with outcomes comparable to or, in some cases, better than native productive soils.[4]

4 Weanack Land, 2024. “About.” *History of Weanack Land*. Accessed December 20, 2024. Available at: https://www.weanack.com/about.

LANGLEY-EUSTIS NATURE-BASED SOLUTIONS

Aerial image of Joint Base Langley-Eustis. (Source: DOD 2024)

Joint Base Langley-Eustis received a grant for $845,000 from the National Coastal Resilience Fund through Department of Defense's (DOD) Readiness and Environmental Protection Integration (REPI) Program, which aims to enhance coastal resilience and protect endangered species at military installations through nature-based solutions. The project currently in design at Langley-Eustis includes four nature-based solutions: thin-layer placement, living oyster reef breakwater structures, submerged aquatic vegetation beds, and sand motors or ephemeral islands along the Back River neighboring the installation. The City of Hampton contributed an additional $143,000 to the project.[5] Joint Base Langley-Eustis is exploring the incorporation of BUDM in its restoration efforts, as U.S. Navy dredging of Skiffe's Creek at the site produces over 500,000 cy of DM per event every 5 years, most of which is currently placed at upland dredged material management areas or used to reinforce existing infrastructure.[6] The shorelines of Joint Base Langley-Eustis contain considerable historical and archaeological resources, including colonial and indigenous artifacts, making shoreline stabilization of cultural as well as mission importance.

[5] DOD, 2024. Readiness and Environmental Protection Integration Program Fact Sheet. 2024 National Coastal Resilience Fund Department of Defense Recipients. Accessed March 13 2025. Available at: https://www.repi.mil/Portals/44/REPI_NCRF_FactSheet_112524_v2.pdf
[6] Siegel 2022

CHINCOTEAGUE NATIONAL WILDLIFE REFUGE TIDAL WETLAND RESTORATION

Restoration area at Chincoteague National Wildlife Refuge. (Source: USFWS)

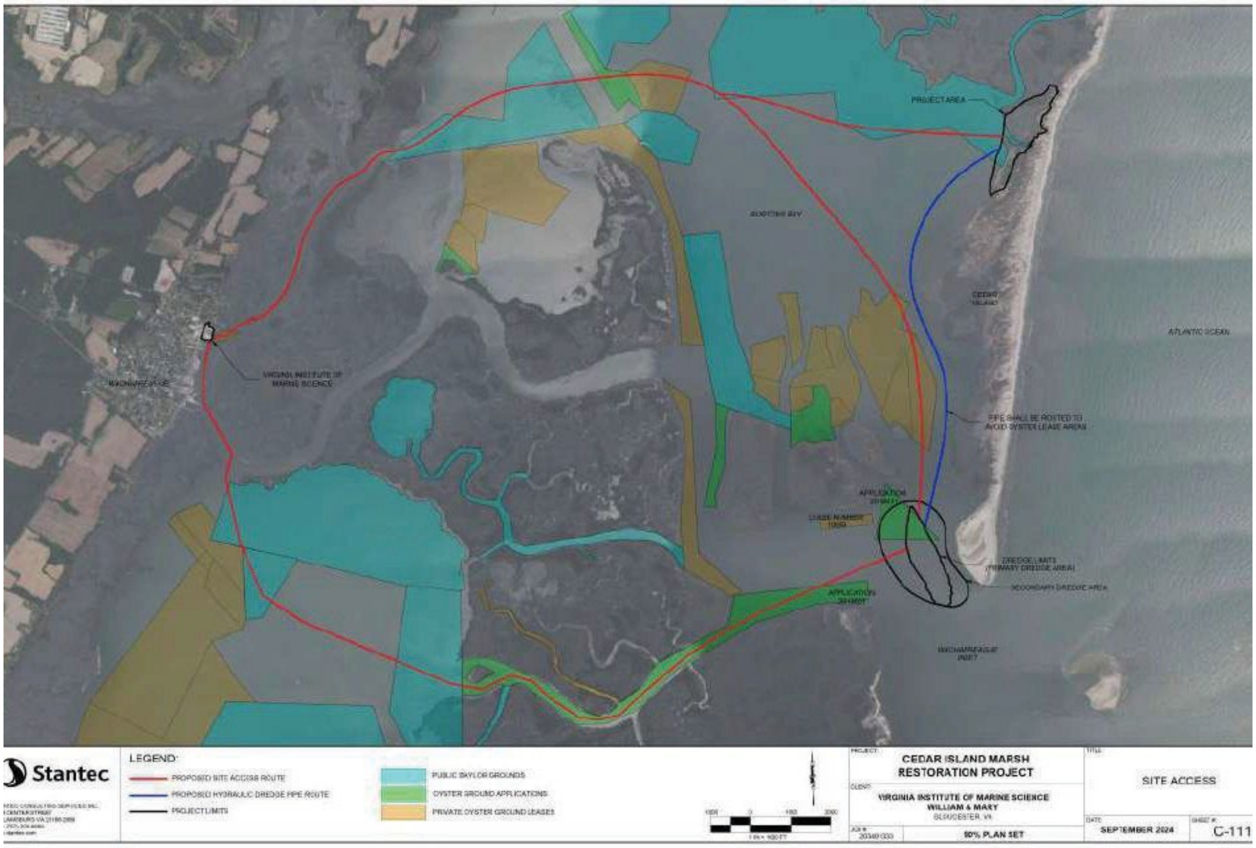
The U.S. Fish and Wildlife Service is planning a BUDM project at Assateague Channel, a narrow inlet dominated by tidal marsh between Chincoteague and Assateague Islands, within Chincoteague National Wildlife Refuge.[7] The habitat in this area has degraded due to erosion, storms, and over- grazing by waterfowl and Chincoteague ponies, into a sandy tidal flat with only remnant patches of marsh. The project aims to use dredged material to create 18.47 acres of marsh habitat extending into current open water, featuring both high marsh and low marsh habitat. An additional 2.08 acres of existing marsh habitat will be rehabilitated as part of the project. Low marsh habitat will be planted with *Spartina alterniflora*, while high marsh habitat will feature *Spartina patens, Distichlis spicata,* and *Juncus gerardii*.[7]

[7] Burgess and Niple 2022

FUTURE (PLANNED)

- CEDAR ISLAND
- HAMPTON ROADS BENEFICIAL USE OF DREDGED MATERIAL
- GUINEA MARSH
- CATLETT ISLANDS

CEDAR ISLAND



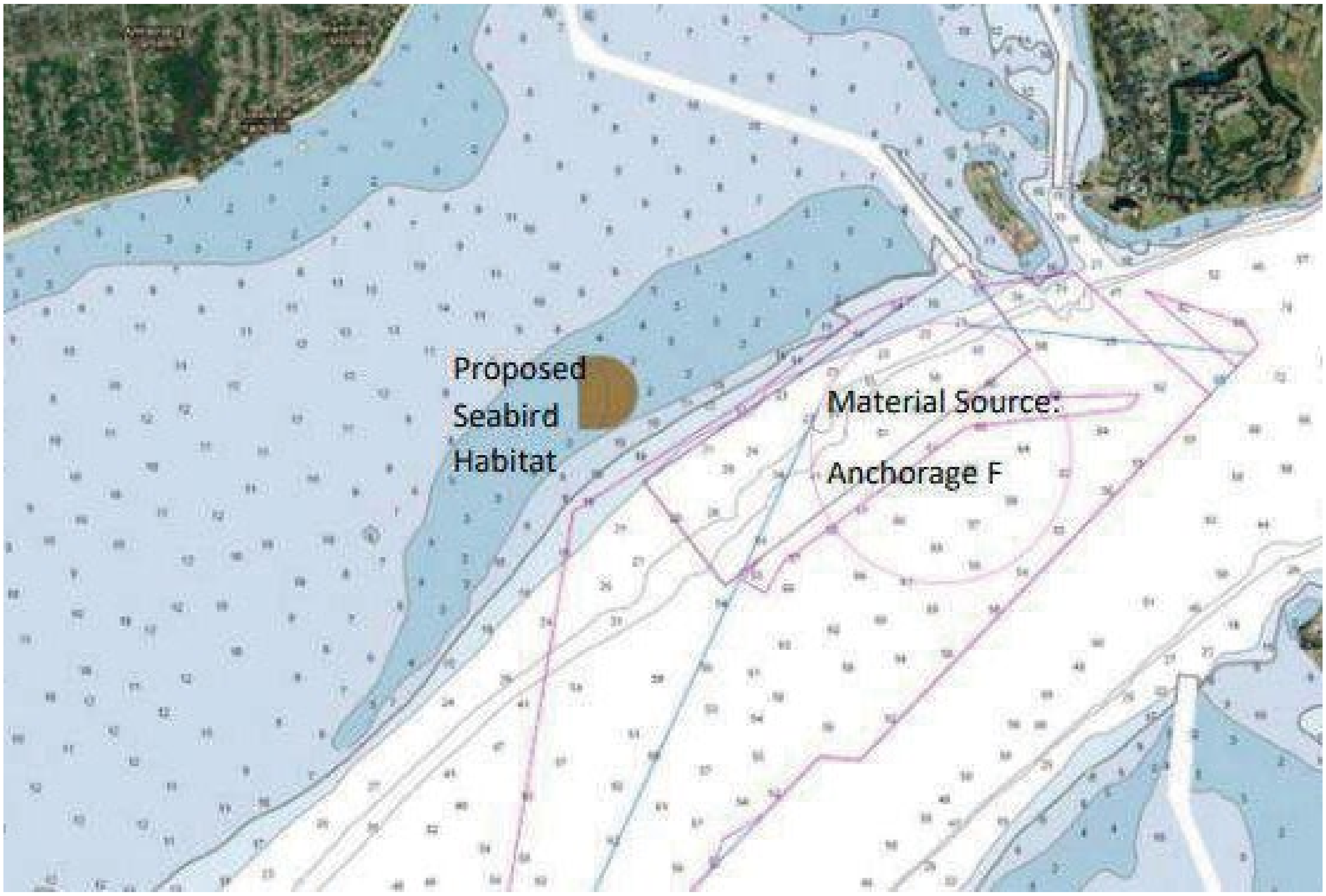
Planned DM placement as part of the Cedar Island Beneficial Use Restoration. (Source: USACE, Norfolk District)

Cedar Island is a barrier island off the coast of the Atlantic side of the Delmarva Peninsula near Wachapreague, Virginia. The back-barrier region of Cedar Island contains tidal wetlands and marsh islands, which are at risk of recession and ecosystem loss due to erosion and SLR. The USACE, Norfolk District, with involvement from the Accomack-Northampton Planning District Commission, Virginia Department of Wildlife Resources, the National Fish and Wildlife Foundation, and U.S. Fish & Wildlife Service, are planning to source material from a subaqueous borrow area to increase the elevation of back-barrier wetlands on the island by approximately 6 inches using TLP, making use of 77,435 cubic yards of DM from nearby channels at Bradford Bay and Finney Creek. Placement is slated to begin in 2027, with an initial TLP located on Fools Gut Marsh Island. Potential follow-up treatments may occur in 2041 and 2055, depending on outcomes from the first TLP.[1] The project plans to create acres of unvegetated tidal flat, 7.58 acres of vegetated low marsh, and 21.26 acres of vegetated high marsh; 4.69 acres will be newly created marsh converted from open water.[2] Site plans for Cedar Island BUDM placement can be found on the USACE Regulatory website under permit application NAO-2024-02581. The placement techniques, monitoring, and knowledge gained through this project will be useful for future BUDM-specific projects that include coastal resiliency goals.

[1] USACE, Norfolk District and VMRC (Virginia Marine Resources Commission), 2019. *Continuing Authorities Program, Section 204, Beneficial Uses of Dredged Material, Cedar Island, Virginia: Final Integrated Feasibility Report Environmental Assessment*. September 18, 2019.

[2] USACE, Norfolk District, 2024a. *NAO-2024-02581 (Cedar Island Resiliency Project, Accomack County, Virginia)*. Last updated December 11, 2024; accessed January 24, 2025 Available at: https://www.nao.usace.army.mil/Media/Public- Notices/Article/3993985/nao-2024-02581-cedar-island-resiliency-project-accomack-county-virginia/.

HAMPTON ROADS BENEFICIAL USE OF DREDGED MATERIAL



Plans for material sourcing and island location. (Source: USACE, Norfolk District)

The Hampton Roads Beneficial Use of Dredged Material project plans to develop a 5-acre seabird nesting habitat island at Hampton Bar, including a 9.7-acre horseshoe-shaped footprint on the sea bottom.[3] The plan involves the use of up to 518,100 cubic yards of DM from maintenance dredging of nearby anchorages and channels. The design of the island is based on Tomkins Island, a successful island used for seabird nesting built in South Carolina using DM from maintenance dredging of Savannah Harbor.[3] Project construction is anticipated to begin in 2027, and the newly created habitat will be monitored and adaptively managed from 2028 to 2037.[3]

[3] USACE, Norfolk District and DWR (Virginia Department of Wildlife Resources), 2024b. *Hampton Roads Beneficial Use of Dredged Material Continuing Authorities Program, Section 204: Draft Detailed Project Report and Environmental Assessment*. November 2024.

GUINEA MARSH

Marsh and upland habitat at Guinea Marsh Wildlife Management Area. (Source: Virginia DWR)

The Guinea Marsh Complex is an eroding system of wetlands, marsh islands, and isolated upland habitat. The Guinea Marsh Islands contain 190 acres of habitat located at the mouth of the York River in Mobjack Bay. The largest island, Great Island or Big Island, is 90 acres, and four other smaller islands, including Hog Island, make up an additional 100 acres of marsh island habitat. The area contains significant SAV cover between the islands.[4] North of Guinea Marsh Islands, the Guinea Marsh Wildlife Management Area contains an additional 728 acres of tidal wetland.

Proposals for restoration on the Guinea Marsh Islands Complex using dredged material includes the use of sandy DM to build up eroding beaches on the islands, and the use of fine-grained DM to increase marsh elevations, or to build a new island.[5] In Guinea Marsh Wildlife Management Area, EPA-funded planned restoration using DM includes beach, marsh, and dune restoration, targeting erosion control in high energy areas.[6]

[4] Virginia Sea Grant, n.d. Guinea Marsh Islands. Accessed March 13, 2025. Available at: Guinea Marsh Islands – WaterAdaptationEconomy.org
[5] Maryland Environmental Service, 2022. Dredged Material Management Process Implementation Study: Preliminary Technical Results. Interim Report of the Bay Enhancement Working Group.
[6] Virginia Department of Wildlife Resources, n.d. EPA Climate Pollution Reduction Grants Program: Implementation Grants General Competition. Unpublished.

CATLETT ISLANDS

Catlett Islands as seen from above. (Source: Erin Reilly, VIMS)

The Chesapeake Bay National Estuarine Research Reserve – Virginia (CBNERR-VA) has begun exploring the possibility of using DM in a BU demonstration project on Catlett Islands, near the mouth of the York River, where marsh grasses have almost completely disappeared due to erosion and inundation. A 5.5-acre site at Catlett Islands will be surrounded by GeoTubes, and 6 to 8 inches of dredged material from nearby Timberneck Creek, a tributary of the York River to the northeast of the Catlett Islands.[7] The proposed project will involve a wide variety of partners from throughout Virginia and the region, including CBNERR-VA, VA DEQ, VMRC, USACE, DCR Natural Heritage, Virginia Institute of Marine Science, MPPDC, NOAA Habitat and Ecosystem Services, Pamunkey Tribe, Mattaponi Tribe, Fairfield Foundation, and VA HDR.

[7] Hardaway, C., D.A. Milligan, C.A. Wilcox, and N.J. DiNapoli, 2020. *Timberneck Creek Dredge Channel Data Report*. Virginia Institute of Marine Science, William & Mary. December 2020. https://doi.org/10.25773/rxtp-me60.