Findings and Recommendations of

Maryland's Oyster Shell and Substrate Taskforce

Submitted to Governor Wes Moore

Under Executive Order 01.01.2023.12

November 15, 2024

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Maryland's Oyster Shell and Substrate Taskforce

Executive Summary

Records from the earliest days of European exploration of the Chesapeake Bay, indicate that oyster reefs were widely abundant, with many intertidal reefs extending from the Bay bottom to the surface of the water. Over the centuries, both the reefs and the oysters that created them have dwindled due to harvesting activities, decimation of oyster populations by disease and changing environmental conditions. Today, the range of oyster reefs is substantially diminished, with most having little 3-dimensional relief from the bottom.

Maryland Executive Order 01.01.2023.12 issued July 20th, 2023, established the Oyster Shell and Substrate Taskforce to identify strategies to retain oyster shell, increase abundance and create an overall additive situation for oyster substrate across the Chesapeake Bay. The twelve-member Taskforce convened on 18 occasions to obtain the most recent information on oyster substrate status and needs to develop recommendations for improving the situation in the immediate, mid, and long-term timeframes.

Approximately 50%-75% of the oysters harvested today in Maryland are shipped out of state, due in part to the lack of shucking houses in the state. With the oysters go the shells, increasing the difficulty for the state and private aquaculture lease holders to obtain them back for replenishment of the reefs. The estimated minimum substrate needed to meet the requirements of current programs for replenishing public fishery grounds, aquaculture, and restoring sanctuaries is approximately two million bushels of shell per year and/or an equivalent amount of alternative substrate. The state of Maryland currently purchases shell back annually from shucking houses (28,000 bushels from Maryland, 1,443 from North Carolina and 132,660 from Virginia shucking houses in 2023) to replenish public fishing reefs and for sanctuary restoration. The state funds shell recycling programs that reclaim shells from restaurants and other consumer outlets that are used primarily in the oyster sanctuary program, but this provides only a small fraction of the shell needed. Oyster aquaculture adds an unknown amount of substrate and some privately funded efforts also supplement oyster substrate planting activities. Together, all of these efforts are neither large enough nor consistent enough to meet the current demands for shell and substrate, let alone future growth, of the three sectors relying on oyster substrate (public fishery, sanctuaries, and aquaculture).

There is no single solution to the problem of limited oyster substrate and meaningful gains will only be made by implementing a range of solutions. While the Taskforce feels that shell is the preferred substrate to use in areas supporting a wild fishery and production of spat-on-shell, alternative non-shell materials should have a role in creating substrate or alleviating the need for oyster shell in certain areas. The Taskforce has developed more than thirty recommendations falling into five broad categories that, taken together, would begin to address substrate needs immediately while setting the state on a course for a more sustainable course for the future.

1. **Analysis and Planning for the Future**

- *Recommendation 1.A.* - The Maryland Department of Natural Resources (MDNR) should improve the ability to define the quantity of existing habitat and goals for rehabilitation.
- *Recommendation 1.B.* - The MDNR should establish a formal process to project the future substrate needs for each sector.
- *Recommendation 1.C.* - The State should commission an economic study of the decline of shucking houses in Maryland (and resulting decline of shucked shell) and potential actions to increase the amount of shucked shell coming from Maryland shucking houses.

2. **Retain Shell and Enhance in-State Supplies**

- *Recommendation 2.A.* - Eliminate large scale industrial use of whole oyster shell for uses other than putting it back into the Bay for oyster production.
- *Recommendation 2.B.* - Continue and/or initiate projects with bar cleaning and reclaiming buried shell using existing gear, such as clam rigs, suction dredge, etc.
- *Recommendation 2.C.* - Utilize targeted shell excavation (e.g., less than 12" into the bottom) under existing laws and regulations.
- *Recommendation 2.D.* - Regarding the currently approved federal permit of dredging of buried shell at Man-O-War Shoal, the Taskforce recognizes the extensive public process which has already occurred regarding this permit and has no agreed-upon input that would supplement that already collected.

3. **Supplement Existing Shell and Substrate**

- *Recommendation 3.A.* - The Taskforce supports importing alternative substrate (including shell from outside of the region) if it is processed to ensure that it is free of contaminants, invasive species, pathogens and other material that could harm the Chesapeake ecosystem. The MDNR should clearly define and publicize the process that importers need to follow to ensure that imported shell from outside of the Chesapeake region meets these criteria.
- *Recommendation 3.B.* - Access to additional shell and substrate sources and permits should be given to all three sectors – aquaculture, the wild fishery, and sanctuaries.
- *Recommendation 3.C.* - Non-shell alternative substrates that are approved by MDNR provide an adequate substrate (dependent on use) but need to be used in such a way to reduce conflicts with other uses of the area such as commercial fisheries, recreational boating, and general navigation.
- *Recommendation 3.D.* - The MDNR should purchase at least two to five million bushels of domestic (e.g. West Coast) shell, store it for future use, and conduct an investigation of the most cost-efficient method of transporting shell across the country.
- *Recommendation 3.E.* - The MDNR should investigate the feasibility and cost of establishing a repository of shell and/or substrate (on land) that is available and accessible to all sectors to plant for oyster substrate.
- *Recommendation 3.F.* - MDNR should conduct (or contract) a suite of pilot shell acquisition programs to acquire oyster shell, such as importing shell from overseas.
- *Recommendation 3.G.* - The MDNR should meet with current and new shell recycling operators frequently regarding the 2022 changes to the shell recycling program to review operations and expenses and determine whether the new regulations are improving shell recycling and further changes if needed.

4. **Funding and Administration**

- *Recommendation 4.A.* - The MDNR should work with regulatory agencies (state and federal) to accelerate the permitting process to incentivize development of new projects.
- *Recommendation 4.B.* - MDNR should develop and publicize a process to evaluate and review novel materials (e.g., manufactured materials) for use in oyster restoration.
- *Recommendation 4.C.* - Increasing the amount and sources of funding for oyster substrate enhancement is paramount to success.
- *Recommendation 4.D.* - The state should work with other state and federal agencies to quickly develop a transparent process through which government, or private interests may claim credit for the nutrient reduction created by oysters and apply them to the state's nutrient reduction goals or sell them on the open market.
- *Recommendation 4.E.* - The MDNR should work with state and federal partners to develop a single permitting process so the state may issue all substrate permits for activities conducted by all sectors, and work with the U.S. Army Corps of Engineers to maximize the use of nationwide permits where possible.
- *Recommendation 4.F.* - The MDNR and MDE should investigate using Water Quality Revolving Loan funds to improve oyster substrate and rebuild healthy oyster populations.
- R*ecommendation 4.G.* - The MDNR should explore and implement regulations / legislation that permits MDNR to use Watershed Protection and Restoration Act funding for approved oyster enhancement (sanctuary/public fishery) projects.
- *Recommendation 4.H.* - The MDNR, should work with the aquaculture industry to increase the knowledge and usage of existing programs designed to help industry (i.e. assistance with applying for funding and technical support programs available at the state, county, and federal levels) and initiate dialogue with the U.S. Department of Agriculture to increase the level of support offered to the Maryland aquaculture industry.
- *Recommendation 4.I.* - The MDNR should publish and make known, through a publicly accessible portal, alternative substrate research on understanding the cost / benefit / suitability of different natural and man-made materials for use as substrate to harden bottom, receive a natural spat set and/or for spat-on-shell production. The state should work with communication partners (e.g., University of Maryland Center for Environmental Science) to communicate this information to all sectors.

5. **Additional Research**

- *Recommendation 5.A.* - The Taskforce strongly supports immediate prioritization of research targeted toward our understanding of substrate suitability and benefits, including ecosystem services of enhanced oyster production on various substrate materials, cost-benefit analyses on the use of alternative substrates, the effect of shell on oyster production compared to alternative substrates, environmental impacts of novel alternative substrates and associated biosecurity measures, environmental and economic tradeoffs and ecosystem impacts associated with shell dredge activity, and others.
- *Recommendation 5.B.* - The state should explore novel ways to reduce the need for oyster shell including evaluating non-traditional materials, both natural and man-made, for use in oyster restoration and modifying/codifying the aquaculture leasing regulations on permittable bottom criteria to reduce the need for shell.

Details of these recommendations and additional background information are contained within the report.

Maryland's Oyster Shell and Substrate Taskforce

Table of Contents

EXECUTIVE SUMMARY I

BACKGROUND 1

TASKFORCE CHARGE 3

PROCESS AND MEETINGS 3

NEED FOR SHELL AND SUBSTRATE 4

QUANTITY 4

FINDINGS AND RECOMMENDATIONS 7

SOURCE OF SHELL AND SUBSTRATE 7

Oyster Shell *7*

Retaining Fresh Shell 8

Shell Recycling 9

Bar Cleaning and Shell Reclamation 10

Shell Excavation 10

Shell Dredging of Buried Shell 11

Imported Shell 12

Alternative Substrate *13*

Imported Substrate 16

Comparison *16*

PERMITTING PROCESS 18

ECONOMICS AND FUNDING SOURCES 19

ENHANCE AVAILABILITY OF SHELL AND SUBSTRATE 20

RESEARCH 20

REFLECTIONS, PATH FORWARD AND NEXT STEPS 23

ACKNOWLEDGEMENTS 24

LITERATURE CITED 24

APPENDIX I. PRESENTATIONS PROVIDED TO MARYLAND'S OYSTER SHELL AND SUBSTRATE TASKFORCE, 2023-24 ..... **APPENDIX I-1**

APPENDIX II. OUT-OF-STATE SHELL IMPORT INSPECTION REPORT USED BY THE MARYLAND DEPARTMENT OF NATURAL RESOURCES FISHING AND BOATING SERVICES ..... **APPENDIX II-1**

APPENDIX III. ALTERNATE SUBSTRATES ALLOWED UNDER U.S. ARMY CORP OF ENGINEERS TO THE STATE OF MARYLAND ..... **APPENDIX III-1**

Final Report

Maryland's Oyster Shell and Substrate Taskforce

Background

Maryland Executive Order 01.01.2023.12 issued on July 20th, 2023, established Maryland's Oyster Shell and Substrate Taskforce. The foundation of the Executive Order was:

- Increasing the abundance of the Eastern Oyster, a critical species for Maryland's economy and water quality, is a priority of the Moore/Miller administration;
- Oysters play a valuable role in creating reefs that clean water and provide habitat for critical species, including crabs and striped bass;
- Oysters are a defining species and their reefs a defining feature of the character and culture of the Chesapeake Bay; and
- The State of Maryland is currently limited in its ability to process oyster shells for use in promoting oyster reproduction and must ship oyster shells out of state for processing, thus losing a valuable resource for the State and the Chesapeake Bay watershed.

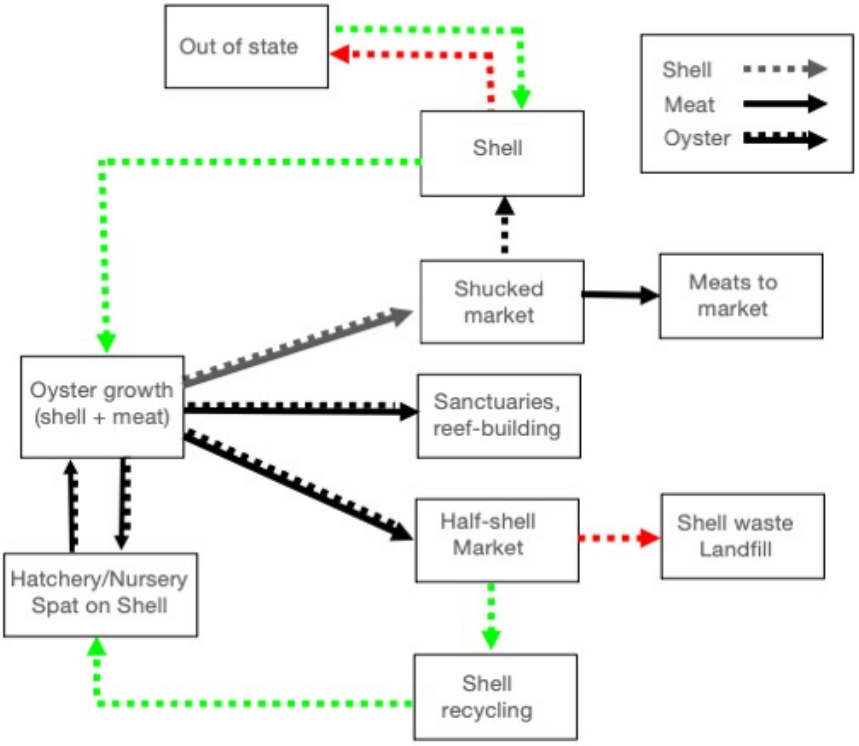
The importance of replenishing oyster reefs with substrate that is suitable for producing the next generations of the species is well established in Maryland's history. The current Maryland Natural Resources Article of the Annotated Code of Maryland contains several provisions which have evolved over time to retain or incentivize the planting of oyster shell and substrate, including:

- Shell purchase (§ 4-1019.2): for planting in privately leased bottom for aquaculture purposes, riparian bottom for the propagation of oysters; or on public shellfish fishery areas.
- Shell recycling program (§ 4-1019.1).
- Export tax and bushel tax (§ 4-1020) to support the repletion of the natural oyster bars and the oyster seed program.

Despite these and other efforts, the shortage of bottom substrate for growing oysters for aquaculture, the public fishery, and the oyster sanctuary (restoration) areas remains problematic. Oysters, and the shells that they produce, cycle in and out of the Chesapeake Bay region through processes that can be complex and heavily influenced by the economics of the oyster meat itself as well as the economics of the oyster shell. (Figure 1). The interacting dynamics of this heavily influence the availability of the shell that ultimately is needed to produce future oysters.

Finding a solution to the charge of the Taskforce is beneficial to oysters and the broader public including oyster harvesters, recreational anglers, and the general public in the context of improved water quality and healthier ecosystems in the Chesapeake Bay.

Figure 1. Flow of oyster meat and shell through the Chesapeake fishery, aquaculture markets, and shell recovery programs.



The oyster shell cycle. Flow of oyster meat and shell through the Chesapeake fishery, aquaculture, markets and shell recovery programs. **Red is shell loss, green is shell recovery.**

Oyster growth produces shell and meat. Meat is harvested for the shucked market and the half-shell market. Shells get separated in shucking houses, half-shell restaurants and in people's homes. The shells are partially returned to the cycle by recycling programs and shell imported from out of state. Shell is used on aquaculture leases, for restorative reef-building in sanctuaries and public fishing grounds (via spat on shell and direct planting). A portion of shell ends up in landfills as waste.

Taskforce Charge

The Executive Order charged the Taskforce with the following responsibilities:

(1) Identify strategies and solutions to retain shell, increase abundance and create an overall additive situation for oyster substrate across the Chesapeake Bay;
(2) Evaluate strategies based on the ability to meet the demand from the public fishery, aquaculture industry and restoration component in the near term and focusing on meeting needs for the growth of all three components; and
(3) Evaluate the economic impacts substrate has on the State and develop recommendations that take into consideration costs and benefits for the fishery.

Composition and members were selected by the Governor as:

(1) The Secretary of Natural Resources or their designee - Josh Kurtz
(2) The Secretary of Commerce or their designee - Nancy Lajoice
(3) A local government official - Ronald Fithian
(4) The University of Maryland Center for Environmental Science - Mike Sieracki
(5) A commercial waterman - Robert T. Brown
(6) A recreational fisherman - David Sikorski
(7) An economist from one of the State's HBCUs - Scott Knoche (Taskforce Chair)
(8) The Oyster Recovery Partnership - H. Ward Slacum
(9) A seafood company owner - Nick Hargrove
(10) A private oyster hatchery owner - Stephan Abel
(11) The State's aquaculture industry - Rachel Dean
(12) The State's conservation community - Allison Colden

Process and Meetings

The Taskforce convened nine times between November 2023 and May 2024 for purposes of collecting and discussing information on specific subjects, with an additional nine meetings between June and October to develop Findings and Recommendations and synthesize them into this report. All meetings were facilitated by a contracted facilitator and open to the public, with time allotted on each agenda for public input. Each informational meeting generally consisted of a particular theme for purposes of information gathering:

- Meeting 1 (November 6, 2023): Introduction and Background-Expectations for Taskforce
- Meeting 2 (November 27, 2023): Maryland and Virginia Shell Dredging and Planting
- Meeting 3 (January 8, 2024): Alternate Shell and Substrate
- Meeting 4 (January 22, 2024): Substrate Requirements and Attributes
- Meeting 5 (February 12, 2024): Man O' War Shoals and Dredging
- Meeting 6 (March 11, 2024): Alternate Substrate Symposium and Alternate Substrate Use by Other States
- Meeting 7 (March 25, 2024): Permitting and Procurement
- Meeting 8 (April 22, 2024): Economics of Oyster Shell and Substrate
- Meeting 9 (May 20, 2024): Past and Potential Future Shell Dredging Logistics/Scenarios and Identifying Commonalities

- Meeting 10: Canceled
- Meeting 11(June 24, 2024): Identifying Commonalities
- Meeting 12 (July 8, 2024): Identifying Commonalities
- Meeting 13 (August 12, 2024): Initial draft of Findings and Recommendations
- Meeting 14 (August 26, 2024): Review of second draft of report
- Meting 15 (September 9, 2024) Review of third draft of report
- Meeting 16 (September 23, 2024) Review of fourth draft of report
- Meeting 17 (October 7, 2024) Review of fifth draft of report
- Meeting 18 (October 28, 2024) Final review and approval of report.

All meeting summaries and final briefing materials were made available on a publicly available Google folder and will be archived by the MDNR for future reference.

A detailed list of presentations made at these meetings is in Appendix I

Need for Shell and Substrate

The very existence of this Taskforce highlights the need to increase substrate that is conducive to increasing oyster populations in Maryland's Chesapeake Bay. **The Taskforce recognizes and emphasizes that this is an *immediate* need requiring solutions that can be implemented in the short term (one year or less) while establishing the basis for intermediate (1-5 years) and longer (greater than 5 years) term solutions**. The Taskforce also recognizes that different types of substrate may not be as equally effective under the same conditions for settling spat and growing oysters (discussed further in this report) and that additional research will be needed (with some already ongoing) to determine the appropriate application of different substrate types that provide maximum returns for the resources needed (financial and other). The application and suitability of different types of substrate should be considered based on spat set potential, durability/longevity, cost (including placement), availability, and environmental suitability (e.g., toxicity, contaminants, and biosecurity considerations).

Quantity

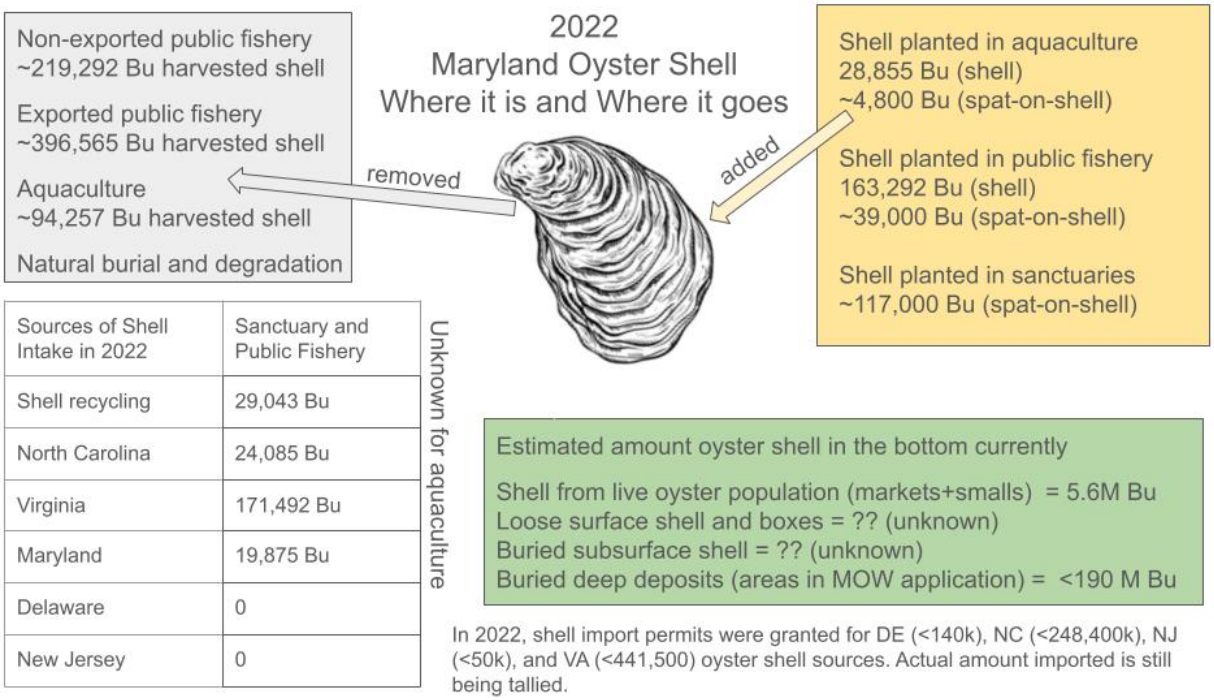
The Taskforce recommends that the MDNR improve the ability to define the quantity of bottom habitat based on re-delineation of oyster bars from current data being collected by Maryland Geological Survey and other ground truthing data and work with the Oyster Advisory Commission (OAC) to define the goals for that habitat. This would assist in further refining estimates of the amount of shell and substrate needed for oyster production.

The minimum substrate needed to meet the requirements of *current* programs is approximately 2 million bushels of shell per year and/or equivalent amount of alternative substrate (Maryland DNR Fishing and Boating Services 2023). This should be considered a bare minimum goal and does not account for any additional needs or expansion of existing programs. As an example of the current substrate needs, as of the beginning of 2024, an estimated 338,000 bushels of shell and 54,000 tons of stone are needed to complete the current sanctuary (restoration) projects underway to fulfill the commitments from the 2014 Chesapeake Bay Watershed Agreement, at a

cost for the stone of $1.4 million and shells are $2.4 million (costs do not reflect transportation and planting costs) (MDDNR 2023).

In 2022, approximately 350,000 bushels of shell were planted for all three sectors (shell and spat on shell), far short of the projected need (See Figure 2). **The Taskforce recommends that the MDNR establish a formal process to project the future substrate needs for each sector that will allow a forward-looking target for potential demand and identify subsequent solutions for meeting this demand.** This would assist the MDNR in projecting future purchasing needs, aligning annual purchases, and developing out-year budget projections that would provide a greater chance of meeting success. While the precise relationship between harvest and substrate needs is uncertain, most oyster management programs apply a 2:1 ratio (for every bushel of oysters harvested, 2 bushels of substrate are put back (Maryland DNR Fishing and Boating Services 2023).

Figure 2. Estimated oyster shell planted, lost, and existing on Bay bottom in 2022.



Sources of Shell Intake in 2022	Sanctuary and Public Fishery
Shell recycling	29,043 Bu
North Carolina	24,085 Bu
Virginia	171,492 Bu
Maryland	19,875 Bu
Delaware	0
New Jersey	0

The overall substrate needed over the next 10 years *under existing programs* is approximately 17.5 million bushels[1] of shell or equivalent amount of alternative substrate assuming the current projects and programs remain constant (Table 1a-c). This can be converted to cubic yards to determine substrate needs using alternative materials. This would cost $105,012,000 using recent cost estimates for shell, not including planting costs.

[1] Total in tables 1a-1c is a close approximation to this figure but does not equal it due to the variable range of annual bushels of shells needed for the public fishery based on the 2:1 ratio of harvest to planting.

Table 1a. Estimated needs and cost f*or just the raw material* from 2024 to 2034 within the state led *sanctuary restoration* projects if using fresh shell (bushels) for spat-on-shell (Maryland DNR Fishing and Boating Services 2023)

Program Name	Bushels Needed	Cost of Shell
Large-scale restoration	337,920	$2 million
Eastern Bay project	352,000	$2 million
Small-scale restoration	144,000	$864,000
Marylanders Grow Oysters	8,530	$51,180
Total (approximate)	842,450	$5 million

Note: In August 2024, DNR was awarded a $10 million grant from NOAA for restoration within a sanctuary(s). The grant will be used for habitat construction. At this time, it is unknown what type of substrate will be used and if the area will need spat restoration seeding. An estimated 50 - 75 acres of habitat will be restored using these grant funds. Potential shell needs for this new project are not included in the table above.

Table 1b. Estimated needs and costs for state led *public fishery* (replenishment) from 2024 to 2034 f*or just for the shell* and no cost associated with producing and planting spat-on-shell.

Program Name	Bushels Needed	Cost of Shell
Replenishment – shell*	5 million to 10 million	$30 million to $60 million
Replenishment - spat-on-shell	720,000	$4 million
Eastern Bay Region Project (spat-on-shell or shell)	400,000 to 1.1 million	$2.4 million to $6.6 million
Total	6.12-11.82 million	$36.4 - $70.6 million

*Based 2 to 1 ratio of shell planted versus oyster harvested to maintain productive fishery oyster reefs.

Table 1c. Estimated needs and cost *for just the raw material* from 2024 to 2034 if using fresh shell (bushels) within *aquaculture*.

	Bushels Needed	Cost of Shell
Total	3.6 million	$21.8 million

Note: The current yearly average for reported plantings for aquaculture is 229,000 bushels of shell. Assuming 10% growth, the 10-year demand will grow to almost 600,000 bushels of shell per year for aquaculture. This estimate is likely conservative

Findings and Recommendations

Recommendations from this Taskforce are founded on the basic principle of promoting solutions that are good for the oyster. Those actions that increase the oyster populations and habitat, balanced with environmental concerns and leading to healthier restored reef habitats, wild fisheries and aquaculture, are most generally desired. There is no single solution to the shortage of shell on the surface of the Bay bottom. **Given the immediate need for shell and substrate, access to additional shell and substrate sources and permits should be given to all three sectors – aquaculture, the wild fishery, and sanctuaries.**

The Taskforce recognizes that different substrates are not all equal in many respects, including efficiency of spat set, cost, environmental considerations, compatibility with multiple user groups and other aspects. Like many features of the Chesapeake Bay, the Bay bottom today is not pristine and has already been fundamentally changed through the centuries. While the structure has changed, maintaining or enhancing the ecological function of Bay bottom structure, such as functioning oyster reefs, should still be a goal. As this goal is pursued, however, it should be recognized that changing the bottom could impact users. Placement of substrate for oyster production should therefore be done after careful consideration of all aspects.

Source of Shell and Substrate

Oyster Shell

Oyster spat will settle and grow on almost any hard surface. The rate at which spat will settle on various surfaces differs and is the subject of research currently being performed by the University of Maryland Center for Environmental Science (UMCES).

Prior to European settlement, oyster reefs in the Chesapeake Bay were formed primarily on old oyster shells. In this sense, shell is natural bottom and is a proven substrate for high spat set in conditions under which the oysters evolved and thrived historically. As a natural substrate, oyster shell might be the preferred substrate to use over alternatives if all else is equal, including availability of any particular shell or substrate, financial resources to obtain and place, environmental considerations of obtaining/placing, and compatibility of the substrate with other uses of the area where it is placed. **The Taskforce agrees that shell is the preferred substrate to use in areas supporting a wild fishery and production of spat-on-shell.** It is likely a highly desirable option in aquaculture and as a component of oyster sanctuaries. The effectiveness of oyster shell substrate in supporting oyster production is not impacted across different species of oyster or the geographic sourcing of the shell. Oyster shell is available from the Chesapeake Bay and most coastal states on the Atlantic and Gulf of Mexico and from the West Coast and Asia.

Oyster shell from within Maryland is available from three main sources: (1) Fresh shell reclaimed from shucking houses, restaurants, etc. in Maryland/Virginia/District of Columbia, (2) Shell excavated from the surface of oyster bars or slightly below the surface of oyster bars, and (3) Shell dredged from buried oyster bars. From outside of Maryland, oyster shell is available from shucking houses in Virginia (primarily) and other oyster producing states, west coast shell brought in from the state of Washington, and shell imported from outside of the continental United States.

Retaining Fresh Shell

The number of oyster shucking houses within Maryland that formerly supplied fresh shell has diminished considerably over the decades. As a result, there are not enough shucking houses to provide shell to meet current needs for shell to replant in the state waters of the Chesapeake Bay. Although formal assessments identifying the decline in the number of shucking houses are lacking, anecdotal information from industry and researchers point to a number of causes, including:

- Lack of a consistent supply of oysters to maintain shucking houses. Note that shucking houses obtain oysters from various suppliers and areas, so this isn't simply the lack of oysters from Maryland and is only one contributing factor.
- Labor availability and cost. As with other seafood processing operations, much of the labor employed in shucking houses require H2B Visas to employ foreign nationals to fill temporary nonagricultural jobs. A frequently heard concern is that a shortage of these visas in Maryland caused labor shortages in the seafood processing businesses. Additionally, Maryland is generally known to have higher labor costs than neighboring states with competing shucking houses, thereby reducing the competitiveness of the state as compared to other locations.

Given the uncertainty in the specific causes to the lack of shucking houses in Maryland (and therefore potential solutions), **the Taskforce recommends that the MDNR, working in conjunction with the Maryland Department of Agriculture and Maryland Department of Commerce, commission an economic study on reasons behind the decline of shucking houses in Maryland and potential actions to increase the number of shucking houses and/or the output of oysters shucked in existing shucking houses.**

In an effort to purchase shell from shucking houses that remain in Maryland, the MDNR issues a public notice annually identifying the price to be paid for shucking house shell, based on market demand. This price is only applied to Maryland shucking houses which may limit the acquisition of some shell. Very few shucking houses sell shell through this program; some shucking houses sell their shell to lease holders for higher prices.

While retaining as much shell as possible for planting purposes is a desirable option, the feasibility of doing this is unlikely. Approximately 50%-75% of shell harvested as live oysters in Maryland are currently shipped out of state and, with the oysters goes the shell. While the export tax that has been applied to every bushel of oysters exported out of state (currently $1.00/bushel) was in part designed to incentivize the retention of oysters in-state for processing, it has not been adequate to stem the flow. Efforts to retrieve shell originating in Maryland from out-of-state processors have proven economically unsuccessful. Additional regulations, laws, and tariffs designed to incentivize the retention of shell in the state, if legal, would come with a high risk of undercutting the market for Maryland oysters (both in-state and out-of-state) as less expensive sourcing from other oyster producing states would supplant the Maryland market.

One action that may help to "retain" an unknown amount of shell is to prohibit uses of shell other than for planting back into the Bay. Maryland Natural Resources Code § 4-1019.2 states that "Unless permission has been obtained from the Department, it shall be unlawful for any person to take or catch oysters or shell in any of the waters of the State for the purpose of converting the

oysters or shell into lime, chicken meal, or road construction materials." However, it is unclear the extent to which this provision is being followed or enforced, as oyster shell is commonly available and used for most of these purposes. **The Taskforce agrees that large scale industrial use of whole oyster shell for uses other than putting it back into the Bay for oyster production should be prohibited or strongly disincentivized and encourages the MDNR to ascertain whether current code is being adequately enforced as well as to investigate additional measures to maximize the return of shell to the Bay bottom in lieu of other uses.**

Shell Recycling

The Maryland DNR and private donations currently support a shell recycling effort, primarily coordinated through the Oyster Recovery Partnership (ORP). The goals of this program are: 1) to Recover shell and 2) Outreach and awareness to the public about the need for shell recycling. Since 2010 this program has been evaluating whether shell can be recovered from restaurants, public and other on-the-ground sources (e.g., festivals, oyster roasts, etc.) that would otherwise end up in landfills, and plant it in the Chesapeake Bay. The ORP is the largest shell recycling effort in the country; in 2023, 25,618 bushels of shell were recycled through this program and since inception, 308,500 bushels have been reclaimed.

While this program began as an income tax credit, in 2022 the Maryland General Assembly approved legislation aimed at increasing the incentive to recycle oyster shells. The changes include:

- Converting the state income tax credit ($5 per bushel) to a $5 per bushel cash-for-shell grant program, capped at $2,000 (400 bushels) per recycler per year.
- Adding community groups, nonprofit organizations, and seafood processors and dealers to the list of entities eligible for the cash-for-shell payments (in addition to restaurants).
- Providing most shell recycling restaurants with state-funded receptacles used to store and recycle shells (Maryland Natural Resources Code § 4-1019.1).

Changes to the shell recycling tax credit program were implemented in September 2024. Due to the nature of the changes and the existing program, it will likely take 1-2 years to fully understand the impacts of the changes and whether they result in greater reclamation of shell from restaurants and other sources. ORP reviewed the updated rules and determined that they will not require significant changes to MDNR's and ORP's current shell recycling program because the vast majority of recycled shell has come from, and will continue to come from, restaurants. However, the changes will likely add costs to ORP's shell recycling operations as more restaurants will likely claim cash payments than previously claimed the state tax credit. Other shell recycling operators, like that of the Chesapeake Bay Foundation which operate differently than ORP, may face challenges to continuing operations based on the regulatory definitions of "authorized shell recycler."

The Taskforce recommends that MDNR meet with current and new shell recycling operators frequently during the first several years of the new program to review operations and expenses to determine whether the new regulations are improving shell recycling in Maryland and whether any changes are needed to regulations to facilitate continued shell recycling operations.

Bar Cleaning and Shell Reclamation

Bar cleaning and shell reclamation are processes of treating the surface of an oyster bar to reduce silt and increase the volume of exposed shells. A thin layer of silt can impede spat set, and deeper layers can bury entire shells and live oysters. Areas compromised in this fashion are candidates for these treatments, whereas viable productive bars are not. Shell reclamation is simply bar cleaning where the shells are transported to another area or bar where they are planted.

In both bar cleaning and shell reclamation, a standard oyster dredge is towed across the bar and affects shells on the surface, up to a few inches into the bottom. Shells that are partially buried and shells that are buried just under the surface are brought up and made part of the exposed habitat. If the dredge doesn't have its bag attached it is bagless dredging and, with a bag, it is bagged dredging. Bagless and bagged dredging have been done many times in the past since the 1980's.

Bagged dredging provides the benefit of catching the shells, bringing them to the boat, and replanting them – all of which cleans the shells more than just treating them on the bottom with a bagless dredge. Also, bagged dredging allows the worker to see what is being accomplished and make adjustments to the gear.

Bagless dredging has had limited effectiveness according to MDNR and a policy shift occurred over 20 years ago to focus on bagged dredging that provides greater ability to clean and wash shells. While there is no definitive evidence that natural spat set increases by exposing buried shell in this manner, as the shell may silt over (University of Maryland Center for Environmental Science, 2005), on-the-water experience by watermen suggests that, in specific circumstances, it may contribute to revitalizing oyster bars that are partially buried or silted over. Various aquaculture industry members have also utilized bar cleaning using modified gear in leased areas.

In 2012, an experimental shell reclamation program (using bagged dredging) was conducted by the MDNR using commercial oyster dredges. This project targeted bars with previous shell plantings where the shells had become silted and might be available for re-use elsewhere (i.e. reclaimed). The plantings were decades old, and it wasn't expected that all the original shells would be accessible, so the project was to determine how much might be recovered. A total of 550,850 bushels were recovered from approximately 5 million that had been planted on the targeted bars since 1960. Shells were removed from 10 bars and replanted on firm bottom on 22 bars or sold to aquaculture lease holders. The program showed that shells can be recovered but not in large enough volumes to mirror the historic levels of shell planting.

Bar cleaning and shell reclamation are ongoing practices that should be continued under existing regulations and laws.

Shell Excavation

Shell excavation collects shell at a relatively shallow depth in the bottom (less than approximately 12 inches). Only buried bars should be targeted for excavation, not live bars or bars with ample surface shell. Shell excavation will permanently alter the bottom, making it

unusable as oyster habitat in the future. MDNR has sampled buried bars using commercial clamming rigs in the past and determined that shells can be excavated at rates in the hundreds of bushels per hour.

In 2023, a pilot project was conducted by MDNR using a clam rig on a test area in Tangier Sound to retrieve buried oyster shells. The shells were held on the boat and then re-planted on a nearby live oyster bar to enhance the habitat. The project demonstrated that a clam rig could successfully collect buried oyster shells, hold them on board, and replant them efficiently. Additionally, excavated sites should be close to the bar to be planted to reduce travel time and risk in open water for the loaded clam boats. Permits from the U.S. Army Corp of Engineers (USACE) will be needed to conduct future shell excavation programs using clam rigs.

The Taskforce recommends that targeted shell excavation should be within the suite of options to reclaim oyster shell from the Chesapeake Bay bottom using readily available gear but not excluding any modifications of this gear, under existing laws and regulations.

Shell Dredging of Buried Shell

Buried shell in deep deposits under relic oyster bars in the Maryland waters is an available source of shell. Shell dredging is reflective of the large-scale historic program that primarily acquired shells from upper bay buried deposits from 1960-2006 using an industrial scale dredge specially built to dredge, sort, and wash shells in one operation. The program moved shells from lower salinity areas (mainly in the upper Bay) that were not conducive to high natural spat sets and transported them to areas of higher salinity to "catch" the higher natural spat set in those areas. A companion Seed Program employed watermen to move some of the dredged shells that received particularly high sets to lower salinity grow-out areas for eventual harvest. The dredge shell program was halted because permits were no longer available to continue shell dredging after 2006. The Virginia Marine Resource Commission still operates a shell dredging program and, although available shell will run out in the currently permitted sites within 10-12 years under current usage scenarios, they plan to seek permits for dredging buried shell in other sites to continue the program.

Shell dredging from deep buried deposits has become highly controversial. It is considered a long-term option (greater than 5-years) considering that the permits that are needed to conduct dredging and the mandated environmental surveys that accompany the dredging activity. The currently approved federal permit for limited dredging (discussed below), is conditional upon a State permit being granted, which hasn't happened yet. Should Maryland issue a permit, and the program begin, at least 3-5 years would be required to yield any shell. There is not a competitive market for shell dredging services due to only a single dredge available on the East Coast and, therefore, estimating exact costs for dredging and planting of shell is difficult to determine prior to a procurement process. Using the current price paid by the Commonwealth of Virginia for obtaining shell from the sole contractor as a surrogate, the price per bushel is somewhat comparable to other sources (discussed later). However, the currently approved federal permit mandates extensive environmental monitoring which, when added to the cost of dredging, makes this endeavor high priced in comparison to other sources of shell and substrate.

Currently approved Federal Permit for Dredging Buried Shell

Note: for extensive information, including public comment regarding this permit, refer to https://dnr.maryland.gov/fisheries/Pages/oysters/permit-applications.aspx)

In 2009, the Maryland legislature and governor directed the MDNR to apply for a permit to resume dredging of shells in an upper Bay site, principally Man O War Shoal located in Baltimore County outside the mouth of the Patapsco River. After several years gathering additional data, public hearings, and consultation with numerous state and federal agencies, the USACE issued a permit, contingent upon a permit being issued by the Maryland Department of the Environment (accompanied by a water quality certification). To date, that permit has not been issued due to considerable public opposition to the plan as documented in the website (https://dnr.maryland.gov/fisheries/Pages/oysters/permit-applications.aspx). Note that some positions, particularly from organizations, may have been modified since the initial compilation of these public comments.

The Taskforce discussed this issue at length, focusing one full meeting on historical shell dredging in Maryland and current day dredging in Virginia, one full meeting on the activities and potential shell harvest that are allowed under the current USACE permit if dredging were to proceed, and discussing potential future shell dredging activities with the former operator of the historical shell dredging program in Maryland. **The Taskforce recognizes the extensive public process which has already occurred regarding this permit and has no agreed-upon input on the currently-approved permit for dredging buried shell that would supplement that already collected.**

Imported Shell

The Taskforce believes that importing oyster shell from outside of the Chesapeake Bay region is a good source of substrate if it meets environmental, invasive species, pathogen and contaminant criteria. The MDNR Aquaculture Division already utilizes an inspection protocol for importation of material (shell and non-shell) that is destined for planting in the Chesapeake Bay (see Appendix II for standard inspection form). With increasing interest in the use of imported oyster shell for oyster substrate, **the Taskforce encourages MDNR to review, define and publicize the process that importers must follow to ensure that imported shell from outside of the Chesapeake region is free of contaminants, diseases, pathogens and other substances that may cause harm to the Chesapeake ecosystem if any were to be accidentally introduced.**

Domestic Shell (West Coast and Gulf of Mexico)

In 2023, a pilot effort was launched to tap a supply of oyster shell (*Crassostrea gigas*) located in the state of Washington. This shell originates with the aquaculture operations in that state and has few viable uses in that region. Approximately 7-10 million bushels of shell are available, with most having aged in piles for 5-10 years. The cost per bushel to load and transport this shell via overland (trucking) is approximately $6.25/bushel plus the cost of in-water planting once it reaches Maryland. The shell met the MDNR Aquaculture Division importation guidelines and, as a supplement, was verified as disease free by the Virginia Institute of Marine Science.

In early 2024 a larger scale importation effort was initiated and is ongoing. To date (September 2024), 6,765 bushels of west coast shell were used for spat on shell production and planted on public fishery bottom, set with an estimated 70.87 million spat. Most of the spat on shell was planted within the Eastern Bay region with the exception of one planting in Nanticoke River. The greatest amount of the west coast shell (88,672 bushels) was planted without spat on oyster bars in Dorchester, Somerset, St. Mary's and Talbot Counties.

These shells are being transported via overland trucking. Other transportation options (e.g., rail, barge) could be investigated and potentially used but would require that a higher volume of shell be imported to be economically competitive with the current operations.

There may also be shell stockpiles along the Gulf of Mexico Coast that could be purchased. In 2010, 50,000 bushels of shell was acquired using private donations and public funds. The shell was transported via truck and rail from New Orleans to Cambridge, Maryland at a cost of $6.25 per bushel.

Foreign Shell (Asian and Pacific Islands)

Similar to West Coast shell, a large supply of excess oyster shell is available from Asian countries, where 95% of the world's oysters are produced (~6 million metric tons, with 5.5 million metric tons coming from China). These are exclusively farm raised. Preliminary investigations are ongoing on the feasibility and cost effectiveness of importing these shells, with a large emphasis on protocols to ensure that the shell is free from disease and pathogens.

Alternative Substrate

Alternative substrate is defined as any non-oyster shell material that could be used to increase the amount of substrate conducive to increasing oyster populations. This can be natural (e.g., conch or clam shell, natural stone, oyster shell fines, etc.) or man-made (e.g., concrete, porcelain, etc.) materials. The Maryland Aquaculture Coordinating Council evaluated and made recommendations for some of these most commonly used alternate materials for oyster production in aquaculture settings (Maryland Aquaculture Coordinating Council 2023). While the Taskforce recognizes that a large amount and variety of alternative substrate has been utilized for oyster reefs (and other purposes) in the Chesapeake Bay, users should still be cognizant of changing the bottom with non-native material. Still, alternative substrate has been successfully tried in the production of oysters, with varying degrees of success and **the Taskforce agrees that non-shell alternatives that are approved by MDNR provide an adequate substrate (dependent on use).** Alternative substrates allowed in current and past MDNR permits issued from the USACE are listed in Appendix III. Currently, the MDNR is in the process of applying for a "baywide permit" from the USACE to allow Maryland to utilize approved alternative substrates in a wider range of locations.

The Taskforce addressed the application of each of these materials individually. Recommendations are found in Table 2 below.

Table 2. Taskforce recommendations on the application of alternate substrate (material that is not oyster shell) in three sectors of the oyster industry.

"Strike" - suitability for oyster spat setting on material.
"Base" - suitability of material for providing a foundation for oyster reef.

Substrate Type	**Sector**		
	Public Fishery	**Aquaculture**	**Sanctuary**
Non-oyster shell (clam, whelk, conch, and/or scallop)	● Good base ● Good natural strike	● Good base ● Good natural strike	● Good base ● Good natural strike
On-land Fossilized Shell	● Good base ● Too heavy for hatchery Spat-On-Shell	● Good base ● Too heavy for setting hatchery Spat-On-Shell	● Good base
Granite	● Good base if 2" in size or less	● Good base if 2" in size or less	● Good base size = 3-6"
Limestone	● Good base ● Good natural strike	● Good base ● Good natural strike	● Good base ● Good natural strike
River Rock	● Good base if 2" in size or less	● Good base if 2" in size or less	● Good base size if 2" in size or less
Other Amphibolite Stone	● Good base if 2" in size or less	● Good base if 2" in size or less	● Good base size = 3-6"
Crushed Recycled Concrete (free of debris)	● Good base if 2" in size or less ● Good natural strike	● Good base	● Good base size = 3-6"
Green Concrete (molded into oyster size or less)	● Need studies	● Need studies	● Case-by-case

Recycle Materials (cinder block or brick)	● Suitable as base if 2” in size or less	● Suitable as base	● Suitable as base but conditional on material
engineered artificial reef structures (reef balls e.g.)	● Not suitable	● Limited suitability ● Case-by-case	● Potentially suitable; ● Need to consider size related to other uses of the area ● Case by case ● Further discussion needed
Marl	● Less suitable for base and spat set (porous and breaks down)	● Less suitable for base and spat set (porous and breaks down	● Less suitable for base and spat set (porous and breaks down

The Taskforce held considerable discussions on the use of alternative materials as a “base” to firm up soft bottom on which a veneer of other substance (e.g., oyster shell) could be applied on which the oysters would grow. This type of application would extend the use of the available supplies of oyster shell and has been commonly used in the Oyster Sanctuary program. The vertical relief provided by building up the base with alternative substrate raises the surface where oysters set and grow above the sedimentation that continually occurs in the Bay.

While the Taskforce recognizes the value in extending the use of oyster shell resources through the use of alternative materials in such a manner, there are some concerns that the material permanently changes the bottom, potentially conflicts with future uses of the area for other purposes and needs to be done in such a way to reduce conflicts with other uses of the area such as commercial fisheries, recreational boating, and general navigation. Alternative substrate should not be applied in areas where oysters and/or shell in high volumes are found.

The Taskforce recommends that MDNR develop and publicize a process to evaluate and review novel materials (e.g., manufactured materials) for the use in oyster restoration. Some counties are beginning to use crushed concrete in the wild fishery; however, changing the bottom may cause problems for other industries (e.g. crabbing etc.). Concrete needs to be of the right size and structure. Additionally, a scientifically well-designed pilot project should be conducted on spat set, mortality, harvestability, gear adaptation, etc. where alternative substrate is planted. Some states, including Virginia, are piloting the use of #57 stone (½ to 1”) but this has not been tested in Maryland at this point.

Imported Substrate

As with oyster shell imported from outside of the Chesapeake region, **the Taskforce is supportive of importing alternative substrate if it is processed to ensure that it is free of contaminants, invasive species, pathogens and other material that could harm the Chesapeake ecosystem.** As discussed previously, this process should be clearly defined and publicized for everyone to follow (See inspection sheet in Appendix II).

Comparison

The cost of shell and substrate from different sources is difficult to compare directly due to several factors:

- The cost for material at any given time is subject to market forces. For example, the cost of #57 stone is currently high which may be in part due to increased demand from construction projects being funded through government infrastructure development programs.
- Costs in the table below do not include additional costs associated with environmental monitoring programs. If initiated in Maryland, dredging of buried shell is subject to considerable environmental monitoring requirements under the permit issued by USACE.
- Shell dredging costs have additional uncertainty since only one shell dredging operation exists on the east coast and therefore it is not a competitive market.

With these considerations, the total cost of obtaining, transporting and planting shell and commonly used substrate ranges from $5.50/bushel - $12.40/bushel (Table 3).

According to MDNR (2023), in many cases, the costs of alternative substrate materials may be less than shell. However, planting costs of the substrate may be higher as most alternative substrates are heavier than shell. Cost for planting stone in large-scale restoration areas is about $70,000 per acre for a foot of substrate placed. This could change as methods of deploying alternate substrate are refined, making deployment of alternates competitive with that of shell.

Program Costs (See Maryland DNR 2023)

Similar to the cost of the raw substrate material itself, developing a direct comparison between program costs of the past, current, and potential future main substrate enhancement programs is difficult. Compounding this, program accomplishments (e.g., bushels planted, acres restored, etc.) cannot be accurately correlated with the ultimate measure of success, oysters produced and/or bushels harvested (although it is commonly accepted that a 2 to 1 ratio of shell planted versus oyster harvested is required to maintain productive fishery oyster reefs, MDNR 2023). Although not completely comparable, some costs of past, current, and potentially future programs are presented in Table 4.

Table 3. Per- bushel shell/substrate costs (2024 dollars)
Source: MDNR via ORP

Type	Raw Material	Raw Material Costs Loaded onto Vessel	Planting Cost	Loading and Planting Cost	Maximum Total Costs
Crushed Concrete	$2.38 - $2.77			$3.25	**$6.02**
Fresh MD shell	$4.50	$5.50	$2.40 - $2.55		**$8.05**
Washington *Gigas* sp. Shell		$6.25	$2.40 - $2.55		**$8.80**
River Rock	$4.13			$4.88	**$9.01**
Fresh VA Shell		$6.50	$2.40 - $2.55		**$9.05**
Recycled Shell	$8.00		$2.40 - $2.55		**$10.55**
Limestone	$5.47			$5.46	**$10.93**
# 57 stone	$6.94			$5.46	**$12.40**
#1 or #3 Stone	$1.11				**$1.11 (material only)**
Mixed Clams	$5.18				**$5.18 (material only)**
Dredged Shell	**$3.50 to $5.50 (Virginia pricing)**				

Note: #57 stone passes through a ½-1" sieve, #1 passes through a 2-4" sieve and #3 passes through a 1-3" sieve). Costs for stone and mixed clam shell presented here are for large scale restoration.

Table 4. Program costs for oyster substrate enhancement or restoration efforts.				
Program Name	Cost (inflated to 2024 dollars)	Bushels of Shell	Years Covered	Notes
Repletion Program	$18 million-$99 million per year	~ 2 to 4 million per year	1997-2007	
Replenishment Program (Shell recycling, purchased from MD and VA shucking houses)	$0.9 million-$2 million per year	227,000	Annual average over 5 years	$8.8M for 1.8M bushels of fresh shell planted from 2013 to 2023
Dredging Man O' War Shoals	$36.8 million over 5 years	5 million	Projected	Includes ($27.5 million dredging + $9.3 million environmental monitoring
Restoration (sanctuaries)	$87.36 million for four tributaries (1,068 acres)			
Harris Creek Restoration	$92,000 - $108,000/ acre			These costs are included in the overall Restoration costs in the line above.

Permitting Process

An area in which the Taskforce had clear agreement was in improving the process of permitting oyster shell and substrate projects. Providing a faster path forward to enhance oyster substrate will incentivize the development of new projects. A clear set of guidelines and steps to take through the review and permitting process would greatly aid in this. Currently, different procedures and rules apply depending on the sector (e.g., aquaculture, wild fishery and sanctuary grounds) and developing some consistency as feasible would be beneficial. Adding to the uncertainty, the Chesapeake Bay falls under the jurisdiction of two different USACE divisions that may have different guidelines and requirements for permitting. The concept of "Nationwide Permits" issued by the USACE may be one model to look toward for developing a similar concept at the state level in this regard.

Economics and Funding Sources

In each of the three sectors (aquaculture, public fishery, and sanctuaries), stakeholders undertake a range of actions that have the potential to increase oyster abundance. By increasing oyster abundance, this produces a range of ecosystem services. For example, oysters filter excess nutrients such as nitrogen and phosphorus from the Bay's water column, and oyster reefs generate benefits to recreational and commercial fisheries through habitat and an enhanced food web for fish and other organisms. (e.g., fisheries habitat, nutrient removal) that benefit society as a whole. These ecosystem services benefit different parties, including commercial and recreational fishers and the general public. Innovative methods and approaches for compensating oyster sectors for producing and increasing ecosystem service provision should be explored.

The current MDNR public fishery replenishment budget is $3.6M in 2024. This is supported through oyster surcharges, bushel tax (currently $2.00/bushel), export tax (currently $1.00/bushel) and a Maryland Department of Transportation grant. The funding needed over the next 10 years is $105 million just for shell but with a current budget of slightly more than $5 million/year (for all items (shell, planting, etc.) a substantial shortfall exists.

Between the available supply of fresh shell, reclaimed shell, buried shell, imported shell and additional alternative substrate, there is very likely an abundance needed to meet the needs of all three sectors in Maryland. *However, funding to obtain and place this shell restricts the ability to utilize it for these needs.* **Finding solutions to the existing funding streams to get financial resources to accomplish the goals and objectives recommended by this Taskforce is paramount to success.**

Funding streams can be developed by tapping into existing funds or developing new and potentially innovative ways to support the oyster shell and substrate needs. For example, the 2012 Watershed Protection and Restoration Act (commonly called the "rain tax") was designed to reduce pollution in the Chesapeake Bay from impervious surface. Developing a means to tap into this for oyster restoration to filter nutrients from the water column could support oyster shell and substrate replenishment.

Similarly, sewage treatment plants that are subject to effluent discharge guidelines but don't meet them could pay into a mitigation fund to support oyster restoration, ostensibly through funding oyster shell and substrate programs to increase oyster habitat and thereby the nutrient filter capabilities within the Bay. Fines levied for sewage overflows or spills could also be used to support this fund.

As an example, a settlement for a 2021 sewage spill in St. Mary's County requires the St. Mary's Metropolitan Commission (MetCom) to complete $37 million in improvements already underway and to create a public alert system if a spill happens again. Additionally, MetCom agreed to $250,000 in penalties, which includes $125,000 to fund oyster restoration projects of the Potomac River Fisheries Commission "that have a reasonable nexus to water quality impacts associated with the violations that are the subject of this Consent Decree."

Nutrient trading credits provide another opportunity to help offset the costs of funding oyster restoration. With facilities and governments being required to meet limits on nutrient discharges

into waterways leading to the Chesapeake Bay, these credits, potentially traded through brokerage arrangements, could support oyster restoration based upon the amount of nutrients that oysters can filter in a given time period. Maryland has already invested substantial financial resources into large-scale oyster restoration projects that have realized significant, demonstrable habitat and living resource benefits. The U.S. Environmental Protection Agency (EPA) has recently developed and approved a method to quantify the nutrient and sediment reductions realized from these projects for application toward the state's EPA required Total Maximum Daily Load reductions. The state should now develop an internal process for taking credit for those reductions and/or selling those credits on the market to offset the costs of future projects.

The Maryland Water Quality Revolving Loan Fund (WQRLF) provides financial assistance "to protect or improve the quality of Maryland's rivers, streams, lakes, the Chesapeake Bay and other water resources." The fund is coordinated through the Maryland Department of the Environment and is oriented toward both point source pollution (e.g., wastewater treatment plants) and nonpoint source (e.g., stormwater, stream restoration, shoreline erosion control, etc.). Given the proven capacity for oysters to filter nutrients and other contaminants from the water column, **the Taskforce recommends that MDNR and MDE investigate funding projects to improve oyster substrate and rebuild healthy oyster populations through restoration, public fishing grounds, and aquaculture using WQRLF funds.**

Enhance Availability of Shell and Substrate

To expedite projects being conducted by the private sector, **the Taskforce suggests that the MDNR investigate the feasibility of establishing a repository of shell and/or substrate (on land) that is available and accessible to all sectors to plant for oyster substrate**. The state could purchase the material in bulk under state procurement guidelines and recoup the cost of these repositories by selling it to the users. Logistics such as allocation rules and policies could be developed in conjunction with user groups.

Research

The Taskforce strongly supports the immediate prioritization of research targeted toward our understanding of substrate suitability and benefits. This includes research into questions related to alternative substrates such as:

- Development of novel alternative materials and manufacturing processes, such as synthesis mechanisms derived from biomimicry of biological processes.
- Research on the short- and long-term co-benefits and ecosystem services of enhanced oyster production on various substrate materials. Such benefits and services include nitrogen removal, shoreline protection and habitat creation.
- Cost-benefit analyses on the use of alternative substrates including economics and carbon footprint, especially for large scale restoration and sanctuaries.
- Further research on the effect of shell on oyster production compared to alternative substrates when used for harvest, aquaculture, or restoration activities.
- Spat production, including set success, survival and growth rates, on various types of substrate.

- Potential environmental impacts of novel alternative substrates and associated biosecurity measures, if needed.
- Research needed to understand the environmental and economic tradeoffs associated with shell dredge activity.

Actions to Implement Recommendations

Many actions are identified in this report or inherent in the findings and recommendations. The Taskforce believes that the cumulative impact of these actions would help to address the shortage of oyster shell and substrate and enhance oyster budget. In particular, the Taskforce highlights the following actions that can be taken within the next ten years:

Short term (<1 year)

1. The MDNR should purchase 2 to 5 million bushels of West Coast shell and store it for future use.
    - The State would be able to recoup purchase cost plus make a nominal profit when sold to local industry, aquaculture, and restoration groups. (There is a concern that other states may try to undercut current agreements and buy the shell for themselves due to the limited supply nationwide. Having a shell depository will buy the State time to develop alternative solutions.) The shell repository should be continually resupplied to maintain a reserve in future years.
    - Included in this is the investigation of the most cost-efficient method of transporting shell across the country.

2. The MDNR should investigate whether oyster enhancement projects would qualify for funding through the Maryland Water Quality Revolving Loan Fund and if not, seek a legislative solution during the 2025 General Assembly to enable these projects to be eligible.

Intermediate (1-5 years)

1. Explore / implement regulations / legislation that permits MDNR to use Watershed Protection and Restoration Act funding for approved oyster enhancement (sanctuary/public fishery) projects. The initial application of these funds is designed to support "a five-year pilot program targeting five Maryland watersheds that best represent the state's diverse land uses, geographies, and impairments" with initial application deadline of December 3, 2024.
2. Develop funding mechanisms (though legislation and other means) to enable mitigation funding to fund oyster-related projects.

- A mechanism already exists to sell nutrient credits from various oyster grow-out / harvesting strategies.
- The State should work with U.S. EPA and others as appropriate to quickly develop a clear and transparent process through which state, local government, or private interests that fund large-scale oyster restoration projects may claim credit for the resulting nutrient and sediment reduction credits and either apply them to the state's TMDL or sell them on the open market. For those large-scale oyster projects (or portions of projects) that are funded with state funds, the state should take full advantage of the resulting credits towards the state's TMDL requirements and/or offsetting the cost of oyster restoration.

3. In partnership with USACE, develop a single permitting process to enable MDE to issue all substrate permits for all sectors (restoration, public fishery, aquaculture). with the following benefits:
    - Clear regulations that apply and are the same for all groups and individuals.
    - Reduces the timeline for approval, having a single agency oversee the process.
    - USACE/MDE issues permits to MDNR.
4. MDNR should conduct (or contract) a suite of pilot shell acquisition programs to acquire "large quantities" of oyster shell to include importing shell from overseas, shell excavation and reclaiming buried shell via a clam rigs, suction dredge, etc. This should include a cost/benefit analysis and long-term viability of conducting these efforts at scales that provide substantial shells for replanting.
5. Explore novel ways to reduce the need for oyster shell including evaluating non-traditional materials, both natural and man-made, for use in oyster restoration and grow-out, modifying the aquaculture leasing regulations on bottom criteria to reduce the need for shell. These include:
    - Supporting research on the efficacy of direct setting of oyster larvae on prepared substrate.
    - Determining a reef and/or tributary-scale shell budget to guide management of sanctuaries and harvest areas.
    - Working with the aquaculture industry members to review 'active lease' requirements to minimize need for shell use when not needed.
6. The MDNR, Aquaculture Coordinating Council, and aquaculture industry should increase the knowledge and usage of existing programs designed to help industry to apply to funding and technical support programs available at the state, county, and federal levels. The MDDR and Maryland Department of Agriculture should initiate dialogue with the U.S. Department of Agriculture to increase the level of

support offered to the Maryland aquaculture industry, including establishing an office of aquaculture within the USDA to focus on the unique needs of the industry.

7. Publish and make known, through a publicly accessible portal, alternative substrate research to understand cost / benefit / suitability of different natural materials for use as substrate to harden bottom, receive a natural spat set and/or for spat-on-shell production. This research should build from that underway by the University of Maryland and be oriented toward implementable solutions.

Long-term (>5 years)

1. Implement the most viable, cost-efficient shell acquisition programs.
2. Develop new loan programs specifically targeting oyster aquaculture operators to enable these growers to acquire substrate, not unlike the current loans through the Maryland Agricultural & Rural Business Industry Grant Programs (MARBIDCO) for aquaculture equipment.

Reflections, Path Forward and Next Steps

Maryland's Oyster Shell and Substrate Taskforce was formed by an Executive Order in July 2023 by Maryland Governor Wes Moore. The charge of this Taskforce was to submit by December 1, 2024 a report to the Governor containing recommendations for achieving a positive oyster shell and substrate environment.

The Taskforce first convened on November 6, 2024. The varied groups such as "recreational fisherman", "commercial waterman", "conservation community", and "seafood company owner", among others were now represented by esteemed professionals with vast experience working to achieve consensus in Chesapeake Bay-related natural resource management issues.

The group began by doing more listening than talking - listening to a wide range of folks with expertise in shell dredging, alternative substrate, regulations/permitting, and other topics, in an effort to build the common knowledge for consensus building down the road. And that was the goal, to build consensus - no easy task given the diversity of viewpoints and interests.

Our consensus building started with the most modest of notions - mostly but not entirely tongue in cheek - that the Taskforce was in agreement with the fact that "we don't want to be sitting around this table in 5 years down the road". In other words, the Taskforce wanted to produce powerful recommendations that would help resolve the State's oyster shell and substrate shortage.

As with any consensus-type approach that involves passionate, knowledgeable stakeholders with clear stakes in the outcome, there were disagreements. Very largely, the Taskforce was able to disagree without being disagreeable. It is a testament to Taskforce members' willingness to work together that consensus was reached on more than 30 recommendations across five categories.

The Taskforce is proud of this accomplishment and yet realizes that much work remains to turn these recommendations into actions that will yield the desired result - alleviating the shortage of oyster shell and substrate that is preventing the public oyster fishery, the aquaculture industry, and the restoration community from achieving their respective objectives. The Taskforce intends to leverage the social capital built through this process and work collaboratively as appropriate to achieve this result.

Further, the Taskforce recognizes that in the upcoming years, new opportunities and challenges will undoubtedly emerge for obtaining the oyster shell and substrate needed for Taskforce interests. This is yet another reason the Taskforce pledges to keep eyes on this important issue and to come together with a collaborative spirit to confront new challenges and take advantage of emerging opportunities related to oyster shell and substrate in the State of Maryland.

Acknowledgements

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Maryland Department of Natural Resources Fishing and Boating Services. 2023. Substrate Requirements for Oyster Management. A Report to the Governor and the Maryland General Assembly. December 31, 2023. 30p.

University of Maryland Center for Environmental Science. 2005. Bar Cleaning" in Oyster Restoration: A Consensus Statement from the University of Maryland Center for Environmental Science. July 11, 2005. 3p.

Appendix I. Presentations Provided to Maryland's Oyster Shell and Substrate Taskforce, 2023-24.

Meeting 2

Maryland's Historical Shell Dredging and Current Shell Planting Programs – Chris Judy, Director, Shellfish Division, Maryland Department of Natural Resources.

Virginia's Current Dredge and Fresh Shell Program – Andrew Button, Deputy Chief, Shellfish Management Division Head, Conservation and Replenishment, Virginia Marine Resources Commission.

Historical and Current Shell Recycling Efforts in Maryland – Ward Slacum, Executive Director at Oyster Recovery Partnership.

Meeting 3
Workgroup on Alternative Substrate – Ward Slacum, Executive Director at Oyster Recovery Partnership.

Background/Introduction of report "Substrate Requirements for Oyster Management" - Jodi Baxter, Shellfish Division Deputy Director, Fishing and Boating Services.

Alternative Shell
- West Coast Shell – Nick Hargrove
- Asian Shell – Tommy Price

Meeting 4
Substrate Requirements for Oyster Management - Jodi Baxter, Shellfish Division Deputy Director, Fishing and Boating Services.

Meeting 5
Man O' War Shoals Background Information Chris Judy, Director, DNR Shellfish Division
- Overview, Dredging Specifications, Permit Conditions.
- Key Issues: Environmental Studies, Shell Allocation, Estimated Cost, Public Comment.
- Alternate Sites for Shell Dredging.
- OAC Consensus Model on Man O' War Shoals.

Meeting 6
Overview of Highlights from UMCES Alternative Substrate Symposium – Dr. Elizabeth North and Dr. Matthew Gray, University of Maryland Center for Environmental Science, Horn Point Laboratory.

Input from Industry Members Harvesting on Alternative Substrate

- JC Hudgins, President, Virginia Watermen's Association/Chair of Virginia Shellfish Management Advisory Committee
- Bill Rodney, Texas Parks & Wildlife

Meeting 7

Overview of Regulatory and Permitting Process for Oyster Shell and Substrate in the Chesapeake Bay

- Brian Callam – Shell Import Permits (MDE/USACE)
- Chris Judy – Regulatory Permits

Overview of State Procurement Process Related to Purchasing Shell and Substrate – Jodi Baxter.

Developing Recommendations for Ensuring Disease Free, Contaminant Free, and Debris Free Substrate

Round Table:

- Tommy Price – Existing International Importation Standards
- Nick Hargrove – Experience with Biotic Testing of Imported Shell
- Tommy Price and Ward Slacum – Practices for Reducing Debris in Recycled Shell

Meeting 8

Brief Overview of Economics in the Context of Oyster Shell & Substrate – Dr. Scott Knoche, Morgan State University, Patuxent Environmental & Aquatic Research Laboratory.

Shell/Substrate and Program Costs

- Shell/Substrate Costs
  - Fresh shell
  - Dredge (fossil) Shell
  - Imported Shell (West Coast)
  - Granite (#57)
  - Other
- Program Costs
  - Replenishment Program
  - Dredging Upper Bay
  - Restoration
  - Other

Economic Outputs

- Public Fishery
- Aquaculture
- Restoration (Ecosystem Services)

Meeting 9

Past and Potential Future Shell Dredging Logistics and Scenarios – Jim Matters (formerly with Langenfelder Marine)

Appendix II. Out-Of-State Shell Import Inspection Report Used by the Maryland Department of Natural Resources Fishing and Boating Services

OUT-OF-STATE SHELL IMPORT INSPECTION REPORT

MARYLAND DEPARTMENT OF NATURAL RESOURCES
FISHING AND BOATING SERVICES

PART I: APPLICANT(S)/PERMITTEE(S)	**PART II: SOURCE/VENDOR**
PART III: INSPECTION DATE	**PART IV: STAFF**
	DNR staff: **Vendor staff:**
PART V: INSPECTION DETAILS	
Pile Disposition	
Onsite location(s): Estimated lot volume/amount(s): Is the imported material separate from other resource onsite: Reported shell age(s): Signs of animal activity: Signs of insect activity: Odor:	

1

PART V: INSPECTION DETAILS *Cont.*
Shell condition
Living or whole shellfish: Shellfish tissue remnants on shells: Shell moisture content: Fouling organisms observed on shells (animals, algaes, fungi, molds, etc.): Non-shellfish organisms observed in pile: Shell fragments and other particulate matter description and approximate composition: Non-shell debris:
PART VI: NOTES

OUT-OF-STATE SHELL IMPORT
INSPECTION REPORT

MARYLAND DEPARTMENT OF NATURAL RESOURCES
FISHING AND BOATING SERVICES

STANDARD OPERATING PROCEDURES

Photography
Photographic documentation is important. Pictures accompanying the written documentation of the inspection should include:

1. The entirety of the pile(s);
2. Any variance in conditions observed;
3. Up close (~1ft) from at least four sides of each pile;
4. Up close (~1ft) on each of the four sides at least one foot into the pile (this will require moving/digging shell).

Inspection
Onsite location(s) – Observe and describe where on the receiving property the shell pile(s) is located. Note proximity to state waters, other processing operations, etc. Walk around the entire pile(s) prior to orient yourself to the pile.

Estimated lot volume/amount(s) – Estimate the volume of shell being inspected.

Is the imported material separate from other resource onsite – Observe and note if the imported material is situated close enough for potential mixing or confusion with other material.

Reported shell age(s) – Describe the aging period of the material reported by the applicant or representative onsite.

Signs of animal activity – Observe and describe any signs of animal activity on or around the pile(s). Animal activity may indicate food sources within the pile (i.e., meat/tissue not yet decomposed).

Signs of insect activity – Observe and describe any insect activity in and around the pile(s) including those flying around/above and insected on and in the pile (e.g., flies, beetles, ants, etc.).

Odor – Observe and describe any smells associated with the pile(s). Note especially smells associated with decomposition.

Living or whole shellfish – Observe and describe any shellfish that remain living or with valves that remain associated. Including non-target species and fouling organisms.

Shellfish tissue remnants on shells – Observe and describe any shellfish tissue/meats on shells that has not decomposed. Including that of fouling organisms.

Shell moisture content – Observe and describe if shells appear to have been aging adequately to dry. This may be considered in context of recent weather.

Appendix III. Alternate Substrates Allowed under U.S. Army Corp of Engineers to the State of Maryland

MD DNR & Private Oyster Planting Projects with Substrate Materials as Approved By Permitting Agencies. 3/11/2024.
P = permitted but not used. U = permitted and used. R = requested in permit application; under review.

Substrate Type	Recent USACE/MDE Permits									
	Baywide Seed and Shell	Aquaculture Leases	St Mary's Sanctuary	Manokin Sanctuary	Harris Creek Sanctuary	Little Choptank Sanctuary	Tred Avon Sanctuary	Flat Rock (Pocomoke Sound fishery area)	Great Marsh (Lower Choptank fishery area)	Baywide Alternative Substrate *PENDING*
Oyster shell - C. virginica	U	U	U	U	U	U	U			
Oyster seed/spat - C. virginica	U	U	U	U	U	U	U			
Oyster shell - C. gigas	P	U	P	P	P	P	P			
Non-oyster shell (clam, whelk, conch, and/or scallop)		U	P		U	U	U			R
Florida Fossilized Shell			P		U	U	P			
Granite			U	U	U	U	U	P	P	R
Limestone			P		P	P	P	P	P	R
River Rock		U	P		P	P	P	P	P	R
Other Amphibolite Stone			P	P	P	P	P	P	P	R
Crushed Recycled Concrete (free of debris)		U	P		P	P	P	P	P	R
Green Concrete			P		P	P	P	P	P	R
Recycle Materials (cinder block or brick)					P	P	P			R
Reef Balls			P		P	P	P			
Marl					P	P	P			

Notes: All planting activity requires DNR's approval prior to planting any material.

Green Concrete is defined here as using a wet concrete mix to form oyster shell sized substrate. Dredged shell is included in "Shell C. virginica" (a permit is needed to acquire Maryland dredged shell).

Substrate types for planting on shellfish aquaculture leases are reviewed on an individual lease basis under the Joint Permit. This table is not blanket permission to use these materials on leases.

Notice: This table does not constitute blanket permission to use these materials on leases.