

2023 Chesapeake Bay Oyster Restoration Update



*Summary of Progress toward the
Chesapeake Bay Watershed Agreement's
'Ten Tributaries by 2025'
Oyster Outcome*

*Prepared by the Chesapeake Bay Program's Maryland Oyster Restoration
Interagency Workgroup and Virginia Oyster Restoration Workgroup*



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Report Context

The [2014 Chesapeake Bay Watershed Agreement](#), which guides the work of the Chesapeake Bay Program, calls for state and federal partners to “restore native oyster habitat and populations in 10 Bay tributaries by 2025, and ensure their protection.” Five tributaries are being restored in Maryland and five in Virginia. To achieve this outcome, the [Chesapeake Bay Program’s Sustainable Fisheries Goal Implementation Team](#) convened [working groups](#) in each state. With guidance from consulting scientists and the public, these groups set tributary-specific restoration goals and developed plans (hereafter, “[Restoration Blueprints](#)”) describing how the tributaries will be restored, consistent with success criteria described in the [Chesapeake Bay Oyster Metrics Report](#) (hereafter, “Oyster Metrics”). These Workgroups develop a report annually to describe progress toward this outcome. Summaries of progress made Bay wide, and broken down by state and by tributary, follow. Progress is reported through the end of calendar year 2023.



Photo: Virginia Marine Resources Commission

Report Notes and Authorship

This report was developed under the Chesapeake Bay Program's Sustainable Fisheries Goal Implementation Team, by the Maryland Oyster Restoration Interagency Workgroup and the Virginia Oyster Restoration Workgroup (Stephanie Reynolds Westby is chair of both workgroups, stephanie.westby@noaa.gov).

Members of the Maryland workgroup include: Oyster Recovery Partnership; Maryland Department of Natural Resources; National Oceanic and Atmospheric Administration; U.S. Army Corps of Engineers.

Members of the Virginia workgroup include: Chesapeake Bay Foundation; Christopher Newport University; City of Norfolk; City of Virginia Beach; Elizabeth River Project; Lynnhaven River NOW; National Fish and Wildlife Foundation; National Oceanic and Atmospheric Administration; The Nature Conservancy; The Pew Charitable Trusts; Pleasure House Oysters/Ludford Brothers Oyster Company; U.S. Army Corps of Engineers; Virginia Commonwealth University; Virginia Institute of Marine Science; Virginia Marine Resources Commission.

Numbers in this document are rounded, and are approximate.

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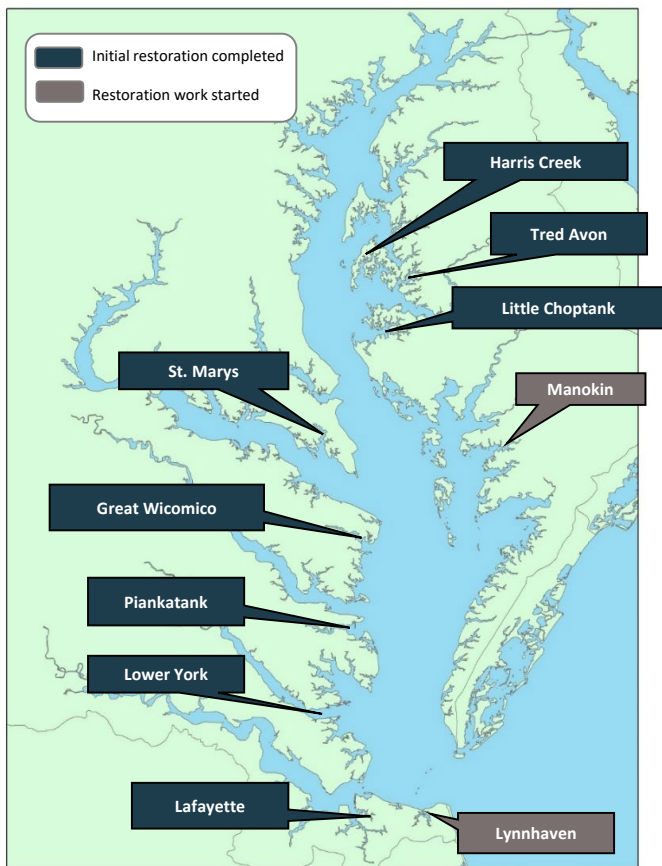


Photo: Oyster Recovery Partnership

Summary: Bay-wide Progress to Date

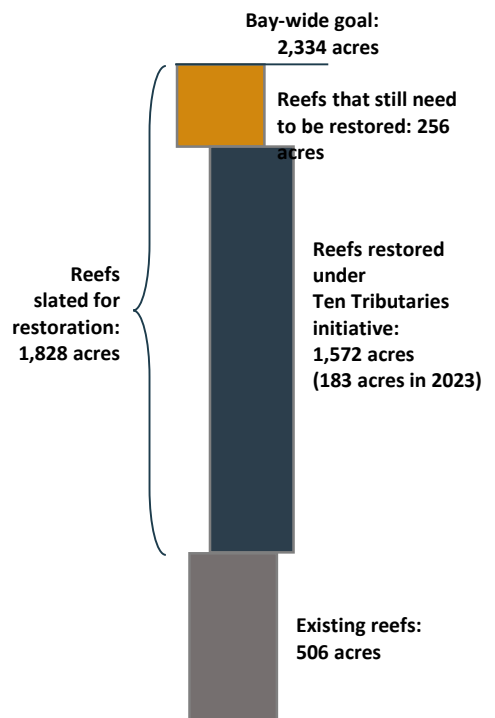
The [2014 Chesapeake Bay Watershed Agreement](#), which guides the work of the Chesapeake Bay Program, calls for state and federal partners to “restore native oyster habitat and populations in 10 Bay tributaries by 2025, and ensure their protection” (hereafter, “Ten Tributaries initiative”). Five tributaries are being restored in Maryland and five in Virginia. To achieve this outcome, the [Chesapeake Bay Program’s Sustainable Fisheries Goal Implementation Team](#) convened [working groups](#) in each state. With guidance from consulting scientists and the public, these groups set tributary-specific restoration goals and developed plans (hereafter, “[Restoration Blueprints](#)”) describing how the tributaries will be restored, consistent with success criteria described in the [Chesapeake Bay Oyster Metrics Report](#) (hereafter, “Oyster Metrics”). Detailed summaries of progress in Maryland and Virginia follow.

Tributaries Complete: Eight of Ten Planned, Bay Wide



Acres of Reef Restored Bay Wide: 1,572 of 1,828 Planned

That is nearly 2.5 square miles of restored oyster reefs—or 2,075 football fields—to date.



Bay-wide Cost to Date:
\$108.40 million
(\$18.37 million in 2023)

This cost is Bay wide, through the end of 2023, for reefs restored under the Ten Tributaries initiative. This includes reef construction and seeding only; costs such as benthic surveys, planning, permitting, and monitoring are not reflected. Restoration cost per acre varies due to factors including material type, reef height and configuration, hydrologic factors, agency and stakeholder preferences, whether a reef requires seeding with juvenile oysters (as is typical in Maryland, due to lower natural oyster reproduction than Virginia rivers), and other factors. Cost is approximate.

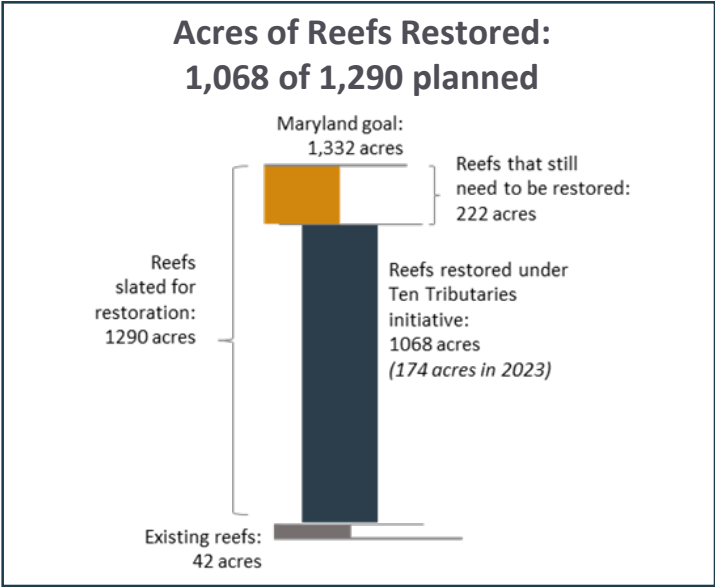
Summary of Maryland Progress

All five Maryland tributaries targeted for restoration under the Ten Tributaries initiative have been selected, and each now has a completed [Oyster Restoration Blueprint](#). Restoration work in four Maryland tributaries has now been completed (Harris Creek, Little Choptank River, Tred Avon River, and St. Marys River). In-water restoration work in the last planned river, the Manokin, started in 2021 and continued in 2022 and 2023. To date, partners have restored 1,068 acres of oyster reefs, across all five tributaries, at a cost of approximately \$87.36 million. These reefs were constructed using one of two methods: by building a substrate base followed by planting with hatchery-produced oyster seed, or by placing only seed onto remnant reefs. [Monitoring results](#) show strong success relative to [preestablished success criteria](#), with 99% of 6-year-old restored reefs meeting at least the minimum threshold oyster density and biomass, and 83% meeting the higher target density and biomass.

Tributaries Complete: Four of Five Planned



Acres of Reefs Restored: 1,068 of 1,290 planned



Seed Planted in Maryland under the Ten Tributaries Initiative: 6.85 billion (919.51 million planted in 2023)

The vast majority of the seed planted was spat-on-shell, produced primarily at the University of Maryland's Horn Point Oyster Hatchery. Chesapeake Bay Foundation, Marylanders Grow Oysters, and The Nature Conservancy's Supporting Oyster Aquaculture & Restoration (SOAR) program contributed oysters as well.

Maryland Cost to Date: \$87.36 million* (\$13.43 million in 2023)

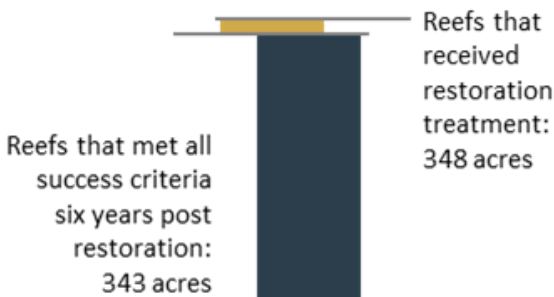
This cost is through the end of 2023, for reefs restored under the Ten Tributaries initiative. This includes reef construction and seeding only; costs such as benthic surveys, planning, permitting, and monitoring are not reflected. Restoration cost per acre varies due to factors including material type, reef configuration, hydrologic factors, agency and stakeholder preferences, and other factors. Cost is approximate.

*An accounting review found a difference of less than 5% from what was reported in past reports. The 2023 total includes the revised estimated cost.

Harris Creek

Per the success criteria established in [Oyster Metrics](#), and the [Harris Creek Restoration Blueprint](#), Harris Creek can now be considered fully, successfully restored. Initial restoration work was completed in 2015, followed by several years of planned second-year-class oyster plantings where needed. As of 2021, all 90 restored reefs (348 acres) in Harris Creek have been monitored as they matured to six years—the point where, per Oyster Metrics, a reef can be considered successfully ‘restored’ if it meets all of the Oyster Metrics success criteria. Harris Creek is the first tributary, Bay wide, where not only has restoration work (reef construction and seeding) been completed, but also where the recommended six-year post-restoration monitoring period has been completed. At six years of age, all but five acres of reefs (343 of the 348 acres that received restoration treatment) met the Oyster Metrics success criteria. [Monitoring results](#) show strong success relative to the preestablished success criteria, with 98% of restored reefs meeting at least the minimum threshold oyster density and biomass, and 76% of reefs meeting the higher, target density and biomass.

Acres Restored: 343

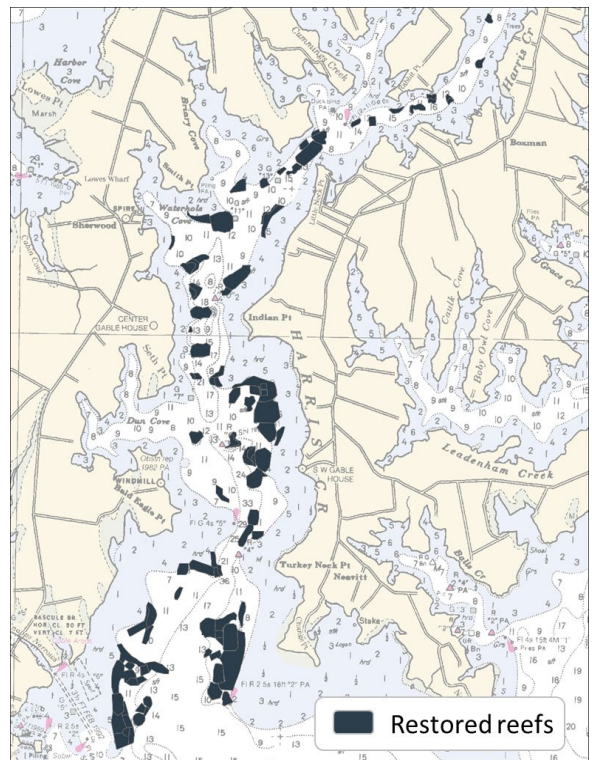


Total Restoration Cost: \$28.37 million

This cost is for reefs restored under the Ten Tributaries initiative. This includes reef construction and seeding only; costs such as benthic surveys, planning, permitting, and monitoring are not reflected. Restoration cost per acre varies due to factors including material type, reef configuration, hydrologic factors, agency and stakeholder preferences, and other factors. Cost is approximate.

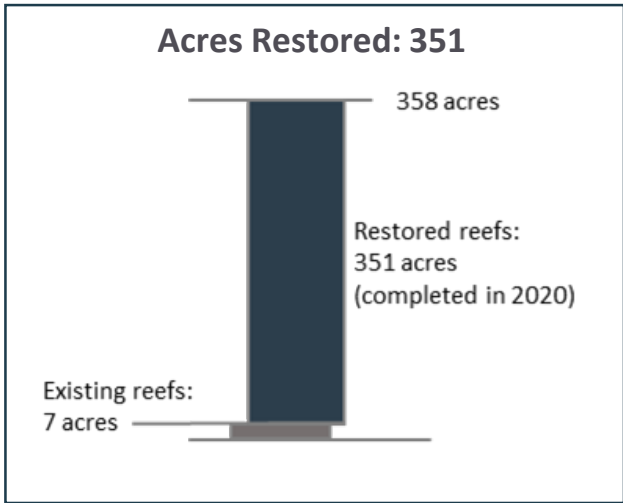
Seed Planted: 2.49 billion (planted from 2011 to 2020)

All seed was spat-on-shell, produced primarily at the University of Maryland’s Horn Point Oyster Hatchery. Some additional seed was produced and planted by the Chesapeake Bay Foundation.



Little Choptank River

Initial restoration work in the Little Choptank River started in 2014 and was completed in 2020 (see [video](#)). Partners have restored 351 acres of reefs in the river. Work in 2023 focused on reef monitoring, and implementing the scheduled second-year-class oyster seedings called for in the [Little Choptank River Restoration Blueprint](#). On reefs where monitoring showed oysters densities and biomass higher than projected, the scheduled second seedings were not implemented. On reefs where densities and biomass were as projected, or lower, the scheduled second-year-class seedings were implemented. Reefs are also evaluated to determine if they meet other Oyster Metrics success criteria, including presence of multiple year classes and reef structural integrity. Monitoring to date shows that virtually all reefs are meeting the established success criteria. See the full [2021 Maryland Oyster Monitoring Report](#) for details. Results from past years were similar.

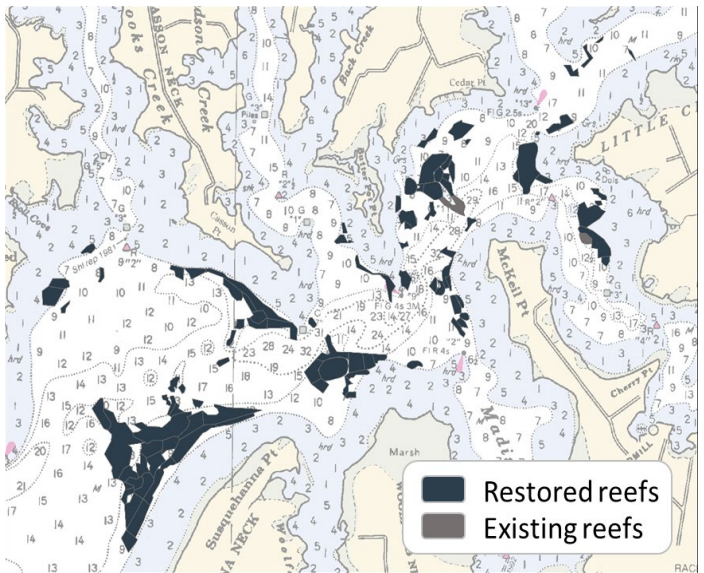


Cost to Date: \$28.17 million
(\$425,000 in 2023)

This cost is for reefs restored under the Ten Tributaries initiative. This includes reef construction and seeding only; costs such as benthic surveys, planning, permitting, and monitoring are not reflected. Restoration cost per acre varies due to factors including material type, reef configuration, hydrologic factors, agency and stakeholder preferences, and other factors. Cost is approximate.

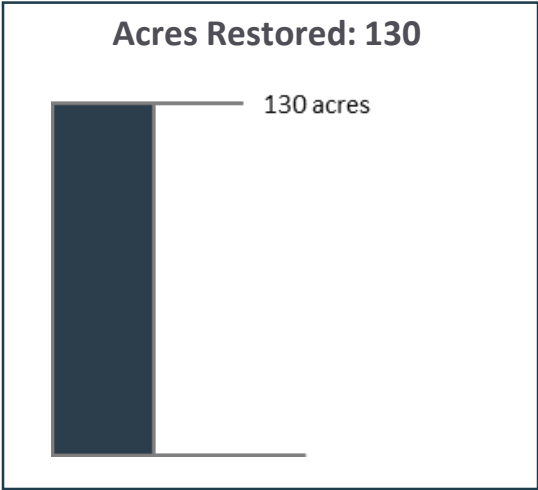
Seed Planted: 2.09 billion
(111.42 million in 2023)

All seed was spat-on-shell, produced primarily at the University of Maryland's Horn Point Oyster Hatchery. Some additional seed was produced and planted by the Chesapeake Bay Foundation in past years.



Tred Avon River

Initial restoration work in the Tred Avon River started in 2015 and was completed in 2021. Work in 2023 focused on reef monitoring and on implementing the scheduled second-year-class oyster seedings called for in the [Tred Avon River Restoration Blueprint](#). On reefs where monitoring showed oysters densities and biomass higher than projected, the scheduled second seedings were not implemented. On reefs where densities and biomass were as projected, or lower, the scheduled second-year-class seedings were implemented. Reefs are also evaluated to determine if they meet other Oyster Metrics success criteria, including presence of multiple year classes and reef structural integrity. Monitoring to date shows that more than 85% of the restored reefs monitored are meeting at least the minimum threshold oyster density and biomass [success criteria](#). See the [2021 Maryland Oyster Monitoring Report](#) for details.

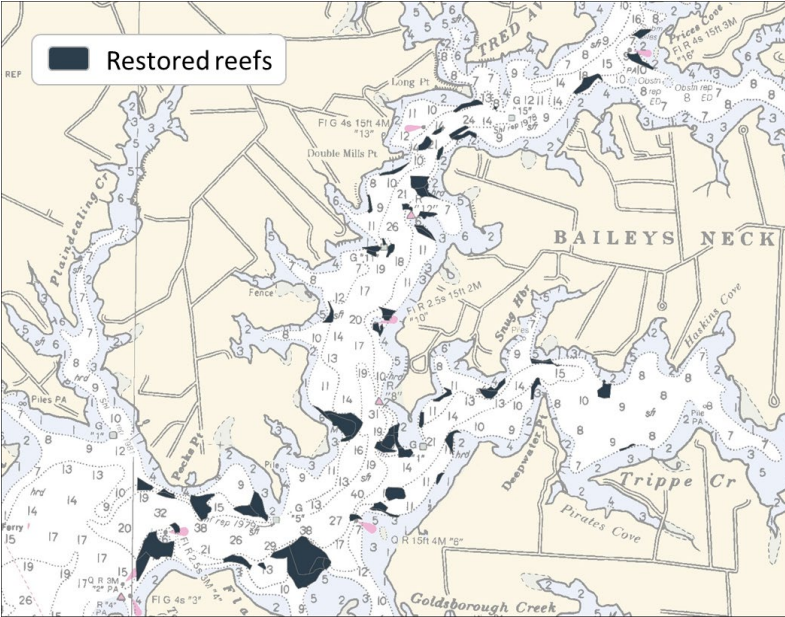


Cost to Date: \$12.11 million
(\$402,000 in 2023)

This cost is for reefs restored under the Ten Tributaries initiative. This includes reef construction and seeding only; costs such as benthic surveys, planning, permitting, and monitoring are not reflected. Restoration cost per acre varies due to factors including material type, reef configuration, hydrologic factors, agency and stakeholder preferences, and other factors. Cost is approximate.

Seed Planted: 1.17 billion
(105.25 million in 2023)

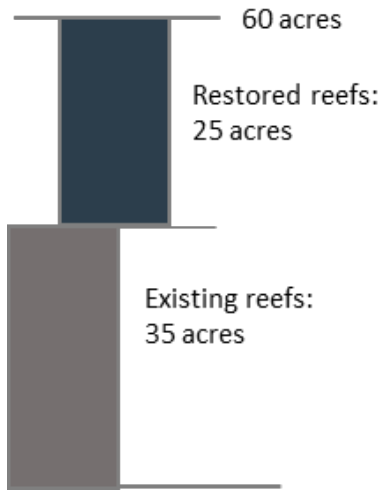
All seed was spat-on-shell, produced primarily at the University of Maryland’s Horn Point Oyster Hatchery. Chesapeake Bay Foundation and Marylanders Grow Oysters also contributed planted oysters.



St. Marys River

Initial restoration work in the St. Marys River started in 2021 and was [completed in 2022](#). Partners have restored 25 acres of reefs in the river. These restored reefs, in addition to the existing 35 acres of healthy reefs, bring the total to 60 acres, as called for in the [St. Mary's River Restoration Blueprint](#). Future work will focus on second-year-class seedings, as needed, per the St. Marys River Restoration Blueprint, and on monitoring reefs per the [Oyster Metrics](#) success criteria. The first three-year monitoring is scheduled for fall 2024.

Acres Restored: 25



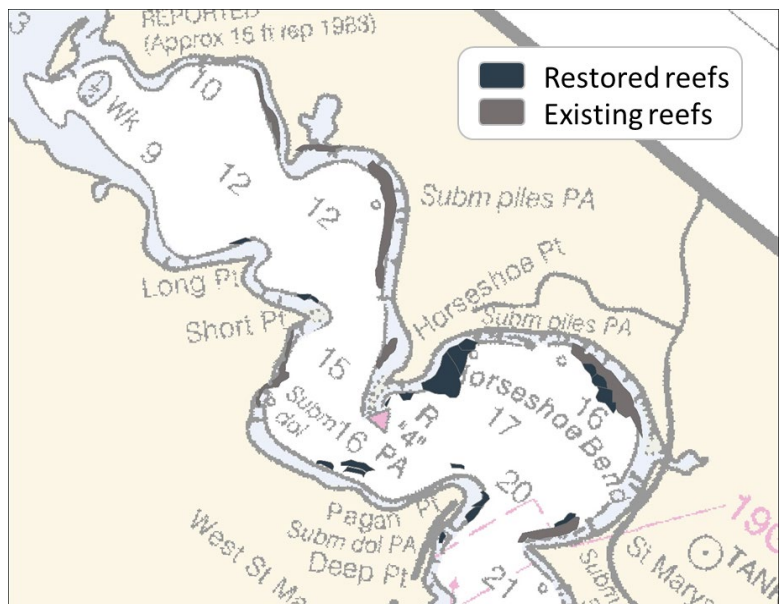
Cost to Date: \$1.55 million

This cost is for reefs restored under the Ten Tributaries initiative. This includes reef construction and seeding only; costs such as benthic surveys, planning, permitting, and monitoring are not reflected. Restoration cost per acre varies due to factors including material type, reef configuration, hydrologic factors, agency and stakeholder preferences, and other factors. Cost is approximate.

Seed Planted: 151.1 million

(planted in 2021 and 2022)

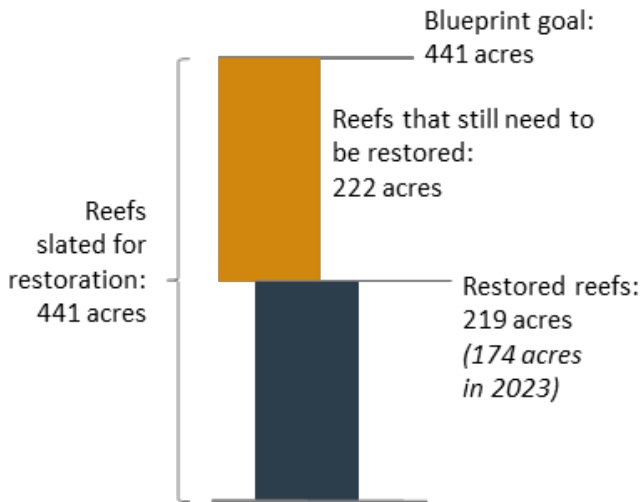
The majority of the seed was spat-on-shell, produced primarily at the University of Maryland's Horn Point Oyster Hatchery. St. Marys River Watershed Association, Marylanders Grow Oysters, and The Nature Conservancy's Supporting Oyster Aquaculture and Restoration (SOAR) program contributed oysters as well.



Manokin River

The [Manokin River Restoration Blueprint](#) sets a goal of restoring 441 acres of reefs in the river. In-water restoration work started in 2021. In 2023, partners initially restored 174 acres of reefs in the river with spat-on-shell. In addition, Murtech Inc., under contract from the Maryland Department of Natural Resources, constructed a 12-inch-high stone base on nearly 103 acres in the river. The stone-base construction work will continue in June 2024, when Murtech, Inc., will complete the remaining approximately eight acres of planned stone-base reef construction. These stone-base reefs will be seeded with spat-on-shell over the next few years. This river requires the largest number of acres to be restored of any of the ten tributaries Bay wide slated for restoration. Restoration work here will likely take until the end of calendar 2025.

Acres Restored: 219
(174 acres in 2023)

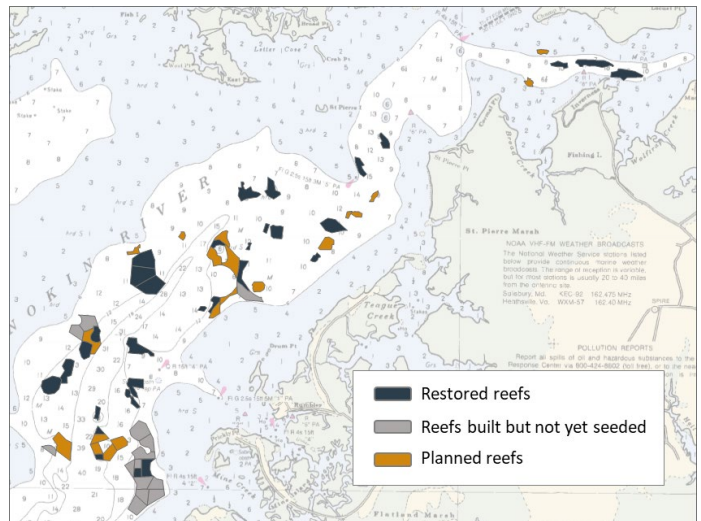


Cost to Date: \$17.17 million
(\$12.61 million in 2023)

This cost is for reefs restored under the Ten Tributaries initiative. This includes reef construction and seeding only; costs such as benthic surveys, planning, permitting, and monitoring are not reflected. Restoration cost per acre varies due to factors including material type, reef configuration, hydrologic factors, agency and stakeholder preferences, and other factors. Cost is approximate.

Seed Planted: 948.04 million
(702.84 million in 2023)

All seed was spat-on-shell, produced primarily at the University of Maryland's Horn Point Oyster Hatchery.



Maryland Notes

2023 Highlights

- In 2020–2023, Maryland saw natural oyster spat sets levels above the long-term, statewide average. This included particularly abundant spat sets in the St. Marys River in 2022, and a high set in Tred Avon River in 2023. The Tred Avon has historically been a lower-natural-recruitment area than any of the other ten tributaries slated for restoration. These trends bode well for the longer-term success of the restored reefs.
- 2023 was a record-setting year for [Horn Point hatchery](#) oyster larvae production. This resulted in planting almost one billion seed oysters in Maryland’s five targeted restoration tributaries.
- If trends hold, the five Maryland tributaries will be initially restored by 2025, thus meeting the Maryland portion of the Ten Tributaries initiative goal.
- As of the end of 2023, more than 1,000 acres of reefs have now been restored in Maryland. This is more than 1.5 square miles—more than 800 football fields—of reefs in Maryland alone.
- Partners have now restored more than half of the planned reef acreage on Manokin River, which when completed in 2025, will have the largest number of acres of reefs restored of any of the Ten Tributaries Bay wide.

2023 Challenges

- Individuals in some user groups (e.g., boating public, adjacent private lease holders, waterfront property owners, watermen) have expressed opposition to some proposed projects in Maryland.
- The Manokin River is the largest tributary yet in terms of the number of acres of reefs that need to be restored.
- Oyster shell is in high demand and low supply across the oyster restoration, aquaculture, and wild harvest sectors in the Chesapeake region and nationally. Although reef base construction has largely switched to using alternative materials such as stone, oyster shell is still required for the hatchery to produce juvenile oysters (spat-on-shell). Partners across all sectors are exploring alternatives under an [initiative led by the Oyster Recovery Partnership](#).
- Hatchery production of spat-on-shell is limited by shell availability, production facilities, and seasonality. Demand has increased due to oyster restoration and commercial harvest. Projections show that the planned Manokin restoration can be completed on time, but there is little room for error, delay, or uncertainty.

Factors Influencing Success

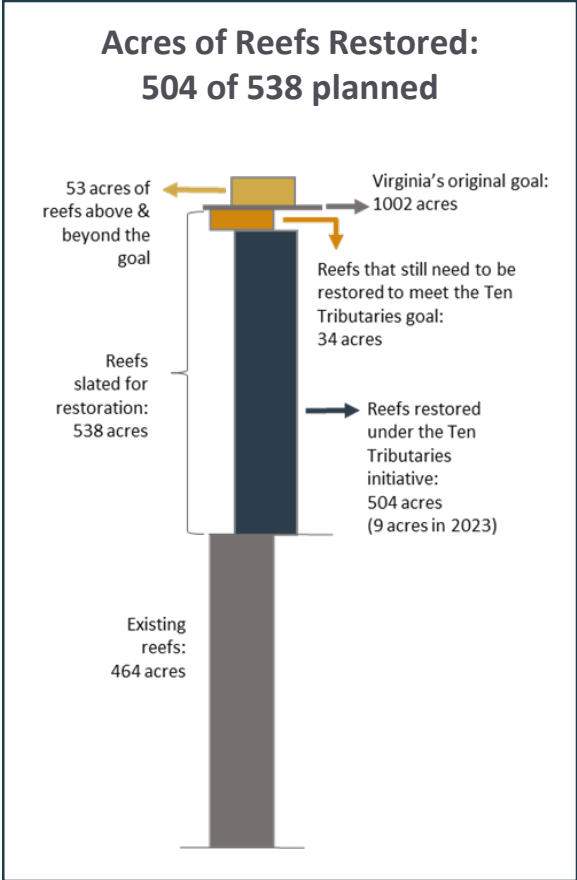
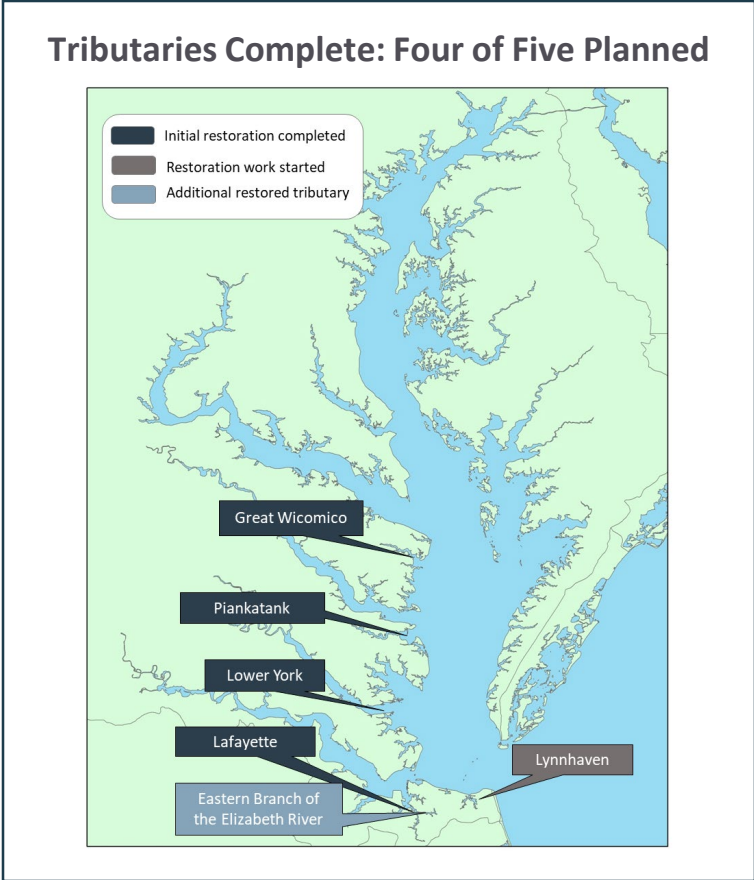
Many factors may influence the success of the Ten Tributaries outcome. These include water quality, oyster disease, fluctuations in natural oyster recruitment, fluctuations in hatchery production, and availability of suitable reef-building substrate. Despite these challenges, oyster restoration efforts in the Maryland waters of the Chesapeake Bay are already showing success with the completion of Harris Creek and the Little Choptank, Tred Avon, and St. Marys rivers. These tributaries serve as evidence that oyster populations can prosper in Chesapeake Bay sanctuaries, either naturally or due to restoration efforts. The [2023 Fall Oyster Survey](#) showed an uptick in total observed mortality, though it was still below the long-term average. Oyster diseases (Dermo and MSX) prevalence and intensity are also increasing. Both of these factors could affect success if trends persist.



Photo: Chesapeake Bay Foundation

Summary of Virginia Progress

All five Virginia tributaries targeted for restoration under the Ten Tributaries initiative have been selected, and each now has a completed [Oyster Restoration Blueprint](#). Restoration work planned under the Ten Tributaries initiative in four Virginia tributaries has been completed (Lafayette, Piankatank, Great Wicomico, and Lower York rivers). Additional restoration work, beyond the goals in the Ten Tributaries initiative, is also being done in some of these rivers. Planned in-water restoration work is well under way in the Lynnhaven River, the last of the five tributaries initially selected for large-scale oyster restoration. To date, partners have restored 504 acres of oyster reefs at a cost of approximately \$21.04 million. Above and beyond the ten tributaries planned for restoration Bay wide, Virginia partners have also restored the Eastern Branch of the Elizabeth River to the same standards, making this an additional ‘bonus’ tributary.



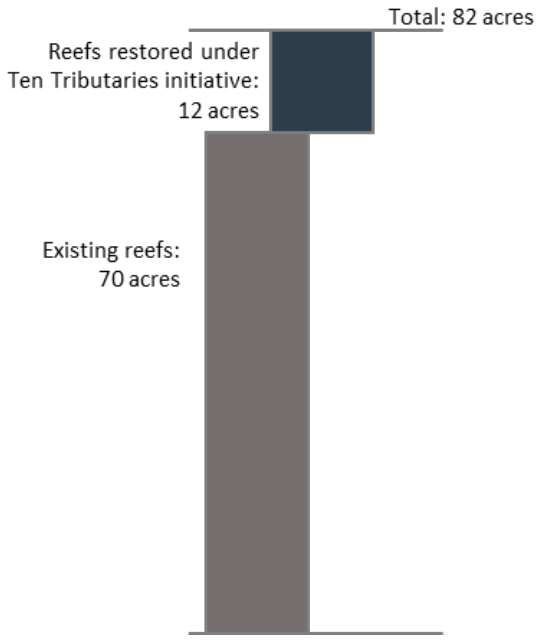
Virginia Cost to Date: \$21.04 million (\$4.94 million in 2023)

This cost is through the end of 2023, for reefs restored under the Ten Tributaries initiative. This includes reef construction and seeding only; costs such as benthic surveys, planning, permitting, and monitoring are not reflected. Restoration cost per acre varies due to factors including material type, reef configuration, hydrologic factors, agency and stakeholder preferences, and other factors. Cost is approximate.

Lafayette River

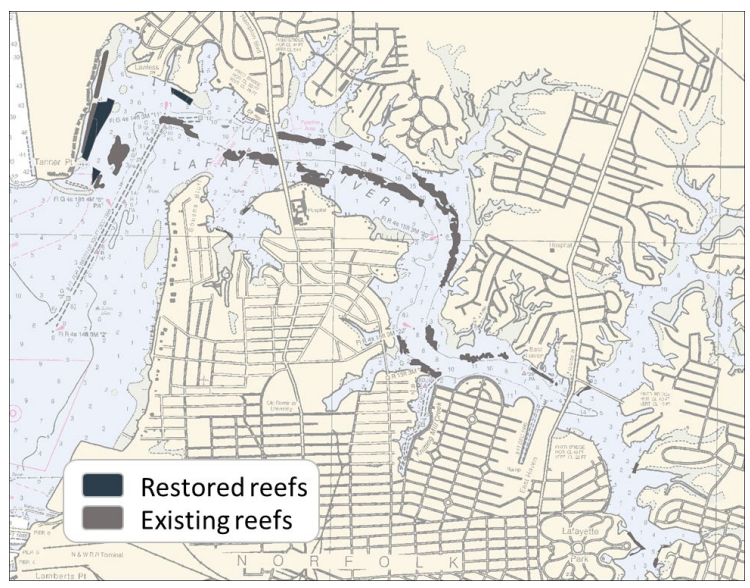
Planned oyster restoration work in the [Lafayette River Restoration Blueprint](#) was completed in 2018, making it the first river in Virginia to be considered complete under the Ten Tributaries initiative. The focus now is on monitoring the restored and existing reefs in the river. Earlier restoration projects show high densities of oysters representing numerous year classes, boding well for the newer Lafayette reefs. In 2022, VIMS conducted bathymetric and video surveys of three restored reefs in the river. The two largest reefs exceed the [Oyster Metrics](#) success targets for biomass and density, while the third met threshold criteria. Since 2018, the Elizabeth River Project has continued to coordinate the construction of shoreline oyster restoration projects through its partnership with the U.S. Navy's Lafayette Annex and waterfront residential property owners.

Acres Restored: 12
(restoration complete)



Cost to Date: \$716,000
(restoration completed in 2018)

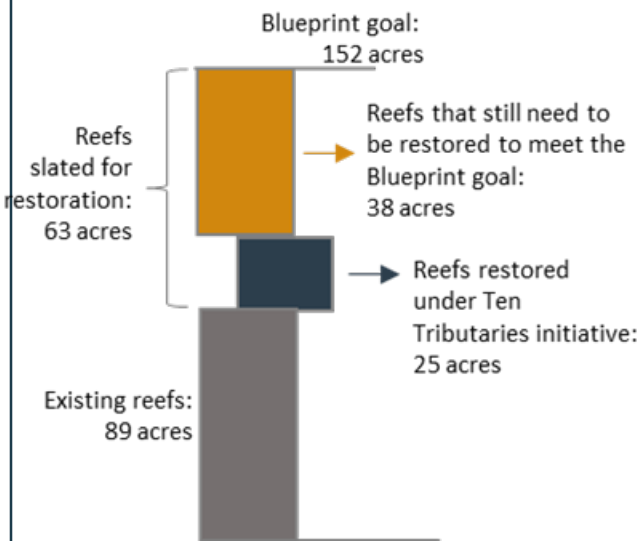
This cost is for reefs restored under the Ten Tributaries initiative. This includes reef construction and seeding only; costs such as benthic surveys, planning, permitting, and monitoring are not reflected. Restoration cost per acre varies due to factors including material type, reef configuration, hydrologic factors, agency and stakeholder preferences, and other factors. Cost is approximate.



Lynnhaven River

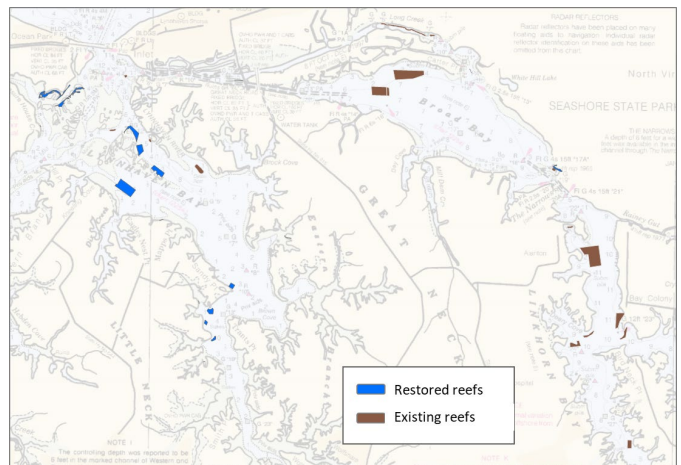
The [Lynnhaven River Restoration Blueprint](#) sets a goal of 152 acres of reefs in the river. In 2022, the Chesapeake Bay Foundation and Lynnhaven River Now constructed three reefs totaling 13 acres. Due to issues with the construction material and reef locations, these reefs are now under consideration for mitigation efforts, including possible removal. As of 2022, these reefs are not being counted toward the restored acreage in the Lynnhaven River. Under the Ten Tributaries initiative, 25 acres of reefs have been restored in the river (excluding the 13 acres now under consideration for mitigation), which is unchanged since the end of 2021. The U.S. Army Corps of Engineers' Norfolk District, with the City of Virginia Beach as its non-federal cost-share partner, awarded a contract in late 2023 to Coastal Design & Construction, Inc., to construct 23.2 acres of new reefs in the Lynnhaven River. These reefs will be constructed to a max height of 12" using 6" of size 1 crushed stone and 6" of fossil shell. The contractor plans to begin reef construction in fall 2024. Recent monitoring on an eight-acre reef constructed in 2021 by U.S. Army Corps of Engineers' Norfolk District, consisting of more than 28,000 reef balls, shows that the reef far exceeds [Oyster Metrics](#) target success criteria for oyster density and biomass.

Acres Restored: 25 of 63 Planned



Cost to Date: \$2.62 million

This cost is through the end of 2022, for reefs restored under the Ten Tributaries initiative. This includes reef construction only; costs such as benthic surveys, planning, permitting, and monitoring are not reflected. Restoration cost per acre varies due to factors including material type, reef configuration, hydrologic factors, agency and stakeholder preferences, and other factors. Cost is approximate.

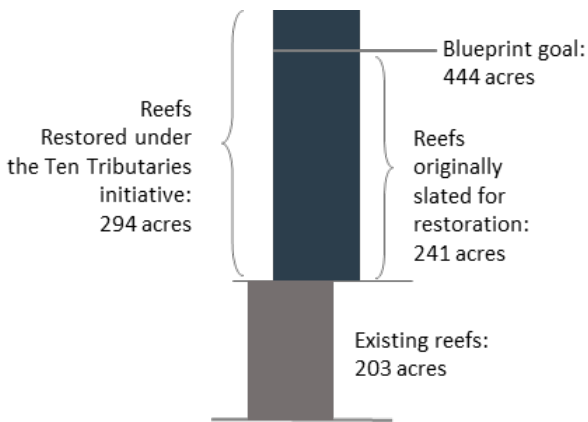


Piankatank River

Oyster reef restoration work was completed in the Piankatank River in 2021, per the [Piankatank River Restoration Blueprint](#). Above and beyond completing the initial planned restoration, the U.S. Army Corps of Engineers' Norfolk District, with the Virginia Marine Resource Commission as its non-federal cost-share partner, constructed 53 acres of stone reefs in the Piankatank River in 2023. Seaward Marine was the contractor, and the final project cost was just under \$4.7 million. Reefs were constructed with class A-1 rip rap, to a height of 12–18 inches, in striations approximately 30 feet wide, spaced approximately 45 feet apart.

Acres Restored: 294

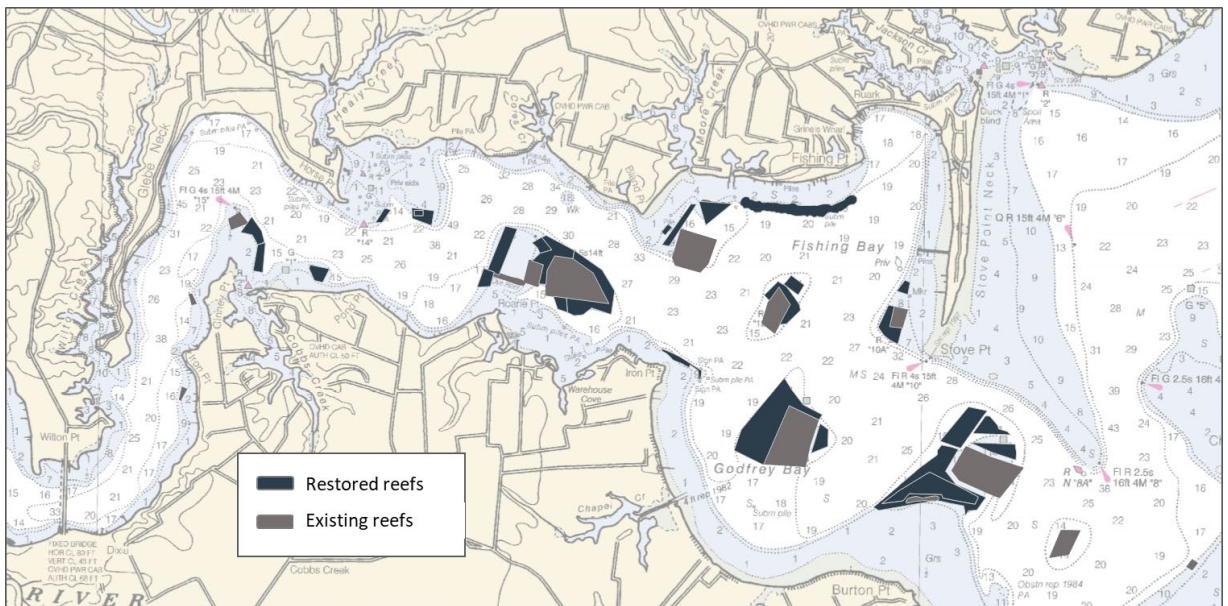
(restoration completed in 2021;
additional reefs restored in 2023)



Cost to Date: \$11.1 million

(\$4.7 million in 2023)

This cost is for reefs restored under the Ten Tributaries initiative. This includes reef construction and seeding only; costs such as benthic surveys, planning, permitting, and monitoring are not reflected. Restoration cost per acre varies due to factors including material type, reef configuration, hydrologic factors, agency and stakeholder preferences, and other factors. Cost is approximate.



Great Wicomico River

Oyster reef restoration work was completed in the Great Wicomico River in 2021, per the river's [Restoration Blueprint](#). The U.S. Army Corps of Engineers' Norfolk District, in partnership with the Virginia Marine Resources Commission, has begun planning efforts to perform adaptive management on existing reefs in the Great Wicomico River. Efforts include raising some of the 2004-constructed reefs to a higher elevation, placing habitat stones on areas prone to degradation, and expanding the footprint of an existing reef. Designs will be finalized in 2024, and construction is estimated to begin in 2025.

Acres Restored: 24
(restoration complete)

Total: 124 acres

Reefs restored under
Ten Tributaries
initiative: 24 acres

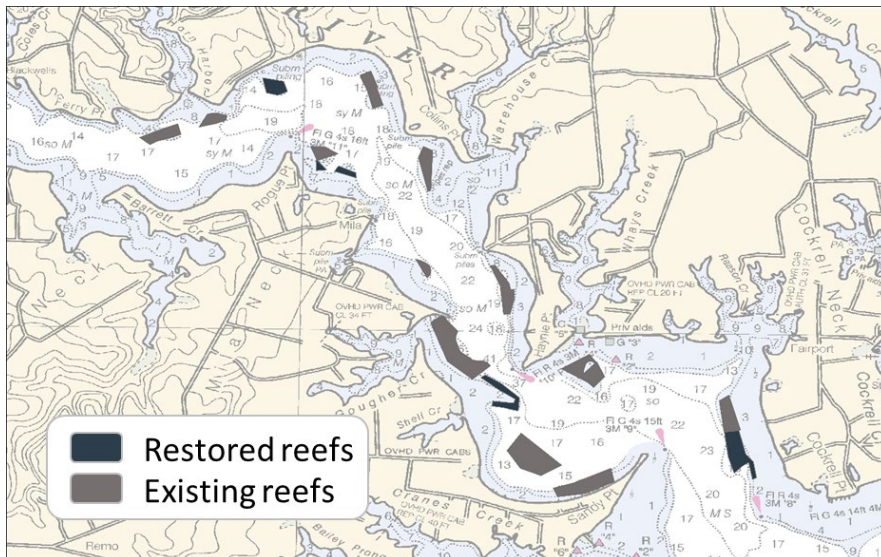
Existing reefs:
100 acres



Cost to Date: \$907,000

(restoration completed in 2021)

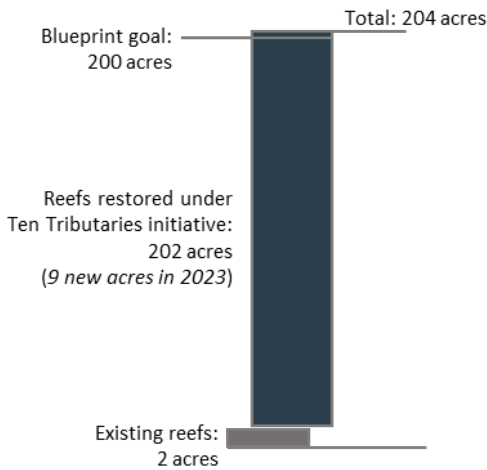
This cost is for reefs restored under the Ten Tributaries initiative. This includes reef construction only; costs such as benthic surveys, planning, permitting, and monitoring are not reflected. Restoration cost per acre varies due to factors including material type, reef configuration, hydrologic factors, agency and stakeholder preferences, and other factors. Cost is approximate.



Lower York River

In 2023, the Virginia Marine Resources Commission constructed nearly nine acres of new stone reefs in the lower York River. This work, combined with intensive reef construction in 2022, surpassed the [Lower York Restoration Blueprint](#) goal of 200 acres of reefs. This means the river can now be considered restored, making it the fourth of five planned Virginia tributaries to be restored under the Ten Tributaries initiative. Future efforts will focus on monitoring to ensure these reefs are meeting established [Oyster Metrics](#) success criteria.

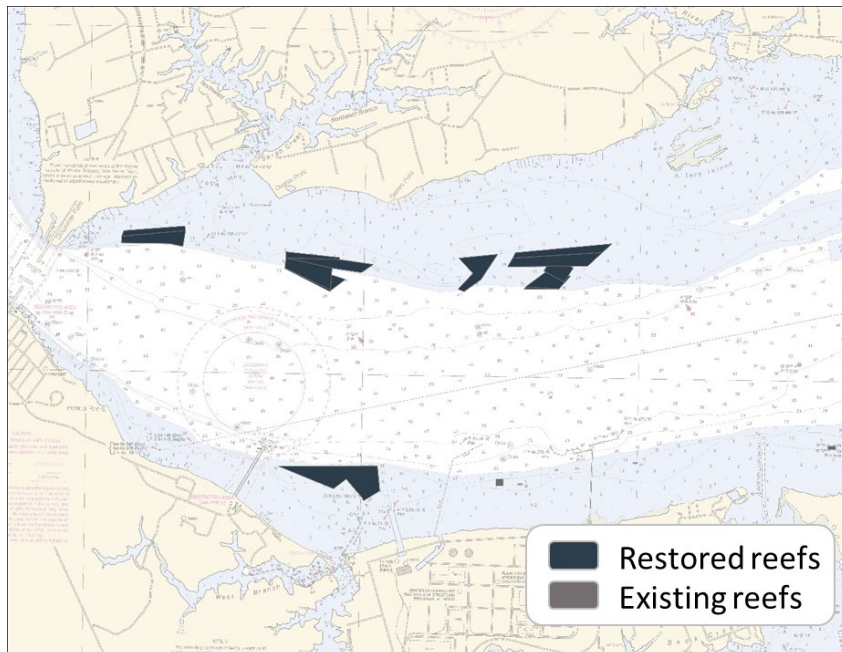
Acres Restored: 202
(9 acres in 2023)



Cost to Date: \$5.71 million

(Approx \$240,000 in 2023 to complete the remaining 9 acres of reefs)

This cost is for reefs restored under the Ten Tributaries initiative. This includes reef construction and seeding only; costs such as benthic surveys, planning, permitting, and monitoring are not reflected. Restoration cost per acre varies due to factors including material type, reef configuration, hydrologic factors, agency and stakeholder preferences, and other factors. Cost is approximate.



Virginia Notes

2023 Highlights

- Restoration in the lower York River was completed.
- If trends hold, five tributaries out of five planned will be completed in Virginia by 2025.
- Virginia has experienced consistently high natural spat sets annually since 2019. This has tended to boost shell volume and the number of larger oysters on restored reefs. This trend is consistent throughout Virginia, including on harvest reefs.

2023 Challenges

- Some individuals in user groups (e.g., boating public, adjacent private lease holders, waterfront property owners, watermen) have expressed opposition to some proposed projects in Virginia.
- Typically, the most suitable areas for reef restoration, and the less-contentious areas, are the first completed. Therefore, as targets are almost reached, the last remaining acreage may become more difficult and/or expensive per acre of restoration on some tributaries.
- Due to issues with construction material and reef locations, 13 acres of reefs in the Lynnhaven River are now under consideration for mitigation efforts in 2023, including possible removal. This makes constructing the remaining planned reefs even more critical for completing restoration work in the river before the 2025 Chesapeake Bay Watershed Agreement deadline.

Factors Influencing Success in Virginia

Factors influencing success of the Ten Tributaries initiative include restoration funding, poaching, water quality, oyster disease, acquisition of real estate rights, fluctuations in natural oyster recruitment, and availability of suitable reef-building substrate. That oyster restoration can succeed in the Virginia waters of the Chesapeake Bay has been validated by past successful oyster restoration efforts, and by the discovery of a relict, self-sustaining oyster population in the Lafayette River. These serve as evidence that oyster populations can prosper in the Chesapeake Bay, either naturally or due to restoration in sanctuaries. Virginia experiences consistent natural oyster recruitment rates, which minimizes the need for augmentation with hatchery-produced oysters. Recent declining trends in disease mortality rates have increased on-reef survival and sustainability of restoration efforts. Unpredictable environmental disturbances (e.g. freshets, sediment influx due to extreme weather events, temperature changes, hypoxia) may affect long-term reef success. These kinds of effects may become more likely in the face of climate change.



Photo: Chesapeake Bay Foundation