Our Path Forward:

The Comprehensive Conservation & Management Plan for Maryland's Coastal Bays (2015–2025)

MARYLAND COASTAL BAYS PROGRAM

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Innovation for a better future

University of Maryland
CENTER FOR ENVIRONMENTAL SCIENCE

Cover photo
Seagrass in the Coastal Bays, by Eduardo Infantes Oanes.

Dear Partners,

The Maryland Coastal Bays watershed is an impressive resource. It supports abundant wildlife and a wealth of aquatic resources in a relaxing, rural atmosphere unique to the mid-Atlantic region. Here, residents and tourists alike enjoy fishing, hunting, boating, sunbathing and the natural serenity offered by the sea. Tourists from New York to Virginia and beyond spend millions of dollars to bring their families to the Coastal Bays in hopes of catching a summer flounder, digging hard clams from the bay bottom or enjoying blue crabs in their favorite local restaurant. And as summer draws to a close, residents look forward to the 'off-season' to enjoy brisk early mornings when migratory ducks and geese fill the sky and seals visit our shores.

Like other coastal areas around the world, the Coastal Bays are experiencing population growth and increased development. Unfortunately, these factors have led to the early warning signs of stress in the bays. Recognizing the potential for additional stress on this fragile and important ecosystem, federal, state and local government agencies have joined with the people who depend on these resources for their livelihood and quality of life to develop this plan of action to protect and restore the health of the Coastal Bays.

Since 1996, the Maryland Coastal Bays Program has worked on behalf of this natural treasure. Part of the National Estuary Program, the Program is a non-profit partnership between the towns of Ocean City and Berlin, Worcester County, the National Park Service, the U.S. Environmental Protection Agency and the Maryland Departments of Natural Resources, Agriculture, Environment and Planning.

With the help of our active community and dedicated volunteers, we have made remarkable achievements over our 18-year history. Much of the original Comprehensive Conservation and Management Plan (CCMP) has now succeeded in its goals. In fact, 80% of the original actions have been accomplished. This updated plan- renewed in 2014- represents a priority "to-do list" needed to leave a legacy of thriving coastal waters in this very special place. With your help, we are confident that these will be achieved these as well.

Sincerely,

Dave Wilson
Executive Director
Maryland Coastal Bays Program

Steve Taylor
Chairman of the Board
Maryland Coastal Bays Foundation

A Coastal Treasure

The bays behind Ocean City and Assateague Island are one of most beautiful places in Maryland.

While these fragile coastal bays have not enjoyed the fanfare of the Chesapeake Bay, they also provide enormous benefits to both the economy and biological diversity in Maryland. The windfall that these healthy beaches and bays bring to the state ranges into the billions of dollars annually.

For this reason and for the simple inherent beauty of the Eastern Shore, I have been proud to work closely with Senator Mikulski and Congress to make sure the Maryland Coastal Bays Program has the tools it needs to help this region remain a cultural and biological gem.

This updated management plan for the barrier island system represents three years of hard work from citizens and our local, state and federal partners to address the emerging challenges we face in this rich coastal estuary.

The National Estuary Program has shown itself to be a leader in working with agriculture, fishing, tourism and building interests to craft practical plans that all sectors can agree on.

This plan is no exception. The consensus-based, coordinated strategy creates a new and exciting pathway to tackle declining water quality and diminishing wildlife populations. With sound science as a guide, the new Coastal Bays Management Plan is now addressing climate change and preparing for its impact to fisheries, birdlife and the economy.

I have been lucky enough to enjoy many outings to Assateague, Ocean City and the bays with Coastal Bays staff and have seen both the challenges and the good work they are doing to counteract and reverse negative trends. It was a pleasure for me to work with the US Army Corps of Engineers to help promote island enhancement and creation in the bays which will serve recreational interests and protect shorebirds.

In addition to wildlife habitat, some tributaries have also shown improvement over the past decade but parts of the southern bays, once considered the pristine jewel of the system, are showing signs of stress. High nutrient levels, declining seagrass acreage and eroding marsh each present serious challenges.

For those who will inherit this legacy, it is up to us to reverse these trends with a combination of sound science and policy.

This management plan delivers that critical union.

United States Senator Ben Cardin (Maryland)

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Your wishes can only find fulfillment if you succeed in attaining love and understanding of people, and animals, and plants, and stars so that every joy becomes your joy and every pain your pain.

—Albert Einstein

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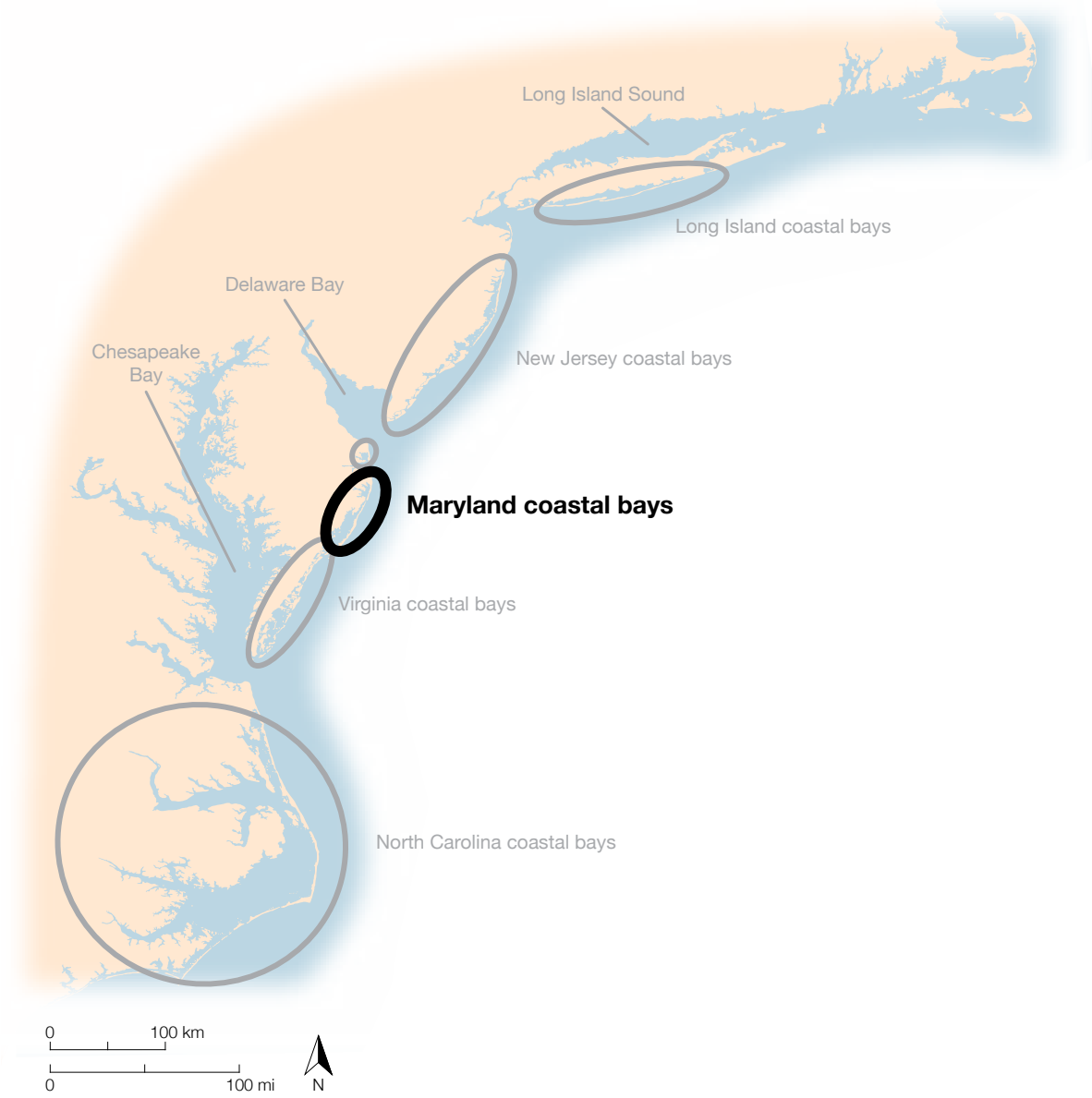


Coastal Bays Watershed

1. Introduction

Never doubt that a small group of thoughtful, committed citizens can change the world. Indeed, it is the only that ever has.
—Margaret Mead

Scientists and community stakeholders discuss local sediment shoaling, business dredging needs and marine species habitat. Photo by Roman Jesien.

Our Path Forward represents a revision to the 1999 Comprehensive Conservation & Management Plan for the Coastal Bays of Maryland. The work is the culmination of three years (2012–2014) of technical investigation and community involvement to protect the future of the Coastal Bays.

The Maryland Coastal Bays Program is a partnership among the Towns of Ocean City and Berlin; Worcester County; Maryland Departments of Natural Resources, Agriculture, Environment and Department of Planning; National Park Service; and the US Environmental Protection Agency. The Program provides an independent, science-based approach that offers a neutral forum for multi-partner discussions. These discussions are important for determining the problems, solutions and creative ideas that are necessary for inclusive and resilient watershed conservation and improvement.

The following prescribed activities have been developed with assistance from natural resource experts, advocates and citizens. This plan reflects significant contributions from individuals, community groups and scientists who share a common interest in a healthy environment and a prosperous region. Many thanks go to these participants for their substantial insights and contributions. This plan would not be possible without their ongoing support for the Program.

Local residents and representatives from the development, agriculture, fishing, golf, forestry-- and tourism industries piloted this effort. Worcester County residents, who own this plan, seek to protect and preserve this special part of Maryland by setting a course for the ecological and economic prosperity of this coastal paradise.

The Maryland Coastal Bays Program invites your comments and participation as we continue to fulfill a vision for the future of this coastal community.

Residents assist DNR and Coastal Bays staff with a tree planting at the Lizard Hill Atlantic White Cedar restoration in Bishopville. Photo by Roman Jesien.

Whelk on Assateague Island. Photo by Roman Jesien.

As an organization, the Maryland Coastal Bays Program is constantly striving to adapt, coordinate, perform and promote consensus-based management of the local ecosystem. Our charge under the Clean Water Act is to "restore and maintain the chemical, physical and biological integrity" of the watershed. This table summarizes the overall layout of the updated Comprehensive Conservation & Management Plan (CCMP) into strategies for implementation by existing committees, performance criteria and specific outputs.

Implementation Strategy	Committee	Purpose
Legislative—actions that require new laws or amendments. These efforts provide a formalized review by partners with a designated policy structure, resources, enforcement, etc.	Executive Director, Policy Committee, Board of Directors	**2** actions have been determined to need high level discussion at the policy level.
Policy Issue—actions that request partners for discretionary changes to existing programs or laws such as providing staff and technical resources and/or financial management input (i.e. funding targets and sources). Partners determine goals, responsibilities, milestones and public involvement directives to promote diverse stakeholder priorities.	Executive Director, Policy Committee, Board of Directors	**27** actions that need priority setting and assign staff to projects to build partnership capacity and leverage limited resources.
Within Existing Resources—projects and efforts that the lead partner can accomplish with existing staff and capitol. This includes the ability to hold workshops, technical meetings, form ad hoc committees to study and plan initiatives, mapping and planning exercises, track and report on indicators of progress.	Implementation Committee	**93** actions have been categorized as feasible through existing resources. Often additional project-specific funding will need to be identified to maintain the existing resources to complete the work.
Education & Outreach—use information and outreach projects for periodic updates to citizens, stakeholder groups and local decision makers to generate understanding and buy-in for environmental projects and behavior change.	Implementation Committee, Citizens Advisory Committee	**46** actions will require outreach and education to build community and partner buy-in for projects and behavior change. This can be accomplished through existing partner staff at the watershed level.
Restoration & Conservation—actions where a policy is already in place and studies are complete. Determine the resources needed to implement projects and prioritize on-the-ground efforts.	Implementation Committee	**13** actions have resulted from prior CCMP efforts, these actions should be considered pipeline projects ready for implementation.
Research & Ecosystem Assessment—actions that require research, monitoring and forms the basis of the Science Agenda. Policy recommendations should result based on scientific findings and lend credibility to Program efforts.	Scientific and Technical Advisory Committee	**41** actions have been identified as requiring new research in addition to long-term monitoring for trends and status. Findings serve to influence independent policy making for conservation and restoration.

Outputs/Outcomes	EPA Performance Evaluation	Indicator
Adaptive management requires new policies for environmental protection based upon the most recent science.	Program Planning and Administration—Annual Workplans, Implementation Performance Reviews	Number of policies and projects that result from these discussions. Number of projects receiving resources and the value of those resources.
Annual Program Work Plans. Finance Plan that includes estimated costs, funding sources, goals, responsibilities and milestones.	Program Planning and Administration—Annual Work Plans, Financial Management, Outreach and Public Involvement	Number of projects receiving resources (staff hours, funding) and the value of those resources. Number and types of opportunities for stakeholder representation in priority setting and Program oversight.
The IC should prioritize the most feasible problems to tackle and devote agenda time and staff efforts toward those pipeline projects. Determine if funding is needed and identify potential sources. Make policy and research recommendations.	CCMP Tracking and Reporting for Implementation Performance Reviews	Status of CCMP actions through periodic evaluations. Value of partnership contributions (leveraging of resources), accomplishments and road blocks to successful implementation over time. Installation and results of best management practices. Focus on citizen engagement and behavior changes that center on connecting people, places, habitats and communities.
Newsletters, newspaper articles, State of the Bays reports & conferences, speaker series, workshops, annual Report Cards, presentations to groups. Develop citizen involvement projects such as cleanups, monitoring opportunities and tree plantings.	Outreach & Public Involvement, Technical Assistance & Capacity Building	Define the audience and outcomes for each effort through a Communications Plan and Public Involvement Plan. Behavior change can be measured via attendance at events, increased recycling, water & energy conservation and the number of volunteer hours donated each year.
Priority project list, identify areas for improvement or conservation, obtain necessary permits and partnerships.	Ecosystem Restoration & Protection Projects, Technical Assistance & Capacity Building	Number of ecosystem improvements, amount of nutrient pollution reduced, acres of conserved land, linear feet of restored shorelines, reduction in the number of waterbody impairments.
STAC Science Agenda requires periodic review of current and impending issues. Monitoring of affects and outcomes from those effects are paramount to determining the effectiveness of restoration and conservation efforts, as well as anticipating potential hazards to community health.	Research, Monitoring and Reporting on Impact	Number of research projects, published peer-reviewed papers and reports such as the Ecosystem Health Assessment, State of the Bays Report, Report Card, TMDL Nutrient Reduction Strategy and Coastal Resiliency.

Revising the CCMP

Evaluation is an ongoing function of management and leadership. Effective evaluation is not an 'event' that occurs at the end of a project, but is an ongoing process which helps decision-makers better understand the project; how it is impacting participants, partner agencies and the community; and how it is being influenced/impacted by both internal and external factors. We should collect and analyze important data for decision-making throughout the life of a project: from assessing community needs prior to designing a project, to making connections between project activities and intended outcomes, to making mid-course changes in program design, to providing evidence to funders that the effort is worth supporting.
-Kellogg Foundation

The National Estuary Program was established under Section 320 of the 1987 Clean Water Act (CWA) Amendments as a U.S. Environmental Protection Agency place-based program to protect and restore the water quality and ecological integrity of estuaries of national significance. Section 320 of the CWA calls for each National Estuary Program to develop and implement a Comprehensive Conservation and Management Plan (CCMP). The CCMP is a long-term plan that contains specific targeted actions designed to address water quality, habitat and living resources challenges in its estuarine watershed.

The 2015–2025 Maryland Coastal Bays Comprehensive Conservation and Management Plan (CCMP) is a revision to the original 2000 CCMP that addresses current and emerging issues impacting the water quality and environmental health of estuaries behind Ocean City and Assateague Island. This 10-year plan is the compilation of management recommendations from scientific studies, new local, state and federal initiatives and the continuation of older successful outreach efforts to watershed stakeholders. This plan includes four plans, 15 goals, 33 challenges and 222 action items that have been vetted by 16 partners and the public and approved by EPA to guide collaborative watershed management efforts. Each action item has been categorized and assigned to existing committees for implementation, tracking, monitoring, evaluation and adaptive management.

From 1999–2014 the Program and partners accomplished great strides in preserving and protecting the Coastal Bays. In the early 1990s, citizens banded together to ask natural resource experts about the status of the bays and to discuss how rapid changes to the landscape and biota could be better managed. At the time, the watershed was nicknamed the 'forgotten bays' because most research and attention was directed to the much larger Chesapeake Bay. The program has evolved from those early days of wondering about the status of ecosystem health to having a data rich collection of studies and monitoring efforts. Today, we are changing the scope of our efforts to identify the sources of nutrient pollution and targeting our resources in the most efficient and effective remediation projects.

Additionally, the CCMP is a living document that will result in tangible products and strategies that will be incorporated over its lifetime. The actions listed within the CCMP provide a basis for furthering directing our attention towards financial planning, monitoring and research, public involvement and communications, habitat improvements and coastal resiliency. The design and timeline of the CCMP encourages local stakeholders and the public to assess the effectiveness of our efforts every three to five years and promote revisions or updates to keep the Plan relevant. Equally important is an adherence to the EPA Performance Criteria for National Estuary Program Evaluations.

	Total	Water Quality	Fish & Wildlife	Recreation & Navigation	Community & Economic Development
Action Plans	**4**				
Goals	**14**	3	4	4	4
Challenges	**34**	8	13	5	7
Actions	**222**	54	99	24	45

The Maryland Coastal Bays Comprehensive Conservation and Management Plan (CCMP) includes four plans, 14 goals, 34 challenges and 222 action items that have been vetted by 16 partners and the public and approved by EPA to guide collaborative watershed management efforts.

Stakeholders listen as businessman Buddy Jenkins discusses the importance of conservation. Photo by Roman Jesien.

2. Water Quality

No water, no life. No blue, no green.
—Dr Sylvia Earle

Public Landing. Photo by Maryland Coastal Bays Program.

Water is the lifeblood of the Coastal Bays. Its beautiful network of bays, necks, creeks and streams define our coastal region. For most who visit here, water is the key allure. Whether it be for boating, fishing, crabbing, parasailing or simply gazing at stunning sunsets, water is the tie that binds the Coastal Bays together. It is thus no wonder that the quality of water in the Coastal Bays is the most important factor in maintaining a healthy and diverse ecosystem. The Coastal Bays watershed supports vibrant human and biological communities alike, and fuels the State of Maryland's largest tourist economy. All of this depends on swimmable and fishable waters. In fact, all of the other focal areas of this CCMP—Fish & Wildlife, Recreation & Navigation and Community & Economic Development—depend on this single critical factor.

Once teeming with oysters, hard clams, blue crabs and economically important fish species, today's bays struggle to maintain their historic equilibrium. Various land activities have resulted in serious water quality problems for the Coastal Bays, particularly when the amount of nutrients and sediments entering the water bodies exceed their ability to process or adapt to such inputs. Nutrients such as nitrogen and phosphorus are of particular concern, as are sediments that cloud the estuaries' waters and inhibit the growth of submerged aquatic vegetation, which functions as the bays' inherent filtration system.

Since the inception of the Coastal Bays Program in 1996, Worcester County and the towns of Ocean City and Berlin, along with state and federal partners, have made remarkable strides towards improving the water quality of the Coastal Bays through progressive zoning, protection and restoration of wetlands, the elimination of point sources of pollution, stormwater management and implementation of state and federal measures to reduce both agricultural and residential run-off. However, much still needs to be done in order to meet target water quality parameters that would bring the bays closer to healthy conditions. Collectively the incremental improvements by many people are showing positive results. By continuing to work together we can meet our water quality goals.

In this section, we look at: 1) ways to address failure and inefficiency of septic systems, 2) excessive lawn fertilization, 3) stormwater runoff in developed areas, 4) nutrient runoff from agricultural lands, 5) wastewater and 6) runoff of toxic chemicals—all of which will assist in implementing a strategy to meet Total Maximum Daily Load (TMDL)[1] reductions.

The following water quality actions rely heavily on existing technology and resource management programs to meet current environmental protection standards and requirements. To remain a viable tool for protecting the environment and managing the resources of the Coastal Bays, the CCMP will undergo periodic updates to reflect new programmatic challenges and opportunities.

1. Total Maximum Daily Load (TMDL) is a calculation of the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards, and an allocation of that load among the various sources of that pollutant (EPA 2014).

Marshy Creek, Chincoteague.
Photo by Leena J/CC BY-NC-ND.

1 WATER QUALITY GOAL
Decrease nutrient loading throughout the watershed

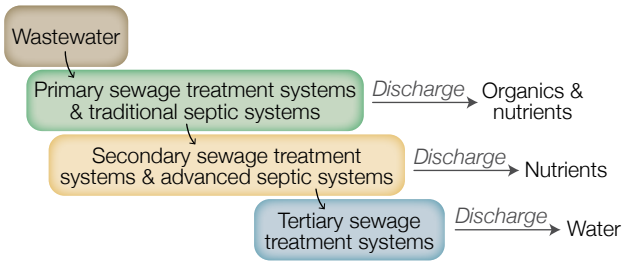
1.1 WATER QUALITY CHALLENGE
Reduce failure rate & inefficiency of septic systems

Priority level: 1 (initiate before 2019) *Public support:* Moderate

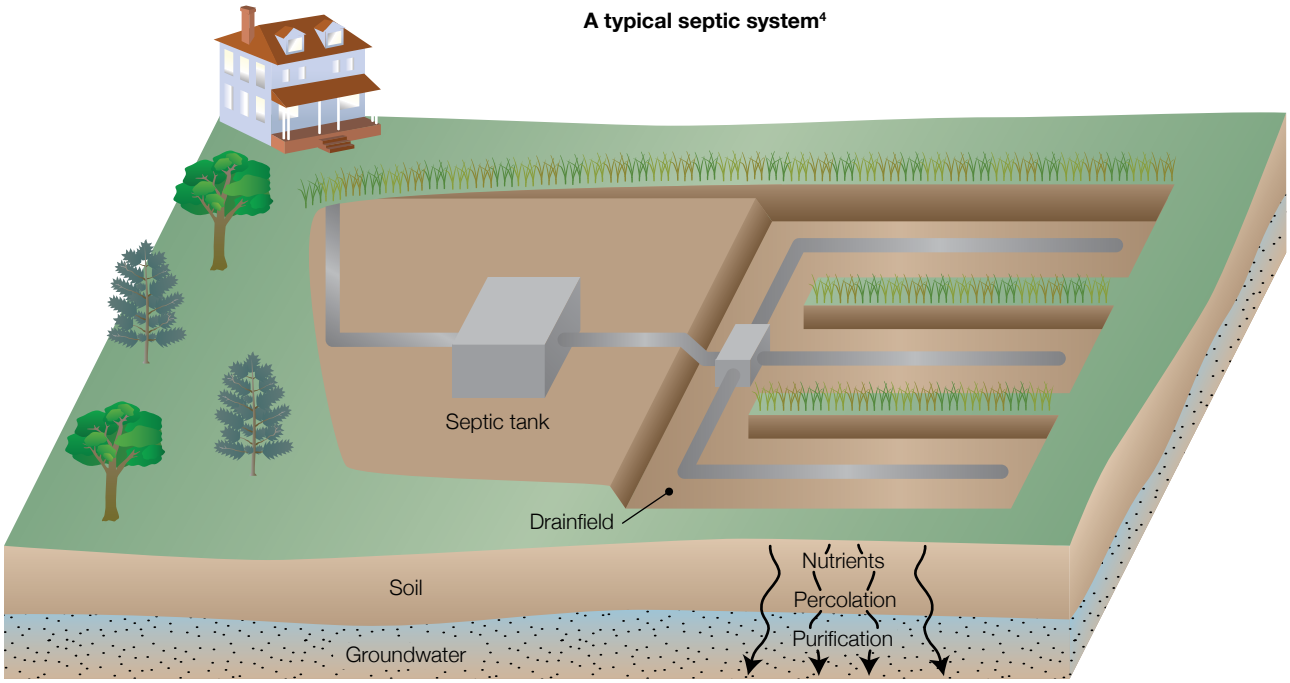
Issue
Over a 50-year timespan (1960–2010), approximately 4,154 individual septic systems have been installed in the Coastal Bays watershed, with 34% (1,429) located in the Critical Area[2] (within 1,000 feet or less of tidal waters). It is anticipated that an additional 454 septic systems could be added to the watershed by 2025 through population growth and new development. To prevent additional nutrient pollution from infiltrating the soil and water, a concentrated effort to replace failing septic systems, adopt newer treatment technologies and provide connections to waste water treatment facilities is necessary.

Solution
There is a net benefit to the public and the environment when connecting existing septic systems to adjacent wastewater treatment facilities. Enhanced treatment lowers the amount of nutrients and household contaminants that flow to the Coastal Bays. As of 2011, a total of 273 septic systems have been taken offline and connected to a public wastewater treatment facility. The Worcester County Comprehensive Plan, Water Resources Element calls for an additional 229 connections by 2025 and would result in a nearly 5,000 pound reduction in total nitrogen loading. This should be done to connect existing systems only, not as means to encourage sprawl. The Isle of Wight Bay and Newport Bay watersheds have the highest number of septic systems but also have established sewer service areas with capacity for growth. As one mechanism for funding such conversions, the Chesapeake and Atlantic Coastal Bays Trust Fund (re-authorized in 2007[3]) provides communities with grants to upgrade septic systems and finance other non-point source pollution reduction projects.

Wastewater treatment & septic system options



A typical septic system[4]



Action item	Category	Lead partner	Outputs (deliverables)	Outcomes (knowledge & behavior)
WQ 1.1.1 WC will implement a proactive program to identify and replace failing septic systems with best available technology systems.The proactive program should identify soil types prone to failure, as well as aged tanks due for inspection and recertification by septic haulers. Whenever possible, septics should be placed in such a way as to avoid storm inundation or subsidence from sea level rise.	Within Existing Resources	WC	Database of all septic systems	Priority Plan for upgrades—include a description of existing high septic use areas, ranking for upgrades and capital fund estimates.
WQ 1.1.2 WC and MDE will pursue retrofitting of septic systems in established sewer service areas, with a priority ranking and timeframe. Where possible, hook up systems to existing wastewater treatment plants. Pursue funds from the Chesapeake & Atlantic Coastal Bays Restoration Fund for upgrades and hook ups.	Within Existing Resources	WC	Indicator tracking: number of retrofits per year to be recorded in CoastStat[5]	Leverage sewer service area priority plans to garner resources. Determine the net reduction in nutrient loading over time.
WQ 1.1.3 MDP and MDE will explore the potential for revision of the Bay Restoration Fund guidelines to allow for retrofits outside of Priority Funding Areas.	Legislative	MDE	Change policy for areas adjacent to Priority Funding Areas	Increased eligibility of funding for septic upgrades adjacent to existing wastewater treatment plants.
WQ 1.1.4 MCBP and WC will develop a program to ensure regular pump-outs and maintenance of residential septic systems. Septic haulers will provide electronic reporting on pumping activity for tracking and monitoring purposes as well as certifications that septic systems are functioning properly. WC will mail notices to homeowners and use the septic tracking system to monitor the volume of septage treated. MCBP will develop educational materials linking septic nutrients to watershed eutrophication.	Education & Outreach	MCBP	Pump-out notices and other educational materials that explain the role of septics in rural areas and their potential for pollution	Increased number of pump-outs.
WQ 1.1.5 MCBP will seek help from University of MD Sea Grant to determine the most appropriate TMDL credit for septic pumping.	Research & Ecosystem Assessment	MCBP	TMDL nutrient reduction credits	Documented change over time.
WQ 1.1.6 WC and MDE will work cooperatively on incentives or other programs to encourage the use of Best Available Technology for enhanced nitrogen removing septic systems with appropriate monitoring and maintenance schedules.	Education & Outreach	WC	Funding or other incentives that may be leveraged for enhanced nutrient removing septic systems	Funding value leveraged over time, net increase in best available technology systems versus the net decrease in nutrient pollution.
WQ 1.1.7 MCBP will facilitate discussions and develop a memorandum of understanding between the states of Maryland and Virginia to reduce the number of failing septic systems affecting Chincoteague Bay.	Policy Issue	MCBP	MOU to reduce septic discharges, active involvement in MCBP by Accomack County, DEQ and/or Virginia State Health Dept.	Decreased nutrient and bacteria levels to that contribute towards meeting TMDL allocations and/or state water quality criteria.

Guidance & references:

- Atlantic Coastal Bays Critical Area Law. 2002. §NR 3:1-09.
- Area of Special State Concern Plan/Critical Area protections. 2002.
- Worcester County Septic Management Areas, Water Resources Element of the Comprehensive Plan. 2011.
- Maryland Sustainable Growth & Agricultural Preservation Act. 2012.
- On-Site Sewage Disposal in Worcester County, Frequently Asked Questions. 2000.
- Worcester County Maryland, Department of Development Review and Permitting, Comprehensive Plan—Water Resources Element, Oct. 4, 2011.
- Maryland Department of Planning, Septics Law Implementation via the 2012 Sustainable Growth & Agricultural Preservation Act.

2. The Critical Area Act passed in 1984 established 'Critical Area' as all land within 1,000 feet of the Mean High Water Line of tidal waters or the landward edge of tidal wetlands and all waters of and lands under the Chesapeake Bay and its tributaries. The Coastal Bays were added in 2002.
3 The trust fund was amended in 2007 with the passage of the Maryland Sustainable Growth and Agricultural Preservation Act.
4. US EPA. 2002. A homeowner's guide to septic systems. *www.epa.gov/owm/septic/pubs/homeowner_guide_long.pdf*
5. CoastStat is a proposed open-source database to track restoration efforts in the Coastal Bays. It would mirror BayStat, the State of Maryland's tool for tracking restoration in the Chesapeake Bay: *baystat.maryland.gov*

Septic systems by watershed (Maryland only)

Assawoman Bay	454
Isle of Wight Bay	1,680
Sinepuxent Bay	1,031
Newport Bay	328
Chincoteague Bay	674
Total	*4,167*

Of this total, 1,300 septics are within the Critical Area (within 1,000 ft of tidal waters or adjacent tidal wetlands). At 16 kg (36 lb) of nitrogen per year per septic, the potential loading equals 21,228 kg (46,800 lb) of nitrogen per year, or 1.2 million liters (325,000 gal) per day. This is equivalent to the load produced by 4.5 Ocean Pines wastewater treatment plants. These numbers do not include the Town of Chincoteague in Virginia, which has around 2,000 households and relies entirely on septic systems.

1 WATER QUALITY GOAL
Decrease nutrient loading throughout the watershed

1.2 WATER QUALITY CHALLENGE
Improve the understanding and protection of groundwater resources

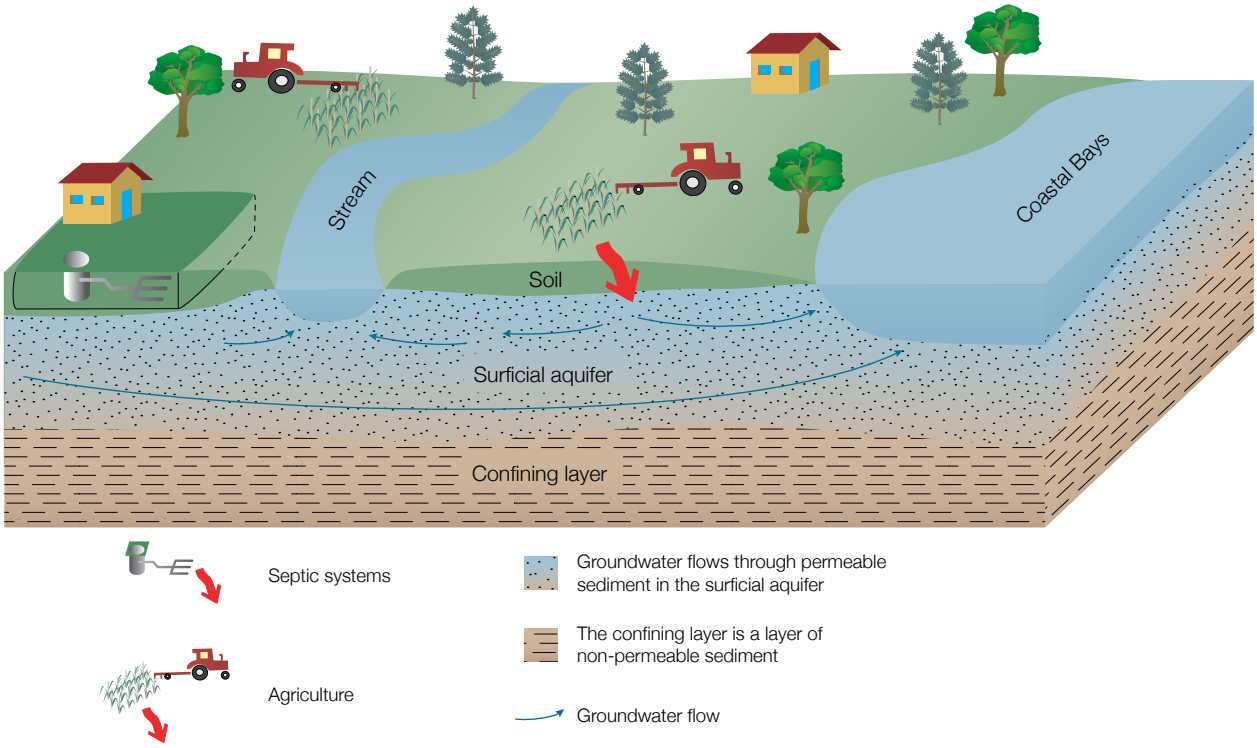
Priority level: 1 (initiate before 2019) *Public support:* Moderate

Issue
The Coastal Bays region is solely dependent on groundwater for public drinking water supplies. Groundwater is also the source for agricultural irrigation, industrial/business needs and much of the freshwater that flows into the bays. There are no less than 40 public wells and hundreds of private wells that are capable of providing 31 million of gallons of water per day. Future growth projections indicate that the use of groundwater in the Coastal Bays watershed will climb to as much as 37 million gallons per day.

The shallow, unconfined aquifer of the watershed is very susceptible to both point (direct) and non-point (indirect) source contamination from fertilizers, pesticides, septic effluent and other sources, and can also be impacted by drought and salt water intrusion. The lag time from actions taken on the land surface and reaction within the water column has been estimated to be less than 10 years, near the surface, but up to over 100 years in deeper aquifers.

Solution
Reclaiming, reusing and returning groundwater to the aquifer source is the best way to protect and preserve the water resources locally. Aquifer recharge areas and wellheads must be protected against contamination to protect public health and assure future freshwater supplies.

Groundwater transport



Nutrients in groundwater are delivered to tributaries of the Coastal Bays, to the Coastal Bays themselves and to the open ocean.

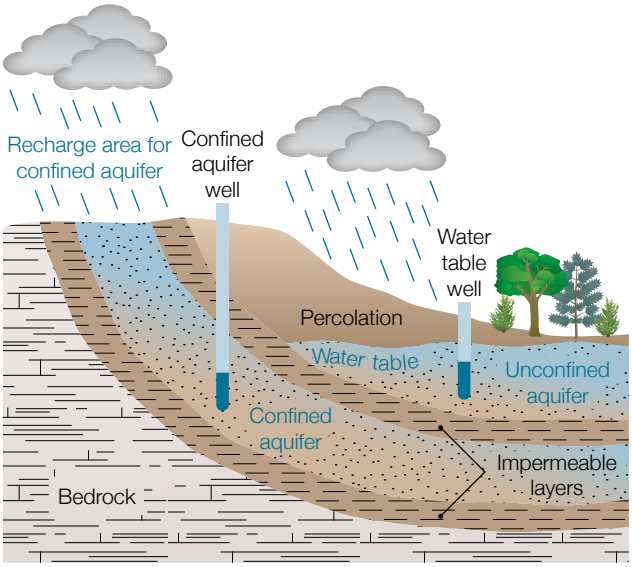
Action item	Category	Lead partner	Outputs (deliverables)	Outcomes (knowledge & behavior)
WQ 1.2.1 MCBP will work to revive interest and funding for the proposed "Sustainability of the Ground Water Resources in the Atlantic Coastal Plain"[6] study to produce a regional groundwater flow model of the Coastal Plain deep aquifer as well as a local model for Worcester County. The model could also be used to simulate the impacts of changes in groundwater recharge and discharge patterns induced by climate change and sea-level rise.	Research & Ecosystem Assessment	MCBP	Groundwater sustainability model for the Coastal Bays region	Ecosystem prediction and response.
WQ 1.2.2 MCBP STAC[7] will compare the USGS surficial aquifer model with other known studies such as thermal imaging to prescribe solutions for water protection and improvements.	Research & Ecosystem Assessment	MCBP	Comparative studies review	Recommendations for ecosystem improvements, better understanding of nutrient flow paths and consequences.
WQ 1.2.3 USGS and NPS will investigate funding resources to continue monitoring nutrient inputs to the Coastal Bays from groundwater. They will study variations in nitrogen concentrations and residence times along surficial groundwater flow paths. This work will provide information on the effects of land use on water quality and provide a basis for planning for conservation areas.	Research & Ecosystem Assessment	USGS	Groundwater monitoring plan. Update the 1955 Mines & Water Resources Bulletin referenced in WC Water Resources Element	Assess flow volumes, groundwater age and percentage nutrient contribution by land use sector.
WQ 1.2.4 NPS will identify baseline groundwater conditions and develop a protocol to monitor and assess changes in the island's groundwater resources related to climate variability.	Research & Ecosystem Assessment	NPS	Status and trends of Assateague Island groundwater resources	Ecosystem prediction and response.
WQ 1.2.5 MDE will work with appropriate state and federal agencies to determine quantity and quality of groundwater resources available for the watershed. Review the source water protection reports' recommendations for each system and determine what is feasible for implementation on a local level.	Research & Ecosystem Assessment	MDE	Source water protection reports with wellhead protection audits	Planning recommendations & priority levels for the Water Resources Element chapter of the County Comprehensive Plan.
WQ 1.2.6 MDE will work with local governments and other state departments to advance the use of gray water reuse for irrigation.	Policy Issue	MDE	Gray water reuse	Water conservation.
WQ 1.2.7 UME will educate the public about water conservation practices. Target high volume water users and gray water reuse systems.	Education & Outreach	UME	Educational pamphlets	Water conservation.

Guidance & references:

- Worcester County Standards, Suitability of Land for Development §ZS 2-501.
- Atlantic Coastal Bays Critical Area Law. 2002. §NR 3-119.
- Worcester County Maryland, Department of Development Review and Permitting, Comprehensive Plan -Water Resources Element, Oct. 4 2011.
- Maryland Department of the Environment Groundwater Protection Strategy and Reports. U.S. Geological Survey "Groundwater Discharge & Nitrate Loadings to the Coastal Bays of MD." 1999.
- Worcester County Department of Comprehensive Planning, Sea Level Response Strategy for Worcester County, Maryland, Oct. 2008 (see vulnerability of roads and potable water supply systems).
- Sanford, W.E., Pope, J. P., Selnick, D.L. and Stumvoll, R.F. 2012. Simulation of groundwater flow in the shallow aquifer system of the Delmarva Peninsula, Maryland and Delaware: U.S. Geological Survey Open-File Report 2012-1140.

6. *pubs.usgs.gov/fs/2006/3009/*
7. The Science and Technical Advisory Committee (STAC) of the Maryland Coastal Bays Program is composed of leading scientists amongst the MCBP partner organizations and from local universities. STAC is responsible for reviewing and making recommendations on the latest science of relevance to the health of the Coastal Bays watershed.
8. University of Maryland Cooperative Extension Service. 2002. Water, Water Wells, & Water Contamination.*extension.umd.edu/publications/PDFs/HW3.pdf*

Confined & unconfined aquifers



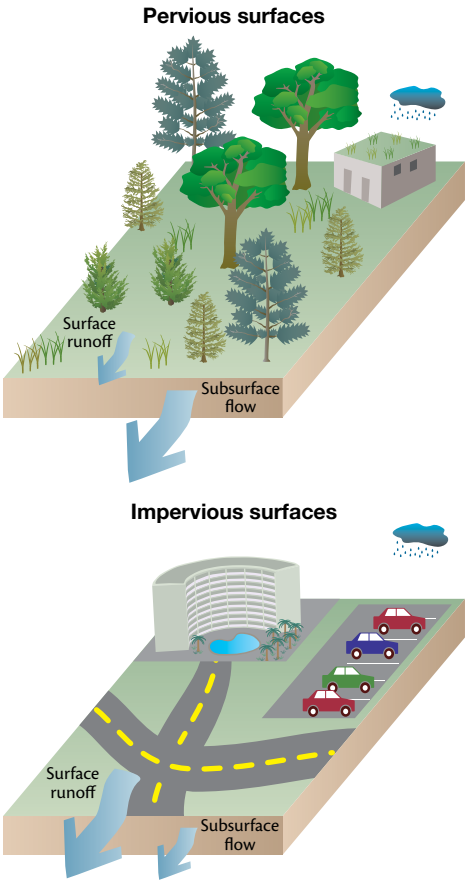
The Coastal Bays are underlain by both surficial (unconfined) and deeper (confined) aquifers.[8]

1 WATER QUALITY GOAL
Decrease nutrient loading throughout the watershed

1.3 WATER QUALITY CHALLENGE
Reduce excessive fertilization by turf professionals and homeowners

Priority level: 1 (initiate before 2019) *Public support:* Moderate

Issue
Excessive or improper use of fertilizer by private homeowners and businesses can contribute a disproportionate amount of nutrients to the bays as non-point source run-off. The same nutrients that contribute to green lawns can be washed away to create green water. Pesticides and herbicides on landscapes can also kill aquatic plants and animals. Studies by the U.S. Geological Survey on the Delmarva Peninsula have found mixtures of different pesticides accumulating in streams and other surface waters, as well as in shallow groundwater, including in water recharge areas.



Pervious surfaces such as grass, soils and 'green roofs' allow water to infiltrate the ground, slowing and reducing runoff and recharging groundwater. Impervious surfaces such as cement, asphalt and roofing prevent infiltration, increasing the volume and velocity of surface runoff which carries nutrients and sediments with it.[9]

Solution
Residents can reduce water quality impacts from lawns, gardens, parks and golf courses by limiting the use of fertilizer, herbicides and pesticides. Properly managed green spaces can help prevent soil erosion, which can cloud the water and smother bay grasses. Trading lawns for trees and native plants reduces the need for chemicals and fertilizer and helps take up nutrients, reducing runoff to the bays. Periodic and sustained educational efforts will provide citizens and businesses with increased knowledge and skills as well as viable alternatives to common lawn problems. It is noteworthy that at least $19,000 in MCBP grant funds has been provided to local groups and neighborhood associations to support Bay Scape projects and rain gardens. Ocean City also provides mini-grants to residents and businesses for dune plantings. As of 2010 there were 73 University of Maryland Extension (UME) Master Gardeners on the Lower Eastern Shore who partner with groups to create community gardens and to provide troubleshooting guidance on native species, insects and plant care.

Flower gardens like this one at Newport Farms help slow runoff, take up nutrients and provide wildlife habitat. Photo by Arlo Hemphill.

Action item	Category	Lead partner	Outputs (deliverables)	Outcomes (knowledge & behavior)
WQ 1.3.1 UME will educate local professional grounds managers and landscapers about fertilizer reduction programs.	Education & Outreach	UME	Workshop(s), citizen survey regarding use of landscapers & fertilizer knowledge	Reduced non-point source nutrient runoff.
WQ 1.3.2 UME will update and disseminate the Voluntary Golf Course Guidelines to reflect changes in the phosphorus free fertilizer law.	Education & Outreach	UME	Dissemination of document	Reduced non-point source nutrient runoff.
WQ 1.3.3 MCBP will produce outreach materials and education to citizens to supplement state and local efforts to reduce over-fertilization of lawns. The state chemist will be consulted for periodic estimation of fertilizer sales in the county.	Education & Outreach	MCBP	Speaking engagements	Social indicator—change in fertilizer use over time.
WQ 1.3.4 MCBP will encourage chemical-free vegetation and buffers to reduce sediment, pesticide and fertilizer runoff from properties. Identify all funding opportunities and encourage participation.	Restoration & Conservation	MCBP	Summary of resources	Change in buffer coverage over time

Guidance & references:

- Maryland Fertilizer Law. 2013.
- Chesapeake Bay Critical Area Law. 2002.
- Voluntary Golf Course Guidelines Recommended for Golf Courses in Worcester County & the Delmarva Peninsula, (Worcester County Planning, Permits & Inspections, date unknown)
- Rain Gardens Across Maryland. Worcester County, MD. 2008.
- University of Maryland Cooperative Extension Master Gardener Annual Report. 2010.
- Debrewer, L.M, Ator, S.W. and Denver, J.M. 2007. Factors Affecting Spatial and Temporal Variability in Nutrient and Pesticide Concentrations in the Surficial Aquifer on the Delmarva Peninsula U.S.Geologic Survey Scientific Investigations Report 2005-5257.

9. Schuler, T. 1987. Controlling Urban Runoff: A Practical Manual For Planning And Designing Urban BMPs. Metropolitan Washington Council of Governments. Washington, D.C.

Volunteers help plant native plants at the rain garden at the Germantown School Community Center in east Berlin. The Maryland Coastal Bays Program was able to help secure funding to help create the garden at the restored historically black school house. Photo by Bill Mahoney.

1 WATER QUALITY GOAL
Decrease nutrient loading throughout the watershed

1.4 WATER QUALITY CHALLENGE
Reduce stormwater runoff from residential and developed areas

Priority level: 1 (initiate before 2019) *Public support:* High

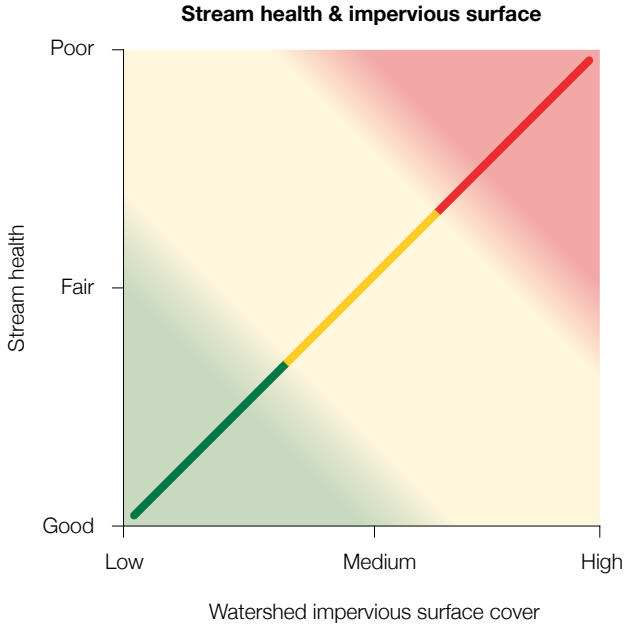
Issue

In developed areas, impervious surfaces such as roads, parking lots and rooftops prevent rainwater from filtering into the soil. Precipitation can either nourish a well-designed landscape or cause problems by transporting soil, nutrients, bacteria, trash and heavy metals to nearby waters. The Coastal Bays watershed is flat and very near sea level, which can cause streams, ditches and parking lots to quickly overflow. Flooding frequently affects business access and creates traffic problems and property damage. The cumulative impact from many small properties can be significant, particularly in areas developed prior to July 1984, when stormwater treatment was not required. Additionally, the edges of wetlands and stream buffers over time have been impacted for building additions, garages and lawns. It is well documented that biological degradation occurs in watersheds with more than 10% total imperviousness.[10] A review of 2004 land use data the Coastal Bays watersheds were found to have the following percent imperviousness; Assawoman Bay (18%), Isle of Wight Bays (10%), St. Martin River (7%), Sinepuxent Bay (6%), Newport Bay (4%) and Chincoteague Bay (1%).

Stream-side vegetation buffers filter nutrients and sediments before they reach the waterways. Photo by Dave Wilson.

Solution

A net loss of natural infiltration areas has occurred and steps should be taken to reestablish natural catch basins and native vegetation. Investments in water infrastructure can be accomplished by establishing stormwater utilities that set aside funds for establishing and maintaining drainage conveyances, swales and catch basins. These funds can be further leveraged through grants that promote watershed restoration. Every effort should be made to retrofit properties in the Coastal Bays watershed built prior to 1984 to accommodate infiltration on site and to reduce total imperviousness by watershed.



This graph demonstrates the relationship between stream health and the amount of impervious surface in the watershed.[10]

Action item	Category	Lead partner	Outputs (deliverables)	Outcomes (knowledge & behavior)
WQ 1.4.1 Berlin will maintain, and OC will explore, stormwater utilities or other alternatives to fund improvements and long-term maintenance of conveyances, structures and natural spaces to prevent flooding and treat stormwater for volume and water quality. WC should follow municipal examples for other areas in the county.	Legislative	Berlin, OC	Stormwater utilities	Resolve flooding issues. Establish a dedicated funding source for green infrastructure improvements and maintenance.
WQ 1.4.2 WC, OC and Berlin will form a unified approach in tracking the cumulative new stormwater runoff volumes resulting from BMP retrofits within the watershed. They will also track reductions for credit under state stormwater management guidelines.	Policy Issue	WC	Evaluation and tracking report for stormwater infrastructure. Create a database and map for improvements, report changes as CoastSTAT data	Improved municipal and county coordination.
WQ 1.4.3 WC will investigate the amount of pre-1984 development in order to estimate the need for stormwater retrofits, provided grant funding is available.	Policy Issue	WC	Indicator tracking: amount financial assistance secured, number of acres treated	Determine and prioritize retrofit needs and opportunities.
WQ 1.4.4 MDP and WC will monitor changes in total impervious surfaces over time. Sub-watersheds with more than 10% impervious surface should be ranked for restoration. Areas ranked as <10% should be targeted for preservation.	Research & Ecosystem Assessment	MDP	Baseline of imperviousness	Percent change over time, effectiveness of effort.
WQ 1.4.5 MDE will evaluate the policy of no net wetland loss and determine the magnitude of wetland impacts approved verses denied over time to determine the effectiveness of preservation programs.	Within Existing Resources	MDE	Indicator tracking: Stormwater database & map	Informed planning through the evaluation of the no net loss wetland policy.
WQ 1.4.6 MCBP will assist local jurisdictions by advocating for Water Quality Act, section 319 non-point source grants for restoration and retrofit funding.	Within Existing Resources	MCBP	Indicator tracking: Stormwater database & map, funding leveraged	Planning & resource sharing.
WQ 1.4.7 MCBP will promote the retention of wetlands and buffers in riparian zones and along existing stream contours. Existing developed areas (ex. parking lots) will be targeted for pervious retrofits or other infiltration practices.	Education & Outreach	MCBP	Public workshops, native vegetation plantings opportunities and sponsoring of impervious retrofits. Continued beach, shoreline and wetland clean-ups	Increase in buffer areas and infiltration practices.

Guidance & references:

- Stormwater Management, Redevelopment §NR 1:I-05, Atlantic Coastal Bays Critical Area Law. 2002. §NR 3-106 Intensively Developed Areas.
- Model Development Principles for Worcester County, a.k.a. Builders for the Bay Roundtable. 2004.
- Worcester County Maryland Comprehensive Plan. 2006.
- University of Maryland, Environmental Finance Center, Financing Feasibility Study for Stormwater Management in Berlin Maryland, Oct. 2012

10. Schuler, T. 2000. The importance of imperviousness. Article 1 in The Practice of Watershed Protection. Center for Watershed Protection. Ellicott City, Maryland

Precipitation can either nourish a well-designed landscape or cause detrimental effects by transporting soil, nutrients, bacteria and heavy metals to nearby waterways. Maryland has progressive stormwater management practices that require post-development hydrology to equal pre-development hydrology for many new developments. Current guidelines and requirements are in the 2000 Maryland Stormwater Design Manual, volumes I & II, via Maryland Department of the Environment: *www.mde.state.md.us*.

1 WATER QUALITY GOAL
Decrease nutrient loading throughout the watershed

1.5 WATER QUALITY CHALLENGE
Reduce nutrient runoff from agricultural lands

Priority level: 1 (initiate before 2019) *Public support:* High

Issue

Agriculture is a core industry in the Coastal Bays watershed. From colonial days when tobacco and subsistence farming dominated, agriculture expanded to include orchards, dairy and fruit and vegetable crops. Truck farming, canneries and seafood harvesting supplemented both the dining table and financial resources for many Delmarva towns and villages. Today, grain crops and poultry production dominate the area. According to the USDA Agricultural Census, Worcester County is the 4th largest county in Maryland for poultry production and produced more than $200 million in agricultural sales in 2012.[11] Many economic, social and environmental benefits are provided by agricultural land such as secure food and fiber sources, carbon capture, species habitat, hunting lease sites and open vistas. Fertilizer (whether it be chemical, biosolids or manure) is necessary for growing crops, which in turn is necessary for poultry production. Soil composition (which in our area tends to be sand, silt, clay and shell) limits all but about 20% of the soils in Worcester County from being farmed without artificial drainage (USDA, SCS 1973). To better facilitate draining farm fields, eight Public Drainage Associations have been created in parts of the watershed, managing a total of 56 miles of ditches. Excessive nitrogen and phosphorus from farming is implicated in nutrient overloading to local waters.

Solution

Agriculture remains a major economic driver in the watershed. Additional care is needed to ensure that plant needs and soil conditions prevent excess nutrients from running off farm fields into local waters or infiltrating the groundwater. The Maryland Farm Bureau feels that an "effective approach to nutrient management would be to work through the Soil Conservation District offices to provide farmers with Soil Conservation and Water Quality Plans which are site specific and address conservation concerns". Efforts to foster collaboration between agricultural producers and natural resource managers can be bolstered.

Guidance & references:

- Atlantic Coastal Bays Critical Area Law. 2002. §NR 3-119.
- Agriculture. Right to Farm Law § ZS1:III-47 Maryland Department of Agriculture, Public Drainage Systems in Worcester County, MD. 2005.
- DNR Stream Corridor Assessments. 2001, 2003, 2004, & 2005. Moving Water: A Report to the Chesapeake Bay Cabinet by the Public Drainage Task Force, Oct. 2000.
- USDA National Agricultural Statistics Service, Census of Agriculture – County Data 2012.
- USDA, SCS (U.S. Department of Agriculture, Soil Conservation Service), 1973. Soil Survey of Worcester County, Maryland. Washington D.C.: U.S. Government Printing Office.
- Maryland Farm Bureau quote from The Delmarva Farmer, July 10, 2012.

Agriculture is a large part of the character of the Coastal Bays region. Photo by Dave Wilson.

Action item	Category	Lead partner	Outputs (deliverables)	Outcomes (knowledge & behavior)
WQ 1.5.1 WSCD will work with local farmers to develop and implement farm specific Soil Conservation and Water Quality Plans.	Within Existing Resources	WSCD	Indicator: BMP tracking for Coastal Bays subwatershed specific agriculture plans (CoastStat)	List of agricultural needs and accomplishments. Share non-confidential information with other economic sectors to balance nutrient reduction burden.
WQ 1.5.2 MDA will determine the annual percentage of agricultural land in the watershed that is in compliance with state nutrient management plans.	Within Existing Resources	MDA	Indicator tracking Coastal Bays sub-watershed-specific agriculture plans (CoastStat)	List of agricultural needs & accomplishments. Share non-confidential information with other economic sectors to balance nutrient reduction burden.
WQ 1.5.3 MDA and SU will consider the extent of phosphorus saturated soils in the Coastal Bay watershed, while researching the utility of adopting the Phosphorus Index[12] and the potential economic implications to local farmers.	Research & Ecosystem Assessment	MDA	Analysis of soil phosphorus saturation, leaching potential and economic impacts to farmers	Management decisions to jointly support TMDL reduction goals and sustainable farming practices.
WQ 1.5.4 MDA and NRCS will track existing agricultural best management plans that are in place and suggest areas that would benefit from increased projects.	Research & Ecosystem Assessment	MDA	Soil Conservation & Water Quality Plan watershed acreage targets and goals.	Effort evaluation & setting future goals. Use of existing statewide Watershed Implementation Plan procedures and staff to track, compile and analyze BMP data.
WQ 1.5.5 MCBP will foster a greater appreciation of farming by informing the public about right to farm laws and the positive changes farmers are implementing to protect natural resources while producing food and fiber.	Education & Outreach	MCBP	Newsletters, public service announcements, press releases, collaborative projects with local farmers	Conflict resolution.
WQ 1.5.6 NRCS and MDA will investigate methods to promote innovative agricultural programs including precision farming practices by facilitating the availability of low interest loans and other funding sources.	Policy Issue	NRCS	Funding directed to watershed	Economic Development.
WQ 1.5.7 MCBP, MDA, NRCS and other partners will encourage and pursue grant funding for BMPs, farmland conservation and other programs in most affected watersheds to support local agriculture.	Policy Issue	MCBP	Funding directed to the watershed (including from MDA Animal Waste Technology Fund, Ag Energy Efficiency Program, etc.)	Economic Development.
WQ 1.5.8 MCBP will establish a workgroup comprised of MDA, SHA, WC, WSCD, NRCS, Public Drainage Association managers and landowners to determine site specific opportunities for innovative ditch design and/or restoration opportunities as well as Public Drainage Association improvements and water control structures. Continue to educate landowners on proper ditch maintenance practices.	Restoration & Conservation	MCBP	Priority projects list and outreach to promote new BMPs and management technologies	Number of BMPs or other technologies to benefit Public Drainage Associations.
WQ 1.5.9 LSLT and MCBP will work with partners and landowners to protect, restore and plant non-tidal wetlands and forest/grass buffers on agricultural land using MALPF, WRE, MACS, CREP, EQIP, NAWCA, CELCP, Coastal Wetlands, Rural Legacy and other state and federal program funding.	Restoration & Conservation	MCBP	Funding for BMPs, wetland restoration projects and farm land preservation	Meet goal to preserve, protect or enhance 1,000 acres of farmland by 2016. Set goals for future efforts.
WQ 1.5.10 MGS, subject to available funding, will quantify the volume of water and nutrients delivered from watershed ditches to the Coastal Bays. Results will be utilized to establish priority areas for appropriate nutrient reduction strategies.	Research & Ecosystem Assessment	MGS	Priority plans for water storage and nutrient reduction	Ecosystem predictions/ water budget.

11. Extracted from USDA 2012 Census of Agriculture.
12. The Phosphorus Index is a tool to assess the potential for phosphorus runoff from individual fields based on soil types, field characteristics and management practices.

1 WATER QUALITY GOAL
Decrease nutrient loading throughout the watershed

1.6 WATER QUALITY CHALLENGE
Promote the use of treated wastewater as a resource rather than a waste product

Priority level: 2 (initiate before 2025) *Public support:* Moderate

Issue

Every gallon of water that is pumped from the ground requires energy and often incurs associated costs for treatment such as iron removal or bacteria sanitation. Once used, many of the gallons cost additional energy and expenses for treatment before being discharged. Effluent from wastewater treatment plants, although treated, is still higher in nutrients than naturally occurring water. As a result, discharges to streams and bays can cause over-stimulation of aquatic algae and lead to eutrophication. Reuse of wastewater as spray irrigation to farms, golf courses, athletic fields, landscaping and forests as nutrient-rich irrigation water is a viable alternative to discharging directly into the bays. Re-use is beneficial for many reasons including decreased nutrients entering the bays, decreased pumping, reduced chemical and fertilizer costs and decreased use of fresh groundwater sources.

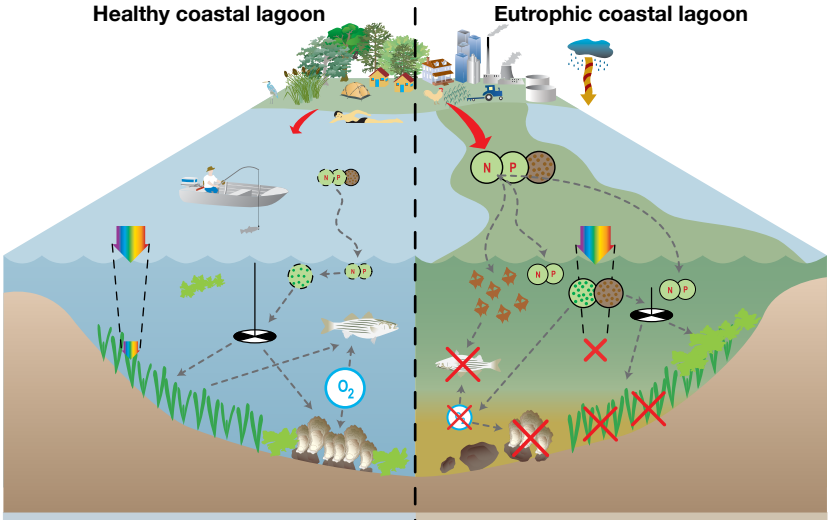
Solution

Water that has been treated for nutrient removal can be a valuable resource rather than a burden for communities. Identifying and promoting spray irrigation sites for existing stream discharges will benefit high water users (golf courses, forests and farms) and protect the environment.

What is eutrophication?
Eutrophication is the process by which the addition of nutrients (largely nitrogen and phosphorus) to waterbodies stimulates algal growth. Excessive nutrient inputs may lead to other serious problems such as low dissolved oxygen and loss of seagrasses. In recent decades, human activities and population growth have greatly increased nutrient inputs to lagoonal systems, leading to degraded water quality and impairments of estuarine resources for human use.

Healthy & eutrophic coastal lagoons

Healthy coastal lagoon | **Eutrophic coastal lagoon**



In healthy ecosystems, nutrient inputs—specifically nitrogen and phosphorus —occur at a rate that stimulates macroalgal and phytoplankton growth in balance with animals that graze on them. A low level of phytoplankton in the water column helps keep water clarity high , allowing light to penetrate deep enough to reach submerged aquatic vegetation . Low levels of phytoplankton and macroalgae result in dissolved oxygen levels suitable for healthy fish and shellfish , so that humans can enjoy the benefits that a healthy coastal environment provides.

In a eutrophic ecosystem, increased sediment and nutrient loads from farming , urban and suburban development , wastewater treatment plants , and industry , together with atmospheric nitrogen , help trigger both macroalgae and phytoplankton blooms, exceeding the capacity of grazer control. These blooms can result in decreased water clarity , decreased light penetration , decreased dissolved oxygen , loss of submerged aquatic vegetation , increased nuisance/toxic algal blooms , and contamination or die-off of fish and shellfish .

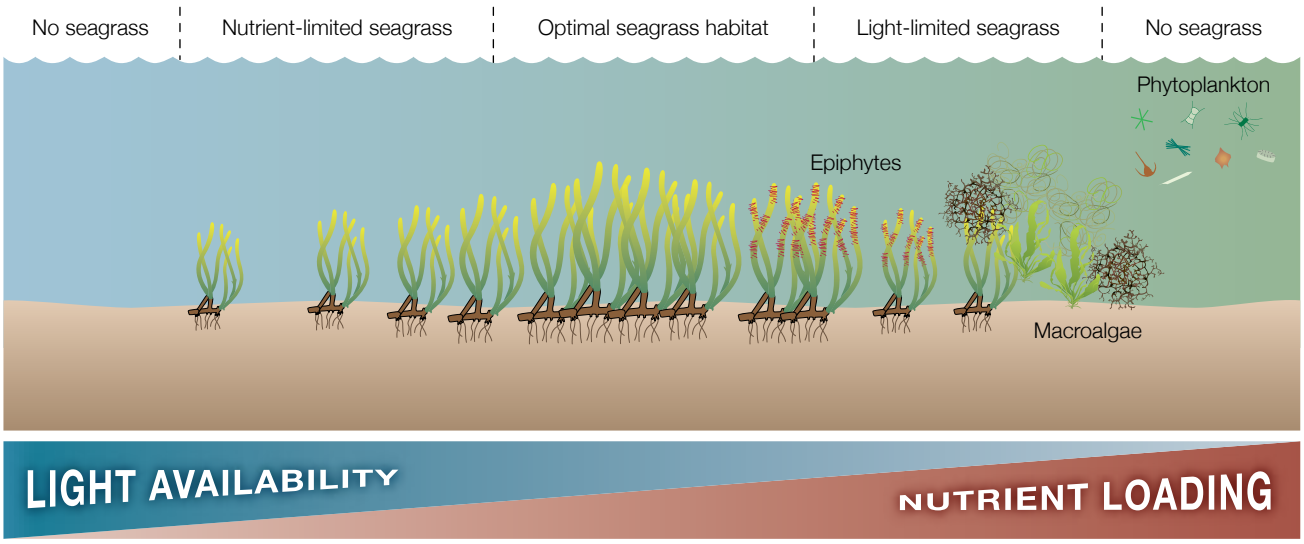
Action item	Category	Lead partner	Outputs (deliverables)	Outcomes (knowledge & behavior)
WQ 1.6.1 WC will maintain the policy of no new wastewater treatment plant discharges to waterways and continue to support spray irrigation or other technologies instead.	Within Existing Resources	WC	Updated County Comprehensive Plan	Decreased point source loading.
WQ 1.6.2 WC will facilitate point source removals at Church Branch and Marshall Creek by connecting land owners with funding sources for spray irrigation or wastewater treatment plant hook ups.	Policy Issue	WC	Funding for spray irrigation	Decreased point source loading.
WQ 1.6.3 WC will require developers to identify potential spray irrigation sites for the Showell Growth Area based on soils, groundwater tables and infiltration capacity.	Within Existing Resources	WC	Map of potential sites	Plans to accommodate future growth.
WQ 1.6.4 OC will explore the financial feasibility of upgrading the Ocean City wastewater treatment plant to Enhanced Nutrient Removal technology.[13]	Within Existing Resources	OC	Feasibility report	Infrastructure investment planning.
WQ 1.6.5 EPA will provide environmental data and analyses collected offshore to inform coastal researchers and local decision-makers about nutrient loading dynamics, particularly from ocean wastewater outfalls.	Within Existing Resources	EPA	Ecosystem data & reports	Integration of off-shore federally collected ecosystem data.
WQ 1.6.6 MCBP STAC will investigate changes to water quality parameters (nutrients, sediment, harmful algal blooms, etc.) that affect the Coastal Bays through inlet flushing.	Research & Ecosystem Assessment	MCBP	Analysis and reports of water quality exchanges with the ocean	Recommendations for monitoring to better understand ecosystem linkages.

Guidance & references:

- Maryland Department of the Environment Guidelines for Land Application/ Reuse of Treated Municipal Wastewaters.
- Worcester County Comprehensive Plan.
- §ZS 1-328 Wastewater and water treatment facilities.
- §PW 5-306 Waters and Sewers, Sanitary Service Areas, services outside of service area.

13. Enhanced Nutrient Removal Technology allows sewage treatment plants to provide advanced levels of nutrient removal, achieving 3 mg/L total nitrogen and 0.3 mg/L total phosphorus.

Effect of nutrient loading on primary producers



Increasing nutrient loading to an ecosystem changes the dominant primary producer, from seagrass to macroalgae to phytoplankton.

2 WATER QUALITY GOAL
Decrease inputs of toxic contaminants

2.1 WATER QUALITY CHALLENGE
Reduce runoff of toxic chemicals, pesticides and petroleum-based hydrocarbon pollution

Priority level: 1 (initiate before 2019) *Public support:* Medium

Issue

Pests can cause significant economic loss to agriculture, private property and public lands. Pesticides are used to lessen investment loss (i.e. crop damage) and can protect human health against diseases carried by mosquitoes, rats and other species. A balanced approach employs Best Management Practices (BMPs) and a variety of alternative techniques to control pests while minimizing damage to the environment. Likewise with herbicides, actions should be taken to reduce their usage. Toxins are also prevalent in hazardous wastes such as batteries, antifreeze, oil, paints and solvents that are improperly disposed of. Programs to minimize hazardous waste and promote proper disposal decrease the potential of contaminants reaching the bays.

Solution

Increase public knowledge and use of BMPs to balance pest control with environmental concerns. Reduce the use and improper disposal of household and business-related hazardous wastes through the promotion of collection sites and programs. Anticipate and prepare for storm surges and other catastrophic events that may release toxins into the environment.

Cover crops and no-till farming BMP's (Best Management Practices) on an agricultural field. Photo by Chesapeake Bay Program/CC BY-NC.

Action item	Category	Lead partner	Outputs (deliverables)	Outcomes (knowledge & behavior)
WQ 2.1.1 MCBP and UME will encourage all farms, golf courses, recreational areas and homeowners associations to have integrated pest management plans. Outreach will be implemented by disseminating information on the identity and avoidance of vectors and pests, and by sponsoring demonstration sites.	Education & Outreach	MCBP	Outreach materials regarding pests and disease vectors. Establish demonstration sites.	Protection of public health and prevention of environmental degradation.
WQ 2.1.2 MCBP and UME will promote educational opportunities (i.e. bird/bat house designs) and encourage homeowners to foster natural insect control such as bats and purple martins.	Education & Outreach	MCBP	Hands on educational opportunities	Community involvement in pest management.
WQ 2.1.3 MDA will use Integrated Pest Management (IPM)[14] strategies to protect public health by using Open Marsh Water Management,[15] biological controls and mosquito larvacides, to the greatest extent possible, thus reducing the need for controlling adult mosquitoes.	Within Existing Resources	MDA	Standard Operating Practice	Balancing public health concerns, vector management and chemical spraying in the environment.
WQ 2.1.4 DNR and MCBP will support saltmarsh management technologies and projects to reduce mosquito, biting midges (no-see-ums) and horsefly populations. Projects will improve saltmarsh ecology and reduce the need for pesticide use.	Within Existing Resources	DNR	Open Marsh Water Management enhancement projects	Improve saltmarsh ecology, reduce erosion and reduce pesticide use.
WQ 2.1.5 NPS-ASIS will continue to pursue saltmarsh restoration and monitoring projects such as ditch plugging and filling, marsh elevation studies and nekton monitoring to restore natural conditions and document long-term changes within salt marshes along Assateague Island.	Within Existing Resources	NPS	Summary of natural salt marsh status and trends, including monitoring of PCBs, PAHs and DDT	Restore saltmarsh hydrology and ecological function, build resiliency, document long-term change.
WQ 2.1.6 MCBP will develop public education pieces as part of integrated stormwater management for flood control, mosquito reduction and wildlife habitat enhancement.	Education & Outreach	MCBP	Educational piece	Improved public awareness and understanding of local ecosystem conditions.
WQ 2.1.7 WC will continue to hold hazardous waste disposal programs for farm and residential hazardous materials, including pesticides and fouled gasoline.	Within Existing Resources	WC	Indicator tracking: Volume & types of waste collected	Program evaluation, fish tissue & sediment monitoring for toxins, pharmaceuticals and household products.
WQ 2.1.8 MDE & WC will conduct a study to identify potential toxic risks (landfills, underground storage tanks for oil, gas, & chemicals, etc.) and other land uses that may be affected by sea level rise and/or land subsidence. Add this information to the County Hazardous Mitigation Plan.	Within Existing Resources	WC	Maps and study of potential toxin sites that may be impacted	Informed planning and prediction scenarios.

Guidance & references:

- Proceedings of the Workshop on Stormwater Management and Mosquito Control (for the Maryland Coastal Bays). EPA 2005.

14. Integrated Pest Management (IPM) is an effective and environmentally sensitive approach to pest management that relies on a combination of common-sense practices. IPM programs use current, comprehensive information on the life cycles of pests and their interaction with the environment. This information, in combination with available pest control methods, is used to manage pest damage by the most economical means, and with the least possible hazard to people, property and the environment. Via EPA 2014. *www.epa.gov/opp00001/factsheets/ipm.htm*
15. Open Marsh Water Management (OMWM), a management tool used in coastal saltmarshes to control mosquitoes, improve habitat resources for fish and wildlife and restore saltmarshes to the hydrological conditions as existed prior to the 1930s and the impacts of parallel grid-ditching. *www.dnrec.delaware.gov/fw/mosquito/Documents/OMWM%20Article%20 11.05.07.pdf*

3 WATER QUALITY GOAL

Implement a strategy to meet Total Maximum Daily Load reductions

3.1 WATER QUALITY CHALLENGE

Develop a comprehensive watershed improvement plan to reduce the number of state-listed impaired waters by targeting pollution problem areas

Priority level: 1 (initiate before 2019) *Public support:* Moderate

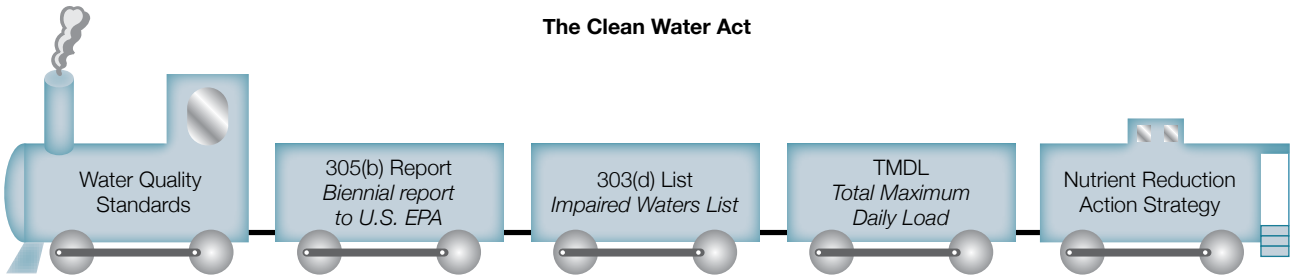
Issue

The 1972 Federal Clean Water Act requires each state to list ponds, reservoirs, streams, rivers and bays that are impaired by polluting substances. All five of the Coastal Bays; Assawoman, Isle of Wight, Sinepuxent, Newport and Chincoteague, have been listed for excessive nutrients since 1996. Additionally, Bishopville Prong, Shingle Landing Prong, St. Martin River, Manklin Creek, Turville Creek, Herring Creek, Marshall Creek and Kitts Branch exhibit high nutrient levels. Both Bishopville Pond and Big Mill Pond are impaired as well. Excessive nutrients rob oxygen from the water and promote excessive algae growth. In turn, fish and shellfish are impacted, which limits fishing and clamming opportunities for people. In certain cases, swimming and boating access may be limited as well.

Solution

Every effort to stem the flow of excessive nutrients must be taken to promote healthy water and by extension a healthy quality of life for citizens. Everything that happens on the landscape has the potential to run off and accumulate in ditches and streams, rivers and bays. Restoring buffers along streams, planting trees, limiting fertilizer and all of the actions listed in the Water Quality section of the CCMP will incrementally improve water quality, thus maintaining the natural ecosystem function for the community today and for future generations.

The Clean Water Act



It is helpful to visualize the provisions of the Clean Water Act as a train, with water quality standards as the 'engine' and each car dependent on the one preceding it. Modified from Georgia Legal Watch.

Action item	Category	Lead partner	Outputs (deliverables)	Outcomes (knowledge & behavior)
WQ 3.1.1 MCBP, MDE, DNR, MDP, MDA, WC, WSCD, NPS, NRCS and others will convene a permanent TMDL/BMP subcommittee to develop and implement a nutrient reduction strategy. This committee will investigate STAC requested TMDL scenarios, prioritize nutrient reduction activities, project sites and funding sources. Nutrient load additions and reductions could be tracked and monitored through the establishment of CoastStat. Existing best management practices will be mapped for presumptive efficiency removal rates, inspection and maintenance schedules, responsible parties, etc.	Policy Issue	MCBP	Development of a Watershed Improvement Plan with a nutrient reduction strategy to reduce the number of impaired water segments. Creation of CoastStat, a TMDL Tracking and Accounting System	Promotion of and commitment to fishable/swimmable waters.
WQ 3.1.2 MCBP will ask EPA (Office of Water) to assist Program efforts by conducting a Recovery Potential Screening for the Coastal Bays.[16] The screening process will be based on ecological, stressor and social indicators, and measured by landscape datasets, impaired water attributes and monitoring data to prioritize restoration projects.	Research & Ecosystem Assessment	MCBP	Recovery Potential Screening Report for the Coastal Bays	Priority planning for conservation or restoration projects.
WQ 3.1.3 MCBP with assistance from the TMDL/BMP subcommittee will conduct a series of focused, subwatershed analyses (and update the Watershed Restoration Action Strategies)[17] to develop specific recommendations for establishing/enhancing buffers in tidal and non-tidal areas, protecting water quality & habitat, conserving resources and promoting sustainable economic interests.	Policy Issue	MCBP	Watershed Improvement Plan with a nutrient reduction strategy	Commitment to develop a Watershed Improvement Plan, priority status & staff/funding resources.
WQ 3.1.4 MCBP will work with EPA and MDE to see that the watershed-based plans meet the nine Clean Water Act, section 319 program elements (also referred to as a.-i. criteria)[18] to secure funding for nonpoint source pollution reduction activities. Once a watershed plan is approved by EPA, MCBP can submit project proposals to secure funding for nonpoint source pollution reduction activities.	Within Existing Resources	MCBP	Quantifiable changes in policy and practice over time, restoration on at least five impaired stream segments by 2016	Promotion of and commitment to fishable/swimmable waters.
WQ 3.1.5 DNR will compile the results and determine trends in air pollution inputs from the National Atmospheric Deposition Program monitoring site on Assateague Island. Disseminate information via the "State of the Bay" report every five years.	Research & Ecosystem Assessment	DNR	Alr pollution data analysis and trends	Data provides feedback on air pollution reduction policies and programs.

Guidance & references:

- Clean Water Act, Atlantic Coastal Bays Critical Area Law (2002) §NR3:I-01.
- Total Maximum Daily Loads for Assawoman Bay, Isle of Wight Bay, Sinepuxent Bay, Newport Bay and Chincoteague Bay in the Coastal Bays Watershed in Worcester County, Maryland.2013.
- Watershed Restoration Action Strategies for the Isle of Wight Bay.2002.
- Watershed Restoration Action Strategies for Assawoman Bay. 2008.
- Watershed Restoration Action Strategies for Newport & Sinepuxent Bays.2005.
- Watershed Restoration Action Strategies for Chincoteague Bay. 2006.
- MDE Integrated Report of Surface Water Quality in Maryland.2012.

16. EPA Recovery Potential Screening is a website tool that offers a flexible framework of methods, tools and technical information for comparing the relative restorability of watersheds. A suite of indicators can be selected for ecological, stressor and social contexts which will assist in developing restoration priorities.
17. DNR Watershed Restoration Action Strategies can be found at *www.dnr.state.md.us/watersheds/surf/proj/wras.html*
18. EPA has identified nine key elements that should be included in a watershed plan for Impaired Waters Funding. For a full description see the EPA Handbook for Developing Watershed Plans to Restore and Protect Our Waters at *water.epa.gov/polwaste/nps/handbook_index.cfm*

The federal **Clean Water Act (CWA)** states "The objective of this Act is to restore and maintain the chemical, physical and biological integrity of the Nation's waters." The Maryland State water quality standards objectives state "Water quality standards shall provide water quality for the designated uses of ... propagation of fish, other aquatic life and wildlife." Terrestrial wildlife may be protected as a function of waterbody health.

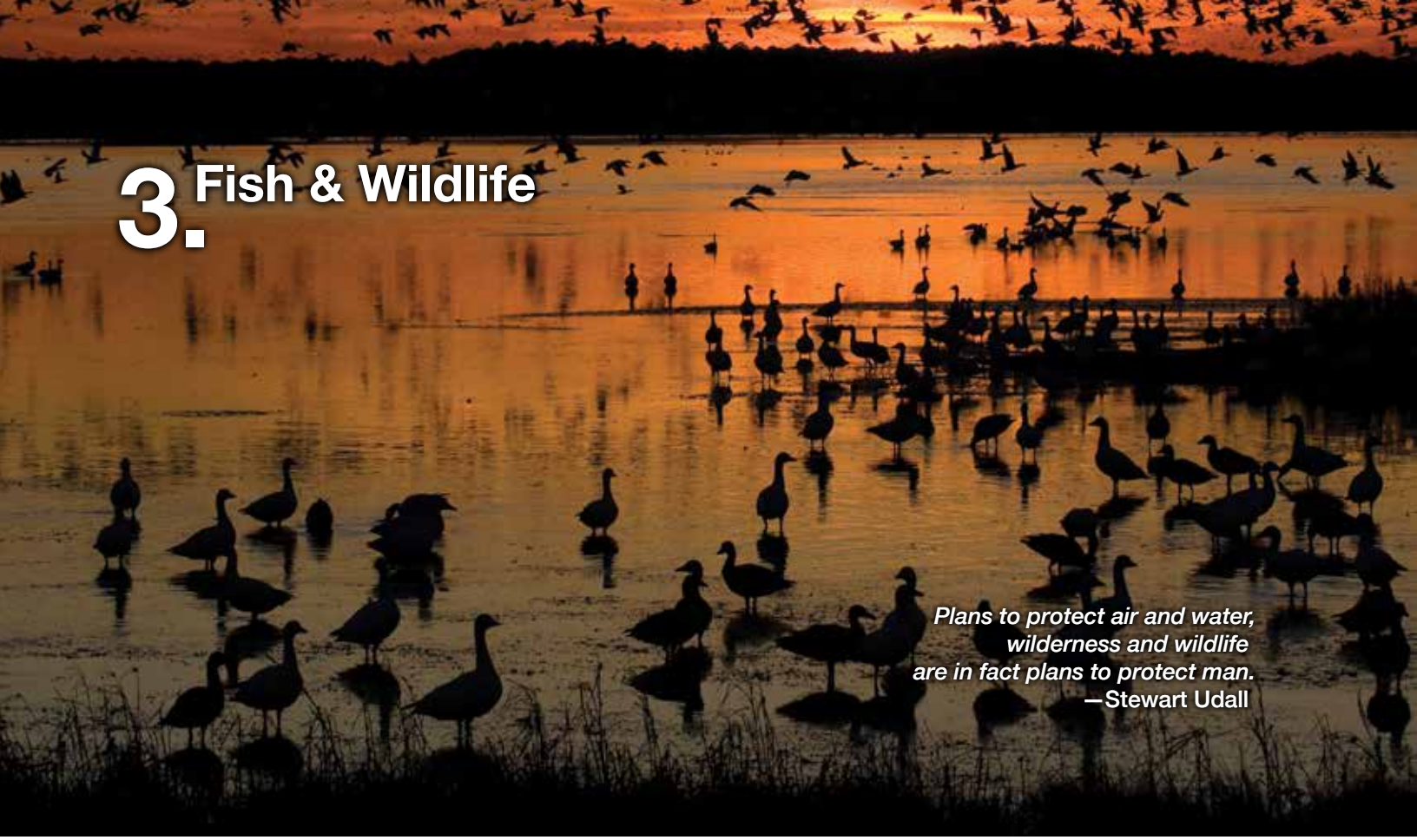
A **Total Maximum Daily Load (TMDL)** establishes the maximum amount of an impairing substance or stressor that a waterbody can assimilate and still meet water quality standards. This load is allocated among pollution contributors, including natural sources.

Acronyms used in this chapter

BMP: Best Management Practices
CELCP: Coastal & Estuarine Land Conservation Program
CREP: Conservation Reserve Enhancement Program
DDT: dichlorodiphenytrichloroethans
DNR: Maryland Dept of Natural Resources
EPA: Environmental Protection Agency
EQIP: Environmental Quality Incentives Program
LSLT: Lower Shore Land Trust
MACS: Maryland Agricultural Water Quality Cost-Share
MALPF: Maryland Agricultural Land Preservation Foundation
MCBP: Maryland Coastal Bays Program
MDA: Maryland Dept of Agriculture
MDE: Maryland Dept of the Environment
MDP: Maryland Dept of Planning
MGS: Maryland Geological Survey
NAWCA: North American Wetlands Conservation Act
NPS: National Park Service
NPS-ASIS: National Park Service Assateague Island National Seashore
NRCS: Natural Resources Conservation Service
OC: Ocean City
PAH: polycyclic aromatic hydrocarbon
PCB: polychlorinated biphenyl
SHA: State Highway Administration
STAC: Scientific & Technical Advisory Committee
SU: Salisbury University
TMDL: Total Maximum Daily Load
UME: University of Maryland Extension
USGS: United States Geological Survey
WC: Worcester County
WRE: Water Resources Element
WSCD: Worcester Soil Conservation District

Sinepuxent Bay. Photo by Jane Thomas

3. Fish & Wildlife



Plans to protect air and water, wilderness and wildlife are in fact plans to protect man.
—Stewart Udall

Geese in Chincoteague Bay. Photo by Photo GEM/CC BY-NC-ND.

After the turn of the 20th century, conversion of forest and wetland habitats began to accelerate to accommodate agriculture and development in the Coastal Bays region. With the completion of the Chesapeake Bay Bridge in 1952, land use changes continued to eliminate habitats vital for migratory birds, anadromous[1] fish, waterfowl and shorebirds, threatened and endangered species and other wildlife.

Fisheries

The Coastal Bays and ocean waters support a variety of shell and finfish species of commercial and recreational value (the state controls waters out to three nautical miles offshore and federal waters extend from there out to 200 nautical miles). Most marine species of interest to our region spend at least part of their life cycle in the Coastal Bays, but may live offshore during other stages. Therefore, many species are managed at the regional level through cooperative efforts among states. The state of Maryland also manages fisheries resources within the Coastal Bays and waters of the state. Management controls include commercial quotas, permit and license requirements, gear and time-of year-restrictions and size and catch limits. The most substantial commercial and recreational fishing activity in the Coastal Bays is for blue crabs, summer flounder, rockfish, sea trout, hard clams, Atlantic croaker, Atlantic menhaden, tautog and bluefish.

Factors important to the health of the Coastal Bays fish and shellfish are habitat and water quality. Degradation of benthic habitat from warming waters, seagrass loss, eutrophication, reduced light penetration and impacts from boating activities affects shellfish and many juvenile finfish species. Chemical contamination in dead-end canals (which receive contaminated runoff from developed areas, pilings and boats) also contributes to degraded sediment quality. Shoreline erosion due to sea level rise, hard shoreline stabilization methods, runoff and boat wake also degrades water quality and aquatic habitat. In addition, hard shoreline stabilization methods reduce the habitat value of shorelines, essential for small fish, horseshoe crabs, birds and terrapins. Dam modification and removal efforts have also recently helped anadromous fish populations

by allowing access to upstream spawning habitat. However, streams and tributaries in the Coastal Bays watershed continue to exhibit a high level of habitat and water quality degradation due to ditching and lack of forested buffers.

Submerged Aquatic Vegetation

Submerged aquatic vegetation (SAV; seagrass beds) are a particularly important resource in the Coastal Bays, providing habitat for fish and shellfish and food for aquatic species and ducks. Eelgrass, the dominant species of SAV, was wiped out in the 1930s due to an eelgrass blight. Between 1986 and 2001, seagrass populations increased substantially but declined again beginning in 2002 and today are back down to pre-1986 levels. Unusually warm summers and high phosphorus levels have decimated SAV beds in the southern bays, and in the northern bays, this and a combination of heavy boat use, prop scarring and struggling water quality combine to limit its growth.

Threatened and Endangered Species

In addition to fish and shellfish, the Coastal Bays are home to a broad variety of species. A number of these are threatened and endangered including three bird, two insect, 14 other animal and 89 plant species. In most cases, their threatened status is due to habitat loss and invasive plants. In recent years, harbor, harp and gray seals have also become frequent winter visitors to the bays. Habitat essential for threatened

1. From the Greek *anadromos* meaning to run upward. Refers to fish that live primarily in saltwater, but return to brackish and freshwater rivers and streams to breed.

Blue crabs. Photo by Chesapeake Bay Program/CC BY-NC.

and endangered species is often vital for other species in the Coastal Bays watershed, including migratory songbirds, waterfowl and shorebirds.

Forests

Loss of forestland disrupts habitat corridors for many bird and wildlife species and can impact water quality in the Coastal Bays. Forests filter sediments from water, limit erosion by protecting soils and take up nutrients. The character or composition of a forest—its individual tree and shrub types, their sizes, ages and population densities—also affect the forested habitat for many species of plants and animals. Forest character and functions are altered when native forests are converted to pine monoculture or development. Deer, invasive plants, disease and pest infestations can also alter forest character and functions.

Although it is recognized that timber production plays an important role in the regional economy and in the overall protection of the watershed, biological diversity within forests is reduced substantially with pine production. Appropriate management of forested lands, particularly those in timber production and unharvested forests, is necessary to retain large, diverse forest tracts that support wildlife habitat needs. Additional forest management options can promote old-growth timber, increased hardwood production or eco-tourism activities. Land managers are also encouraged to hold property in grasslands and early successional states due to the loss of so many species dependent upon these habitat types, including northern bobwhite quail.

Wetlands

In addition to forest and field habitat losses, tidal and non-tidal wetlands have decreased substantially, especially in the northern bays. The draining and clearing of wetlands for agriculture, development and other human uses decreases habitat for wildlife and adversely affects the land's nutrient and sediment absorbing potential (e.g. buffering capability). Tidal wetlands are also succumbing to land subsidence and sea level rise. Although habitat loses has slowed considerably due to federal and state laws restricting impacts to wetlands, losses still occur from changes in land use and natural processes such as shore erosion and land subsidence. An increase in the amount of wetlands is necessary to maintain habitat for waterfowl, buffer coastal storms, treat sediment and nutrient runoff, absorb flood waters and maintain adequate water quality for all inhabitants of the Coastal Bays.

Summary

In this section, we look at challenges to address the management of recreational and commercial fisheries; fishing access and opportunities; the protection of marine resources; seagrass, wetlands and shoreline restoration; forest conservation; and the monitoring and protection of wildlife.

The following fish and wildlife actions rely heavily on existing resource management programs to meet current standards, catch limits and other requirements. To remain a viable tool for protecting the environment and managing the resources of the Coastal Bays, the CCMP will undergo periodic updates to reflect new programmatic challenges and opportunities.

Monarch butterfly. Photo by John Britt/CC BY-NC-SA.

1 FISH & WILDLIFE GOAL

Characterize, monitor and manage fishery resources and habitats

1.1 FISH & WILDLIFE CHALLENGE

Cooperatively manage and monitor recreationally and commercially important finfish and shellfish species using targets and thresholds identified within state and federal fisheries management plans

Priority level: 1 (initiate before 2019) *Public support:* Moderate

Issue

The shallow waters of Maryland's Coastal Bays have historically supported large populations of shellfish and migratory finfish, particularly juveniles. Adults of many species of fish are also seasonally common. Over 140 species of finfish including Atlantic croaker, bluefish, summer flounder and weakfish *Cynoscion regalis* can be found here.[2] Loss of quality habitat and pollution from land use activities as well as overfishing can result in unsustainable stock populations, which in turn would negatively impact the local economy. Locally and coastwide, seafood restaurants, tackle shops, boat dealers, tournament sponsors, charter boat captains and many other marine and tourism businesses thrive on healthy fish stocks.

Solution

To maintain our healthy fisheries we need to work with our state and federal partner agencies to sustainably manage important finfish and shellfish species that occur in the Coastal Bays. Since 1972, Maryland DNR has monitored Coastal Bays fishery resources and provided data for use in coastwide stock assessments. The state cooperatively manages coastwide fisheries with the Atlantic States Marine Fisheries Commission[3] and the Mid-Atlantic Fisheries Management Council.[4] Through those partnered efforts, fish abundance targets and harvesting thresholds are set to meet management goals and objectives, and progress is strictly monitored. Conveying the economic and ecological importance of these resources will educate the community about the importance of fishery management plans and our impact on the landscape.

Trawling is one way that DNR samples finfish in the Coastal Bays. Photo by Angel Bolinger.

Action item	Category	Lead partner	Outputs (deliverables)	Outcomes (knowledge & behavior)
FW 1.1.1 DNR will work with partner agencies to manage recreationally and commercially important finfish species to the targets and thresholds described in state and federal fishery management plans. This management requires additional actions and strategies outlined in the plans, including ecosystem-based goals.	Within Existing Resources	DNR	Synopsis of current targets and thresholds, and additional actions and strategies that may need to be implemented	Ability to adaptively manage sustainable fisheries.
FW 1.1.2 DNR will continue to provide data needed for stock assessments via the Coastal Bays Fisheries Investigation Surveys. Data include finfish, macroalgae, offshore trawl data, seafood dealer port sampling, volunteer angler summer flounder surveys, etc.	Within Existing Resources	DNR	Annual updates on stock status	Assessment, monitoring and reporting on the status of fishery resources and impacts on them.
FW 1.1.3 DNR will provide annual updates on the stock status of key fish species in relationship to established targets and thresholds.	Research & Ecosystem Assessment	DNR	Annual trends & status reports that relate to thresholds and targets from a designated baseline year(s).	Knowledge to support and predict sustainable harvests.
FW 1.1.4 DNR will continue to improve the quality and timeliness of commercial landings reports by implementing online, multi-platform tools for real-time reporting for finfish and shellfish, including crabs.	Within Existing Resources	DNR	Electronic reporting tools	Improved cooperation with watermen and stakeholders. Improved stock assessment.
FW 1.1.5 DNR will provide the public with annual updates of harvest results to commercial and recreational stakeholders (including species landed and economic impact) for educational and ecological purposes.	Education & Outreach	DNR	Annual harvest reports to be shared with the public. Percent change over time in harvests. Also use DNR quarterly newsletters	Stakeholder feedback, economic valuation of local fisheries.
FW 1.1.6 DNR will investigate the feasibility of developing alternative methods of volunteer recreational harvest sampling including but not limited to logbooks and web-based surveys.	Research & Ecosystem Assessment	DNR	Volunteer input regarding recreational harvest	Stakeholder involvement and volunteer opportunities.
FW 1.1.7 DNR will provide horseshoe crab spawning population data to partner management agencies.	Within Existing Resources	DNR	Annual spawning survey data for use in the Adaptive Resource Management framework	Cooperative resource management.

Guidance & references:

- Maryland Dept. of Natural Resources, Maryland Coastal Bays Ecosystem Health Assessment. 2004.
- Maryland Dept. of Natural Resources, Investigation of Maryland's Coastal Bays and Atlantic Ocean Finfish Stocks, 2007–2011 Report.
- Magnuson–Stevens Fishery Conservation & Management Act.
- Coastal Bays Fisheries Investigation Surveys.

2. Maryland Dept. of Natural Resources, Investigation of Maryland's Coastal Bays and Atlantic Ocean Finfish Stocks, 2007–2011 Report.
3. Atlantic States Marine Fisheries Commission *www.asmfc.org*
4. Mid-Atlantic Fisheries Management Council *www.mafmc.org*

Most abundant species, from MD DNR surveys

- Bay anchovy (*Anchoa mitchilli*).
- Atlantic silverside (*Menidia menidia*).
- Atlantic menhaden (*Brevoortia tyrannus*).
- Summer flounder (*Paralichthys dentatus*).
- Silver perch (*Bairdiella chrysoura*).
- Winter flounder (*Pseudopleuronectes americanus*)
- Weakfish (*Cynoscion regalis*).
- Pinfish (*Lagodon rhomboides*)
- Spot (*Leiostomous xanthurus*).
- Alewife (*Alosa pseudoharengus*)
- Hogchoker (*Trinectes maculatus*)
- Mummichog (*Fundulus heteroclitus*).
- Bluegill (*Lepomis macrochirus*)
- Atlantic croaker (*Micropogonias undulatus*).
- White mullet (*Mugil cerema*).

1 FISH & WILDLIFE GOAL
Characterize, monitor and manage fishery resources and habitats

1.2 FISH & WILDLIFE CHALLENGE
Promote and protect shellfish resources

Priority level: 1 (initiate before 2019) *Public support:* Moderate

Issue
In 1993 DNR initiated a comprehensive study to inventory the shellfish (mussels, oysters, clams, scallops, crabs, etc.) of the Coastal Bays in order to determine a baseline of abundance for both commercially and ecologically important species (Tarnowski 2004). Each species serves an important ecological role such as water filtration, armoring marsh sediments against erosion, providing food or habitat to other species, etc. Potential threats to shellfish include invasive species that compete for food and habitat, diseases, sediment and chemical runoff, shoreline development and harmful algae blooms.

Solution
Continue to investigate and monitor the shellfish inventory for abundance and diversity. Measure the threats to healthy shellfish populations and update state and federal management plans to improve water quality and habitat protection for these species.

Clamming is a popular recreational activity in the Coastal Bays. Photo by Jerry Gerlitski.

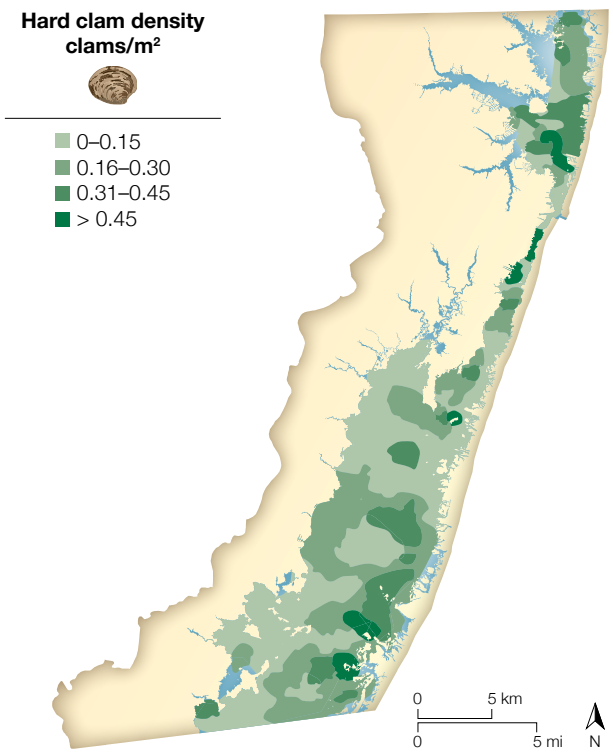
Action item	Category	Lead partner	Outputs (deliverables)	Outcomes (knowledge & behavior)
FW 1.2.1 DNR will annually complete a survey of the shellfish resources within Maryland's Coastal Bays.	Within Existing Resources	DNR	Shellfish surveys	Assessment, monitoring & reporting on impact
FW 1.2.2 DNR will regularly update the Coastal Bays Hard Clam Fisheries Management Plan (FMP), including the strategies and actions contained within the FMP. Possibly expand FMP to include bay scallops *Argopecten irradians* and razor clams *Ensis directus*.	Within Existing Resources	DNR	Updated implementation tables	Provide progress on action items.
FW 1.2.3 DNR will regularly update the Coastal Bays Blue Crab FMP including the strategies and actions contained within the FMP.	Within Existing Resources	DNR	Updated implementation tables	Provide progress on action items.
FW 1.2.4 EPA will assist with funding to assess benthic species and habitats, and the effects of emerging contaminants, including microplastics.	Policy Issue	EPA	Funding	Support for National Coastal Assessment.
FW 1.2.5 DNR and MCBP will support efforts to monitor and assess harmful algae.	Research & Ecosystem Assessment	DNR	Species, frequency, duration and effects (i.e. hypoxia, human illness, living resource degradation)	Protection of public health, aquaculture and seagrass growth.

Guidance & references:

- Tarnowski, M. 2004. Status of shellfish population in the Maryland Coastal Bays, MCB Ecosystem Health Assessment.
- Coastal Bays Blue Crab Fishery Management Plan. 2001.

Threats to shellfish

Threats to shellfish in the Coastal Bays include:
Shoreline development.
Sediment and chemical runoff.
Toxic leachates and contaminant spills at marinas.
Navigational dredging and spoil dumping.
Low dissolved oxygen.
Large-scale oil spills.
Loss of intertidal habitat.
Erosion from boat wakes.
Threats to seagrass habitat.
Harmful algal blooms.
Destructive non-indigenous species.
Increased water temperature from climate change.



Hard clams are found throughout the Coastal Bays

1 FISH & WILDLIFE GOAL
Characterize, monitor and manage fishery resources and habitats

1.3 FISH & WILDLIFE CHALLENGE
Provide and enhance fishing opportunities and access

Priority level: 1 (initiate before 2019) *Public support:* Moderate

Issue
Fishing for recreation and sustenance may be the oldest social and cultural tradition in the Coastal Bays watershed. Over time, as more shoreline areas have become private property, there has been a decline in fishing participation. Sport fishing is a significant contributor to the nation's fisheries and conservation programs. Excise taxes are collected on fishing rods, reels, artificial baits and lures and many other products (TRCP 2004). Those 'hook and bullet' dollars have built some of the most successful programs for fisheries management, conservation and restoration in the world.

Solution
We can continue this tradition and boost the local economy by using sportfishing funds to provide and maintain public access points for residents that do not have properties adjacent to the bay and ocean.

Spectacular recreational fishing in both the ocean and the bays, as seen here and on the facing page, is supported by the Clean Water Act's quality standards. Photos by Allen Sklar.

Action item	Category	Lead partner	Outputs (deliverables)	Outcomes (knowledge & behavior)
FW 1.3.1 DNR will work with MCBP to implement RN 1.1.2 to enhance public awareness of public access points.	Education & Outreach	DNR	Updated Coastal Bays Boaters Guide	Social Indicator: Public access in linear feet or acres.
FW 1.3.2 WC, OC and DNR will maintain and enhance existing piers, boat ramps and kayak launches. Include soft shoreline enhancements to mitigate stormwater runoff.	Within Existing Resources	WC	Documented needs and accomplishments for access points	Improved access and habitat at public use sites.
FW 1.3.3 DNR will work to improve the angler recruitment program by investigating the use of community-based social marketing techniques to improve license sales and promote conservation.	Education & Outreach	DNR	Increased participation and license sales	Social Indicator: Valuation of recreational fishing via counts of licenses purchased.
FW 1.3.4 DNR and MCBP will educate anglers on size and creel limits and encourage responsible fishing practices such as catch-and-release, innovative hook designs and other best practices.	Education & Outreach	DNR	Dissemination of fishing guides & boat rulers	Regulatory compliance while promoting the appreciation of and respect for nature.

Guidance & references:

- Theodore Roosevelt Conservation Partnership, Responsive Management: Issues Related to Hunting and Fishing Access in the United States: A Literature Review. 2004.

1 FISH & WILDLIFE GOAL
Characterize, monitor and manage fishery resources and habitats

1.4 FISH & WILDLIFE CHALLENGE
Promote sustainable economic opportunities for fisheries

Priority level: 1 (initiate before 2019) *Public support:* Moderate

Issue
Maryland's coastal fishermen supply a diverse array of seafood to consumers. Much of the catch ultimately ends up being shipped out of state or overseas. Expanding the market for local seafood will ultimately result in higher profits to the industry and reduce carbon impacts from shipping. A recently expanding alternative to wild harvesting is aquaculture, which has been a part of Maryland's history for more than a century. At one time there were 40 oyster farms in lower Chincoteague Bay that cultivated trainloads of 'Chincoteague Salts' for northern markets (Dennison et al 2009). With the opening of the Ocean City inlet, the increasingly salty ocean water proved too much for oyster propagation. More recently, however, the success of clam farming in Virginia and the decline in wild hard clams has prompted renewed interest in aquaculture. In addition to growing seafood, many aquaculture products can be used for restoration of depleted resources and habitats. For example, ribbed mussels have been used in restoration projects to bind shorelines and prevent erosion. As of 2008, approximately 250 acres of bay bottom have been leased primarily for clam culturing. Actual market production is still limited and obstacles such as obtaining permits, equipment expenses and finding suitable habitat persist.

Solution
The Maryland Department of Natural Resources has developed a Seafood Marketing Division[5] which has expanded the local market for seafood throughout the region. The continued success of the program is based on connecting local seafood markets and chefs with harvesters. Aquaculture conflicts between interest groups need to be explored and resolved. The concept of expanding aquaculture should be supported with appropriate environmental practices, state and local application streamlining and with the collaboration of the various bay stakeholder groups.

Blue crabs are a familiar sight in the Coastal Bays. Photo by Bob Simmons/ CC BY-NC-ND.

Action item	Category	Lead partner	Outputs (deliverables)	Outcomes (knowledge & behavior)
FW 1.4.1 DNR and UME will promote and support responsible aquaculture development by providing incentives to assist with shellfish aquaculture production where practical and by providing best practices training.	Within Existing Resources	DNR	Incentives and training	Economic development through aquaculture.
FW 1.4.2 MCBP will educate the public about aquaculture, underwater leasing and the maritime heritage of the Coastal Bays.	Education & Outreach	MCBP	Newspaper articles, presentations to homeowners and other stakeholders about successful efforts	Reduced conflict between watermen and waterfront property owners.
FW 1.4.3 DNR will continue to refine the Shellfish Aquaculture Siting Tool[6] that is used to evaluate potential aquaculture sites.	Within Existing Resources	DNR	Interactive online map viewer to assist users in making informed decisions when locating shellfish aquaculture sites.	Economic development and educational potential.
FW 1.4.4 DNR will work to expand seafood marketing programs to improve markets for existing commercial fisheries.	Within Existing Resources	DNR	Seafood marketing programs	Increased income for Maryland harvesters.
FW 1.4.5 DNR will continue to work with recreational and commercial stakeholders to ensure that services provided to each sector, (such as monitoring stock assessments, harvest monitoring and outreach, etc.) are recovered from each sector.	Within Existing Resources	DNR	Balanced fisheries budget	Improved understanding of the function of the Fisheries Service.

Guidance & references:

- §NR3-124(k) Atlantic Coastal Bays Critical Area, Water Dependent Facilities, Fisheries Activities.
- Dennison, W.C., Thomas, J.E., Cain, C.J., Carruthers, T.J.B., Hall, M.R., Jesien, R.V., Wazniak, C.E., & Wilson, D.E. 2009. Shifting Sands, Environmental and cultural change in Maryland's Coastal Bays. Cambridge, MD, p.139

5. *www.seafood.maryland.gov*
6. Maryland's Aquaculture Siting Tool is a mapping application that can assist in locating prospective areas for aquaculture. Maryland regulations prohibit aquaculture leases within 150 feet of: A) a public shellfish fishery area, B) a harvest reserve, C) a federal navigation channel, D) a registered pound net site and E) any Yates Bar this is located within an oyster sanctuary. *gisapps.dnr.state.md.us/Aquaculture/index.html*

Recreational and commercial fishing has a significant impact on the local economy. Seafood restaurants, tackle dealers, boat dealiers, hotels, charter boats and other businesses benefit substantially from local fishing activity. Photo by Carol Cain.

1 FISH & WILDLIFE GOAL
Characterize, monitor and manage fishery resources and habitats

1.5 FISH & WILDLIFE CHALLENGE
Promote and protect marine resources through public outreach

Priority level: 1 (initiate before 2019) *Public support:* Moderate

Issue

Research in the Coastal Bays has often involved scientists collaborating with other scientists to record ecological conditions and observe changes in the environment. Information is most valuable when we can share it with others in a meaningful way. Knowledge is the product of experience and information. In order to better facilitate research and information sharing we must continue to pique the interest of residents and visitors to this area. Relaying engaging stories to the local community, while creating opportunities for citizen science and public dissemination of why marine resources are valuable are on-going goals.

Solution

In today's increasingly complex world, we must use every tool at our disposable to reach members of the local community with information and opportunities that increase awareness, understanding and support for conservation and management efforts in the Coastal Bays. Digital media has rapidly grown as an important tool to compliment traditional forms of outreach. Likewise, by creating hands-on opportunities to participate in ecosystem monitoring and restoration we can better explain the interactions between society and nature, and cultivate a conservation ethic. Meanwhile, thoughtful discussion and enhanced community stewardship can be fostered through informational meetings and written materials. Many citizens have skills, time and interest in marine issues that can be of benefit to natural resource managers. Therefore soliciting public input for decision-making and recruiting assistance with field work is a win-win for researchers and residents alike.

Collecting fish below Bishopville Dam, July 2013. Photo by Carol Cain.

Action item	Category	Lead partner	Outputs (deliverables)	Outcomes (knowledge & behavior)
FW 1.5.1 DNR and MCBP will protect horseshoe crab populations by promoting the protection of bay beaches and other bottom habitats and promote volunteer monitoring of spawning populations throughout the coastal bays.	Within Existing Resources	MCBP	Annual spawning survey report	Protection of beach habitats, public stewardship & involvement, HSC management plan data.
FW 1.5.2 MCBP will continue to aid the Oyster Recovery Partnership[7] in oyster gardening, shell recycling and reef enhancement.	Restoration & Conservation	MCBP	Number and success of oyster gardens and community interest	Enhanced community stewardship and ecosystem enhancement.
FW 1.5.3 MCBP will continue terrapin counts and promote the use of cull rings and Turtle Exclusion Devices (TEDs) on all recreational pots. Data will be shared with the Terrapin Work Group.	Research & Ecosystem Assessment	MCBP	Terrapin counts & promotion of excluders for retailers/ public	Increased public participation & stewardship, improved population estimates.
FW 1.5.4 DNR will continue to facilitate stakeholder meetings to share information and collect feedback.	Within Existing Resources	DNR	Information regarding policy effects & conflict resolution	Public outreach & involvement. Consensus & buy-in for adaptive management, communication among committees.
FW 1.5.5 DNR and MCBP will educate anglers on the purpose of biological reference points, quota divisions and control measures for sustainable yields.	Education & Outreach	DNR	Dissemination of information about reference points, quotas and yields.	Improved awareness of resources.
FW 1.5.6 DNR and MCBP will continue to use all available tools for communication, including social media and multi-lingual communication tools.	Education & Outreach	DNR	Fisheries outreach content and products for multiple audiences.	Increased awareness of resource protection. Audience diversity, balance of diverse interests.
FW 1.5.7 DNR will provide information regarding Highly Migratory Marine Species[8] (population estimates, sustainable harvest, economic value of local tournaments, protection efforts).	Within Existing Resources	DNR	Linkages between bay and ocean ecosystems	Public awareness. Tie near-shore and off-shore data together for adaptive management.
FW 1.5.8 MCBP will continue to assist the Marine Mammal Stranding Program,[9] the National Aquarium, DNR and other groups with local educational and volunteer efforts (e.g. seal sightings, dolphin counts, Coastal Clean-ups, etc.)	Education & Outreach	MCBP	Data and education & outreach products	Coordination with partner efforts, shared data. Increased public stewardship & volunteer opportunities.

Guidance & references:

- Maryland Grows Oysters Program, Magnuson–Stevens Fishery Conservation & Management Act.

7. The Oyster Recovery Partnership (ORP) is a cooperative coalition of multiple partners that contribute to a large-scale restoration program to plant disease-free oysters back into the Chesapeake Bay. The ORP also operates the region's Shell Recycling Alliance, supports the state's Marylanders Grow Oysters program and provides shellfish aquaculture and fishery support services. *www.oysterrecovery.org*
8. NOAA manages a number of fish species (tuna, sharks, swordfish and billfish) in U.S. Atlantic and Gulf of Mexico waters known as highly migratory species (HMS). These fish often migrate long distances and are managed under the Magnuson-Stevens Fishery Conservation and Management Act. *www.nmfs.noaa.gov/sfa/hms*
9. The Marine Mammal Protection Act of 1972 was enacted in response to increasing concerns among scientists and the public that significant declines in some species of marine mammals were caused by human activities. A network of Marine Mammal Stranding Teams respond to injured dolphins, whales, seals and other sea mammals. *www.nmfs.noaa.gov/pr/health*

National Park Service personnel deploy remote water quality sensors in Chincoteague Bay. Photo by Brian Sturgis.

2 FISH & WILDLIFE GOAL
Characterize, monitor and manage fishery resources and habitats

2.1 FISH & WILDLIFE CHALLENGE
Expand seagrass range to historical levels and improve benthic habitats

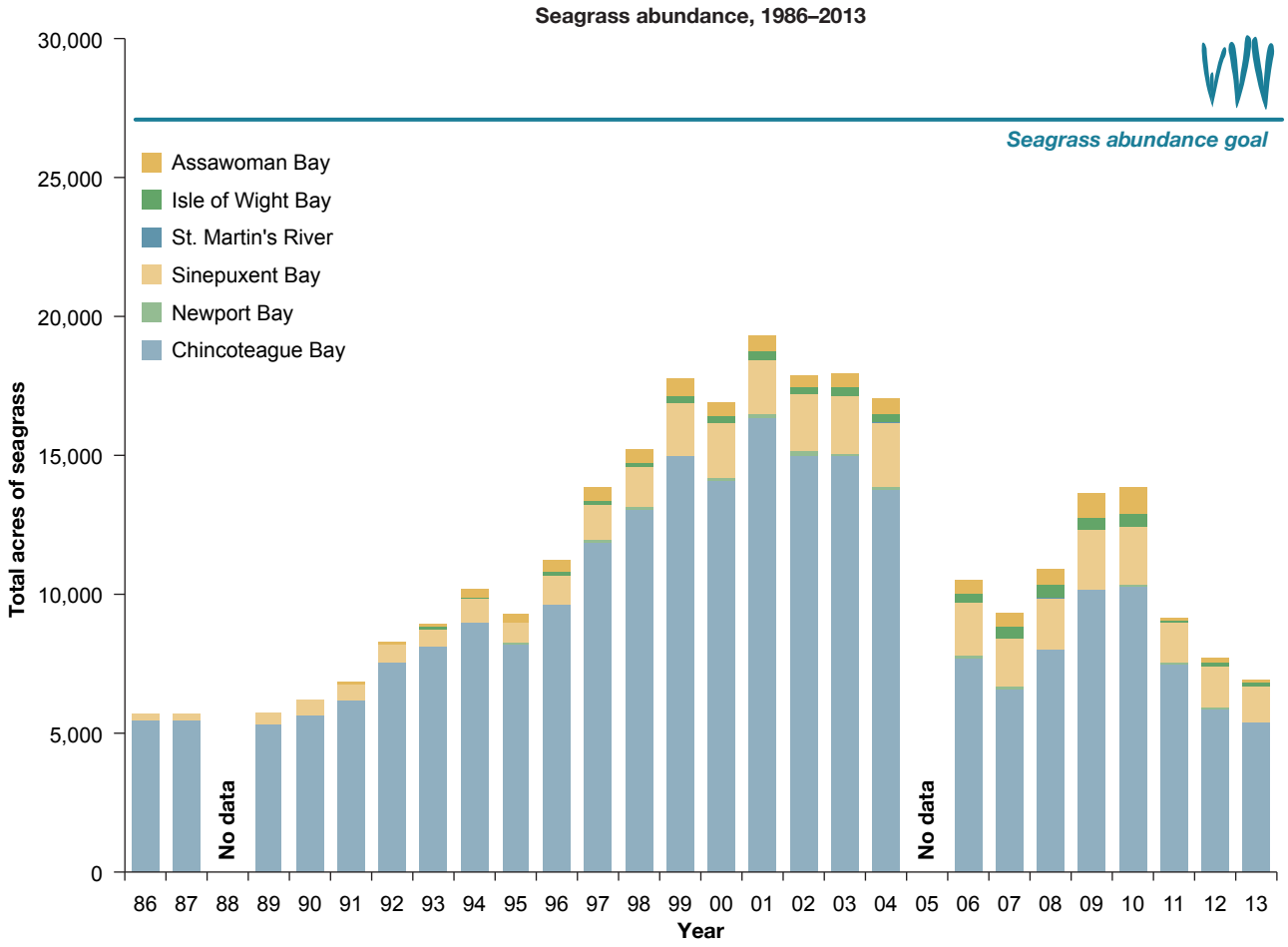
Priority level: 1 (initiate before 2019) *Public support:* High

Issue

Underwater seagrass beds serve as refuge and feeding grounds for many species including fish, shellfish and waterfowl. Seagrasses—also referred to frequently as submerged aquatic vegetation (SAV)—are considered essential habitat for summer flounder and scallops, and critical habitat for blue crabs. Additionally, grasses act to anchor sediments that prevent cloudy water. There are two types of seagrasses found locally; eelgrass and widgeon grass. Both species increased in acreage steadily from 1986 through 2001, then leveled off and began to decrease. Water quality trends reveal degradation that occurred in the bays during the late 1990s coincided with the reversal of seagrass expansion. Other factors that affect the seagrasses include harmful algae blooms, increasing water temperatures, excessive nutrients and sediment runoff and mats of macroalgae that can smother plants.

Solution

Annual monitoring of seagrass acreage is determined by aerial flights and interpretation by the Virginia Institute of Marine Sciences (VIMS).[10] Historical aerial photos and seagrass studies have been reviewed to determine the most likely acreage extent based upon healthy water quality and suitable habitat (sandy soils with light penetration to 1.5 meters) is 27,070 acres with nearly 85% expected to be found along the bayside shoreline of Assateague Island in Sinepuxent and Chincoteague bays. In 2013, there were only 6,900 acres of seagrass in the Coastal Bays. Seagrasses are a sensitive indicator of bay health and as such monitoring will continue to serve as a measure of ecosystem response to management efforts.



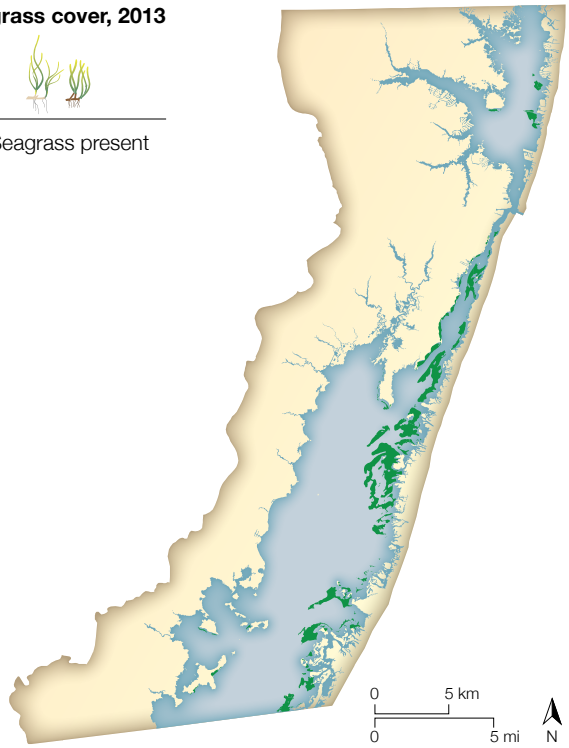
Seagrass coverage in the Coastal Bays increased until 2001, after which it has been declining.

Action item	Category	Lead partner	Outputs (deliverables)	Outcomes (knowledge & behavior)
FW 2.1.1 DNR, VIMS, NPS and MCBP will continue funding support for aerial mapping of seagrass beds extent and monitor the attainment of SAV goals for each embayment.	Within Existing Resources	DNR	Acres & extent of sea grasses	Quantifiable Goal: determine percent coverage of SAV annually to compare with potential SAV habitat (27,070 acres).
FW 2.1.2 MCBP, DNR, MDE and NPS will ground-truth SAV beds during routine monitoring or other on-the-water efforts.	Within Existing Resources	MCBP	Acres & extent of sea grasses	Resource sharing & coordination.
FW 2.1.3 DNR (Boating Services) will utilize buoys and markers to prevent prop scarring of SAV beds by recreational vessels.	Within Existing Resources	DNR	Safety devices and signage to protect SAV.	Protection of SAV.
FW 2.1.4 MCBP will educate residents, businesses and marina patrons to avoid SAV beds.	Education & Outreach	MCBP	Poster, signs, outreach meetings	Protection of SAV.
FW 2.1.5 DNR will research the effects of warming temperatures, brown tide and sea level rise on seagrass abundance.	Research & Ecosystem Assessment	DNR	Impact study	Coastal resiliency information.

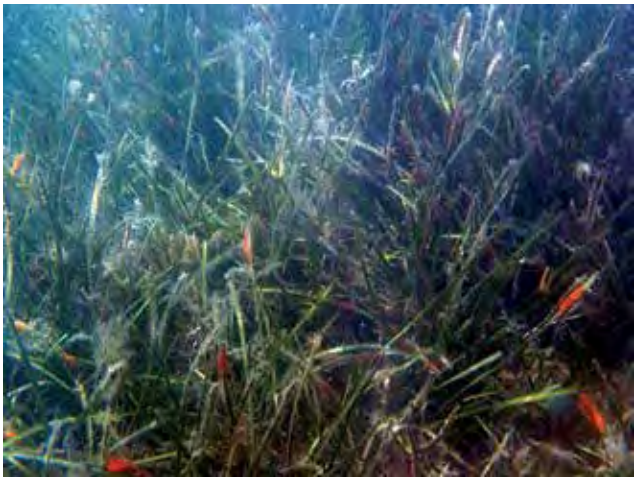
Guidance & references:

- Dennison, W.C., Thomas, J.E., Cain, C.J., Carruthers, T.J.B., Hall, M.R., Jesien, R.V., Wazniak, C.E., & Wilson, D.E. 2009. Shifting Sands, Environmental and cultural change in Maryland's Coastal Bays. Cambridge, MD, p.380

10. Submerged Aquatic Vegetation (SAV) in Chesapeake Bay and Delmarva Peninsula Coastal Bays *web.vims.edu/bio/sav/index.html*



Seagrass cover in the Maryland portion of the Coastal Bays in 2013.



Eelgrass in Chincoteague Bay. Photo by Adrian Jones.

2 FISH & WILDLIFE GOAL
Characterize, monitor and manage fishery resources and habitats

2.2 FISH & WILDLIFE CHALLENGE
Preserve and protect marshes, shorelines and near-shore habitats

Priority level: 1 (initiate before 2019) *Public support:* Highest of all actions

Issue

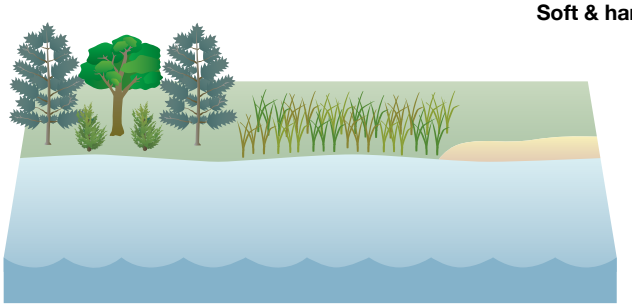
Marshes, shorelines and near shore habitats are critical to the health of the Coastal Bays and public protection as a first line of defense against storm surges and flooding. These productive, yet sensitive, areas provide significant benefits for slowing runoff, filtering nutrients and absorbing wave energy. Native trees and shrubs along the water's edge provide shade and refuge for birds, terrapins and fish as well as anchor sediments to prevent erosion. Natural shorelines and buffers are increasingly impacted by development and sea level rise. Erosion control structures such as riprap stone and bulkheads can inadvertently cause additional erosion to adjacent properties when wave energy bounces off the structure and scours sediment from natural areas.

Solution

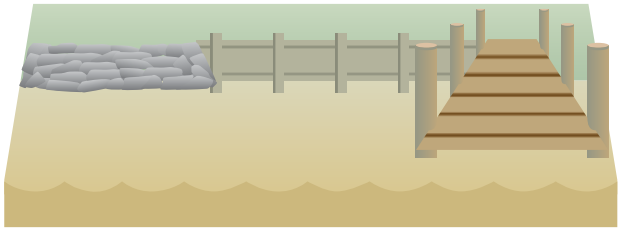
With over 300 miles of shoreline along the Coastal Bays, a little over half of this area has been hardened with erosion control devices. As a result, nesting sites for birds, terrapins, horseshoe crabs and other marsh species has declined. Because portions of the Greater Chesapeake region are slowly subsiding and sea levels are rising, the community is at greater risk for flooding and storm surges here compared to other coastal regions. In fact, with its 3,000 miles of low-lying coastline, Maryland is the 3rd most vulnerable US state to the impacts of sea level rise (MDE 2013). Efforts to monitor structural changes must continue, as should projects to reclaim and reinforce soft shorelines for the benefit of the public and nature alike.

Montego Bay residential park in Assawoman Bay. Photo by Jane Thomas.

Soft & hard shorelines



Soft shorelines—those with trees, shrubs, marshes or sandy shorelines—benefit water quality, living resources and habitat. Trees and shrubs shade the water and improve conditions for fish and shorebirds. Fringe marsh protects water quality by slowing runoff, reducing erosion and filtering nutrients which can cause algal blooms and reduce oxygen. Natural shorelines also provide critical habitat for fisheries species at both juvenile and adult life stages.



Hardened shorelines—those with riprap, bulkheads, docks or piers—offer few benefits to water quality, living resources and habitat and can be damaging. They generally do not filter water before it reaches the Coastal Bays and provide little habitat for species such as nesting terrapins and horseshoe crabs. Bulkheads can result in increased erosion and sediment suspension, and can also leach wood preservative chemicals into the water.

Action item	Category	Lead partner	Outputs (deliverables)	Outcomes (knowledge & behavior)
FW 2.2.1 DNR will contract with VIMS to repeat the shoreline inventory of 2004 to determine the change in hardened versus soft shorelines. Set a target for reducing hardened shoreline throughout the watershed.	Research & Ecosystem Assessment	MCBP	Shoreline study (baseline = 52% hardened as of 2004)	Change in landscape over time.
FW 2.2.2 MCBP will continue to assist DNR with near shore species and habitat monitoring (including colonial nesting birds, horseshoe crabs, terrapins, shorebirds, sea turtles, waterfowl, marsh birds, mosquito ditch restoration, vegetation, etc.)	Within Existing Resources	MCBP	Biometric data	Monitoring assistance.
FW 2.2.3 DNR and others will determine the extent of marshes, the potential for marsh migration in response to sea level rise, and the economic value of ecosystem services.	Research & Ecosystem Assessment	DNR	Ecosystem valuation	Return on investment data.
FW 2.2.4 DNR (Chesapeake & Coastal Services) will coordinate with WC to implement protections identified in the Blue Infrastructure Near-Shore Assessment;[11] a detailed spatial evaluation of coastal habitat, critical natural resources and associated human uses in tidal waters and near-shore areas. Consider ways to monitor sea level rise and implement protective measures to maintain habitats.	Restoration & Conservation	DNR	Technical assistance (GIS data, training, maps, etc.)	Protection and maintenance of near shore habitats to permit species and habitat migration.
FW 2.2.5 DNR will continue to expand and update data and information via the Coastal Atlas.[12]	Research & Ecosystem Assessment	DNR	Comprehensive database and resource maps for the Coastal Bays. Expanded Coastal Atlas and/ or iMap.	Planning resources.
FW 2.2.6 Using the above resources map data base WC and MCBP will produce reference documents to identify resource management issues and educate elected and appointed officials. Include background information about conservation laws and regulations in effect locally.	Education & Outreach	WC	Reference documents and maps	Informed decision-makers.
FW 2.2.7 WC will continue to work with existing partners and programs such as Rural Legacy, Forest Legacy, Program Open Space and The Nature Conservancy to protect natural shorelines and adjacent landward areas through the purchase of development rights, shoreline easements or 'fee simple' purchases.	Within Existing Resources	WC	Acres or linear feet of protection	Natural shorelines will be able to naturally migrate as sea level rises.
FW 2.2.8 MCBP will work with EPA, NOAA, ACOE and UMCES to develop "user-friendly" indicators of storm severity (ex. hours/days above predicted high tide, king tide effects)	Within Existing Resources	MCBP	Storm severity indicators	Coastal Resiliency information.
FW 2.2.9 MCBP will work with NOAA, EPA, NPS, DNR, WC and OC to monitor and document actual sea level rise.	Within Existing Resources	MCBP	Community measures of sea level rise	Determine local measurements and compare to regional projections.
FW 2.2.10 MCBP and partners work to clarify and confirm differences in known flooding issues, sea level rise and the draft FEMA Flood Insurance Rate Maps (FIRMs). Conduct outreach to the community to inform them of the changes and how it may affect them.	Education & Outreach	MCBP	Discussion and understanding of the FIRMs, how they may differ from actual observed conditions and how they may or may not relate to sea level rise or land subsidence.	Community understanding of the differences amongst the various issues and how they may relate to their own property and the community in general.

Guidance & references:

- VIMS Coastal Bays Comprehensive Shoreline Inventory. 2004.
- MDE 2011 Greenhouse Gas Emissions Reduction Act of 2009 *www.mde.state.md.us/programs/air/climatechange/pages/air/climatechange/index.aspx*
- DNR Blue Infrastructure *www.dnr.state.md.us/ccs/bi.asp*
- DNR Coastal Atlas *dnr.maryland.gov/ccs/coastalatlas*

11. The Blue Infrastructure (BI) Near-shore Assessment is a detailed spatial evaluation of coastal habitat, critical natural resources and associated human uses in the tidal waters and near-shore area of Maryland's coastal zone. The near-shore assessment serves as a link between Maryland's terrestrial and aquatic environments and contributes to prioritization systems that help target conservation and management activities to maintain and improve coastal habitats. *www.dnr.state.md.us/ccs/bi.asp*
12. The Coastal Atlas is an online mapping and planning tool that allows state and local decision-makers to visually analyze and explore data for coastal and ocean planning activities. The data available through the Coastal Atlas includes physical characteristics, human uses and ecological resources. Users are able to visualize, query, map and analyze available data to better manage our marine and estuarine resources. *dnr.maryland.gov/ccs/coastalatlas*

2 FISH & WILDLIFE GOAL
Characterize, monitor and manage fishery resources and habitats

2.3 FISH & WILDLIFE CHALLENGE
Conserve, protect and restore wetlands

Priority level: 1 (initiate before 2019) *Public support:* High

Issue
Wetlands are extremely valuable to society. These areas, be they salt marshes or forested freshwater wetlands, absorb water, decrease flooding, remove pollutants, recharge groundwater, provide habitat for wildlife and serve as recreational and cultural outlets through trapping and hunting. When wetlands are lost, the cost of replacing them can be extremely expensive and it is difficult to replicate their natural function. In the Coastal Bays watershed it is estimated that more than 26,000 acres (about 41%) of natural wetlands were altered or destroyed in the 20th century for development and agriculture (Dennison et al 2009).

Solution
In the late 1990s, a goal to protect 10,000 acres of existing and new wetlands was set. A cursory review of habitat projects by Program partners to conserve, enhance, rehabilitate or re-establish tidal and on-tidal wetlands over eleven years (2000–2011) indicates that at least 2,159 acres (21% of the goal) has been met. Partners have included USDA Natural Resources Conservation Service; the Maryland Departments of Agriculture, Environment, Natural Resources and State Highway Administration; the Army Corps of Engineers; the National Oceanic and Atmospheric Administration (NOAA); U.S. Fish & Wildlife Service (USFWS); Worcester County; The Nature Conservancy; Ducks Unlimited and other organizations. Coordinated tracking of wetland gains and losses has proven to be difficult amongst the multiple partners and periodic reviews. This may be accomplished through a Watershed Resources Registry[13] and complimented with other existing studies such as MDE's Priority Areas for Wetland Restoration, Preservation and Mitigation recommendations.[14]

Mosquito ditches draining the western shores of Newport Bay. Photo by Jane Thomas.

The U.S. Army Corps of Engineers, DNR and Worcester County worked together to restore approximately 10 acres of saltmarsh on the southern tip of the Isle of Wight Wildlife Management area, seen in the foreground. Photo by Jane Thomas

Action item	Category	Lead partner	Outputs (deliverables)	Outcomes (knowledge & behavior)
FW 2.3.1 MDE will compare the Watershed Resources Registry analysis with the priority projects identified for Priority Areas for Wetland Restoration, Preservation & Mitigation in Maryland's Coastal Bays (MDE 2004). Outline examples of how WC can use the information for planning purposes and what resources are available for implementation of projects.	Restoration & Conservation	MDE	Wetland implementation plan	EPA Habitat Restoration goals, carbon/nutrient/ sediment sinks.
FW 2.3.2 MCBP will convene a workshop with EPA, NRCS, DNR, NOAA, USACE, SHA, MDE, USFWS, WC, TNC, Ducks Unlimited and other interested partners to develop a system of tracking wetland gains and losses, mitigation success and high priority conservation areas. Create a list and map of all known projects & impacts since 2000. Federal, state and local regulatory personnel will develop a comprehensive wetlands plan for the region to provide additional guidance for wetlands protection.	Restoration & Conservation	MCBP	Wetland net gain vs. net loss tracking system.	Percent attainment of 10,000 acre protection & restoration goal since 2000.
FW 2.3.3 EPA will provide an overview of findings based on the Watershed Resources Registry and how the tool can be applied locally in decision-making.	Policy Issue	EPA	Federal technology transfer	Information sharing.
FW 2.3.4 MDE and WC will work together to explore opportunities for the creation of wetlands to treat waste water (both urban and agricultural), retain sediments, aid stormwater management and provide wildlife habitat.	Policy Issue	MDE	Formulate & adopt work plan and a list of opportunities for wetland creation as a BMP	Leveraging of resources for BMPs.
FW 2.3.5 USACE, DNR and MDE will consider the utility of preparing a Special Area Management Plan[15] to provide ideas to resolve conservation and development conflicts.	Within Existing Resources	USACE	Special Area Management Plan	Conflict avoidance.
FW 2.3.6 MDE will review known local wetland gains (mitigation & creation) and net loss (permitting) since 2000. Track tidal and non-tidal impacts & gains and maintain a list of previous and future restoration sites.	Within Existing Resources	MDE	Local tracking of ongoing net loss or gain, compare impact data to MDE authorization records	Indicator for the 10,000 acre goal attainment.
FW 2.3.7 MDE will annually monitor and report on the success of wetland mitigation sites and compile the most current wetland inventory for the Coastal Bays. The inventory will include voluntary and mitigated wetland gains and losses over time.	Research & Ecosystem Assessment	MDE	Ecological monitoring, updated wetland inventory	Return on investment for mitigation dollars. BMP cost estimates will be used for project planning.
FW 2.3.8 USACE, MDE and USFW will develop a user-friendly check list to permitting guidance.	Policy Issue	USACE	Streamlined permitting process & guidance	

Guidance & references:

- Dennison, W.C., Thomas, J.E., Cain, C.J., Carruthers, T.J.B., Hall, M.R., Jesien, R.V., Wazniak, C.E., & Wilson, D.E. 2009. Shifting Sands, Environmental and cultural change in Maryland's Coastal Bays. Cambridge, MD, p.363.
- Watershed Resources Registry *www.watershedresourcesregistry.com*
- Maryland Department of the Environment. 2014. "Priority Areas for Wetland Restoration, Preservation & Mitigation in Maryland's Coastal Bays" *www.mde.state.md.us/programs/Water/WetlandsandWaterways/AboutWetlands/Pages/Programs/WaterPrograms/Wetlands_Waterways/about_wetlands/prioritizingareas.aspx*

13. Watershed Resources Registry, an interactive mapping tool to characterize and prioritize natural resource management opportunities using a watershed approach. Areas across Maryland have been scored on a scale of one to five stars based on their potential benefits for restoration or preservation. *www.watershedresourcesregistry.com*
14. *www.mde.state.md.us/programs/Water/WetlandsandWaterways/AboutWetlands/Pages/Programs/WaterPrograms/Wetlands_Waterways/about_wetlands/prioritizingareas.aspx*
15. States, local governments and private groups can play a major role in preparing Special Area Management Plans (SAMPs) which may provide some predictability for wetlands regulation, can be helpful in resolving conservation and development conflicts in areas of rapid growth, and can help control cumulative impacts on wetlands. Funding is available to states for preparation and implementation of SAMPs in coastal zones. *www.mde.state.md.us/programs/Water/WetlandsandWaterways/Regulations/Pages/Programs/WaterPrograms/Wetlands_Waterways/regulations/lawsandprograms4.aspx*

Anthropogenic stressors to wetlands

Tidal and non-tidal wetlands:
- Development.
- Exotic species out-competing native plants.
- Fragmentation through loss of adjacent natural upland habitats.
- Reduction in fire frequency.
- Excess nutrient loading.
- Excess herbivory by native species whose population densities are anthropogenically altered, e.g. white-tailed deer.

Tidal wetlands:
- Mosquito ditches.
- Climate Change.

Non-tidal wetlands:
- Drainage ditches.
- Farming.
- Logging.
- Conversion to loblolly pine plantations.

3 FISH & WILDLIFE GOAL
Characterize, monitor and manage terrestrial resources and habitats

3.1 FISH & WILDLIFE CHALLENGE
Protect and improve streams, ditches and headwater areas

Priority level: 1 (initiate before 2019) *Public support:* High

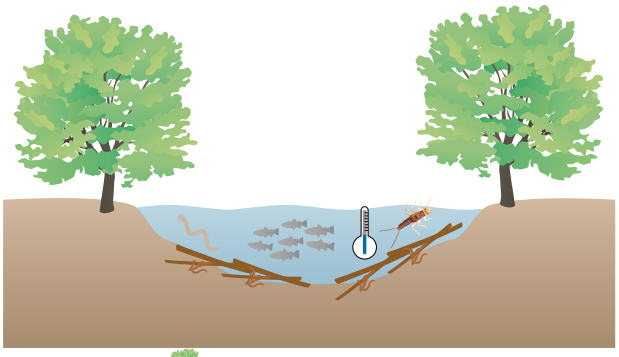
Issue

Within the watershed there are 165 miles of streams and an additional 448 miles of ditches that deliver water, nutrients and sediment to the bays (Dennison et al 2009). These streams also collect stormwater, release groundwater and provide habitat for plants and animals. Only two local streams have natural channels, Massey Branch and Little Mill Creek, the remainder have been straightened at some time in the past to facilitate better drainage from the landscape. Channelization increases the speed that water can move through the stream or ditch but also results in erosion when fast moving water scours the floodplain and stream banks. Standard practice for stream and ditch maintenance has been to remove trees and shrubs to allow streamside access, as well as to remove woody debris that may slow water down. These practices allow for water capacity but not quality. Today most streams contain only pollution tolerant fish and insects that are capable of living in high temperature and nutrient conditions with little natural habitat.

Solution

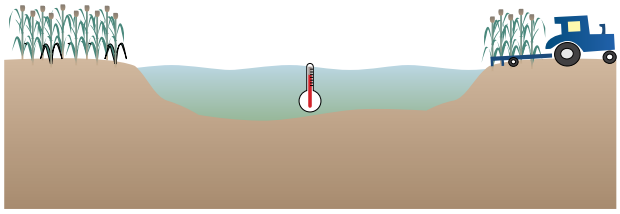
We can improve local streams by mimicking nature's design with meandering curves that slow water down by planting buffers for nutrient uptake and shade, and by removing blockages that prevent fish and other animals from moving up and down stream channels. Stormwater management techniques have changed over the past 15 years to provide for both water quantity and water quality improvements. Monitoring of existing flow volumes, the width of buffers and the presence and abundance of wildlife species will mark progress as best management practices are implemented.

Stream



Shaded by trees and other stream-side vegetation, stream waters are cooler . Woody debris in the stream provides habitat for fish and invertebrate animals .

Ditch



Lack of trees and other stream-side vegetation makes ditch waters warmer and shallower, with little habitat diversity for stream-dwelling animals.

Natural channels (left) have a much wider variety of habitats than ditched streams (right), including habitat for organisms such as insects, crustaceans and fishes that process nutrients in the stream. In addition, the riparian (stream-side) zone provides areas for storage of water and sediments. Photos by Roman Jesien.

Action item	Category	Lead partner	Outputs (deliverables)	Outcomes (knowledge & behavior)
FW 3.1.1 MCBP will facilitate discussions with USGS and MGS to fully fund the watershed's two stream gauges at Birch Branch and Bassett Creek. The long-term data sets generated by these gauges are necessary for determining water and nutrient budgets as well as supporting project evaluation and ecosystem changes.	Policy Issue	MCBP	MOU to fully fund stream gauge stations and/or a commitment to secure funding	Decreased nutrient and bacteria levels to meet TMDL allocations and/or state water quality criteria. Ecosystem response evaluation for watershed changes due to projects and climate.
FW 3.1.2 DNR will characterize the health of streams within the Coastal Bays watershed.	Within Existing Resources	DNR	Coastal Bays Streams Characterization Report, data for Terrestrial Monitoring Plan	Status of local streams, StreamStats,[16] State of the Coastal Bays.
FW 3.1.3 MDE will summarize which streams of the Coastal Bays watershed are not attaining water quality standards (i.e. 303d list of impaired waters[17])	Within Existing Resources	MDE	List of 303d impaired streams	Focus resources to remediate impaired streams.
FW 3.1.4 DNR will consider the Coastal Bays for potential aquatic habitat management and restoration projects. Consider areas that may be designated as Stronghold Watersheds[18] or that are identified in BioNet.[19]	Within Existing Resources	DNR	Habitat Management Plans	Recommendations for restoration, conservation and protection.
FW 3.1.5 DNR-MBSS will assist MCBP in identifying aquatic areas that are most vulnerable to climate change and make recommendations for protection.	Research & Ecosystem Assessment	DNR	Identification of sensitive areas	Climate change projections.
FW 3.1.6 MCBP will continue annual stream surveys for water quality and rapid assessment of habitat conditions. Special consideration will be given to biometrics and chemistry spectrums in brackish, tannic and freshwater habitats.	Research & Ecosystem Assessment	MCBP	Data for state and local consideration	Stream health monitoring.
FW 3.1.7 MCBP and MCC-Assateague will participate in Stream Wader[20] collection opportunities as they become available through DNR.	Research & Ecosystem Assessment	MCBP	Data for state and local consideration	Stream health monitoring and volunteer participation.
FW 3.1.8 NRCS will collaborate with state agencies, local entities and landowners to facilitate stream restoration and protection efforts, particularly problems identified in DNR Stream Corridor Assessments (fish blockages, inadequate buffers, trash, erosion sites, etc.).	Restoration & Conservation	NRCS	Project plans and funding	Improved habitat and water quality
FW 3.1.9 NRCS, WSCD and MDA will encourage use of habitat enhancing BMPs in management plans (buffers, wetlands, meadows, headwater forests, etc.).	Within Existing Resources	NRCS	Tracking of BMPs	Increased landowner interest.
FW 3.1.10 MCBP will request that the Coastal Bays watershed become a Conservation Effects Assessment Project—a multiagency effort coordinated by NRCS to quantify the environmental benefit of conservation practices implemented on private lands, BMP efficiencies and potential water quality benefits from wetland restoration projects.	Policy Issue	MCBP	BMP effectiveness evaluation, TMDL implementation data	Adaptive management.

Guidance & references:

- Dennison, W.C., Thomas, J.E., Cain, C.J., Carruthers, T.J.B., Hall, M.R., Jesien, R.V., Wazniak, C.E., & Wilson, D.E. 2009. Shifting Sands, Environmental and cultural change in Maryland's Coastal Bays. Cambridge, MD, p.369.
- Maryland Water Quality Assessment Report; combined 303(d) and 305(b) report.
- Department of Natural Resources Stream Waders program and Corridor Assessments.

16. StreamStats is a USGS web-based Geographic Information System (GIS) that provides users with access to an assortment of analytical tools that are useful for water resources planning and management, and for engineering design applications, such as the design of bridges. StreamStats allows users to easily obtain streamflow statistics, drainage basin characteristics and other information for user-selected sites on streams. *water.usgs.gov/osw/streamstats/index.html*
17. The Clean Water Act requires states to assess all of their water body for pollution. All water bodies are listed on list 305b and from these all of the polluted waters are listed on the list 303(d). *water.epa.gov/lawsregs/lawsguidance/cwa/tmdl/overview.cfm*
18. The Maryland Biological Stream Survey has identified those watersheds around the State that are most important for the protection of Maryland's aquatic biodiversity. Known as Maryland's "Stronghold Watersheds", these locations are the places where rare, threatened, or endangered species of fish, amphibians, reptiles, or mussels have the highest numbers. *www.streamhealth.maryland.gov/stronghold.asp*
19. BioNet is a digital map that prioritizes areas for terrestrial and freshwater biodiversity conservation. It was developed as an additional tool for the MD DNR Natural Heritage Program and its conservation partners to use for proactive land conservation activities, such as targeting for acquisitions and easements, locating appropriate areas for project mitigation or habitat restoration, and planning for areas that require management to sustain dwindling species and habitats. *www.dnr.state.md.us/wildlife/Plants_Wildlife/pdfs/BIONET_FactSheet.pdf*
20. Maryland Department of Natural Resources Stream Waders Program *www.dnr.maryland.gov/streams/streamWaders.asp*

3 FISH & WILDLIFE GOAL
Characterize, monitor and manage terrestrial resources and habitats

3.2 FISH & WILDLIFE CHALLENGE
Conserve and enhance forestry areas with multiple ecosystem benefits

Priority level: 1 (initiate before 2019) *Public support:* Moderate

Issue

Historically, forests covered much of the Coastal Bays watershed, providing clean water and air, contiguous wildlife habitat and an abundance of hunting opportunities. The most common forest type is a mix of loblolly pine and oak, sweet gum and red maple. Swamps and fresh water areas are often dominated by sweet gum, red maple, ash and bald cypress. Rare pitch pines can be found on ancient sand dune ridges, while white cedar was nearly extirpated. Over time, the abundance of forest products and natural resources allowed for successful settlement for farms, homes and businesses. The rich abundance of forest products and development has resulted in land being cleared over the centuries. Currently 38% of the watershed is forested and a decline to 35% is anticipated by 2020 (Dennison et al 2009).

Solution

Given the importance of healthy forests to healthy communities, it is important to continue to monitor and assess the watershed forest cover. The state of Maryland has a no-net-loss policy in place with a goal to maintain 40% of its canopy (Society of American Foresters 2013). Forest products such as lumber from pine plantations have traditionally supported the local economy, while new practices are encouraging older, more diverse forests less damaging to wildlife populations. Many programs exist to assist landowners with tree planting and management of natural forests. Ongoing monitoring and collaboration with forest professionals may develop ideas for preserving and expanding local forests.

Action item	Category	Lead partner	Outputs (deliverables)	Outcomes (knowledge & behavior)
FW 3.2.1 DNR (*ad hoc* forest committee) will use the most current GIS layer of Forest Interior Dwelling Species (FIDS) to determine forested parcels that are 50 acres or more in size, with at least 10 acres of FIDs habitat. Calculate canopy cover, composition and stream widths through field surveys.	Research & Ecosystem Assessment	DNR	Data for Terrestrial Monitoring Plan, FIDS layer	Multi-agency coordination.
FW 3.2.2 DNR will use current high-resolution imagery to assess forest and tree cover.	Research & Ecosystem Assessment	DNR	Mapping exercise	Data on change in percent forest cover over time.
FW 3.2.3 WC, DNR LSLT, TNC, USFWS and others will maintain a coastal land conservation group that meets once or twice per year to share information on projects, goals, funding etc.	Within Existing Resources	WC	Meeting minutes outlining the status of ongoing and potential conservation projects with the potential for collaboration	Collaboration, information sharing and leveraging resources for conservation. Alignment of local & state no net loss policy.
FW 3.2.4 DNR will determine areas in need of afforestation (e.g., creeks, streams and wetland buffers). Determine a protection goal to meet by 2025. Conduct outreach to owners of these properties with information about opportunities for restoration of their land with tree planting.	Within Existing Resources	DNR	Baseline of forested acres and goal to increase those acres by 2025	Conservation targets and priority planting sites with willing landowners.
FW 3.2.5 WC will direct forest mitigation fees to restoration projects identified through collaborative restoration planning. They will determine if funds can be leveraged through other existing programs such as Stream ReLeaf,[21] Forest Legacy,[22] Stream Restoration Challenge,[23] etc.	Restoration & Conservation	WC	Priority Planning	Fund leveraging.
FW 3.2.6 UME, DNR and NRCS will coordinate efforts to maintain forest health and extent via land conservation efforts, forest management, outreach and education, cost share programs and forest stewardship plans. Forest management plans should strive to be in place for at least 75% of watershed acreage within 10 years.	Education & Outreach	UME	Strategic acreage goal for forest stewardship by 2025	Multi-agency coordination.

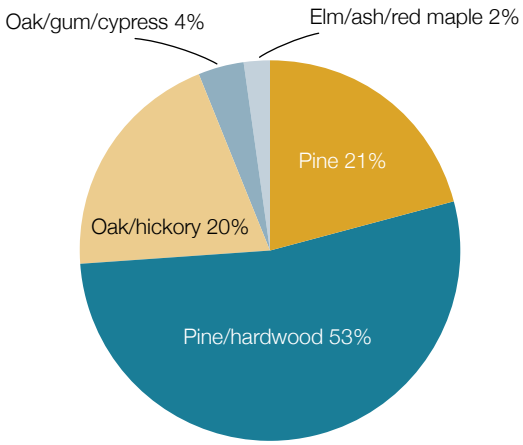
Action item	Category	Lead partner	Outputs (deliverables)	Outcomes (knowledge & behavior)
FW 3.2.7 NRCS will ensure coordination among cost-share programs such as EQIP, WHIP, WRE, CREP and MACS.	Within Existing Resources	NRCS	Implementation of existing programs	Amount of cost-share and acres treated.
FW 3.2.8 UME and WC will promote the use of "Woods in Your Backyard"[24] and "Backyard Buffer"[25] Programs through Master Gardener trainings.	Education & Outreach	UME		Number of program participants & acres of forest stewarded over time.
FW 3.2.9 DNR, MCBP, WC, LSLT, TCF and TNC will target parcels containing deciduous forests for conservation. Define criteria for these forested areas and promote easements and/or plans that support hardwood succession.	Within Existing Resources	DNR	Define and set criteria for deciduous forest conservation. Map existing areas that meet the criteria and make recommendations for where to target conservation of 300 acres of hardwoods per year.	Promotes wildlife diversity and conservation.
FW 3.2.10 DNR will identify opportunities to increase forest diversity through multi-species reforestation.	Within Existing Resources	DNR	Track opportunities and outcomes of reforestation sites	Promotion of forest diversity.
FW 3.2.11 DNR and the Maryland Sustainable Forestry Council will identify options to improve long-term viability and environmental benefits of forest industries and utilization of renewable wood products.	Research & Ecosystem Assessment	DNR	Economic status & sustainability of forestry operations in WC	Determine and support the economic sustainability of forestry.
FW 3.2.12 MCBP and partners will collaborate with local stakeholders and organizations to develop plans, projects and maintenance guidelines that provide access and recreational opportunities on publically owned forests.	Education & Outreach	MCBP	Public access to upland natural areas	

Guidance & references:

- Society of American Foresters. Maryland Passes 'No Net Loss' Legislation, The Forestry Source. May 2013.

21. DNR Forest Service provides staff support for Maryland Stream ReLeaf, a statewide initiative supporting riparian forest buffers. Stream ReLeaf coordinates the efforts of a wide variety of state, local, federal and nonprofit agencies and groups, all of whom play a part in expanding or maintaining streamside and shoreline forests. *www.dnr.state.md.us/forests/programapps/rfbrestoration.asp*
22. The Forest Legacy Program is a federal program that works in partnership with states and is designed to identify and protect environmentally important forests through the use of perpetual conservation easements or fee simple purchases at market value between willing sellers and willing buyers. *www.dnr.state.md.us/forests/forestlegacy.asp*
23. Maryland's Stream Restoration Challenge is a competitive grant program open to local governments and non-government organizations to establish 1,000 acres of stream-side forests by 2015. *dnr.maryland.gov/trustfund/streamchallenge/pdfs/StreamTF_FS.pdf*
24. The University of Maryland Extension Service provides workshops and workbooks to landowners who are interested in enhancing or creating natural areas and woodland for recreation, aesthetics, wildlife and water quality. *extension.umd.edu/woodland/woods-your-backyard*
25. The University of Maryland Extension Service coordinates the Backyard Buffers Program to assist homeowners, with less than five acres of land, who have a stream or other waterway on or adjacent to their property to create a streamside buffer of native trees and shrubs. *extension.umd.edu/news/events/sat-2014-04-19-0900-backyard-buffers-program*

Forest types



Forest types in the Maryland portion of the Coastal Bays watershed. The 'pine' category includes planted pine forests as well as any natural pine stands with little hardwood.

3 FISH & WILDLIFE GOAL

Characterize, monitor and manage terrestrial resources and habitats

3.3 FISH & WILDLIFE CHALLENGE

Characterize, monitor and protect birds, mammals, amphibians, reptiles, insects and plant communities indigenous to the watershed and Coastal Bays

Priority level: 1 (initiate before 2019) *Public support:* Moderate

Issue

Watershed health isn't measured just by the diversity and richness of aquatic plants and animals but also by those creatures that live on land. The temperate climate and ocean interface of the Coastal Bays watershed supports more species of wildlife than any other place in Maryland. Many creatures depend on specific habitats within the watershed. For example, amphibians spawn in wetlands; while wider ranging species such as white-tailed deer browse in fields and forests. Each habitat is interdependent upon the next and together make up the entire ecosystem. Thus, changes in habitats change the ecosystem as a whole. While natural variations in species richness and abundance take place over time, declines are exacerbated by human-influenced factors. Therefore, having a more complete picture of terrestrial habitats and the species found there will provide citizens and decision-makers with information to balance human and natural needs.

Solution

Many researchers and natural resource managers focus exclusively on terrestrial species. It is worthwhile to convene periodic conferences to share information and collaborate on beneficial restoration and conservation projects in the watershed. Likewise, many citizens are actively involved in monitoring birds, reptiles, insects and other taxa, as well as supporting projects to protect or enhance habitats. Together, the scientific information and on-the-ground efforts can support mutual interests.

Action item	Category	Lead partner	Outputs (deliverables)	Outcomes (knowledge & behavior)
FW 3.3.1 DNR Wildlife & Heritage Service will characterize the terrestrial areas within the Coastal Bays watershed using existing indicators, monitoring data and game harvest information. Data will include colonial waterbird nesting sites, bird migratory stopover areas, presence & abundance of rare & endangered species, location & productivity of terrapin nesting beaches and natural communities.	Research & Ecosystem Assessment	DNR	Data for Coastal Bays Terrestrial Monitoring Plan	Wildlife characterization. Project areas and priorities change over time in sensitive habitats and species.
FW 3.3.2 NPS will continue to monitor barrier island threatened and endangered species including piping plover *Charadrius melodus*, seabeach amaranth *Amaranthus pumilus*, sea turtles and tiger beetles (Cicindelinae).	Research & Ecosystem Assessment	NPS	Information and annual reports	Conservation and population trends of threatened and endangered species.
FW 3.3.3 DNR, NRCS and MCBP will identify and implement appropriate enhancement techniques for landowners interested in providing habitat for songbirds and other species through native plantings and other restoration techniques.	Research & Ecosystem Assessment	DNR	Detailed offerings of restoration and enhancement techniques	Project areas and priorities.
FW 3.3.4 USDOI and DNR will compile information for forest interior songbirds, neotropical migrants, colonial waterbirds, waterfowl and shorebirds in the watershed from existing databases and produce a status and trends report as well as habitat improvement recommendations.	Research & Ecosystem Assessment	DNR	Status & Trends report for birds	Change in acres designated for habitat services.
FW 3.3.5 MCBP will promote citizen participation in the Audubon Christmas Bird Count,[26] eBird compilations,[27] Backyard Bird Count,[28] Project Feeder Watch[29] and Breeding Bird Surveys.[30]	Within Existing Resources	MCBP	Species counts	Citizen involvement.
FW 3.3.6 MCBP will continue to train volunteers and promote annual herpetology surveys for field data compilation, targeted conservation and community stewardship.	Within Existing Resources	MCBP	Species counts for Herp Atlas	Citizen involvement.

Action item	Category	Lead partner	Outputs (deliverables)	Outcomes (knowledge & behavior)
FW 3.3.7 MCBP will review all county-owned lands, including grounds of public facilities such as schools and parks, to determine areas where native habitat enhancement is feasible through alternative management strategies and/or planting native vegetation.	Within Existing Resources	MCBP	Mapping exercise	Change in acres designated for habitat services.
FW 3.3.8 DNR will help WC, OC and Berlin to establish urban tree canopy goals and identify areas for projects. The 2013 Forest Preservation Act commits Maryland to maintaining tree canopy cover at 40%.	Research & Ecosystem Assessment	DNR	Comparison of local tree canopy cover to state wide percentage and established goals at or above 40%	Project areas and priorities, mitigation of carbon emissions.
FW 3.3.9 Where appropriate, MCBP will coordinate volunteer efforts to assist with tree planting, non-native species removal, buffer planting and monitoring of projects for long-term success evaluation.	Within Existing Resources	MCBP	Citizen involvement	Evaluation of habitat improvement success.
FW 3.3.10 DNR (Wildlife & Heritage) will present findings from BioNet that prioritizes areas for terrestrial and freshwater biodiversity conservation. The tier mapping is meant for targeting land conservation activities, acquisitions, easements, mitigation sites and habitat restoration.	Restoration & Conservation	DNR	Discussion at Implementation Committee, list of potential restoration/conservation sites.	Change over time in sensitive habitats and species.
FW 3.3.11 Using tools such as DNR's BioNet, WC and DNR will work together to identify land conservation priorities within the Newport–Chincoteague Land Conservation Area, with a goal of protecting 500 acres annually through conservation easements and other means.	Within Existing Resources	WC	Conserve 500 acres per year through 2018	Comparison of conservation efforts, targeting and leveraging opportunities.

Guidance & references:

- Society of American Foresters. Maryland Passes 'No Net Loss' Legislation, The Forestry Source. May 2013.

26. The National Audubon Society has for 114 years invited scientists and the public to monitor birds annually from December 14 through January 5 throughout the Americas. Audubon and other organizations use data collected in this longest-running wildlife census to assess the health of bird populations—and to help guide conservation action. *birds.audubon.org/christmas-bird-count*
27. A real-time, online checklist program, eBird has revolutionized the way that the birding community reports and accesses information about birds. Launched in 2002 by the Cornell Lab of Ornithology and National Audubon Society, eBird provides rich data sources for basic information on bird abundance and distribution at a variety of spatial and temporal scales. *ebird.org/content/ebird/*
28. The Great Backyard Bird Count is an annual four-day event that engages bird watchers of all ages in counting birds to create a real-time snapshot of bird populations. Participants are asked to count birds for as little as 15 minutes (or as long as they wish) on one or more days of the event and report their sightings online at *www.birdcount.org*.
29. Project Feeder Watch is a winter-long (November to April) survey of birds that visit feeders at backyards, nature centers, community areas and other locales in North America. Feeder Watch data help scientists track broadscale movements of winter bird populations and long-term trends in bird distribution and abundance. *feederwatch.org*
30. The North American Breeding Bird Survey is a cooperative effort between the U.S. Geological Survey's Patuxent Wildlife Research Center and Environment Canada's Canadian Wildlife Service to monitor the status and trends of North American bird populations. Data are collected by thousands of dedicated participants along thousands of randomly established roadside routes throughout the continent. Professional BBS coordinators and data managers work closely with researchers and statisticians to compile and deliver these population data and population trend analyses on more than 400 bird species, for use by conservation managers, scientists and the general public. *www.pwrc.usgs.gov/bbs/*

The Coastal Bays are home to a wide variety of wildlife. Photo by Allen Sklar.

4 FISH & WILDLIFE GOAL

Expand upon the coordinated effort to collect and report on Coastal Bays geomorphic and biometric information

4.1 FISH & WILDLIFE CHALLENGE

Incorporate upland and oceanic resources data into the Coastal Bays Monitoring Plan and Ecosystem Health Assessment

Priority level: 1 (initiate before 2019) *Public support:* Moderate

Issue

The first citizen-led, concerted effort to call for state and federal resources to evaluate and manage changes to the Coastal Bays ecosystem occurred in 1990. The resulting conference issued a report entitled "Focus on Maryland's Forgotten Bays, The Citizen's Agenda" (1990); which outlined twelve recommendations, including the designation of the watershed as an "estuary of national significance" under the federal Clean Water Act.[31]
Over the last 24 years, a great deal more has been revealed through local research and citizen involvement, particularly regarding water quality and marine species. Because ecosystems are interrelated, it is integral to expand our awareness and focus to include terrestrial and ocean influences on the estuary.

Solution

The original Comprehensive Conservation and Management Plan (1999) included the Estuarine Eutrophication Monitoring Plan which has served as the monitoring guidebook for local aquatic conditions. It was recognized in those early days that a terrestrial monitoring plan would be equally beneficial as impacts occurring on land affect the bays. As we update the 1999 CCMP in this volume, we propose to include the addition of terrestrial and oceanic research and ecosystem indicators that are already being monitored as well as highlight gaps in research and management.

Ecosystems of the Coastal Bays include terrestrial, aquatic and oceanic habitats. Photo by Jane Thomas.

Action item	Category	Lead partner	Outputs (deliverables)	Outcomes (knowledge & behavior)
FW 4.1.1 MCBP STAC will hold workshops to formally adopt the Coastal Bays Terrestrial Monitoring Plan. The plan will consist of a three-tiered approach: landscape/GIS assessment, rapid site assessment and field surveys. A monitoring frequency schedule, a list of indicators and responsible parties will be produced. Finding will be incorporated into the five-year Coastal Bays Ecosystem Health Assessment Reports.[32]	Research & Ecosystem Assessment	MCBP	Detailed offerings of enhancement techniques	Project areas and priorities.
FW 4.1.2 MCBP and partners will collect, manage and share GIS data layers that are publicly available for the watershed.	Within Existing Resources	MCBP	Data layer inventory	Spatially related decision-making.
FW 4.1.3 DNR (Coastal & Chesapeake Services) and the Mid-Atlantic Regional Council for the Ocean (MARCO),[33] will characterize critical offshore habitat, migratory pathways, biological populations and ecological processes.	Research & Ecosystem Assessment	DNR	Data posted to the MARCO Portal[34] and a characterization report for managers and the public.	Information for long-term ecosystem-based management.
FW 4.1.4 MCBP, DNR, MDE and NPS will pursue funding opportunities to better understand oceanic inputs and fluxes of nutrients to the estuary.	Within Existing Resources	MCBP	Spatially related ocean water quality data and fluxes	Ecosystem stressors and biotic impacts. Leveraging of limited resources to prevent duplication of effort.
FW 4.1.5 DNR and MCBP will collaborate on educational and outreach products regarding ocean issues for local stakeholders.	Education & Outreach	DNR	Outreach and educational products	Increased awareness for stewardship and action.
FW 4.1.6 MCBP will assist MARCO by providing an existing stakeholder process for sharing information and collecting input regarding commercial, recreational and cultural issues.	Education & Outreach	MCBP	Stakeholder input on regional ocean efforts	Foster dialogue between managers and end users to advance collaborative ocean planning.
FW 4.1.7 Ocean City will continue to sponsor permits for the Ocean City Reef Foundation[35] to support sustained improvements in reef enhancements.	Within Existing Resources	OC	Permits and technical advice to support nonprofit efforts.	Sustained improvements in offshore habitats and marine species.
FW 4.1.8 DNR and USACE will continue to perform periodic renourishment per the Atlantic Coast Project[36] authorization in order to maintain beaches and dunes for storm damage reduction.	Within Existing Resources	DNR	Leveraging. ACOE designs and manages dredging. MD is the lead, OC is support.	Property and infrastructure protection from storms and floods.
FW 4.1.9 Ocean City will continue the Beach District Planting and Bayscape Planting[37] programs to provide water quality and habitat benefits, while also improving erosion control and curb appeal.	Within Existing Resources	OC	Use of mitigation funds to improve habitat, water quality, erosion control and curb appeal.	Public stewardship & volunteer opportunities

Guidance & references:

- Maryland Department of Natural Resources. 2004. Maryland Coastal Bays Ecosystem Health Assessment.
- Maryland Department of Natural Resources, Coastal Zone Management. 1990. Focus on Maryland's Forgotten Bays, The Citizen's Agenda.
- Maryland Coastal Bays Program, Eutrophication Monitoring Plan, Appendix A of the Maryland Coastal Bays Comprehensive Conservation and Management Plan. *www.dnr.state.md.us/coastalbays/res_protect/pubs/mon_plan.pdf*

31. An 'estuary of national significance' is an estuary whose waters, natural ecosystems and economic activities were deemed by Congress to be critical to the environmental health and economic well-being of the nation. There are 28 such estuaries across the nation that model ecosystem based management. *www.epa.gov*
32. The Maryland Coastal Bays Ecosystem Health Assessment uses environmental indicators to measure the health of the bays and provide an assessment of progress made toward implementing the priority actions of the Comprehensive Conservation and Management Plan (CCMP). This report attempts to capture the major elements of the bays' health that reflect the current perceptions of scientists and managers as to what constitutes the state of the Coastal Bays health. It contains many of the traditional measures for assessing aquatic ecosystem health. *www.dnr.state.md.us/coastalbays/sob_2004.html*
33. MARCO, the Mid-Atlantic Regional Council for the Ocean is a state-led partnership based on an agreement between the governors of Virginia, Maryland, Delaware, New Jersey and New York. For more information, see *www.midatlanticocean.org*
34. The MARCO portal is an online toolkit for visualizing and analyzing ocean data in the Mid-Atlantic ocean: *www.midatlanticocean.org/data-portal*
35. The Ocean City Reef Foundation is a membership driven organization that is committed to the enhancement of our local marine habitat through the creation and monitoring of artificial reef systems to benefit future generations of recreational fishermen and divers. *www.ocreeffoundation.com*
36. This project provides for a steel sheet-pile bulkhead along the boardwalk for ~1.4 miles from 4th street to 27th street; the placement of sand along the Ocean City coastline to widen and raise the beach profile for 8.3 miles from 3rd Street, north to the Maryland-Delaware state line with an additional 0.3 mile transition into Delaware; and a vegetated sand dune for 6.9 miles from 27th Street north to just beyond the state line. *www.nab.usace.army.mil/Media/FactSheets/FactSheetArticleView/tabid/10470/Article/492795/atlantic-coast-of-maryland-hurricane-shoreline-protection-md.aspx*
37. The Town of Ocean City has created a successful mini-grant/cost-share program to encourage BayScape gardens, rain gardens, beach district plantings, rain barrels and stormwater management retrofits. *oceancitymd.gov/Engineering/ocstormwater.html*

4 FISH & WILDLIFE GOAL

Expand upon the coordinated effort to collect and report on Coastal Bays geomorphic and biometric information

4.2 FISH & WILDLIFE CHALLENGE

Hold periodic conferences to share information, inform resource management and identify research needs and community concerns

Priority level: 1 (initiate before 2019) *Public support:* Moderate

Issue

Research is only as good as our ability to share the information for good decision-making. Public involvement is only satisfying when citizen efforts are recognized and valued. Bridging technical and societal information and efforts are therefore a key component of responsible ecosystem management.

Solution

The Maryland Coastal Bays Program exists to build bridges among citizens, businesses and local, state and federal government. Together we strive to identify issues, needs and gaps as well as to develop consensus among stakeholder to maintain our quality of life. We value our rural and cultural heritage as well as our robust summer tourism industry along Maryland's seashore and believe community involvement is imperative to maintaining it. Education and outreach to the local community is an important part of restoring and conserving the Coastal Bays watershed. An informed citizen, reached through all possible communication tools, is an empowered one, and an ally in conservation efforts.

MCBP staff scientist Roman Jesien (center) briefs partners on the Bishopville Habitat Restoration Project. From left to right: Bill Mahoney (MCBP Program Manager), Ed Tudor (Director, Worcester County Planning, Permits and Inspections), Roman Jesien, David Greaves (EPA Region III) and Bhaskar Subramanian, MD Department of Natural Resources. Photo by Arlo Hemphill.

Action item	Category	Lead partner	Outputs (deliverables)	Outcomes (knowledge & behavior)
FW 4.2.1 MCBP will compile all CCMP actions that are categorized as Research and Ecosystem Monitoring for STAC review and input. Identify roles and responsibilities for partners and a research schedule.	Within Existing Resources	MCBP	CCMP related STAC Science Agenda	Process for identifying research needs.
FW 4.2.2 MCBP will work with partners to convey research findings to non-technical audiences. Clearly explain the relationship between human activities and impacts on resources.	Education & Outreach	MCBP	Easy to understand scientific findings	Adaptive management through better communication.
FW 4.2.3 NPS, DNR and MCBP will continue to collaborate and maintain bay water quality monitoring programs to assess nutrient loading and living resource responses.	Research & Ecosystem Assessment	NPS	Spatially related estuarine water quality data	Ecosystem stressors and biotic impacts. Leveraging of limited resources to prevent duplication of effort.
FW 4.2.4 MCBP will produce and distribute Report Cards that provide updates on watershed status and major partner accomplishments.	Education & Outreach	MCBP	Report Cards on the health of Coastal Bays	Improve community feedback.
FW 4.2.5 MCBP STAC and partners will publish a comprehensive State of the Bays report every five years. The reports are based upon watershed status and trends, research findings, partner accomplishments and emerging issues of concern.	Within Existing Resources	MCBP	State of the Bays Report	Record and review changes over time.

Guidance & references:

- TRCP. 2004. Theodore Roosevelt Conservation Partnership, Responsive Management: Issues Related to Hunting and Fishing Access in the United States: A Literature Review.
- VIMS. 2004. Coastal Bays Comprehensive Shoreline Inventory. 2004

Berlin Mayor Gee Williams describes his town's efforts to reduce nutrients during the 2010 Report Card ceremony at Macky's in Ocean City. Photo by Sandi Smith

Acronyms used in this chapter

BMP: Best Management Practices
CREP: Conservation Reserve Enhancement Program
DNR: Maryland Dept of Natural Resources
EPA: Environmental Protection Agency
EQIP: Environmental Quality Incentives Program
FEMA: Federal Emergency Management Agency
GIS: Geographic Information Systems
LSLT: Lower Shore Land Trust
MACS: Maryland Agricultural Water Quality Cost-Share
MBSS: Maryland Biological Stream Survey
MCBP: Maryland Coastal Bays Program
MCC: Maryland Conservation Corps
MDA: Maryland Dept of Agriculture
MDE: Maryland Dept of the Environment
MOU: Memorandum of Understanding
NCRS: Natural Resources Conservation Service
NOAA: National Oceanic & Atmospheric Administration
NPS: National Park Service
OC: Ocean City
SHA: State Highway Administration
TCF: The Conservation Fund
TMDL: Total Maximum Daily Load
TNC: The Nature Conservancy
UME: University of Maryland Extension
USACE: United States Army Corps of Engineers
USDOI: United States Dept of the Interior
USGS: United States Geological Survey
USFWS: US Fish & Wildlife Service
VIMS: Virginia Institute of Marine Science
WC: Worcester County
WHIP: Wildlife Habitat Incentives Program
WRE: Wetlands Reserve Easement
WSCD: Worcester Soil Conservation District

Wild turkeys. Photo by Chesapeake Bay Program/CC BY-NC.

4. Recreation & Navigation

Do not tell fish stories where people know you; but particularly don't tell them where they know the fish.
—Mark Twain

Recreational and commercial boating is extremely popular in the Coastal Bays. Photo by Allen Sklar.

Maryland's Coastal Bays provide a myriad of recreational opportunities, ranging from active pursuits such as hunting, fishing and boating to more passive activities like swimming, bird watching and kayaking. As recreational and commercial use of the bays grows and diversifies, balancing resource protection with public use has become increasingly complex. Sensitive areas such as seagrass beds, bird rookeries, turtle and horseshoe crab nesting beaches and aquatic species nursery areas provide unique recreational experiences, yet can be significantly impacted by certain activities.

No less than 14 marinas exist for commercial and private use. Miles of shoreline is accessible for surf fishing. Private and public fishing piers and freshwater ponds are popular locally. Additionally, there are more than 2,000 private docks along the Coastal Bays shoreline.[1] While fishing is popular year-round, April through October marks tournament seasons for striped bass, flounder, bluefish, shark, tuna, marlin, spot, red drum and tautog and other species resulting in millions of dollars in prizes. There are many sport and commercial fishing associations such as the Ocean City Marlin Club, Maryland Saltwater Sport Fishing Association, Ocean Pines Anglers, Coastal Conservation Association, Ocean City Reef Foundation, Maryland Waterman's Association and the Ocean City Charter Captain's Association. Visitors can find fish markets, tackle shops, jet-ski and boat rentals along with charter and party boats for hire. To say that recreation and navigation is important to the community would be an understatement.

Due to the relatively shallow nature of the Coastal Bays, the maintenance of navigable waterways to support recreational and commercial pursuits will always be a critical need. This section of the plan is structured to assist with coordination among federal, state, local and private interests to continue to balance the need for navigation and dredging with potential adverse effects on natural resources. A Navigation and Dredging Advisory Group was created to develop a Coastal Bays Master Plan[2] to guide navigation and dredging projects in the bays, provide a forum for public input into related decision-making and enhance and protect natural resources either at risk or that may benefit

from navigation-related activities. This 2005 plan is being reviewed and updated. The committee will continue to organize as the forum of diverse users and agencies responsible for navigation and dredging in a way that allows concerns, needs, obstacles and benefits to be highlighted, discussed and coordinated. By doing so, navigation and dredging actions can be expedited and provide the greatest benefits at least cost to bay users and bay ecology.

1. Shifting Sands, page 52, based on data extracted from the Virginia Institute of Marine Science, Development of the Maryland shoreline inventory methods and guidelines for Worcester County. 2006
2. *http://www.mdcoastalbays.org/files/pdfs_pdf/Dredging_Master_Plan_2005.pdf*

Fishing is just one of the many recreational opportunities available in the Coastal Bays. Photo by Allen Sklar.

1 RECREATION & NAVIGATION GOAL

Improve recreational opportunities and access to the Coastal Bays and tributaries

1.1 RECREATION & NAVIGATION CHALLENGE

Enhance recreational access, opportunities and infrastructure

Priority level: 1 (initiate before 2019) *Public support:* Moderate

Issue

Recreational access for boating, kayaking, fishing, crabbing and clamming is a community mainstay and there are many different social clubs in the watershed for enthusiasts. Clean and safe access to sites make these activities more enjoyable. To facilitate sustainable community access and infrastructure a number of dedicated funding sources and programs are available such as DNR's Waterway Improvement Fund, Program Open Space and Clean Marina Programs. Worcester County and Ocean City manage access sites and oversee improvements based upon citizen uses and needs. The Coastal Bays assists in these efforts by maintaining programs for collecting monofilament, conducting presentations to local social clubs such as the Ocean Pines Anglers and the Boating Club and providing general education, outreach and recreational opportunities to the public.

Solution

Recreational access does not happen in a vacuum, but rather is actively managed and maintained. Public usage strongly influences the amount and quality of access areas and the public is enlisted to be watchful stewards and active participants in sustainability initiatives such as recycling, proper sewage and trash disposal and the proper handling of hazardous materials such as oils and gasoline. Likewise, marina operators, park personnel and state officials can assist the community with long-term planning for infrastructure improvements, sea level rise, best management practices to reduce toxins and information to share with the public.

Triathletes on the swim leg of the annual Osprey Sprint Triathlon in Chincoteague Bay near Public Landing. Photo by Arlo Hemphill.

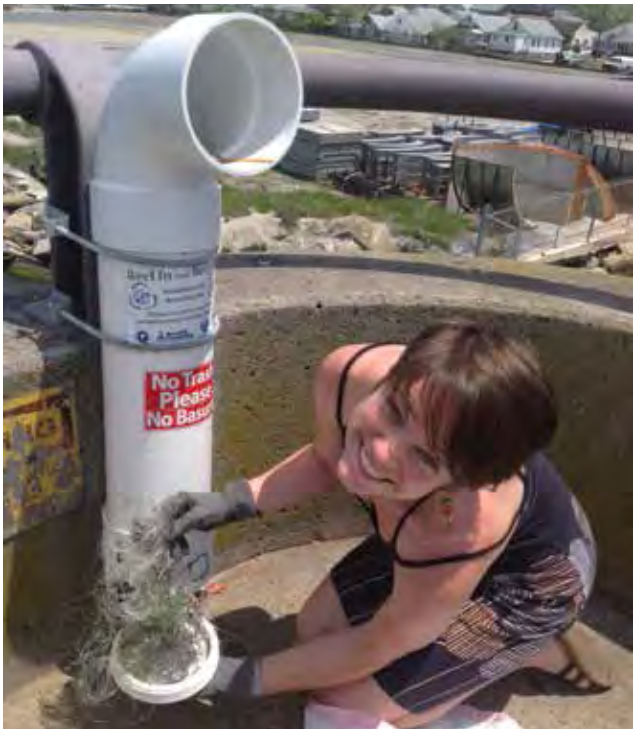
Action item	Category	Lead partner	Outputs (deliverables)	Outcomes (knowledge & behavior)
RN 1.1.1 WC will investigate the potential consequences of storm inundation and sea level rise (up to 2 feet by 2050) on marinas, launch ramps and other marina-related facilities.	Within Existing Resources	WC	Water access report—compare with results of RN 4.1.3 Waterway Improvement Benefits, Needs & Opportunities report.	Planning & maintenance information.
RN 1.1.2 MCBP will enhance public awareness of existing facilities, opportunities and access points by producing fact sheets, newspaper articles and public service announcements. Stress the importance of protecting the environment and respecting public and private properties (e.g. no trash/campfires to protect sensitive species & habitats). Maintain the Reel In & Recycle[3] program for monofilament in the watershed.	Education & Outreach	MCBP	Educational pieces and volunteer opportunities, Support & assist county efforts to fund renovation projects at parks and access sites.	Sustainable recreational use and public access.
RN 1.1.3 DNR will evaluate the adequacy of signage and existing sewage pump-out and recycling facilities for used oil, gasoline, antifreeze and solid waste through the Clean Marina Initiative.[4]	Within Existing Resources	DNR	Evaluation of Clean Marina Initiative.	Determine local needs for BMPs or other resources.
RN 1.1.4 DNR will develop and distribute educational materials on pollution prevention related to bottom paints, corrosion anodes, fueling methods and waste disposal.	Education & Outreach	DNR	Pollution Prevention materials.	MCBP will assist DNR with target audiences & events.
RN 1.1.5 DNR will explore the availability of grants and loans or other incentives to assist marina owners/operators in installing and maintaining best management practices. (e.g. septic pump-outs).	Within Existing Resources	DNR	Funding for BMPs	Reduced toxins loading to waterways.
RN 1.1.6 MCBP, USCG-Auxillary, DNR and MDE will collaborate on educational efforts regarding hazardous materials spill response capabilities, first responders contact information, safety and disposal methods for local marinas and the boating public. Contact numbers will be checked annually.	Education & Outreach	MCBP	Spill response plan for boaters & marinas	Increase in public knowledge of which first responders to contact in the event of an emergency.

Guidance & references

- Maryland DNR Waterway Improvement Capitol Program Benefits, Needs & Opportunities Report. 2011.
- Worcester County Parks, Recreation & Land Preservation Plan. 2012.

3. The Coastal Bays Program is taking part in a Boat US Foundation initiative to place monofilament collection containers at popular fishing sites. Volunteers and interns periodically empty the containers and send the contents to a special recycling facility in Iowa.
4. The Maryland Clean Marina Initiative recognizes and promotes marinas, boatyards and yacht clubs of any size that meet legal requirements and voluntarily adopt pollution prevention practices. DNR has certified nearly 25% of Maryland's estimated 600 marinas as Clean Marinas or Clean Marina Partners and aim to continue increasing this number moving forward. *dnr.maryland.gov/boating/cleanmarina*

Visitors to the Coastal Bays stimulate the local economy
Of the 8.5 million people who come to Worcester County every year, more than 2 million participate in Coastal Bays-related activities. Sightseeing alone is worth about $21.4 million annually. For wildlife observation, including birding, around $20.7 million was the total impact in 2000. Recreational fishing, camping, hunting and boating are also a significant part of the $500 million in goods and services purchased by consumers every year in the Coastal Bays watershed. Food, lodging and transportation related to these activities have a yearly market value of around $114 million.



"Reel in and Recycle" receptacles at popular fishing areas. This effort is designed to encourage the proper disposal of fishing line and similar marine debris and prevent it from reaching our waterways. The receptacles are emptied by volunteers and the fishing line is sent for recycling. Photo by Carrie Samis.

2 RECREATION & NAVIGATION GOAL

Balance resource protection with recreational use

2.1 RECREATION & NAVIGATION CHALLENGE

Reduce resource impacts from water-based recreational activities

Priority level: 2 (initiate before 2025) *Public support:* Moderate

Issue

On average, the Coastal Bays are only four feet deep and have many shoals and sand bars. The shallow nature and protection from ocean waves make the bays a thriving nursery and habitat for many species. It is also a very popular recreational destination for residents and visitors alike. In order to prevent harm to sensitive aquatic areas and promote public safety, it is imperative to have a well-informed boating public. An extensive study of Sensitive Areas was completed in 2004 to share information with the public and local decision makers. Likewise, a Boater's Guide to the Coastal Bays[5] was produced and widely disseminated as an on-board reference for citizens.

Solution

Periodic review of navigational conditions and distribution of educational products will assist in maintaining a well-informed public. By updating the Sensitive Areas Initiative with other near shore assessments we can continue to share the importance of these resources with local planners and the boating public. Equally important, we must continue to support and fund positions within Natural Resource Police who act as the front-line eyes and voices for these habitats. Lastly, more attention to marine debris and ghost crab pots is warranted to keep the bays clean.

Boat propeller scars in a seagrass bed in Sinepuxent Bay. Photo by Jane Thomas.

Action item	Category	Lead partner	Outputs (deliverables)	Outcomes (knowledge & behavior)
RN 2.1.1 DNR will revisit the Sensitive Areas research gaps and needs outlined by the technical task force and create a plan for addressing and prioritizing those needs. (e.g. shoreline changes, fish blockages, island habitats, harmful algae blooms, sea level rise, etc.).	Research & Ecosystem Assessment	DNR	Updated Sensitive Areas/Blue Infrastructure Report with management recommendations	Informed planning for adaptive management, increased use of DNR Coastal Atlas mapping tool for estuaries.
RN 2.1.2 MDE will reallocate the fee structure used for wetlands permits to increase mitigation, permit review and enforcement staff.	Policy Issue	MDE	Regulatory review	Funding for permitting & enforcement staff.
RN 2.1.3 MCBP will enhance public awareness of resource protection issues and needs by producing fact sheets, brochures, newspaper articles, posters, digital media, etc., to publicize resource problems/solutions and sensitive areas. A targeted public education campaign will be developed so the public and local decision makers (including the Shoreline Commission, Port Wardens, & Planning Commission) will know about sensitive areas and species.	Education & Outreach	MCBP	Sensitive Habitats campaign—distribution of education items will be coordinated with the USCG auxiliary, NRP and local boating & fishing groups. Incorporate info into boating classes and NA-DAG plan	Technical resources for the community, reduction in user conflicts, natural resource protection and boater safety.
RN 2.1.4 MCBP will seek funding and partnerships to emulate the Derelict Gear Retrieval Project[6] for ghost pot collections to the Coastal Bays areas. MCBP will assist with organizing collection efforts and recording information (amount, location, # of terrapin carapaces. etc.) to assess the effort.	Policy Issue	MCBP	MOU with the Oyster Recovery Partnership, funds for ghost pot removal, data on by-catch	Economic development/ reduction in derelict gear & resource mortality.
RN 2.1.5 MCBP will request additional buoys in sensitive area habitats that experience high traffic from boat rentals, approach channels, bar and restaurant moorings, etc.	Within Existing Resources	MCBP	Buoys in areas of high usage to protect sensitive resources (e.g. Frontier Town channel)	Enhanced protection of living resources. Link to Sensitive Areas study.
RN 2.1.6 DNR Natural Resources Police will review a policy to allow them to issue citations to boaters who prop dredge shallow areas.	Policy Issue	DNR	Policy change to allow citations for prop dredging	Disincentive to boat in shallow areas and habitats.

Guidance & references

- Boater's Guide to the Coastal Bays, Sensitive Areas Initiative, Maryland Coastal Bays Aquatic Sensitive Areas Initiative, Technical Report. 2004.

5. http://www.mdcoastalbays.org/files/pdfs_pdf/Boater_s_Guide_to_the_Coastal_Bays.pdf
6. The Maryland Department of Natural Resources, the Oyster Recovery Partnership and the Maryland Watermen's Association (MWA) conducted a Derelict Gear Retrieval Project to support commercial watermen throughout Maryland who were directly impacted by extreme weather events in the summer of 2011. The funds had been made available as part of a three-year Federal Crab Disaster grant from NOAA.

Abandoned or lost fishing gear can trap and kill wildlife. Here a male terrapin rests atop a large female after being rescued from a 'ghost' crab pot. This crab pot contained an additional five dead terrapins that drowned. Photo by Bill Mahoney.

2 RECREATION & NAVIGATION GOAL

Balance resource protection with recreational use

2.2 RECREATION & NAVIGATION CHALLENGE

Reduce conflicts between water-based activities and user groups while improving compliance with safe boating and resource protection rules

Priority level: 2 (initiate before 2025) *Public support:* Moderate

Issue

The Coast Guard Auxiliary, Natural Resources Police, Power Squadron and other groups work together to ensure boaters of all ages are knowledgeable and operating safely. To supplement these efforts, the Maryland Coastal Bays Program conducted a use assessment and public opinion survey to determine local knowledge of favorite fishing areas and frequent user conflicts. This worthwhile endeavor revealed the perceptions, attitudes and opinions of local boaters and now serves as a baseline to measure changes in usage and/or conflicts over time.

Solution

Public input is a core function of the Coastal Bays Program. Conducting periodic surveys to determine perceptions and attitudes about local boating experiences and the amount of support for management options allows resource managers to plan for the future. Survey tools not only measure the change in perception over time but also serve as a vehicle for education and democratic involvement. An engaged and educated public will result in increased compliance with safety and resource protection.

The U.S. Coast Guard assists a disabled boater. Photo by Coast Guard News/CC BY-NC-ND.

Action item	Category	Lead partner	Outputs (deliverables)	Outcomes (knowledge & behavior)
RN 2.2.1 MCBP will repeat the 2002 Coastal Bays Water Use Assessment and public opinion/user satisfaction survey to identify user conflicts such as overcrowded channels or boat ramps, PWC activity/safety and environmental impacts.	Within Existing Resources	MCBP	Water Use Assessment—determine changes in use and or perception of crowding & safety	Increased public participation.
RN 2.2.2 MCBP will produce educational materials describing user conflict issues, areas to avoid, boating courtesy and other target information to address existing problems. Educational media include fact sheets, newspaper articles, public service announcement, etc., with a special focus on visitors.	Education & Outreach	MCBP	Update Boater's Guide to the Coastal Bays	Reduced user conflict.
RN 2.2.3 MCBP will request from NRP a breakdown of Reportable Boat Accidents for the Coastal Bays to identify areas and times that exhibit frequent incidents/accidents. MCBP will use this information for public awareness purposes.	Within Existing Resources	MCBP	Local accident summaries over time	Changes in violations and accident rates.
RN 2.2.4 MCBP will develop/update educational media for boat dealers, marinas, rental outlets, boating classes, etc., will improve education on the rules and regulations, and will promote boating safety. Consider using videos and public service announcements for educational purposes.	Education & Outreach	MCBP	Reprint the Coastal Bays Boaters Guide & create PSAs/other materials	Changes in violations and accident rates.

Guidance & references

- Falk, J.M. and P. C. Gerner. 2002. Maryland Coastal Bays Water Use Assessment: Understanding User's Behaviors, Attitudes and Perceptions.

Jetskiers off Ocean City. Photo by Adrian Jones.

3 RECREATION & NAVIGATION GOAL

Continue to implement the Ocean City Water Resources Study Recommendations

3.1 RECREATION & NAVIGATION CHALLENGE

Facilitate and monitor conservation and restoration projects

Priority level: 1 (initiate before 2019) *Public support:* Moderate

Issue

In 1998 the Army Corps of Engineers and local partner completed the Ocean City and Vicinity Water Resources Report. The purpose of the study was to determine the feasibility of implementing a short- and long-term sand management plan, implementing navigation improvements and restoring fish and wildlife habitat in the Coastal Bays. The study provides the findings of economic, social, environmental and engineering analyses that were used to select a recommended plan of action for each component. Seven projects were identified for restoration and sand management and over time five of these have been completed (salt marsh restorations) or have become an institutionalized annual effort (inlet dredging).

Solution

The Water Resources Study has been a long-term success in decreasing the amount of sand filling in the Coastal Bays. Twice a year, 72,000 cubic yards of sand are moved from the ebb and blood tidal deltas around the Ocean City Inlet and deposited in the surf zone of northern Assateague Island. Additionally, more than 20 acres of saltmarsh habitat have been restored at Ocean Pines and the Isle of Wight Wildlife Management Area. Restoration of Dog Island Shoals and South Point Spoils Island should continue to be pursed for future efforts. Other projects such as the St. Martin River Ecosystem Restoration Feasibility Study could be added. Additionally, as the Coastal Bays has lost as much as 40% of dredge spoil islands, continuing to permit Skimmer Island as a dredge spoil site will ensure that approach channels in the harbor have a viable and affordable local disposal site. Nesting habitat for endangered royal terns, black skimmers and many other colonial nesting birds on Skimmer Island proves that island building can benefit both the business and natural communities.

Huge pipes carry dredged sand and water from Sunset Marina to Skimmer Island, just north of the Rt 50 bridge. After the water decants, the sand is moved to renourish the depleted island. Within months of this effort horseshoe crabs and shorebirds make use of the new habitat. Photos by Dave Brinker and Carol Cain.

Action item	Category	Lead partner	Outputs (deliverables)	Outcomes (knowledge & behavior)
RN 3.1.1 MCBP and WC will develop public and political support for the ACOE Ocean City Water Resources Study recommended habitat projects and long-term sand by-passing program at the Ocean City Inlet through planning, monitoring and outreach publicizing existing problems and explaining potential benefits. Seven projects were identified in the OCWRS: Revisit the study process for additional projects & needs. 1. Ocean Pines Saltmarsh Restoration (done—8.5 acres of salt marsh restored) 2. Isle of Wight Saltmarsh Restoration (done—12 acres of salt marsh restored) 3. Ocean City Harbor and Inlet Deepening (conducted twice yearly) 4. Assateague Island Short-Term Restoration (done 2002—1.4M m^3) 5. Assateague Island Long-Term Nourishment (2004 & on-going 144K m^3/year) 6. Dog Island Shoals Restoration—to be done 7. South Point Spoils Island Restoration—to be done 8. Skimmer Island—needs to become institutionalized	Restoration & Conservation	MCBP	Acres of habitat enhanced or created. Monitor the effectiveness of projects over time.	Reevaluate local sediment needs & opportunities.
RN 3.1.2 USACE and NPS will continue to facilitate the Assateague Island North End Restoration Project to restore the natural sediment supply to the barrier island.	Restoration & Conservation	ACOE	Documented sand volume net gain	Reduced unnatural sedimentation within the Ocean City Inlet and Coastal Bays. Restoration of the sand supply to Assateague Island
RN 3.1.3 MCBP - NADAG, MDE, USACE and WC will facilitate discussions with local marina owners and other interested parties to better understand permitting impediments and issues.	Education & Outreach	MCBP	Improved efficiency & understanding. Remove the incentive for consultants to prolong the process.	Reduced frustration

Guidance & references

- Army Corps of Engineers. 1998. Ocean City, Maryland and Vicinity Water Resources Report, Integrated Feasibility Report and Environmental Impact Statement.
- R. Jesien, 2012 brochure. Skimmer Island: Natural Habitat for Endangered Birds.

Skimmer Island restoration

In the late 1990s, Skimmer Island was over seven acres in size. Since then it has been rapidly losing ground, and by 2009 (above), it was just over two acres. In 2009, a joint effort to conserve Skimmer Island was started by the Ocean City Fishing Center, the Maryland Coastal Bays Program and the Maryland Department of Natural Resources. These organizations are working in a public–private partnership to use clean sand dredged from the Fishing Center's approach channel to nourish and restore the island. Photo by USGS.

Each March, sand is pumped onto Skimmer Island to improve nesting habitat conditions for birds. The above photo was taken during the 2012 restoration. The yellow line is a floating boom used to keep the sand from drifting off-site. This "design with nature" management approach places sand on Skimmer Island to balance what is lost to erosive tidal currents. As sea levels rise, managers will continue to nourish the island with clean, dredged sand to maintain critical habitats. Skimmers, terns, horseshoe crabs and a myriad of other species will take advantage of the habitats that Skimmer Island and the tidal sand flats provide. Photo by Roman Jesien.

4 RECREATION & NAVIGATION GOAL

Manage sediment alterations in a manner beneficial to the local economy and natural resources

4.1 RECREATION & NAVIGATION CHALLENGE

Develop and implement the Coastal Bays Navigation & Sediment Management Planning Guide

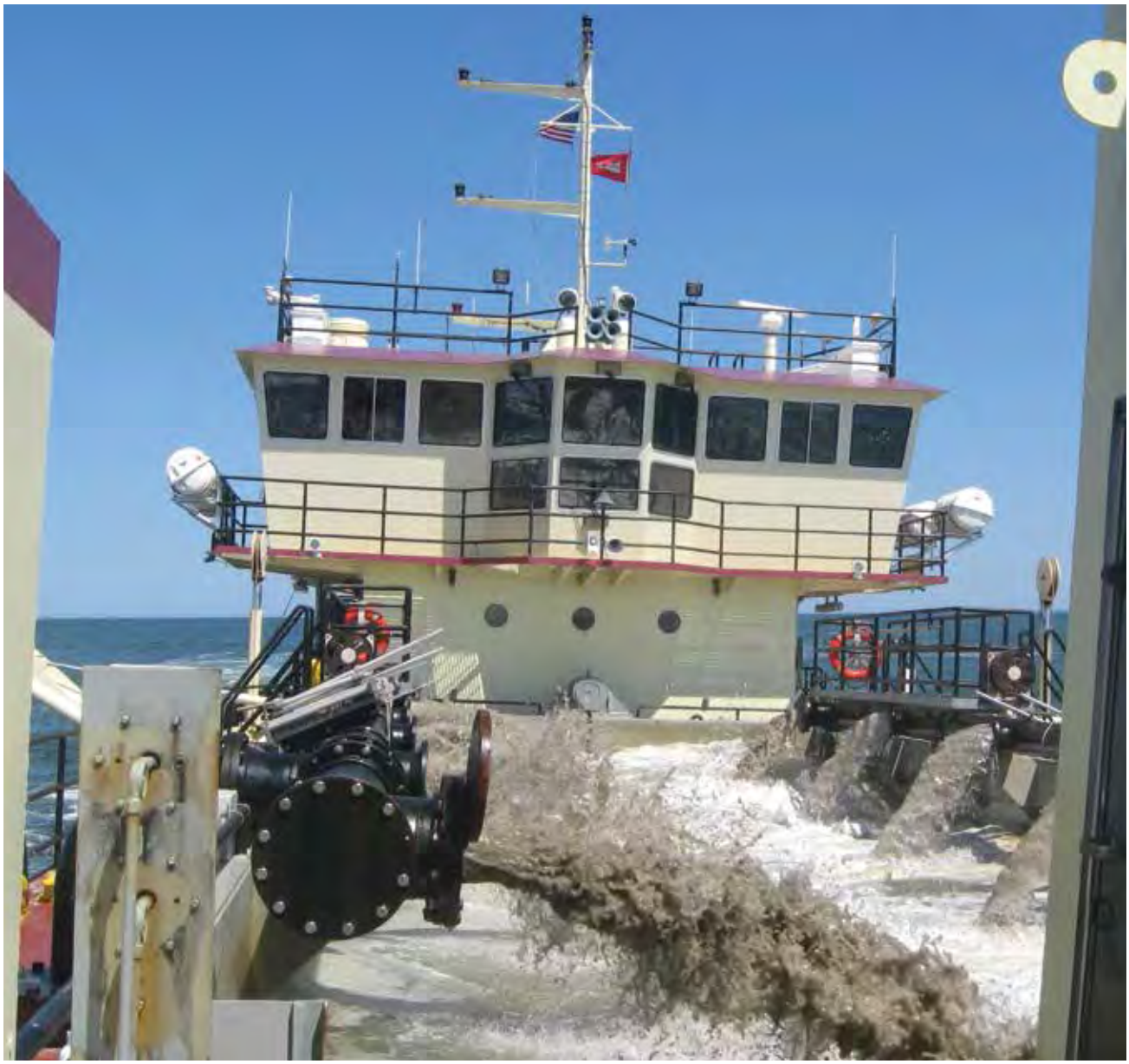
Priority level: 1 (initiate before 2019) *Public support:* Moderate

Issue

Responsibility for navigation and dredging in the Coastal Bays is shared by several federal, state and local agencies as well as private communities, businesses and individuals. A Navigation and Dredging Advisory Group (NADAG) was established to conduct overall planning and coordination to address a variety of problems including public confusion over jurisdiction, inadequate environmental safeguards, beneficial use of dredged sediment and channel maintenance/marking. A draft master dredging and sediment management plan was developed by the advisory group in 2010 and is due to be revisited.

Solution

The Navigation and Sediment Management Plan is designed to be an iterative process that informs the public as well as jurisdictional partners. Periodic meetings and project results over the last few years should be included in the Management Plan to not only establish the timeline of efforts but also to serve as a baseline for changes in the environment. Navigation and access is a cornerstone of local economic activity and is an expensive maintenance endeavor. Every effort to share information and expenses to benefit many will be worthwhile.



The US Army Corps of Engineers dredging operations. Photo by Bob Blama.

Action item	Category	Lead partner	Outputs (deliverables)	Outcomes (knowledge & behavior)
RN 4.1.1 MCBP will reconvene and maintain a Navigation & Dredging Advisory Group (NADAG) to improve planning and coordination of sediment management. MCBP will advertise the forum for public input.	Within Existing Resources	MCBP	Committee minutes	Improved coordination, increased public participation.
RN 4.1.2 NADAG will develop educational materials that provide information about key dredging and navigation issues including channel "ownership" and maintenance scheduling, public versus private responsibilities, agency responsibilities, regulatory requirements, points of contact for permits or other information and a list of information regarding problems/issues/solutions associated with dredging and navigation.	Education & Outreach	MCBP	Educational handouts, website	Increased public awareness.
RN 4.1.3 MCBP will lead the NADAG in the development, endorsement and updates to the Coastal Bays Navigation and Dredging Planning Guide. The revised edition will be comprised of the following chapters:	Within Existing Resources	MCBP	Coastal Bays Navigation & Dredging Planning Guide	Mapping, planning, coordinating and tracking group effort.
RN 4.1.4 Chapter 1: Navigation channels, markers and other aids. A. WC, OC, OP, NRP, USACE and NADAG will conduct an in-depth analysis to mark small channels to public boating access points throughout the Coastal Bays and determine future needs to establish new channels for access. B. NADAG will identify and secure funding for marker upgrades, mapping and planning exercises, habitat restoration projects and maintenance dredging. C. MCBP will update and distribute the Coastal Bays Boater's Guide to identify navigation channels. Include information about sensitive species areas, personal water craft restricted areas and descriptions of informational markers.	Within Existing Resources	MCBP	A. Map of channels & public access points. List of potential future access points. (DNR Boating Services) B. Funding from Waterway Improvement Act (DNR Boating Services) C. Redesign, print and disseminate Boater's Guide for the Coastal Bays (MCBP)	Mapping, planning, coordinating and tracking group effort.
RN 4.1.5 Chapter 2: Maintenance of navigation channels. A. NADAG will clarify and identify the responsible parties for federal and non-federal channel maintenance and make bay wide recommendations for sediment management. B. ACOE will acquire bathymetric data to evaluate the 'west channel' and evaluate the feasibility of dredging portions of the shoal north of the bridge and south of Skimmer Island. C. NADAG will assist local government in developing guidance criteria for determining when channels should be dredged and develop a method for prioritizing identified projects. D. DNR CCS and Sea Grant will complete a Coastal Bays inventory of marine related business and resources as part of the Working Waterfront Initiative.[7]	Within Existing Resources	MCBP	A. Maintenance & sediment management recommendations (MCBP) B. Bathymetry & dredging feasibility study (ACOE) C. Guidance criteria for prioritization process for dredging (MCBP) D. Coastal Bays Working Waterfront Inventory (infrastructure & economic value-DNR)	Informed planning, institutionalized coordination and adaptive management.

Guidance & references

- Wikar, C.P. 2005. Navigation and Dredging Planning Guide for Maryland's Coastal Bays.

7. Working waterfronts are essential to sustaining the viability of water-dependent businesses so important to rural economics and maritime heritage. In 2008 the Maryland Working Waterfront Commission noted that these areas are declining due to increased coastal population growth, declining profitability of commercial fishing, rising real estate values and conflicting waterfront land uses. Maryland DNR is working to inventory working waterfronts throughout the state and ascribe the socio-economic impacts to local communities, as well as develop strategies for the preservation of existing and historic working waterfronts.

Acronyms used in this chapter

USACE: United States Army Corps of Engineers
DNR: Department of Natural Resources
DNR CCS: Department of Natural Resources Chesapeake and Coastal Service
MCBP: Maryland Coastal Bay Program
MDE: Maryland Department of Environment
NADAG: Navigation and Dredging Advisory Group
NPS: National Park Service
NRP: National Response Plan
OC: Ocean City
OP: Ocean Pines
OCWRS: Ocean City Water Resources Study
PWC: Personal Water Craft
USCG: U.S. Coast Guard
WC: Worcester County

A fishing boat heads out of Ocean City for some offshore fishing. Photo by Allen Sklar.

5. Community & Economic Development

Ecology and Economy have the same Greek root word 'eco' meaning home, house or household. Ecology is the study of home, while economics is the management of the home.
—David Suzuki

Cornfield in summer. Photo by Chesapeake Bay Program/CC BY-NC.

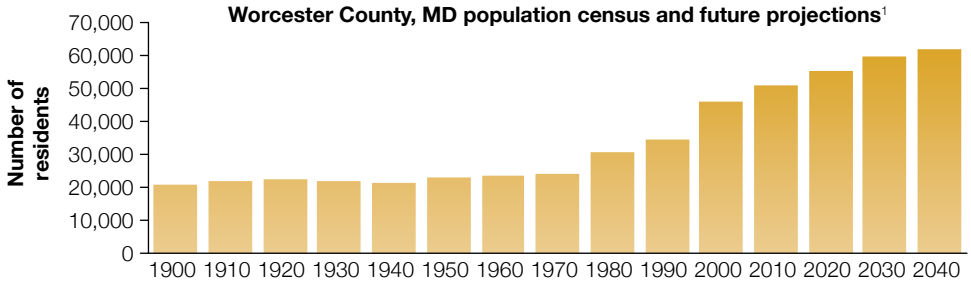
Because of their economic, aesthetic and recreational value, estuaries have always been attractive to both people and commerce. Like other coastal areas around the country, the Coastal Bays community continues to experience population growth and increased development. Nationally, 55% of the U.S. population is already living within 50 miles of the coast. The environmental impacts of development directly affect the ability of communities to balance natural resource protection with sustainable economic growth in their decision-making.

The Coastal Bays along Maryland's seaside have long been recognized as a very special place. The diverse ecology, fertile soil, abundant timber and easy access to water have supported untold generations in hunting, fishing, trapping and agriculture. The temperate climate supports more species of wildlife than any other place in Maryland. Combined, these qualities have served as a platform for more than 150 years of building and commercial trade, as well as tourism and leisure, which has further helped the region to prosper. Today, these activities continue to be pursued and draw millions of visitors here each year that support hundreds of local farms and businesses.

Around the United States, there are approximately 144 bays and estuaries. Of those 144, only 28 have been declared "Estuaries of National Significance" because of the value of their natural resources. The Maryland Coastal Bays were inducted into this prestigious and high profile designation in 1995. This national recognition has resulted in millions of dollars in support of monitoring, research, restoration and conservation projects.

Nature provides many benefits that are difficult to ascribe a value to. For example, trees and vegetation purify the air, wetlands absorb tidal surges and flood waters, healthy soils and aquifers provide our food and drinking water and microbes and other organisms naturally break down and recycle wastes.

As popularity of the watershed continues to increase, citizens recognize the negative changes to the bays and landscape and are increasingly willing to consider personal



changes to strike a better balance between ecology and economics. From 2005 – 2009, the public and county planning staff diligently ensured schools, public safety , transportation and bay health, were top priorities in the county's comprehensive plan and rezoning. They showed great care in avoiding sprawl zoning to keep the county's taxes near the lowest in the state, protect citizens from natural disasters and preserve wildlife and water quality.

We recognize the interrelatedness and interdependence of social, economic and environmental aspects that contribute to our quality of life. In this section of the plan, we look at challenges to support sustainability, determine the economic value of nature's services, devise new strategies for community resiliency in the face of natural disasters and sea level rise, protect natural and cultural resources and increase public participation in community-level decision-making.

1. Census data compiled from U.S. Census records 1990–1960 and Maryland Department of Planning Historical and Projected Household Population for Maryland's Jurisdictions, 1970–2040. Revised July 2014.

The relaxed charm of small towns enhances the quality of life in our local communities. Photo by Carol Cain.

1 COMMUNITY & ECONOMIC DEVELOPMENT GOAL

Manage the watershed to maximize economic benefits while minimizing negative resource impacts

1.1 COMMUNITY & ECONOMIC CHALLENGE

Compare multiple measures of economic contributions to local economic sectors

Priority level: 1 (initiate before 2019) *Public support:* Moderate

Issue

Natural resources underlie all economic sectors in the Coastal Bays; agriculture, forestry, tourism, fisheries, marine-related services and construction. Clean air, water and healthy soils have allowed untold generations to thrive in the areas and are no less important for the future. Economic indicators are an extension of environmental services that many of us take for granted.

Solution

It is important to connect people and quality of life to the ecosystems that support them. Communities can utilize knowledge, technology and resources that are available to live sustainably thus ensuring the region will continue to grow and provide jobs for citizens. Indicators are needed to show trends and to measure progress towards our collective goals.

Tourism plays a large part in the Coastal Bays' economy. Photo by Allen Sklar.

Action item	Category	Lead partner	Outputs (deliverables)	Outcomes (knowledge & behavior)
CE 1.1.1 UME, WC and SU-BEACON will analyze the economic contributions of farming, forestry, commercial & recreational fishing, (traditional and low impact) tourism and other natural resource dependent economic sectors in the watershed. Include value of farmers markets, direct to farm products, historical assets and marine-related businesses, etc.	Research & Ecosystem Assessment	UME	Economic sector/ resource-based industries report with indicators for measuring change over time.	Better understanding of natural resource related industry.
CE 1.1.2 MDP will determine the cost of sprawl in the watershed, including the impacts to air & water quality, greenhouse gases, affordable housing and public health. Examine the impacts of different land uses on county finances and determine the return on investment of public dollars.	Within Existing Resources	MDP	Return on investment of public infrastructure to support compact development.	Efficiency of public funding among land use sectors.
CE 1.1.3 MCBP will produce educational materials based on the results of CE 1.1.1 through CE 1.1.3 regarding the economic importance of protecting wetlands, marshes, dunes, forests, farmland and cultural resources to ensure cultural integrity, community safety and economic viability of the Coastal Bays region.	Education & Outreach	MCBP	Educational materials	Improved resource appreciation.
CE 1.1.4 MCBP will conduct an economic analysis of the value of the National Estuary Program to the watershed; the number of jobs created, number and amount of grants provided to local citizen groups, local monitoring efforts, research and restoration funds, assistance provided to municipal and county projects and total funds leveraged over time. Further, analyze the community's economic support provided to MCBP via fundraising and total leveraging.	Within Existing Resources	MCBP	Dollar value of the National Estuary Program to the watershed	Annual feedback report to the public and decision-makers (EPA leveraging requirement).
CE 1.1.5 MCBP will communicate to local businesses the benefits of ecosystem health to economic development, tourism, recreation and quality of life. Emphasize that economic prosperity is linked to ecosystem health.	Education & Outreach	MCBP	Value added to economy by preserving and improving the ecosystem	Improved communication between stakeholder groups.
CE 1.1.6 MCBP will use the above information and a compilation of CCMP actions to formulate a gap analysis to determine financial needs to reduce nutrients and support education and outreach efforts.	Within Existing Resources	MCBP	Financial gap analysis	Grant & Fundraising goals, marketing strategy.
CE 1.1.7 MDA, DNR Forestry, WSCD and WC will create economic and other incentives to retain farming and forestry. Also, seek support industries such as corn research, beneficial use of chicken litter, wood markets, expand farmers markets, value-added products, agri-tourism opportunities, etc.	Policy Issue	MDA	Communicate economic incentives and outreach efforts	Support for Coastal Bays' farmers, forest owners and agriculture affiliated businesses.
CE 1.1.8 MDE will formulate a statewide zero-waste strategy by developing policies and actions to increase recycling rates including food scraps. Focus on waste source reduction from commercial, institutional, governmental and residential generators.	Policy Issue	MDE	Zero Waste Strategy[2] to reduce 85% of waste by 2030	Increases in wastes being reused, recycled, composted or prevented through source reduction. Save tax dollars by preserving landfill cells.
CE 1.1.9 DNR will assist MCBP in developing implementation strategies for promoting ecosystem service markets such as forest, species and habitat banks, wetland mitigation banks, carbon sequestration and nutrient trading and biomass-based carbon sequestration and fuel production.	Within Existing Resources	DNR	Establishment of ecosystem service markets and credits	Natural resources-based economic development. Improved protection of natural resources-based on economic valuation and demand for ecosystem services.

Guidance & references

- An Assessment of the Economic Value of the Coastal Bays Natural Resources to the Economy of Worcester County, Maryland. 2001.
- Maryland Department of the Environment. 2014. Draft Zero Waste Maryland, The O'Malley/Brown Administration's Plan to Reduce, Reuse & Recycle Nearly All Waste Generated in Maryland by 2040. *www.mde.state.md.us/programs/Marylander/Documents/Zero_Waste_Plan_Final_Draft_4.30.14.pdf*

2. 'Zero waste' is concept whereby all waste products should be designed to become resources for another use. Furthermore, this concept has goals to avoid and eliminate the volume and toxicity of waste while conserving resources such as energy, water and landfill space. As part of its legislatively mandated Green House Gas Reduction Plan, the state of Maryland has established long-term 2040 recycling and waste diversion goals of 80% and 85%, respectively.

1 COMMUNITY & ECONOMIC DEVELOPMENT GOAL

Manage the watershed to maximize economic benefits while minimizing negative resource impacts

1.2 COMMUNITY & ECONOMIC CHALLENGE

Make education and enforcement of environmental laws more consistent

Priority level: 1 (initiate before 2019) *Public support:* Moderate

Issue

Our natural environment, though resilient, is also fragile and in need of special legal protections. Federal laws governing the environment, such as the Clean Air Act and the Clean Water Act, among others, require each state to have an environmental regulatory program with a criminal enforcement component. The state of Maryland also has a number of laws governing natural resources such as stormwater retention, wetlands, drinking water and critical areas protections. Effective education and enforcement is key to ensuring that our shared resources and public health are protected. Compliance can range from sanctions and fines to deter violators, compliance assistance programs that focus on preventing violations and lastly citizen-based law suits that prod regulators to enforce existing laws. There have been numerous arguments for and against environmental enforcement; some feeling that environmental laws are unfriendly to business while others believing compliance to be lax. These arguments allow for much middle ground to learn from while building consensus and understanding.

Former Worcester County Commissioner Jeanne Lynch speaks at the Coastal Bays 10-year anniversary in 2006. The surly environmental champion was the original voice to call for setting up a National Estuary Program to help protect the Coastal Bays. Her persistence helped marshal a groundswell of public support and local, state, and federal backing that ultimately created the Maryland Coastal Bays Program. Lynch currently lives in Arizona with her husband Nelson. Photo by Dave Wilson.

Solution

To be effective, state and local enforcement personnel and policies must work together to promote citizen engagement and education. Citizens likewise must accommodate the laws passed for community protection and support enforcement personnel. Compliance assistance programs that assist individuals, businesses and other interest groups are the best option for engaging the public on how to comply with the laws and why those laws exist.

Students paint a coastal bays mural at Northside Park as part of an Ocean City activity to increase awareness. Photo by Dave Wilson.

Natural Resources Police on patrol in the Coastal Bays. Photo by Ben Fertig.

Action item	Category	Lead partner	Outputs (deliverables)	Outcomes (knowledge & behavior)
CE 1.2.1 MDE, WC and municipalities will use all existing legal and administrative remedies to carry out enforcement activities in a timely, effective and consistent manner. Seek additional authority if necessary, for example; expanding civil penalty authority for use in all enforcement. Track violations and enforcement activities for evaluation purposes. Determine the most common violations and create outreach materials.	Within Existing Resources	MDE	Track the reduction of violations over time as the community becomes more aware of the purpose for enforcement	Improved coordination and compliance. Build community consensus and political support to prevent violations.
CE 1.2.2 MDE will implement supplemental environmental projects in the location where environmental damage to be mitigated has occurred, preferably in the same subwatershed.	Restoration & Conservation	MDE	Mitigation projects	No net loss of ecosystem services.
CE 1.2.3 MCBP will compile concerns/needs to support better communication between MDE permits division and the enforcement division. MDE will provide technical assistance to the regulated community to facilitate compliance and minimize need for enforcement action.	Policy Issue	MCBP	Improved communication between the regulated community and state regulators.	Information to promote compliance and minimize enforcement actions.

Guidance & references

- Maryland Attorney General, Environmental Crimes Unit, website *www.oag.state.md.us/ECU*

Local kids handle their first starfish during an enrichment boat ride sponsored by the Maryland Coastal Bays Program. Photo by Dave Wilson.

Environmental champion Ilia Fehrer accepts the 2002 Chesapeake Bay Trust's Ellen Fraites Wagner Award during the annual Maryland Tributary Teams Conference.

Perhaps the greatest champion for conservation the Eastern Shore has ever known, Ilia Fehrer passed away from cancer in 2007. Whether she was fighting for the Coastal Bays, Nassawango Creek or the Pocomoke, she never once strayed from her conviction that other living things have the right to live in places unadulterated by the hand of man. Different from most environmentalists, Ilia most often spoke about the individual creatures that would be affected by a given development or piece of legislation. Indeed "water quality" and "habitat" were part of the equation but this astute sliver of a woman was able to understand the danger of unraveling the parts that make up the whole. In her eyes, blue herons, eagles, box turtles, otters and even snakes were those parts. For most of Ilia's campaign to protect nature, she was a lone voice in a sea of avarice. She never got rich and never became popular on the shore for putting the rights of nature and its living parts above human rapacity. We will all miss that gentle smile. But if we look closely, we will see it in the birds and the flowers and the trees, and she will continue to remind us all of what matters. Photo by Dave Wilson.

2 COMMUNITY & ECONOMIC DEVELOPMENT GOAL

Enhance the level of sustainability in land use decision-making

2.1 COMMUNITY & ECONOMIC CHALLENGE

Reduce the threat of development to cultural and natural resources

Priority level: 1 (initiate before 2019) *Public support:* Moderate

Issue

Worcester County and its residents pride themselves on our rural and coastal character. Where else can we find a similar seaside county with premier family resorts, compact communities, thriving businesses, rich farmland and wild barrier island parks? The richness and diversity of the natural resources and cultural amenities are second to none. Careful planning and resource protection underscores our efforts to maintain the quality of life that draws so many residents and visitors. Nationally, regionally and locally, land consumption per home has outpaced population growth, rendering the expense of long-term infrastructure maintenance and service delivery unsustainable.

Solution

Quality of life and preservation of what makes the watershed different from urban areas can be protected through careful planning and zoning. Every effort should be made to continue to preserve our farms, forests, small towns and villages while accommodating new growth around existing infrastructure. Architectural standards promote our shared sense of place in the world and why we are special. Celebrating cultural resources and treasured landmarks strengthens our community and prevents the division of the landscape into large lots with cookie-cutter development and big box stores, which have proven a detriment to both taxpayers and wildlife.

Sustainable agricultural practices and strong zoning could reduce the potential for sprawl development. Photo by Dave Wilson.

Worcester County underwent a comprehensive re-zoning in 2009. A principle goal of the plan was to protect forests and farmland while keeping growth adjacent to existing infrastructure. This has the multiple effect of preserving open space, reducing county tax burden, and protecting water quality and wildlife.

Action item	Category	Lead partner	Outputs (deliverables)	Outcomes (knowledge & behavior)
CE 2.1.1 WC will develop and track changes in land use indicators including land use/land cover, impervious surfaces, amount of development occurring inside and outside of County Growth Areas/Priority Funding Areas, % water and wastewater capacity, % school capacity, septic tank upgrades and stormwater reductions.	Within Existing Resources	WC	Suite of land use indicators for change over time (ex. percent growth within vs. outside of PFAs)	Informed planning.
CE 2.1.2 WC, OC, Berlin, SHA and MDP will encourage aesthetically pleasing and ecologically beneficial low-impact developments, such as streetscapes, parking facilities, commercial architectural standards and walkable/bikeable access between residential and commercial areas.	Within Existing Resources	WC	Design standards, education & outreach materials regarding waivers and special exceptions	Increased use of low impact techniques, reduced greenhouse gas emissions, healthier communities.
CE 2.1.3 WC will continue to retain strong A-1 and Rural Preservation zoning to protect natural and cultural resources.	Within Existing Resources	WC	Zoning principles	Protection of agricultural and cultural land uses.

Guidance & references

- Worcester County Comprehensive Plan 2006.
- Worcester County Zoning Code 2009.
- Lower Eastern Shore Heritage Area Management Plan 2002

The town of Berlin is surrounded by forests and farms. Photo by Jane Thomas.

2 COMMUNITY & ECONOMIC DEVELOPMENT GOAL

Enhance the level of sustainability in land use decision-making

2.2 COMMUNITY & ECONOMIC CHALLENGE

Enhance coastal resiliency to natural disasters, sea level rise and climate change

Priority level: 1 (initiate before 2019) *Public support:* Moderate

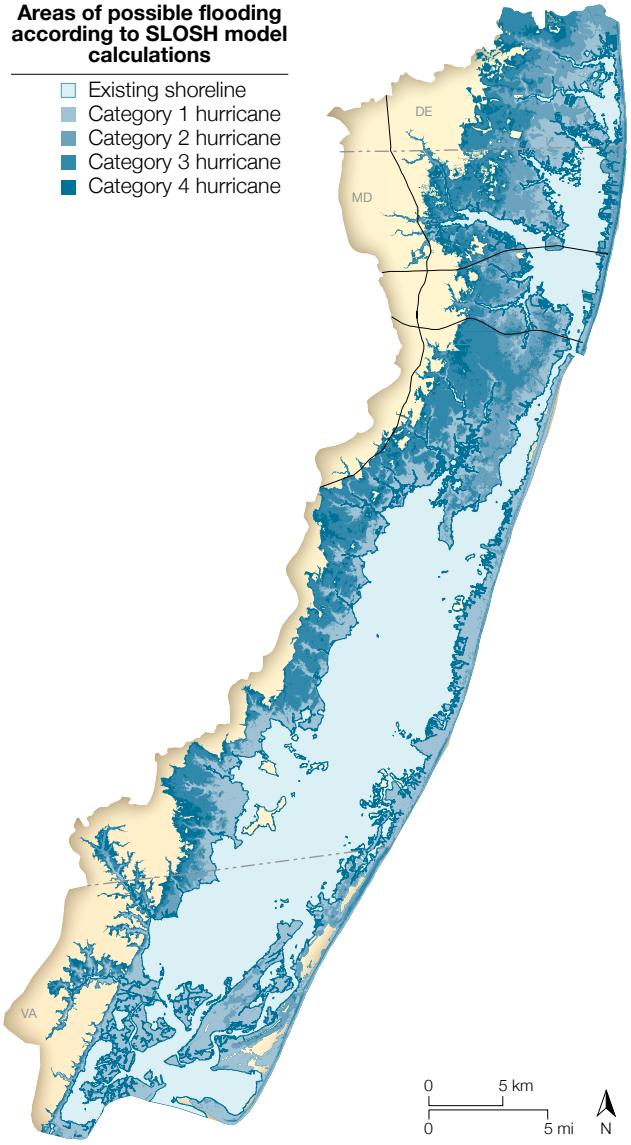
Issue

Over the past century, the Mid-Atlantic coastal region has seen a one-foot increase in sea level, which is double the global average. It is predicted that the area will experience another 2–3-foot rise by 2100. [Shifting Sands pg. 54] Increasing sea level can result in coastal erosion, exacerbated flooding and storm damage, inundation and loss of wetlands and other low-lying areas, salt intrusion into drinking water aquifers and streams and higher water tables. Higher sea surface temperatures associated with global warming are likely to increase the frequency and intensity of hurricanes, while increasing land temperatures can result in longer periods of drought.

A summer thundershower floods Coastal Highway in Ocean City. Sitting only a few feet above sea level, Ocean City floods frequently, especially when rain events occur at high tide. Photo by Gail Blazer.

Solution

Climate change warrants response strategies such as steering future development and infrastructure out of harm's way, conserving natural areas that buffer against flooding, and reducing the potential for human vulnerability and economic losses from storms and water inundation. Numerous discussions and plans such as the Worcester County Sea Level Response Strategy and local Emergency Response Plans should be revisited for implementation and expansion upon the recommendations made to date.



This map shows areas of potential flooding in the Coastal Bays watershed under different hurricane scenarios, using the SLOSH (Sea, Lake and Overland Surges from Hurricanes) model.

Action item	Category	Lead partner	Outputs (deliverables)	Outcomes (knowledge & behavior)
CE 2.2.1 WC will evaluate the 2008 Sea Level Response Strategy and consider revising and implementing its recommendations. Start by identifying and prioritizing actions and strategies aimed at building resilience.	Within Existing Resources	WC	Revised Worcester County Sea Level Response Strategy and public workshops	Informed planning, priority setting for project plans.
CE 2.2.2 MCBP will work with city, county and state officials to ensure planning efforts include adaptation to climate change to protect infrastructure, public health, agriculture, wetlands and forests. Update comprehensive plans to include sea level rise considerations and greenhouse gas reduction measures.	Policy Issue	MCBP	Updates to Berlin, Ocean City and Worcester County Comprehensive Plans	Institutionalized climate change adaptation and preparedness.
CE 2.2.3 WC will consider adopting a local ordinance that disincentivizes building and rebuilding in floodplains.	Policy Issue	WC	Ordinance change,	Community safety.
CE 2.2.4 WC, OC and OP will review ongoing and existing sea level rise studies and consider making appropriate code changes to minimize property loss while maximizing public safety. If warranted, determine if code conditions exist to elevate buildings and other property.	Policy Issue	WC	Code changes	Information sharing and resource leveraging.
CE 2.2.5 WC will continue to have roadway corridor standards that will include specific recommendations for safety, aesthetics, biodiversity, transportation efficiency, stormwater management, walking/biking trails and evacuation concerns.	Within Existing Resources	WC	Roadway corridor plans	Policy recommendations.
CE 2.2.6 MCBP will pursue the designation of the Coastal Bays as an EPA Climate Ready Estuary and incorporate strategies in all planning activities and projects. For example, tidal wetland projects should allow for landward migration. Work with the DNR Hazard Assessment and Coastal Planning and local Community Emergency Response Teams.	Policy Issue	MCBP	Assess climate change vulnerabilities, develop adaptation strategies, engage and educate stakeholders	Climate Ready Estuary designation and improved community safety.
CE 2.2.7 MCBP will work with local Emergency Management professionals to develop recovery plans that support ecosystem conservation and resilience in the wake of natural disasters.	Within Existing Resources	MCBP	Emergency response recovery planning, risk reduction projects	Information sharing.
CE 2.2.8 MDP, MHT and LESHC will identify cultural resources that may be impacted by sea level rise/subsidence or other natural disasters (such as Rackliffe House, Genesar and St. Martins Church) and suggest future preservation recommendations.	Within Existing Resources	MDP	Preservation plans	Adaptive management for historic preservation.
CE 2.2.9 MDE will map and review existing underground storage facilities and hazardous materials holding tanks (ex. gas tanks) at commercial and residential sites that may be affected by storms and or sea level rise.	Within Existing Resources	MDE	Map with recommendations to move or secure tanks that hold toxic material	Better planning tools and information for haz-mat first responders. Pollution prevention.
CE 2.2.10 UME and WSCD will promote crop diversity and intensify water management as a buffer against climate-related impacts to agriculture. (i.e. more frequent summer droughts and increased winter precipitation).	Within Existing Resources	UME	Research into potential crop commodities. Resources for water management	Agricultural support for changing conditions.
CE 2.2.11 MCBP STAC will track changes in the ecosystem from climate change through monitoring chemical, ecological and spatial trends.	Research & Ecosystem Assessment	MCBP	Indicator species, chemical parameter and range of physical changes in the ecosystem	Data and trends will be useful for predictions and projections of future conditions. Use information for adaptive management.

Guidance & references

- Worcester County Sea Level Response Strategy. 2008.
- Worcester County Hazard Mitigation Plan. 2006, updated 2014).
- Draft Ocean City, Maryland Multi Hazard Mitigation Plan. 2001.

2 COMMUNITY & ECONOMIC DEVELOPMENT GOAL 2

Enhance the level of sustainability in land use decision-making

2.3 COMMUNITY & ECONOMIC CHALLENGE

Enhance coordination between Delaware, Maryland and Virginia in an effort to direct development and infrastructure away from flood zones and towards existing communities

Priority level: 2 (initiate before 2025) *Public support:* Moderate

Issue

Watersheds, ecosystems, plants and animals do not abide by political boundaries. Sustainable land use and community growth are regional and national endeavors and, as such, communication among neighboring jurisdictions can be a productive and responsible undertaking.

Solution

Sharing information regarding land use, pollution, infrastructure, coastal hazards and other pertinent issues can be accomplished through periodic conferences and communication among local, state and federal stakeholders.

The Coastal Bays watershed locator map

Action item	Category	Lead partner	Outputs (deliverables)	Outcomes (knowledge & behavior)
CE 2.3.1 MCBP will participate in periodic conferences with Delaware, Virginia and Maryland. Critical issues include ecosystem based management, ocean resources/ conflicts, GIS technology needs and technical transfer, transportation, air pollution, climate change, habitat corridors, recreation, off-shore development, power grids and water quality improvements.	Within Existing Resources	MCBP	Conference proceedings	Information sharing at a regional level.
CE 2.3.2 MCBP and EPA will continue to inform USFW, NOAA, DOI, DOE, FEMA and other federal agencies about the purpose and benefits of the National Estuary Program. Time, research and resources will be solicited to benefit the watershed.	Policy Issue	MCBP	Acquisition of technical assistance and funding for CCMP implementation	Adaptive management.

Looking from Maryland into Delaware, the need for sharing information and resources across jurisdictions becomes apparent. Photo by Jane Thomas.

3 COMMUNITY & ECONOMIC DEVELOPMENT GOAL

Educate and inform the population so it can make knowledgeable decisions for the community and its future

3.1 COMMUNITY & ECONOMIC CHALLENGE

Promote energy conservation, alternative energy production and reduce airborne pollution

Priority level: 1 (initiate before 2019) *Public support:* Moderate

Issue

Conserving energy, increasing efficiency and diversifying energy production leads not only to a cleaner environment, but also saves individuals, businesses and government money. Human health is heavily impacted by air pollution, which is a significant contributor to asthma and aggravates existing heart and lung diseases. Moreover, nearly one-third of the total nitrogen reaching the Coastal Bays is from air deposition from coal, vehicle emissions and small engines.

Solution

Investing in conservation practices, efficiency upgrades and diversifying energy sources will protect human and ecological health. Resources exist to promote education and adoption of newer technologies.

Workers install the first residential wind turbine in Ocean City on the Boardwalk at 14th Street. The new system should produce around 61,000 kilowatts of electricity each year—enough to power the condo for the summer. Photo courtesy of Ocean City Today.

Action item	Category	Lead partner	Outputs (deliverables)	Outcomes (knowledge & behavior)
CE 3.1.1 MCBP, MEA and MDE will develop educational materials on home and workplace energy conservation practices and combustion contributions to atmospheric pollution.	Education & Outreach	MCBP	Energy conservation outreach materials	Adoption of clean energy technology.
CE 3.1.2 MEA will advance the use of clean energy sources such as geothermal, solar and wind.	Within Existing Resources	MEA	Resources for local communities & businesses	Investments in clean energy to stimulate the local economy.
CE 3.1.3 MCBP and Berlin will pursue opportunities for residents, businesses and local governments to conserve energy through the EmPOWER Maryland Program.[3]	Within Existing Resources	MCBP	Resources for energy and water conservation	Reduction in greenhouse gas emissions, more affordable energy through efficiency upgrades.
CE 3.1.4 DNR will explore the feasibility and potential of expanding precipitation chemistry parameters at the National Atmospheric Deposition site at Assateague State Park to include greenhouse gases. Consider the utility of collecting data for carbon dioxide, ozone, particulates, nitrous oxides, methane, fluorinated gases, etc. Assateague NPS will continue to operate the NADP site which is part of the partnership between NPS, DNR and Worcester County	Research & Ecosystem Assessment	DNR	Status and trends of atmospheric deposition since 2000. Expanded monitoring parameters to measure change over time.	Reduction in greenhouse gases (25% by 2020 GGRP).[4]

Guidance & references

- Maryland Energy Administration website *energy.maryland.gov/facts/empower.html*
- National Atmospheric Deposition Monitoring.
- Maryland Department of the Environment. 2013. Greenhouse Gas Reduction Act Plan
- EmPOWER Maryland.

3. The Maryland Energy Administration's 'EmPOWER Maryland' initiative seeks to reduce energy consumption by 15% by 2015. To help achieve this goal, MEA encourages residents to adopt the energy saving measures that are most appropriate for their home. Utility companies are offering programs and rebates as incentives to reduce energy use.
4. The 2012 Greenhouse Gas Emissions Reduction Act (GGRA) Plan fulfills the mandate to propose a plan that achieves a 25% statewide reduction in GHG emissions by 2020, while also spurring job creation and helping improve the economy. The GGRA also requires a report in 2015 that, amongst other things, requires MDE to provide a recommendation on what the State's longer term reduction target should be. In 2008, the Maryland Commission on Climate Change recommended that Maryland consider a 2050 goal as high as a 90% reduction from 2006 levels. This plan spurs reductions in GHGs through incentives that increase energy efficiency using existing technologies, and identifies ways to transition to new energy sources and stimulate further technology development.

3 COMMUNITY & ECONOMIC DEVELOPMENT GOAL

Educate and inform the population so it can make knowledgeable decisions for the community and its future

3.2 COMMUNITY & ECONOMIC CHALLENGE

Increase public and stakeholder participation in local, state and federal decision-making.

Priority level: 1 (initiate before 2019) *Public support:* Low

Issue

An informed and engaged public is central to our democratic ideals. Natural resource managers, local decision makers and federal administrators count on public participation to develop and implement fair rules, educational materials and effective programs to serve all stakeholders. Developing relationships between local individuals and groups begins at the community level to articulate local problems and propose local solutions. Communities rely on county, state and federal resources to assist with addressing the problems and instituting cost effective and feasible projects.

Solution

The Coastal Bays Program is a consensus-based group that seeks to conserve, protect and restore the watershed. It is the privilege and responsibility of the group (citizens, businesses, special interest groups and all levels of government) to work together to share information and concerns. Our quality of life and economic stability depend on 'we the people' to act as responsible stewards of our natural resources. Many small victories have already been accomplished and cumulatively the region is improving. Vigilance and planning is as much a constant need as is change inevitable.

Clean water is defined as being swimmable and fishable. Photo by Maryland Coastal Bays Program.

Citizens, stakeholders and decision-makers are provided a tour of the back bays to learn about restoration and preservation projects. Photo by Sandi Smith.

Action item	Category	Lead partner	Outputs (deliverables)	Outcomes (knowledge & behavior)
CE 3.2.1 MCBP will identify and implement high priority Work Plan/CCMP actions and develop outreach and education programs to support those efforts.	Within Existing Resources	MCBP	EPA required Work Plans	Transparency and collaborative goal setting.
CE 3.2.2 MCBP will conduct surveys to gather data on citizen perceptions, concerns and understanding of watershed conditions.	Within Existing Resources	MCBP	Community surveys and needs assessment	Topics of interest & concern will serve as the basis of a communication plan.
CE 3.2.3 MCBP will develop, implement and refine a communication plan to inform residents, stakeholders and government officials about the resources of the Coastal Bays including the economic and ecological value of these resources and threats to the continued viability and quality of life. Annual presentations should be considered to keep the community informed of reports & publications (e.g. Report Cards, State of the Bays Reports, etc.).	Within Existing Resources	MCBP	EPA required communication plan and associated reports and outreach materials. Multi-lingual products should be pursued whenever possible.	Citizens, stakeholders and partners are well informed and share information and resources, specific behavior changes identified & tracked.

Action item	Category	Lead partner	Outputs (deliverables)	Outcomes (knowledge & behavior)
CE 3.2.4 MCBP will keep local, state and federal governments engaged in improving the condition of the Coastal Bays by holding frequent in-person meetings with partners and making every effort to facilitate and promulgate partners projects and policies.	Policy Issue	MCBP	Meetings & presentations, approval from partners on priority projects	Program accomplishments and annual work plan (# of presentations given).
CE 3.2.5 MCBP will develop, implement and expand public involvement and education projects or programs based on CCMP priorities, public interest, pollution prevention, resource availability and other opportunities that arise, (e.g. Harbor Day at the Docks). Facilitate awareness and transferal of public opinions and Program partner's initiatives. Establish a suite of social indicators; (ex., recycling rates, acres preserved/enhanced, visitor/tourism numbers, agricultural production, etc.).	Within Existing Resources	MCBP	EPA required Public Involvement Plan with metrics and social indicators	Measures of public support and feedback.
CE 3.2.6 MCBP will offer volunteer opportunities to the community via property management, wildlife surveys, events and meetings. Create a calendar of volunteer events to include monitoring (reptiles, terrapins, birds, horseshoe crabs, water quality, seals, seagrass ground-truthing), tree plantings, invasive species control, trail and park maintenance, etc. Maintain a year-round program of outreach and feedback.	Education & Outreach	MCBP	Calendar of volunteer/citizen science events, meetings and educational lectures.	Informed community and increased participation rates, total volunteer hours/year. Monitoring and restoration assistance.
CE 3.2.7 MCBP will support the WC School Board with resources and curricula development for environmental literacy and facilitate meaningful outdoor experiences for K-12 students.	Education & Outreach	MCBP	Teacher trainings and outdoor experiences.	Improved environmental literacy and participation.
CE 3.2.8 MCBP will periodically update and distribute the Homeowner's Guide to the Coastal Bays to inform citizens about local resources and how to enhance sustainability.	Education & Outreach	MCBP	Homeowners Guide to the Coastal Bays.	Adoption of best management practices by homeowners.
CE 3.2.9 MCBP will utilize the Citizens Advisory Committee to seek comments/ideas on annual work projects, present accomplishments such as mini grant results and gather input on local issues of concern. The CAC will appeal to and engage multiple stakeholders groups and diverse audiences.	Education & Outreach	MCBP	At least two CAC meetings per year. Meeting minutes and surveys for feedback will inform project ideas and priority setting.	Enhanced and expanded volunteer base. Increased support for environmental protection policies and restoration projects.
CE 3.2.10 MCBP outreach efforts will target underserved communities and those affected most by environmental degradation.	Education & Outreach	MCBP	Outreach materials, projects and support for environmental justice efforts.	Expanded public decision making by marginalized groups, fair distribution of resources.
CE 3.2.11 MCBP, EPA, DNR and NPS will continue to support the Coastal Stewards outdoor summer employment program for local high school and college students.	Education & Outreach	MCBP	Experiences in education, interpretation, restoration, conservation and environmental stewardship.	Promotion of stewardship and appreciation of local history, cultural and natural resources.
CE 3.2.12 MCBP will continue to recognize the lifetime contributions of citizens devoted to conservation and protection through the Osprey Award. Work with other businesses and civic group with similar programs (ex. Worcester County Green Awards).	Within Existing Resources	MCBP	Guidelines and nomination form for Osprey Award. Provide nominations and technical resources for similar community efforts	Recognition of deserving individuals, businesses and groups.
CE 3.2.13 MCBP Scientific and Technical Advisory Committee will develop a long-term Science Agenda and the State of the Coastal Bays report every five years.	Research & Ecosystem Assessment	MCBP	MCBP Science Agenda, Maryland Coastal Bays Report	Technical transfer, leveraging knowledge and resources, science-based information for decision making.

Acronyms used in this chapter

CAC: Citizens Advisory Committee
CCMP: Comprehensive Conservation and Management Plan
DNR: Department of Natural Resources
DOI: Department of Interior
DOE: Department of Environment
EPA: Environmental Protection Agency
FEMA: Federal Emergency Management Agency
GIS: Geographic Information System
LESHC: Lower Eastern Shore Heritage Committee
MCBP: Maryland Coastal Bays Program
MCBP STAC: Maryland Coastal Bays Program Scientific and Technical Advisory Committee
MDA: Maryland Department of Agriculture
MDE: Maryland Department of Environment
MDP: Maryland Department of Planning
MEA: Maryland Energy Administration
MHT: Maryland Historical Trust
NADP: National Atmospheric Deposition Program
NOAA: National Oceanic Atmospheric Administration
NPS: National Park Service
OC: Ocean City
OP: Ocean Pines
SHA: Safe Harbor Agreements
SU-BEACON: Salisbury University, Business Economic and Community Outreach Network
UME: University of Maryland Extension
USFW: United States Fish and Wildlife Service
WC: Worcester County
WSCD: Worcester Soil Conservation District

Fishing is a vital element of the Coastal Bays' economy. Photo by Allen Sklar.

6. Coastal Resiliency

Resilience is all about being able to overcome the unexpected. Sustainability is about survival. The goal of resilience is to thrive.
Jamais Cascio

Superstorm Sandy caused localized flooding throughout the watershed, including here at Kitt's Branch. Photo by Dave Wilson.

The Great Recession, superstorms and nor'easters, oil spills, droughts, land subsidence and sea level rise are all examples of how our communities can be exposed to different areas of vulnerability. Resiliency is the ability to bounce back from natural and human-induced disasters as well as the ability of the ecosystem to recover. Furthermore, questions about our longer term capacity to continue our agricultural and tourism based economy in the face of expanding populations are worthy of consideration.

Are we agile enough to thrive during times of adversity? Are we robust enough to find opportunities for improvement before and after a harmful event?

Many potential scenarios have been studied and local planning documents include the Worcester County Hazard Mitigation Plan Update (2014) and the Ocean City All Hazards Mitigation Plan Update (2011). Emergency Planning Guides and Response Trainings are available for every citizen and business. Staff and equipment are in place to lessen the peril and anxiety that arise from the natural volatility of life.

This chapter is a compilation of actions that may provide another perspective for discussions and scenario evaluation to strengthen our coastal resiliency and response agility. The community should study and supplement existing practices to help us prepare for, respond to and rapidly recover from significant environmental and ecological damage to our community.

CCMP ACTIONS THAT ADDRESS COASTAL RESILIENCY				
Action item	**Category**	**Lead partner**	**Outputs (deliverables)**	**Outcomes (knowledge & behavior)**
WQ 1.1.1 WC will implement a proactive program to identify and replace failing septic systems with best available technology systems. The proactive program should identify soil types prone to failure, as well as aged tanks due for inspection and recertification by septic haulers. Whenever possible, septics should be placed in such a way as to avoid storm inundation or subsidence from sea level rise.	Within Existing Resources	WC	Database of all septic systems	Priority Plan for upgrades—include a description of existing high septic use areas, ranking for upgrades and capital fund estimates.
WQ 1.2.1 MCBP will work to revive interest and funding for the proposed "Sustainability of the Ground Water Resources in the Atlantic Coastal Plain" study to produce a regional groundwater flow model of the Coastal Plain deep aquifer as well as a local model for Worcester County. The model could also be used to simulate the impacts of changes in groundwater recharge and discharge patterns induced by climate change and sea-level rise.	Research & Ecosystem Assessment	MCBP	Groundwater sustainability model for the Coastal Bays region	Ecosystem prediction and response.
WQ 1.2.4 NPS will identify baseline groundwater conditions and develop a protocol to monitor and assess changes in the island's ground water resources related to climate variability.	Research & Ecosystem Assessment	NPS	Status and trends of Assateague Island groundwater resources	Ecosystem prediction and response.
WQ 1.4.1 Berlin will maintain, and OC will explore, stormwater utilities or other alternatives to fund improvements and long-term maintenance of conveyances, structures and natural spaces to prevent flooding and treat stormwater for volume and water quality. WC should follow municipal examples for other areas in the county.	Legislative	Berlin, OC	Stormwater utilities	Resolve flooding issues. Establish a dedicated funding source for green infrastructure improvements and maintenance.
WQ 1.4.2 WC, OC and Berlin will form a unified approach in tracking the cumulative new stormwater runoff volumes resulting from BMP retrofits within the watershed. They will also track reductions for credit under state stormwater management guidelines.	Policy Issue	WC	Evaluation and tracking report for stormwater infrastructure. Create a database and map for improvements, report changes as CoastSTAT data	Improved municipal and county coordination.
WQ 1.4.3 WC will investigate the amount of pre-1984 development in order to estimate the need for stormwater retrofits, provided grant funding is available.	Policy Issue	WC	Indicator tracking: amount financial assistance secured, number of acres treated	Determine and prioritize retrofit needs and opportunities.
WQ 1.4.4 MDP and WC will monitor changes in total impervious surfaces over time. Sub-watersheds with more than 10% impervious surface should be ranked for restoration, areas ranked as <10% should be targeted for preservation.	Research & Ecosystem Assessment	MDP	Baseline of imperviousness	Percent change over time, effectiveness of effort.
WQ 1.4.7 MCBP will promote the retention of wetlands and buffers in riparian zones and along existing stream contours. Existing developed areas (ex. parking lots) will be targeted for pervious retrofits or other infiltration practices.	Education & Outreach	MCBP	Public workshops, native vegetation plantings opportunities and sponsoring of impervious retrofits. Continued beach, shoreline and wetland clean-ups	Increase in buffer areas and infiltration practices.
WQ 1.5.7 MCBP, MDA, NRCS and other partners will encourage and pursue grant funding for BMPs, farmland conservation and other programs in most affected watersheds to support local agriculture.	Policy Issue	MCBP	Funding directed to the watershed (including from MDA Animal Waste Technology Fund, Ag Energy Efficiency Program , etc.)	Economic development and community resiliency

Action item	Category	Lead partner	Outputs (deliverables)	Outcomes (knowledge & behavior)
WQ 2.1.5 NPS ASIS will continue to pursue saltmarsh restoration and monitoring projects such as ditch plugging and filling, marsh elevation studies and nekton monitoring to restore natural conditions and document long-term changes within salt marshes along Assateague Island.	Within Existing Resources	NPS	Summary of natural salt marsh status and trends, including monitoring of PCBs, PAHs and DDT	Restore saltmarsh hydrology and ecological function, build resiliency, document long-term change.
WQ 2.1.6 MCBP will develop public education pieces as part of integrated stormwater management for flood control, mosquito reduction and wildlife habitat enhancement.	Education & Outreach	MCBP	Educational piece	Improved public awareness and understanding of local ecosystem conditions.
WQ 2.1.7 WC will continue to hold hazardous waste disposal programs for farm and residential hazardous materials, including pesticides and fouled gasoline.	Within Existing Resources	WC	Indicator tracking: Volume & types of waste collected	Program evaluation, fish tissue & sediment monitoring for toxins, pharmaceuticals and household products.
WQ 2.1.8 MDE and WC will conduct a study to identify potential toxic risks (landfills, underground storage tanks for oil, gas, chemicals, etc.) and other land uses that may be affected by sea level rise and/or land subsidence. Add this information to the County Hazardous Mitigation Plan.	Within Existing Resources	WC	Maps and study of potential toxin sites that may be impacted	Informed planning and prediction scenarios.
FW 2.1.5 DNR will research the effects of warming temperatures, brown tide and sea level rise on seagrass abundance.	Research & Ecosystem Assessment	DNR	Impact study	Coastal resiliency information.
FW 2.2.1 DNR will contract with VIMS to repeat the shoreline inventory of 2004 to determine the change in hardened versus soft shorelines. Set a target for reducing hardened shoreline throughout the watershed.	Research & Ecosystem Assessment	MCBP	Shoreline study (baseline = 52% hardened as of 2004)	Change in landscape over time.
FW 2.2.3 DNR and others will determine the extent of marshes, the potential for marsh migration in response to sea level rise, and the economic value of ecosystem services.	Research & Ecosystem Assessment	DNR	Ecosystem valuation	Return on investment data.
FW 2.2.4 DNR (Chesapeake & Coastal Services) will coordinate with WC to implement protections identified in the Blue Infrastructure Near-Shore Assessment; a detailed spatial evaluation of coastal habitat, critical natural resources and associated human uses in tidal waters and near-shore areas. Consider ways to monitor sea level rise and implement protective measures to maintain habitats.	Restoration & Conservation	DNR	Technical assistance (GIS data, training, maps, etc.)	Protection and maintenance of near shore habitats to permit species and habitat migration.
FW 2.2.7 WC will continue to work with existing partners and programs such as Rural Legacy, Forest Legacy, Program Open Space and The Nature Conservancy to protect natural shorelines and adjacent landward areas through the purchase of development rights, shoreline easements or 'fee simple' purchases.	Within Existing Resources	WC	Acres or linear feet of protection	Natural shorelines will be able to naturally migrate as sea level rises.
FW 2.2.8 MCBP will work with EPA, NOAA, ACOE and UMCES to develop user-friendly indicators of storm severity (ex. hours/days above predicted high tide, king tide affects)	Within Existing Resources	MCBP	Storm severity indicators	Coastal Resiliency information.
FW 2.2.9 MCBP will work with NOAA, EPA, NPS, DNR, WC and OC to monitor and document actual sea level rise.	Within Existing Resources	MCBP	Community measures of sea level rise	Determine local measurements and compare to regional projections.
FW 2.2.10 MCBP and partners work to clarify and confirm differences in known flooding issues, sea level rise and the draft FEMA Flood Insurance Rate Maps (FIRMs). Conduct outreach to the community to inform them of the changes and how it may affect them.	Education & Outreach	MCBP	Discussion and understanding of the FIRMs, how they may differ from actual observed conditions and how they may or may not relate to sea level rise or land subsidence.	Community understanding of the differences amongst the various issues and how they may relate to their own property and the community in general.

Action item	Category	Lead partner	Outputs (deliverables)	Outcomes (knowledge & behavior)
FW 3.1.1 MCBP will facilitate discussions with USGS and MGS to fully fund the watershed's two stream gauges at Birch Branch and Bassett Creek. The long-term data sets generated by these gauges are necessary for determining water and nutrient budgets as well as supporting project evaluation and ecosystem changes.	Policy Issue	MCBP	MOU to fully fund stream gauge stations and/or a commitment to secure funding	Decreased nutrient and bacteria levels to meet TMDL allocations and/or state water quality criteria. Ecosystem response evaluation for watershed changes due to projects and climate.
FW 3.1.5 DNR-MBSS will assist MCBP in identifying aquatic areas that are most vulnerable to climate change and make recommendations for protection.	Research & Ecosystem Assessment	DNR	Identification of sensitive areas	Climate change projections.
FW 3.3.8 DNR will help WC, Ocean City and Berlin to establish urban tree canopy goals and identify areas for projects. The 2013 Forest Preservation Act commits Maryland to maintaining or tree canopy cover at 40 percent.	Research & Ecosystem Assessment	DNR	Comparison of local tree canopy cover to state wide percentage and established goals at or above 40%.	Project areas and priorities, mitigation of carbon emissions.
FW 4.1.8 DNR and ACOE will continue to perform periodic renourishment per the Atlantic Coast Project authorization in order to maintain beaches and dunes for storm damage reduction.	Within Existing Resources	DNR	Leveraging. ACOE designs and manages dredging. MD is the lead, OC is support.	Property and infrastructure protection from storms and floods.
RN 1.1.1 WC will investigate the potential consequences of storm inundation and sea level rise (up to 2 feet by 2050) on marinas, launch ramps and other marina related facilities.	Within Existing Resources	WC	Water access report—compare with results of RN 4.1.3 Waterway Improvement Benefits, Needs & Opportunities report.	Planning & maintenance information.
RN 1.1.6 MCBP, USCG-Auxiliary, DNR and MDE will collaborate on educational efforts regarding hazardous materials spill response capabilities, first responders contact information, safety and disposal methods for local marinas and the boating public. Contact numbers will be checked annually.	Education & Outreach	MCBP	Spill response plan for boaters & marinas	Increase in public knowledge of which first responders to contact in the event of an emergency.
RN 2.1.1 DNR will revisit the Sensitive Areas research gaps and needs outlined by the technical task force and create a plan for addressing and prioritizing those needs. (e.g. shoreline changes, fish blockages, island habitats, harmful algae blooms, sea level rise, etc.).	Research & Ecosystem Assessment	DNR	Updated Sensitive Areas/Blue Infrastructure Report with management recommendations	Informed planning for adaptive management, increased use of DNR Coastal Atlas mapping tool for estuaries.
CE 1.1.2 MDP will determine the cost of sprawl in the watershed, including the impacts to air & water quality, greenhouse gases, affordable housing and public health. Examine the impacts of different land uses on county finances and determine the return on investment of public dollars.	Within Existing Resources	MDP	Return on investment of public infrastructure to support compact development.	Efficiency of public funding among land use sectors.
CE 1.1.3 MCBP will produce educational materials based on the results of CE 1.1.1 through CE 1.1.3 regarding the economic importance of protecting wetlands, marshes, dunes, forests, farmland and cultural resources to ensure cultural integrity, community safety and economic viability of the Coastal Bays region.	Education & Outreach	MCBP	Educational materials	Improved resource appreciation and coastal resiliency.
CE 1.1.9 DNR will assist MCBP in developing implementation strategies for promoting ecosystem service markets such as forest, species and habitat banks, wetland mitigation banks, carbon sequestration and nutrient trading and biomass-based carbon sequestration and fuel production.	Within Existing Resources	DNR	Establishment of ecosystem service markets and credits	Natural resources based economic development. Improved protection of natural resources based on economic valuation and demand for ecosystem services.

Action item	Category	Lead partner	Outputs (deliverables)	Outcomes (knowledge & behavior)
CE 2.1.1 WC will develop and track changes in land use indicators including land use/land cover, impervious surfaces, amount of development occurring inside and outside of County Growth Areas/Priority Funding Areas, % water and wastewater capacity, % school capacity, septic tank upgrades and stormwater reductions.	Within Existing Resources	WC	Suite of land use indicators for change over time (ex. percent growth within vs. outside of PFAs)	Informed planning.
CE 2.1.2 WC, OC, Berlin, SHA and MDP will encourage aesthetically pleasing and ecologically beneficial low impact developments, such as streetscapes, parking facilities, commercial architectural standards and walkable/bikeable access between residential and commercial areas.	Within Existing Resources	WC	Design standards, education & outreach materials regarding waivers and special exceptions	Increased use of low impact techniques, reduced greenhouse gas emissions, healthier communities.
CE 2.1.3 WC will continue to retain strong A-1 and Rural Preservation zoning to protect natural and cultural resources.	Within Existing Resources	WC	Zoning principles	Protection of agricultural and cultural land uses.
CE 2.2.1 WC will evaluate the 2008 Sea Level Response Strategy and consider revising and implementing its recommendations. Start by identifying and prioritizing actions and strategies aimed at building resilience.	Within Existing Resources	WC	Revised Worcester County Sea Level Response Strategy and public workshops	Informed planning, priority setting for project plans.
CE 2.2.2 MCBP will work with city, county and state officials to ensure planning efforts include adaptation to climate change to protect infrastructure, public health, agriculture, wetlands and forests. Update comprehensive plans to include sea level rise considerations and greenhouse gas reduction measures.	Policy Issue	MCBP	Updates to Berlin, Ocean City and Worcester County Comprehensive Plans	Institutionalized climate change adaptation and preparedness.
CE 2.2.3 WC will consider adopting a local ordinance that disincentives building and rebuilding in floodplains.	Policy Issue	WC	Ordinance change,	Community safety.
CE 2.2.4 WC, OC and OP will review ongoing and existing sea level rise studies and consider making appropriate code changes to minimize property loss while maximizing public safety. If warranted, determine if code conditions exist to elevate buildings and other property.	Policy Issue	WC	Code changes	Information sharing and resource leveraging.
CE 2.2.5 WC will continue to have roadway corridor standards that will include specific recommendations for safety, aesthetics, biodiversity, transportation efficiency, stormwater management, walking/biking trails and evacuation concerns.	Within Existing Resources	WC	Roadway corridor plans	Policy recommendations.
CE 2.2.6 MCBP will pursue the designation of the Coastal Bays as an EPA Climate Ready Estuary and incorporate strategies in all planning activities and projects. For example, tidal wetland projects should allow for landward migration. Work with the DNR Hazard Assessment and Coastal Planning and local Community Emergency Response Teams.	Policy Issue	MCBP	Assess climate change vulnerabilities, develop adaptation strategies, engage and educate stakeholders	Climate Ready Estuary designation and improved community safety.
CE 2.2.7 MCBP will work with local Emergency Management professionals to develop recovery plans that support ecosystem conservation and resilience in the wake of natural disasters.	Within Existing Resources	MCBP	Emergency response recovery planning, risk reduction projects	Information sharing.
CE 2.2.8 MDP, MHT and LESHC will identify cultural resources that may be impacted by sea level rise/subsidence or other natural disasters (such as Rackliffe House, Genesar and St. Martins Church) and suggest future preservation recommendations.	Within Existing Resources	MDP	Preservation plans	Adaptive management for historic preservation.
CE 2.2.9 MDE will map and review existing underground storage facilities and hazardous materials holding tanks (ex. gas tanks) at commercial and residential sites that may be affected by storms and or sea level rise.	Within Existing Resources	MDE	Map with recommendations to move or secure tanks that hold toxic material	Better planning tools and information for haz-mat first responders. Pollution prevention.

Action item	Category	Lead partner	Outputs (deliverables)	Outcomes (knowledge & behavior)
CE 2.2.10 UME and WSCD will promote crop diversity and intensify water management as a buffer against climate-related impacts to agriculture. (i.e. more frequent summer droughts and increased winter precipitation).	Within Existing Resources	UME	Research into potential crop commodities. Resources for water management	Agricultural support for changing conditions.
CE 2.2.11 MCBP STAC will track changes in the ecosystem from climate change through monitoring chemical, ecological and spatial trends.	Research & Ecosystem Assessment	MCBP	Indicator species, chemical parameter and range of physical changes in the ecosystem	Data and trends will be useful for predictions and projections of future conditions. Use information for adaptive management.
CE 2.3.1 MCBP will participate in periodic conferences with Delaware, Virginia and Maryland. Critical issues include ecosystem based management, ocean resources/ conflicts, GIS technology needs and technical transfer, transportation, air pollution, climate change, habitat corridors, recreation, off-shore development, power grids and water quality improvements.	Within Existing Resources	MCBP	Conference proceedings	Information sharing at a regional level.
CE 3.1.1 MCBP, MEA and MDE will develop educational materials on home and workplace energy conservation practices and combustion contributions to atmospheric pollution.	Education & Outreach	MCBP	Energy conservation outreach materials	Adoption of clean energy technology.
CE 3.1.2 MEA will advance the use of clean energy sources such as geothermal, solar and wind.	Within Existing Resources	MEA	Resources for local communities & businesses	Investments in clean energy to stimulate the local economy.
CE 3.1.3 MCBP and Berlin will pursue opportunities for residents, businesses and local governments to conserve energy through the EmPower Maryland Program.	Within Existing Resources	MCBP	Resources for energy and water conservation	Reduction in greenhouse gas emissions, more affordable energy through efficiency upgrades.
CE 3.1.4 DNR will explore the feasibility and potential of expanding precipitation chemistry parameters at the National Atmospheric Deposition site at Assateague State Park to include greenhouse gases. Consider the utility of collecting data for carbon dioxide, ozone, particulates, nitrous oxides, methane, fluorinated gases, etc. Assateague NPS will continue to operate the NADP site which is part of the partnership between NPS, DNR and Worcester County	Research & Ecosystem Assessment	DNR	Status and trends of atmospheric deposition since 2000. Expanded monitoring parameters to measure change over time.	Reduction in greenhouse gases (25% by 2020 GGRP).

7. Public Involvement Plan & Communication Strategy

An enlightened citizenry is indispensable for the proper functioning of a republic. Self-government is not possible unless the citizens are educated sufficiently to enable them to exercise oversight.
—Thomas Jefferson

Volunteers provided more than 200 hours to plant 1,130 trees during the Bishopville Dam restoration. This project allows fish to access the nearly seven miles of stream habitat above the dam. Photo by Amanda Poskaitis.

The Coastal Bays Program is set up to serve as independent, consensus-driven, community information clearinghouse for schools, businesses, researchers, government and the public. Two of the most important functions of the Program are providing hands-on activities in the watershed and sharing information in a meaningful way. Equally important is our ability to gather information about local environmental and regulatory concerns and convey those messages to decision makers. This non-advocacy approach works with every segment of society and is a place to share concerns without fear of retaliation or litigation.

A thoughtful strategy to communicate information to target audiences by variable avenues promotes involvement. Volunteer opportunities to participate in research and restoration have provided exponential benefits not only in economic savings but perhaps more importantly in community appreciation and long-term stewardship. The public's attitudes, perceptions, beliefs and knowledge can have a profound effect on our success. While science serves as the foundation of our management plan, stakeholders are ultimately the ones who are most impacted by our decisions. Having the public weigh in on our efforts should:

- Produce better outcomes or decisions
- Garner public support for projects, agencies and decisions
- Provide new local knowledge about the watershed
- Increase public understanding of natural resources
- Reduce or resolve conflicts between stakeholders
- Ensure implementation of new programs or policies
- Increase compliance with laws and regulation
- Help partners to understand practical flaws in existing management strategies
- Create new relationships that may result in more successful projects and outcomes

Below is a compilation of all actions that have been categorized as Education & Outreach as well as others that are closely linked with on-going activities. Note that as scientific information, policy issues and restoration actions are accomplished that they too will be communicated to interested parties.

CCMP ACTIONS THAT ADDRESS EDUCATION AND OUTREACH

Action item	Category	Lead partner	Outputs (deliverables)	Outcomes (knowledge & behavior)
WQ 1.1.4 MCBP and WC will develop a program to ensure regular pump-outs and maintenance of residential septic systems. Septic haulers will provide electronic reporting on pumping activity for tracking and monitoring purposes as well as certifications that septic systems are functioning properly. WC will mail notices to homeowners & use the septic tracking system to monitor the volume of septage treated. MCBP will develop educational materials linking septic nutrients to watershed eutrophication.	Education & Outreach	MCBP	Pump out notices and other educational materials that explain the role of septics in rural areas and their potential for pollution	Increased number of pump outs.
WQ 1.1.6 WC and MDE will work cooperatively on incentives or other programs to encourage the use of Best Available Technology for enhanced nitrogen removing septic systems with appropriate monitoring and maintenance schedules.	Education & Outreach	WC	Funding or other incentives that may be leveraged for enhanced nutrient removing septic systems	Funding value leveraged over time, net increase in best available technology systems versus the net decrease in nutrient pollution.
WQ 1.2.7 UME will educate the public about water conservation practices. Target high volume water users and gray water reuse systems.	Education & Outreach	UME	Educational pamphlets	Water conservation.
WQ 1.3.1 UME will educate local professional grounds managers and landscapers about fertilizer reduction programs.	Education & Outreach	UME	Workshop(s), citizen survey regarding use of landscapers & fertilizer knowledge	Reduced non-point source nutrient runoff.
WQ 1.3.2 UME will update and disseminate the Voluntary Golf Course Guidelines to reflect changes in the phosphorus free fertilizer law.	Education & Outreach	UME	Dissemination of document	Reduced non-point source nutrient runoff.
WQ 1.3.3 MCBP will produce outreach materials and education to citizens to supplement state and local efforts to reduce over-fertilization of lawns. The state chemist will be consulted for periodic estimation of fertilizer sales in the county.	Education & Outreach	MCBP	Speaking engagements	Social indicator – change in fertilizer use over time.
WQ 1.4.7 MCBP will promote the retention of wetlands and buffers in riparian zones and along existing stream contours. Existing developed areas (ex. parking lots) will be targeted for pervious retrofits or other infiltration practices.	Education & Outreach	MCBP	Public workshops, native vegetation plantings opportunities and sponsoring of impervious retrofits. Continued beach, shoreline and wetland clean-ups	Increase in buffer areas and infiltration practices.
WQ 1.5.5 MCBP will foster a greater appreciation of farming by informing the public about right to farm laws and the positive changes farmers are implementing to protect natural resources while producing food and fiber.	Education & Outreach	MCBP	Newsletters, public service announcements, press releases, collaborative projects with local farmers	Conflict resolution.
WQ 2.1.1 MCBP and UME will encourage all farms, golf courses, recreational areas and homeowners associations to have integrated pest management plans. Outreach will be implemented by disseminating information on the identity and avoidance of vectors and pests, and by sponsoring demonstration sites.	Education & Outreach	MCBP	Outreach materials regarding pests and disease vectors. Establish demonstration sites.	Protection of public health and prevention of environmental degradation.
WQ 2.1.2 MCBP and UME will promote educational opportunities (i.e. bird/bat house designs) and encourage homeowners to foster natural insect control such as bats and purple martins.	Education & Outreach	MCBP	Hands on educational opportunities	Community involvement in pest management.
WQ 2.1.6 MCBP will develop public education pieces as part of integrated stormwater management for flood control, mosquito reduction and wildlife habitat enhancement.	Education & Outreach	MCBP	Educational piece	Improved public awareness and understanding of local ecosystem conditions.

Action item	Category	Lead partner	Outputs (deliverables)	Outcomes (knowledge & behavior)
FW 1.1.4 DNR will continue to improve the quality and timeliness of commercial landings reports by implementing online, multi-platform tools for real-time reporting for finfish and shellfish, including crabs.	Within Existing Resources	DNR	Electronic reporting tools	Improved cooperation with watermen and stakeholders. Improved stock assessment.
FW 1.1.5 DNR will provide the public with annual updates of harvest results to commercial and recreational stakeholders (including species landed and economic impact) for educational and ecological purposes.	Education & Outreach	DNR	Annual harvest reports to be shared with the public. Percent change over time in harvests. Also use DNR quarterly newsletters	Stakeholder feedback, economic valuation of local fisheries.
FW 1.1.6 DNR will investigate the feasibility of developing alternative methods of volunteer recreational harvest sampling including but not limited to logbooks and web-based surveys.	Research & Ecosystem Assessment	DNR	Volunteer input regarding recreational harvest	Stakeholder involvement and volunteer opportunities.
FW 1.3.1 DNR will work with MCBP to implement RN 1.1.2 to enhance public awareness of public access points.	Education & Outreach	DNR	Updated Coastal Bays Boaters Guide	Social Indicator: Public access in linear feet or acres.
FW 1.3.3 DNR will work to improve the angler recruitment program by investigating the use of community-based social marketing techniques to improve license sales and promote conservation.	Education & Outreach	DNR	Increased participation and license sales	Social Indicator: Valuation of recreational fishing via counts of licenses purchased.
FW 1.3.4 DNR and MCBP will educate anglers on size and creel limits and encourage responsible fishing practices such as catch-and-release, innovative hook designs and other best practices.	Education & Outreach	DNR	Dissemination of fishing guides & boat rulers	Regulatory compliance while promoting the appreciation of and respect for nature.
FW 1.4.2 MCBP will educate the public about aquaculture, underwater leasing and the maritime heritage of the Coastal Bays.	Education & Outreach	MCBP	Newspaper articles, presentations to homeowners and other stakeholders about successful efforts	Reduced conflict between watermen and waterfront property owners.
FW 1.5.1 DNR and MCBP will protect horseshoe crab populations by promoting the protection of bay beaches and other bottom habitats and promote volunteer monitoring of spawning populations throughout the coastal bays.	Within Existing Resources	MCBP	Annual spawning survey report	Protection of beach habitats, public stewardship & involvement, HSC management plan data.
FW 1.5.3 MCBP will continue terrapin counts and promote the use of cull rings and Turtle Exclusion Devices (TEDs) on all recreational pots. Data will be shared with the Terrapin Work Group	Research & Ecosystem Assessment	MCBP	Terrapin counts & promotion of excluders for retailers/ public	Increased public participation & stewardship, improved population estimates.
FW 1.5.4 DNR will continue to facilitate stakeholder meetings to share information and collect feedback.	Within Existing Resources	DNR	Information regarding policy effects & conflict resolution	Public outreach & involvement. Consensus & buy-in for adaptive management, communication among committees.
FW 1.5.5 DNR and MCBP will educate anglers on the purpose of biological reference points, quota divisions and control measures for sustainable yields.	Education & Outreach	DNR	Dissemination of information about reference points, quotas and yields.	Improved awareness of resources.
FW 1.5.6 DNR and MCBP will continue to use all available tools for communication, including social media and multi-lingual communication tools	Education & Outreach	DNR	Fisheries outreach content and products for multiple audiences.	Increased awareness of resource protection. Audience diversity, balance of diverse interests.
FW 1.5.7 DNR will provide information regarding Highly Migratory Marine Species (population estimates, sustainable harvest, economic value of local tournaments, protection efforts)	Within Existing Resources	DNR	Linkages between bay and ocean ecosystems	Public awareness. Tie near-shore and off-shore data together for adaptive management.

Action item	Category	Lead partner	Outputs (deliverables)	Outcomes (knowledge & behavior)
FW 1.5.8 MCBP will continue to assist the Marine Mammal Stranding Program, the National Aquarium, DNR and other groups with local educational and volunteer efforts (ex. seal sightings, dolphin counts, Coastal Clean-ups,etc.)	Education & Outreach	MCBP	Data and education & outreach products	Coordination with partner efforts, shared data. Increased public stewardship & volunteer opportunities.
FW 2.1.4 MCBP will educate residents, businesses and marina patrons to avoid SAV beds.	Education & Outreach	MCBP	Poster, signs, outreach meetings	Protection of SAV.
FW 2.2.6 Using the above resources map data base WC and MCBP will produce reference documents to identify resource management issues and educate elected and appointed officials. Include background information about conservation laws and regulations in effect locally.	Education & Outreach	WC	Reference documents and maps	Informed decision makers.
FW 2.2.10 MCBP and partners work to clarify and confirm differences in known flooding issues, sea level rise and the draft FEMA Flood Insurance Rate Maps (FIRMs). Conduct outreach to the community to inform them of the changes and how it may affect them.	Education & Outreach	MCBP	Discussion and understanding of the FIRMs, how they may differ from actual observed conditions and how they may or may not relate to sea level rise or land subsidence.	Community understanding of the differences amongst the various issues and how they may relate to their own property and the community in general.
FW 3.2.3 WC, DNR LSLT, TNC, USFWS and others will maintain a coastal land conservation group that meets once or twice per year to share information on projects, goals, funding etc.	Within Existing Resources	WC	Meeting minutes outlining the status of ongoing and potential conservation projects with the potential for collaboration	Collaboration, information sharing and leveraging resources for conservation. Alignment of local & state no net loss policy.
FW 3.2.6 UME, DNR and NRCS will coordinate efforts to maintain forest health and extent via land conservation efforts, forest management, outreach and education, cost share programs and forest stewardship plans. Forest management plans should strive to be in place for at least 75% of watershed acreage within 10 years.	Education & Outreach	UME	Strategic acreage goal for forest stewardship by 2025	Multiagency coordination.
FW 3.2.8 UME and WC will promote the use of "Woods in Your Backyard" and "Backyard Buffer" Programs through Master Gardener trainings.	Education & Outreach	UME		Number of program participants & acres of forest stewarded over time.
FW 3.2.12 MCBP and partners will collaborate with local stakeholders and organizations to develop plans, projects and maintenance guidelines that provide access and recreational opportunities on publically owned forests.	Education & Outreach	MCBP	Public access to upland natural areas	
FW 3.3.5 MCBP will promote citizen participation in the Audubon Christmas Bird Count, eBird compilations, Backyard Bird Count, Project Feeder Watch and Breeding Bird Surveys.	Within Existing Resources	MCBP	Species counts	Citizen involvement.
FW 3.3.6 MCBP will continue to train volunteers and promote annual herpetology surveys for field data compilation, targeted conservation and community stewardship.	Within Existing Resources	MCBP	Species counts for Herp Atlas	Citizen involvement.
FW 3.3.9 Where appropriate, MCBP will coordinate volunteer efforts to assist with tree planting, non-native species removal, buffer planting and monitoring of projects for long term success evaluation.	Within Existing Resources	MCBP	Citizen involvement	Evaluation of habitat improvement success.
FW 4.1.3 DNR (Coastal & Chesapeake Services) and MARCO, the Mid-Atlantic Regional Council for the Ocean, will characterize critical offshore habitat, migratory pathways, biological populations and ecological processes.	Research & Ecosystem Assessment	DNR	Data posted to the MARCO Portal and a characterization report for managers and the public.	Information for long-term ecosystem-based management.

Action item	Category	Lead partner	Outputs (deliverables)	Outcomes (knowledge & behavior)
FW 4.1.5 DNR and MCBP will collaborate on educational and outreach products regarding ocean issues for local stakeholders.	Education & Outreach	DNR	Outreach and educational products	Increased awareness for stewardship and action.
FW 4.1.6 MCBP will assist MARCO by providing an existing stakeholder process for sharing information and collecting input regarding commercial, recreational and cultural issues.	Education & Outreach	MCBP	Stakeholder input on regional ocean efforts	Foster dialogue between managers and end users to advance collaborative ocean planning.
FW 4.1.9 Ocean City will continue the Beach District Planting and Bayscape Planting programs to provide water quality and habitat benefits, while also improving erosion control and curb appeal.	Within Existing Resources	OC	Use of mitigation funds to improve habitat, water quality, erosion control and curb appeal.	Public stewardship & volunteer opportunities.
FW 4.2.2 MCBP will work with partners to convey research findings to non-technical audiences. Clearly explain the relationship between human activities and impacts on resources.	Education & Outreach	MCBP	Easy to understand scientific findings	Adaptive management through better communication.
FW 4.2.4 MCBP will produce and distribute Report Cards that provide updates on watershed status and major partner accomplishments.	Education & Outreach	MCBP	Report Cards on the health of Coastal Bays	Improve community feedback.
RN 1.1.2 MCBP will enhance public awareness of existing facilities, opportunities and access points by producing fact sheets, newspaper articles and public service announcements. Stress the importance of protecting the environment and respecting public and private properties (e.g. no trash / campfires/ to protect sensitive species & habitats). Maintain the Reel In & Recycle program for monofilament in the watershed.	Education & Outreach	MCBP	Educational pieces and volunteer opportunities, Support & assist county efforts to fund renovation projects at parks and access sites.	Sustainable recreational use and public access.
RN 1.1.4 DNR will develop and distribute educational materials on pollution prevention related to bottom paints, corrosion anodes, fueling methods and waste disposal.	Education & Outreach	DNR	Pollution Prevention materials.	MCBP will assist DNR with target audiences & events.
RN 1.1.6 MCBP, USCG-Auxillary, DNR and MDE will collaborate on educational efforts regarding hazardous materials spill response capabilities, first responders contact information, safety and disposal methods for local marinas and the boating public. Contact numbers will be checked annually.	Education & Outreach	MCBP	Spill response plan for boaters & marinas	Increase in public knowledge of which first responders to contact in the event of an emergency.
RN 2.1.3 MCBP will enhance public awareness of resource protection issues and needs by producing fact sheets, brochures, newspaper articles, posters, digital media, etc., to publicize resource problems/solutions and sensitive areas. A targeted public education campaign will be developed so the public and local decision makers (including the Shoreline Commission, Port Wardens, & Planning Commission) will know about sensitive areas and species.	Education & Outreach	MCBP	Sensitive Habitats campaign—distribution of education items will be coordinated with the USCG auxiliary, NRP and local boating & fishing groups. Incorporate info into boating classes and NADAG plan	Technical resources for the community, reduction in user conflicts, natural resource protection and boater safety.
RN 2.2.1 MCBP will repeat the 2002 Coastal Bays Water Use Assessment and public opinion/user satisfaction survey to identify user conflicts such as overcrowded channels or boat ramps, PWC activity/safety and environmental impacts.	Within Existing Resources	MCBP	Water Use Assessment—determine changes in use and or perception of crowding & safety	Increased public participation.
RN 2.2.2 MCBP will produce educational materials describing user conflict issues, areas to avoid, boating courtesy and other target information to address existing problems. Educational media include fact sheets, newspaper articles, public service announcement, etc., with a special focus on visitors.	Education & Outreach	MCBP	Update Boater's Guide to the Coastal Bays	Reduced user conflict.

Action item	Category	Lead partner	Outputs (deliverables)	Outcomes (knowledge & behavior)
RN 2.2.3 MCBP will request from NRP a breakdown of Reportable Boat Accidents for the Coastal Bays to identify areas and times that exhibit frequent incidents/accidents. MCBP will use this information for public awareness purposes.	Within Existing Resources	MCBP	Local accident summaries over time	Changes in violations and accident rates.
RN 2.2.4 MCBP will develop/update educational media for boat dealers, marinas, rental outlets, boating classes, etc., will improve education on the rules and regulations, and will promote boating safety. Consider using videos and public service announcements for educational purposes.	Education & Outreach	MCBP	Reprint the Coastal Bays Boaters Guide & create PSAs/ other materials	Changes in violations and accident rates.
RN 3.1.3 MCBP - NADAG, MDE, ACOE and WC facilitate discussions with local marina owners and other interested parties to better understand permitting impediments and issues.	Education & Outreach	MCBP	Improved efficiency & understanding. Remove the incentive for consultants to prolong the process.	Reduced frustration
RN 4.1.1 MCBP will reconvene and maintain a Navigation & Dredging Advisory Group (NADAG) to improve planning and coordination of sediment management. MCBP will advertise the forum for public input.	Within Existing Resources	MCBP	Committee minutes	Improved coordination, increased public participation.
RN 4.1.2 NADAG will develop educational materials that provide information about key dredging and navigation issues including channel "ownership" and maintenance scheduling, public versus private responsibilities, agency responsibilities, regulatory requirements, points of contact for permits or other information and a list of information regarding problems/issues/solutions associated with dredging and navigation.	Education & Outreach	MCBP	Educational handouts, website	Increased public awareness.
CE 1.1.3 MCBP will produce educational materials based on the results of CE 1.1.1 through CE 1.1.3 regarding the economic importance of protecting wetlands, marshes, dunes, forests, farmland and cultural resources to ensure cultural integrity, community safety and economic viability of the Coastal Bays region.	Education & Outreach	MCBP	Educational materials	Improved resource appreciation.
CE 1.1.4 MCBP will conduct an economic analysis of the value of the National Estuary Program to the watershed; the number of jobs created, number and amount of grants provided to local citizen groups, local monitoring efforts, research and restoration funds, assistance provided to municipal and county projects and total funds leveraged over time. Further, analyze the community's economic support provided to MCBP via fundraising and total leveraging.	Within Existing Resources	MCBP	Dollar value of the National Estuary Program to the watershed	Annual feedback report to the public and decision makers (EPA leveraging requirement).
CE 1.1.5 MCBP will communicate to local businesses the benefits of ecosystem health to economic development, tourism, recreation and quality of life. Emphasize that economic prosperity is linked to ecosystem health.	Education & Outreach	MCBP	Value added to economy by preserving and improving the ecosystem	Improved communication between stakeholder groups.
CE 1.1.7 MDA, DNR Forestry, WSCD and WC will create economic and other incentives to retain farming and forestry. Also, seek support industries such as corn research, beneficial use of chicken litter, wood markets, expand farmers markets, value-added products, agri-tourism opportunities, etc.	Policy Issue	MDA	Communicate economic incentives and outreach efforts	Support for Coastal Bays' farmers, forest owners and agriculture affiliated businesses.
CE 2.2.1 WC will evaluate the 2008 Sea Level Response Strategy and consider revising and implementing its recommendations. Start by identifying and prioritizing actions and strategies aimed at building resilience.	Within Existing Resources	WC	Revised Worcester County Sea Level Response Strategy and public workshops	Informed planning, priority setting for project plans.

Action item	Category	Lead partner	Outputs (deliverables)	Outcomes (knowledge & behavior)
CE 2.2.6 MCBP will pursue the designation of the Coastal Bays as an EPA Climate Ready Estuary and incorporate strategies in all planning activities and projects. For example, tidal wetland projects should allow for landward migration. Work with the DNR Hazard Assessment and Coastal Planning and local Community Emergency Response Teams.	Policy Issue	MCBP	Assess climate change vulnerabilities, develop adaptation strategies, engage and educate stakeholders	Climate Ready Estuary designation and improved community safety.
CE 3.1.1 MCBP, MEA and MDE will develop educational materials on home and workplace energy conservation practices and combustion contributions to atmospheric pollution.	Education & Outreach	MCBP	Energy conservation outreach materials	Adoption of clean energy technology.
CE 3.2.2 MCBP will conduct surveys to gather data on citizen perceptions, concerns and understanding of watershed conditions.	Within Existing Resources	MCBP	Community surveys and needs assessment	Topics of interest & concern will serve as the basis of a communication plan.
CE 3.2.3 MCBP will develop, implement and refine a communication plan to inform residents, stakeholders and government officials about the resources of the Coastal Bays including the economic and ecological value of these resources and threats to the continued viability and quality of life. Annual presentations should be considered to keep the community informed of reports & publications (ex. Report Cards, State of the Bays Reports, etc.).	Within Existing Resources	MCBP	EPA required communication plan and associated reports and outreach materials. Multi-lingual products should be pursued whenever possible.	Citizens, stakeholders and partners are well informed and share information and resources, specific behavior changes identified & tracked.
CE 3.2.4 MCBP will keep local, state and federal governments engaged in improving the condition of the Coastal Bays by holding frequent in-person meetings with partners and making every effort to facilitate and promulgate partners projects and policies.	Policy Issue	MCBP	Meetings & presentations, approval from partners on priority projects	Program accomplishments and annual work plan (# of presentations given).
CE 3.2.5 MCBP will develop, implement and expand public involvement and education projects or programs based on CCMP priorities, public interest, pollution prevention, resource availability and other opportunities that arise, (e.g. Harbor Day at the Docks). Facilitate awareness and transferal of public opinions and Program partner's initiatives. Establish a suite of social indicators; (ex., recycling rates, acres preserved/enhanced, visitor/tourism numbers, agricultural production, etc.).	Within Existing Resources	MCBP	EPA required Public Involvement Plan with metrics and social indicators	Measures of public support and feedback.
CE 3.2.6 MCBP will offer volunteer opportunities to the community via property management, wildlife surveys, events and meetings. Create a calendar of volunteer events to include monitoring (reptiles, terrapins, birds, horseshoe crabs, water quality, seals, seagrass ground-truthing), tree plantings, invasive species control, trail and park maintenance, etc. Maintain a year-round program of outreach and feedback.	Education & Outreach	MCBP	Calendar of volunteer/citizen science events, meetings and educational lectures.	Informed community and increased participation rates, total volunteer hours/year. Monitoring and restoration assistance.
CE 3.2.7 MCBP will support the WC School Board with resources and curricula development for environmental literacy and facilitate meaningful outdoor experiences for K-12 students.	Education & Outreach	MCBP	Teacher trainings and outdoor experiences.	Improved environmental literacy and participation.
CE 3.2.8 MCBP will periodically update and distribute the Homeowner's Guide to the Coastal Bays to inform citizens about local resources and how to enhance sustainability.	Education & Outreach	MCBP	Homeowners Guide to the Coastal Bays.	Adoption of best management practices by homeowners.
CE 3.2.9 MCBP will utilize the Citizens Advisory Committee to seek comments/ideas on annual work projects, present accomplishments such as mini grant results and gather input on local issues of concern. The CAC will appeal to and engage multiple stakeholders groups and diverse audiences.	Education & Outreach	MCBP	At least two CAC meetings per year. Meeting minutes and surveys for feedback will inform project ideas and priority setting.	Enhanced and expanded volunteer base. Increased support for environmental protection policies and restoration projects.

Action item	Category	Lead partner	Outputs (deliverables)	Outcomes (knowledge & behavior)
CE 3.2.10 MCBP outreach efforts will target underserved communities and those affected most by environmental degradation.	Education & Outreach	MCBP	Outreach materials, projects and support for environmental justice efforts.	Expanded public decision making by marginalized groups, fair distribution of resources.
CE 3.2.11 MCBP, EPA, DNR and NPS will continue to support the Coastal Stewards outdoor summer employment program for local high school and college students.	Education & Outreach	MCBP	Experiences in education, interpretation, restoration, conservation and environmental stewardship.	Promotion of stewardship and appreciation of local history, cultural and natural resources.
CE 3.2.12 MCBP will continue to recognize the lifetime contributions of citizens devoted to conservation and protection through the Osprey Award. Work with other businesses and civic group with similar programs (ex. Worcester County Green Awards).	Within Existing Resources	MCBP	Guidelines and nomination form for Osprey Award. Provide nominations and technical resources for similar community efforts	Recognition of deserving individuals, businesses and groups.

8. Financial Management Planning

Coming together is a beginning;
keeping together is progress;
working together is success.
—Henry Ford

We have a responsibility to manage and improve our natural resources as an investment for our future. Photo by Carol Cain.

The Program works by recognizing the mutual dependence of good management practices and citizen-based efforts to sustain our community's culture and economy. Working together promotes a shared sense of accomplishment and spreads the risk, expense and responsibility among stakeholder groups. By sharing knowledge and resources we prevent duplication of effort and promote efficiency at the project level.

Implementing corrective actions is contingent on opportunity, community support and funding. The Program strives to prioritize activities based upon critical need and then match those needs with available technical and financial resources. Grants, fundraising activities, volunteer hours and other cooperative agreements are used to leverage cash. Additionally, grant programs are available to local community groups and researchers to address local needs and questions.

The National Estuary Program provides funding for the development of the CCMP under Section 320 of the Clean Water Act, but it does not provide full funding for implementing all of the specific actions. While partners have agreed to implement nearly half of the identified actions with existing resources, additional funding is needed to bring the remainder to fruition. A more detailed look at how the Program serves the watershed and identifies resources to resolve local problems is a long standing endeavor. The action table below helps to articulate funding issues to address in this update. The cost for implementing each action will need to be estimated, targets for fundraising and emergency reserves should be set.

CCMP ACTIONS REQUIRING SUBSTANTIAL FUNDING

Action item	Category	Lead partner	Outputs (deliverables)	Outcomes (knowledge & behavior)
WQ 1.1.2 WC and MDE will pursue retrofitting of septic systems in established sewer service areas, with a priority ranking and timeframe. Where possible, hook up systems to existing wastewater treatment plants. Pursue funds from the Chesapeake & Atlantic Coastal Bays Restoration Fund for upgrades and hook ups.	Within Existing Resources	WC	Indicator tracking: number of retrofits /per year to be recorded in Coast STAT	Leverage sewer service area priority plans to garner resources. Determine the net reduction in nutrient loading over time.
WQ 1.1.6 WC and MDE will work cooperatively on incentives or other programs to encourage the use of Best Available Technology for enhanced nitrogen removing septic systems with appropriate monitoring and maintenance schedules.	Education & Outreach	WC	Funding or other incentives that may be leveraged for enhanced nutrient removing septic systems	Funding value leveraged over time, net increase in best available technology systems versus the net decrease in nutrient pollution.
WQ 1.2.3 USGS and NPS will investigate funding resources to continue monitoring nutrient inputs to the Coastal Bays from groundwater. They will study variations in nitrogen concentrations and residence times along surficial groundwater flow paths. This work will provide information on the effects of land use on water quality and provide a basis for planning for conservation areas.	Research & Ecosystem Assessment	USGS	Groundwater monitoring plan. Update the 1955 Mines & Water Resources Bulletin referenced in WC Water Resources Element	Assess flow volumes, groundwater age and percentage nutrient contribution by land use sector.
WQ 1.2.1 MCBP will work to revive interest and funding for the proposed "Sustainability of the Ground Water Resources in the Atlantic Coastal Plain" study to produce a regional groundwater flow model of the Coastal Plain deep aquifer as well as a local model for Worcester County. The model could also be used to simulate the impacts of changes in groundwater recharge and discharge patterns induced by climate change and sea-level rise.	Research & Ecosystem Assessment	MCBP	Groundwater sustainability model for the Coastal Bays region	Ecosystem prediction and response.
WQ 1.4.1 Berlin will maintain, and OC will explore, stormwater utilities or other alternatives to fund improvements and long-term maintenance of conveyances, structures and natural spaces to prevent flooding and treat stormwater for volume and water quality. WC should follow municipal examples for other areas in the county.	Legislative	Berlin, OC	Stormwater utilities	Resolve flooding issues. Establish a dedicated funding source for green infrastructure improvements and maintenance.
WQ 1.4.3 WC will investigate the amount of pre-1984 development in order to estimate the need for stormwater retrofits, provided grant funding is available.	Policy Issue	WC	Indicator tracking: amount financial assistance secured, number of acres treated	Determine and prioritize retrofit needs and opportunities.
WQ 1.4.6 MCBP will assist local jurisdictions by advocating for Water Quality Act, section 319 non-point source grants for restoration and retrofit funding.	Within Existing Resources	MCBP	Indicator tracking: Stormwater database & map, funding leveraged	Planning & resource sharing.
WQ 1.5.3 MDA and SU will consider the extent of phosphorus saturated soils in the Coastal Bay watershed, while researching the utility of adopting the Phosphorus-Index and the potential economic implications to local farmers.	Research & Ecosystem Assessment	MDA	Analysis of soil Phosphorous saturation, leaching potential and economic impacts to farmers	Management decisions to jointly support TMDL reduction goals and sustainable farming practices.
WQ 1.5.6 NRCS and MDA will investigate methods to promote innovative agricultural programs including precision farming practices by facilitating the availability of low interest loans and other funding sources.	Policy Issue	NRCS	Funding directed to watershed	Economic Development.
WQ 1.5.7 MCBP, MDA, NRCS and other partners will encourage and pursue grant funding for BMPs, farmland conservation and other programs in most affected watersheds to support local agriculture.	Policy Issue	MCBP	Funding directed to the watershed (including from MDA Animal Waste Technology Fund, Ag Energy Efficiency Program, etc.)	Economic Development.

Action item	Category	Lead partner	Outputs (deliverables)	Outcomes (knowledge & behavior)
WQ 1.5.7 MCBP, MDA, NRCS and other partners will encourage and pursue grant funding for BMPs, farmland conservation and other programs in most affected watersheds to support local agriculture.	Policy Issue	MCBP	Funding directed to the watershed (including from MDA Animal Waste Technology Fund, Ag Energy Efficiency Program, etc.)	Economic Development.
WQ 1.5.9 LSLT and MCBP will work with partners and landowners to protect, restore and plant non-tidal wetlands and forest/grass buffers on agricultural land using MALPF, WRE, MACS, CREP, EQIP, NAWCA, CELCP, Coastal Wetlands, Rural Legacy and other state and federal program funding.	Restoration & Conservation	MCBP	Funding for BMPs, wetland restoration projects and farm land preservation	Meet goal to preserve, protect or enhance 1,000 of farmland by 2016. Set goals for future efforts.
WQ 1.5.10 MGS, subject to available funding, will quantify the volume of water and nutrients delivered from watershed ditches to the Coastal Bays. Results will be utilized to establish priority areas for appropriate nutrient reduction strategies.	Research & Ecosystem Assessment	MGS	Priority plans for water storage and nutrient reduction	Ecosystem predictions/ water budget.
WQ 1.6.2 WC will facilitate point source removals at Church Branch and Marshall Creek by connecting land owners with funding sources for spray irrigation or wastewater treatment plant hook ups.	Policy Issue	WC	Funding for spray irrigation	Decreased point source loading.
WQ 3.1.1 MCBP, MDE, DNR, MDP, MDA, WC, WSCD, NPS, NRCS and others will convene a permanent TMDL/ BMP subcommittee to develop and implement a nutrient reduction strategy. This committee will investigate STAC requested TMDL scenarios, prioritize nutrient reduction activities, project sites and funding sources. Nutrient load additions and reductions could be tracked and monitored through the establishment of CoastSTAT. Existing best management practices will be mapped for presumptive efficiency removal rates, inspection and maintenance schedules, responsible parties, etc.	Policy Issue	MCBP	Development of a Watershed Improvement Plan with a nutrient reduction strategy to reduce the number of impaired water segments. Creation of CoastSTAT, a TMDL Tracking and Accounting System	Promotion of and commitment to fishable/ swimmable waters.
WQ 3.1.3 MCBP with assistance from the TMDL/BMP subcommittee will conduct a series of focused, subwatershed analyses (and update the Watershed Restoration Action Strategies) to develop specific recommendations for establishing/enhancing buffers in tidal and non-tidal areas, protecting water quality & habitat, conserving resources and promoting sustainable economic interests.	Policy Issue	MCBP	Watershed Improvement Plan with a nutrient reduction strategy	Commitment to develop a Watershed Improvement Plan, priority status & staff/funding resources.
WQ 3.1.4 MCBP will work with EPA and MDE to see that the watershed-based plans meet the nine Clean Water Act, section 319 program elements (also referred to as a.-i. criteria) to secure funding for nonpoint source pollution reduction activities. Once a watershed plan is approved by EPA, MCBP can submit project proposals to secure funding for nonpoint source pollution reduction activities.	Within Existing Resources	MCBP	Quantifiable changes in policy and practice over time, restoration on at least five impaired stream segments by 2016	Promotion of and commitment to fishable/ swimmable waters.
FW 1.1.5 DNR will provide the public with annual updates of harvest results to commercial and recreational stakeholders (including species landed and economic impact) for educational and ecological purposes.	Education & Outreach	DNR	Annual harvest reports to be shared with the public. Percent change over time in harvests. Also use DNR quarterly newsletters	Stakeholder feedback, economic valuation of local fisheries.
FW 1.2.4 EPA will assist with funding to assess benthic species and habitats, and the effects of emerging contaminants, including microplastics.	Policy Issue	EPA	Funding	Support for National Coastal Assessment.
FW 1.2.5 DNR and MCBP will support efforts to monitor and assess Harmful Algae.	Research & Ecosystem Assessment	DNR	Species, frequency, duration and effects (i.e.. hypoxia, human illness, living resource degradation)	Protection of public health, aquaculture and sea grass growth.

Action item	Category	Lead partner	Outputs (deliverables)	Outcomes (knowledge & behavior)
FW 1.4.1 DNR and UME will promote and support responsible aquaculture development by providing incentives to assist with shellfish aquaculture production where practical and by providing best practices training.	Within Existing Resources	DNR	Incentives and training	Economic development through aquaculture.
FW 1.4.3 DNR will continue to refine the Shellfish Aquaculture Siting Tool that is used to evaluate potential aquaculture sites.	Within Existing Resources	DNR	Interactive online map viewer to assist users in making informed decisions when locating shellfish aquaculture sites.	Economic development and educational potential.
FW 1.5.7 DNR will provide information regarding Highly Migratory Marine Species (population estimates, sustainable harvest, economic value of local tournaments, protection efforts)	Within Existing Resources	DNR	Linkages between bay and ocean ecosystems	Public awareness. Tie near-shore and off-shore data together for adaptive management.
FW 2.1.1 DNR, VIMS, NPS and MCBP will continue funding support for aerial mapping of seagrass beds extent and monitor the attainment of SAV goals for each embayment.	Within Existing Resources	DNR	Acres & extent of sea grasses	Quantifiable Goal: determine percent coverage of SAV annually to compare with potential SAV habitat (27,070 acres).
FW 2.2.1 DNR will contract with VIMS to repeat the shoreline inventory of 2004 to determine the change in hardened versus soft shorelines. Set a target for reducing hardened shoreline throughout the watershed.	Research & Ecosystem Assessment	MCBP	Shoreline study (baseline = 52% hardened as of 2004)	Change in landscape over time.
FW 2.2.3 DNR and others will determine the extent of marshes, the potential for marsh migration in response to sea level rise, and the economic value of ecosystem services.	Research & Ecosystem Assessment	DNR	Ecosystem valuation	Return on investment data.
FW 3.1.1 MCBP will facilitate discussions with USGS and MGS to fully fund the watershed's two stream gauges at Birch Branch and Bassett Creek. The long-term data sets generated by these gauges are necessary for determining water and nutrient budgets as well as supporting project evaluation and ecosystem changes.	Policy Issue	MCBP	MOU to fully fund stream gauge stations and/or a commitment to secure funding	Decreased nutrient and bacteria levels to meet TMDL allocations and/or state water quality criteria. Ecosystem response evaluation for watershed changes due to projects and climate.
FW 3.1.8 NRCS will collaborate with state agencies, local entities and landowners to facilitate stream restoration and protection efforts, particularly problems identified in DNR Stream Corridor Assessments (fish blockages, inadequate buffers, trash, erosion sites, etc.)	Restoration & Conservation	NRCS	Project plans and funding	Improved habitat and water quality
FW 3.2.3 WC, DNR LSLT, TNC, USFWS and others will maintain a coastal land conservation group that meets once or twice per year to share information on projects, goals, funding etc.	Within Existing Resources	WC	Meeting minutes outlining the status of ongoing and potential conservation projects with the potential for collaboration	Collaboration, information sharing and leveraging resources for conservation. Alignment of local & state no net loss policy.
FW 3.2.5 WC will direct forest mitigation fees to restoration projects identified through collaborative restoration planning. They will determine if funds can be leveraged through other existing programs such as Stream ReLeaf, Forest Legacy, Stream Restoration Challenge, etc.	Restoration & Conservation	WC	Priority Planning	Fund leveraging.
FW 3.2.11 DNR and the Maryland Sustainable Forestry Council will identify options to improve long term viability and environmental benefits of forest industries and utilization of renewable wood products.	Research & Ecosystem Assessment	DNR	Economic status & sustainability of forestry operations in WC	Determine and support the economic sustainability of forestry.

Action item	Category	Lead partner	Outputs (deliverables)	Outcomes (knowledge & behavior)
FW 4.1.4 MCBP, DNR, MDE and NPS will pursue funding opportunities to better understand oceanic inputs and fluxes of nutrients to the estuary.	Within Existing Resources	MCBP	Spatially related ocean water quality data and fluxes	Ecosystem stressors and biotic impacts. Leveraging of limited resources to prevent duplication of effort.
FW 4.1.9 Ocean City will continue the Beach District Planting and Bayscape Planting programs to provide water quality and habitat benefits, while also improving erosion control and curb appeal.	Within Existing Resources	OC	Use of mitigation funds to improve habitat, water quality, erosion control and curb appeal.	Public stewardship & volunteer opportunities
RN 1.1.5 DNR will explore the availability of grants and loans or other incentives to assist marina owners/operators in installing and maintaining best management practices. (e.g. septic pump-outs).	Within Existing Resources	DNR	Funding for BMPs	Reduced toxins loading to waterways.
RN 2.1.2 MDE will reallocate the fee structure used for wetlands permits to increase mitigation, permit review and enforcement staff.	Policy Issue	MDE	Regulatory review	Funding for permitting & enforcement staff.
RN 2.1.4 MCBP will seek funding and partnerships to emulate the Derelict Gear Retrieval Project for ghost pot collections to the Coastal Bays areas. MCBP will assist with organizing collection efforts and recording information (amount, location, # of terrapin carapaces. etc.) to assess the effort.	Policy Issue	MCBP	MOU with the Oyster Recovery Partnership, funds for ghost pot removal, data on by-catch	Economic development/ reduction in derelict gear & resource mortality.
RN 4.1.4 Chapter 1: Navigation channels, markers and other aids A. WC, OC, OP, NRP, ACOE and NADAG will conduct an in-depth analysis to mark small channels to public boating access points throughout the Coastal Bays and determine future needs to establish new channels for access. B. NADAG will identify and secure funding for marker upgrades, mapping and planning exercises, habitat restoration projects and maintenance dredging. C. MCBP will update and distribute the Coastal Bays Boater's Guide to identify navigation channels. Include information about sensitive species areas, personal water craft restricted areas and descriptions of informational markers.	Within Existing Resources	MCBP	A. Map of channels & public access points. List of potential future access points. (DNR Boating Services) B. Funding from Waterway Improvement Act (DNR Boating Services) C. Redesign, print and disseminate Boater's Guide for the Coastal Bays (MCBP)	Mapping, planning, coordinating and tracking group effort.
RN 4.1.5 Chapter 2: Maintenance of navigation channels A. NADAG will clarify and identify the responsible parties for federal and non-federal channel maintenance and make bay wide recommendations for sediment management. B. ACOE will acquire bathymetric data to evaluate the 'west channel' and evaluate the feasibility of dredging portions of the shoal north of the bridge and south of Skimmer Island. C. NADAG will assist local government in developing guidance criteria for determining when channels should be dredged and develop a method for prioritizing identified projects. D. DNR CCS and Sea Grant will complete a Coastal Bays inventory of marine related business and resources as part of the Working Waterfront Initiative.	Within Existing Resources	MCBP	A. Maintenance & sediment management recommendations (MCBP) B. Bathymetry & dredging feasibility study (ACOE) C. Guidance criteria for prioritization process for dredging (MCBP) D. Coastal Bays Working Waterfront Inventory (infrastructure & economic value-DNR)	Informed planning, institutionalized coordination and adaptive management.
CE 1.1.1 UME, WC and SU-BEACON will analyze the economic contributions of farming, forestry, commercial & recreational fishing, (traditional and low impact) tourism and other natural resource dependent economic sectors in the watershed. Include value of farmers markets, direct to farm products, historical assets and marine related businesses, etc.	Research & Ecosystem Assessment	UME	Economic sector/ resource-based industries report with indicators for measuring change over time.	Better understanding of natural resource related industry.

Action item	Category	Lead partner	Outputs (deliverables)	Outcomes (knowledge & behavior)
CE 1.1.2 MDP will determine the cost of sprawl in the watershed, including the impacts to air & water quality, greenhouse gases, affordable housing and public health. Examine the impacts of different land uses on county finances and determine the return on investment of public dollars.	Within Existing Resources	MDP	Return on investment of public infrastructure to support compact development.	Efficiency of public funding among land use sectors.
CE 1.1.3 MCBP will produce educational materials based on the results of CE 1.1.1 through CE 1.1.3 regarding the economic importance of protecting wetlands, marshes, dunes, forests, farmland and cultural resources to ensure cultural integrity, community safety and economic viability of the Coastal Bays region.	Education & Outreach	MCBP	Educational materials	Improved resource appreciation.
CE 1.1.4 MCBP will conduct an economic analysis of the value of the National Estuary Program to the watershed; the number of jobs created, number and amount of grants provided to local citizen groups, local monitoring efforts, research and restoration funds, assistance provided to municipal and county projects and total funds leveraged over time. Further, analyze the community's economic support provided to MCBP via fundraising and total leveraging.	Within Existing Resources	MCBP	Dollar value of the National Estuary Program to the watershed	Annual feedback report to the public and decision makers (EPA leveraging requirement).
CE 1.1.5 MCBP will communicate to local businesses the benefits of ecosystem health to economic development, tourism, recreation and quality of life. Emphasize that economic prosperity is linked to ecosystem health.	Education & Outreach	MCBP	Value added to economy by preserving and improving the ecosystem	Improved communication between stakeholder groups.
CE 1.1.6 MCBP will use the above information and a compilation of CCMP actions to formulate a gap analysis to determine financial needs to reduce nutrients and support education and outreach efforts.	Within Existing Resources	MCBP	Financial gap analysis	Grant & Fundraising goals, marketing strategy.
CE 1.1.7 MDA, DNR Forestry, WSCD and WC will create economic and other incentives to retain farming and forestry. Also, seek support industries such as corn research, beneficial use of chicken litter, wood markets, expand farmers markets, value-added products, agri-tourism opportunities, etc.	Policy Issue	MDA	Communicate economic incentives and outreach efforts	Support for Coastal Bays' farmers, forest owners and agriculture affiliated businesses.
CE 1.1.9 DNR will assist MCBP in developing implementation strategies for promoting ecosystem service markets such as forest, species and habitat banks, wetland mitigation banks, carbon sequestration and nutrient trading and biomass-based carbon sequestration and fuel production.	Within Existing Resources	DNR	Establishment of ecosystem service markets and credits	Natural resources-based economic development. Improved protection of natural resources-based on economic valuation and demand for ecosystem services.
CE 2.3.2 MCBP and EPA will continue to inform USFW, NOAA, DOI, DOE, FEMA and other federal agencies about the purpose and benefits of the National Estuary Program. Time, research and resources will be solicited to benefit the watershed.	Policy Issue	MCBP	Acquisition of technical assistance and funding for CCMP implementation	Adaptive management.
CE 3.2.3 MCBP will develop, implement and refine a communication plan to inform residents, stakeholders and government officials about the resources of the Coastal Bays including the economic and ecological value of these resources and threats to the continued viability and quality of life. Annual presentations should be considered to keep the community informed of reports & publications (ex. Report Cards, State of the Bays Reports, etc.).	Within Existing Resources	MCBP	EPA required communication plan and associated reports and outreach materials. Multi-lingual products should be pursued whenever possible.	Citizens, stakeholders and partners are well informed and share information and resources, specific behavior changes identified & tracked.
CE 3.2.11 MCBP, EPA, DNR and NPS will continue to support the Coastal Stewards outdoor summer employment program for local high school and college students.	Education & Outreach	MCBP	Experiences in education, interpretation, restoration, conservation and environmental stewardship.	Promotion of stewardship and appreciation of local history, cultural and natural resources.

9. Monitoring the Coastal Bays

Not everything that can be counted counts and not everything that counts can be counted.
Albert Einstein

A wildlife camera captures an image of real and decoy (circled) Royal Terns on Skimmer Island. Note the red arrow pointing at a tern egg in a bare sand nest scrape. Photo by David Brinker.

It wasn't very long ago that this area was considered by many as the 'forgotten bays'. The rural watershed tucked along the Atlantic seaside did not enjoy the attention, nor the allocation of resources, afforded to the much larger Chesapeake Bay. Today we routinely monitor water quality conditions, species abundance and richness and habitat quality. A deliberate and well planned monitoring scheme not only provides a compendium of programs and results but also can be mined for changes over time and space (i.e. are we losing or gaining wetland acres). More significant is the predictive capabilities that an integrated monitoring system can provide.

There are four types of integration: ecological, spatial, temporal and programmatic[1]

A major challenge to designing a comprehensive assessment program is integrating the diverse types of measurements that are collected. Integration may involve ecological, spatial, temporal and programmatic aspects:

Ecological: Considers the linkages among ecosystem components. An effective ecosystem monitoring strategy will employ a suite of individual measurements that collectively monitor the integrity of the entire ecosystem. One approach for effective ecological integration is to select indicators at various hierarchical levels of ecological organization (e.g., community, population, genetic).

Spatial: Establishes linkages of measurements made at different spatial scales, or between local monitoring efforts and broader, national programs. Effective spatial integration requires an understanding of scalar ecological processes, the co-location of measurements of comparably scaled monitoring indicators and the design of statistical sampling frameworks that permit the extrapolation and interpolation of spatially dependent data.

Temporal: Establishes linkages between measurements made at various temporal

1. B.J. Longstaff, T.J.B. Carruthers, W.C. Dennison, T.R. Lookingbill, J.M. Hawkey, J.E. Thomas, E.C. Wicks, J. Woerner. 2010. Integrating and Applying Science: A handbook for effective coastal ecosystem assessment. IAN Press.

scales. Different indicators are often measured at different frequencies. Temporal integration can be accomplished by nesting more frequently sampled indicators within the context of those indicators that are measured less frequently.

Programmatic: Coordinates and communicates monitoring activities within and among other monitoring groups. Effective programmatic integration can promote broad participation in monitoring and broad use of the resulting data.

CCMP ACTIONS THAT ADDRESS MONITORING

Action item	Category	Lead partner	Outputs (deliverables)	Outcomes (knowledge & behavior)
WQ 1.1.4 MCBP and WC will develop a program to ensure regular pump-outs and maintenance of residential septic systems. Septic haulers will provide electronic reporting on pumping activity for tracking and monitoring purposes as well as certifications that septic systems are functioning properly. WC will mail notices to homeowners and use the septic tracking system to monitor the volume of septage treated. MCBP will develop educational materials linking septic nutrients to watershed eutrophication.	Education & Outreach	MCBP	Pump out notices and other educational materials that explain the role of septics in rural areas and their potential for pollution	Increased number of pump outs.
WQ 1.1.6 WC and MDE will work cooperatively on incentives or other programs to encourage the use of Best Available Technology for enhanced nitrogen removing septic systems with appropriate monitoring and maintenance schedules.	Education & Outreach	WC	Funding or other incentives that may be leveraged for enhanced nutrient removing septic systems	Funding value leveraged over time, net increase in best available technology systems versus the net decrease in nutrient pollution.
WQ 1.2.3 USGS and NPS will investigate funding resources to continue monitoring nutrient inputs to the Coastal Bays from groundwater. They will study variations in nitrogen concentrations and residence times along surficial groundwater flow paths. This work will provide information on the effects of land use on water quality and provide a basis for planning for conservation areas.	Research & Ecosystem Assessment	USGS	Groundwater monitoring plan. Update the 1955 Mines & Water Resources Bulletin referenced in WC Water Resources Element	Assess flow volumes, groundwater age and percentage nutrient contribution by land use sector.
WQ 1.2.4 NPS will identify baseline groundwater conditions and develop a protocol to monitor and assess changes in the island's ground water resources related to climate variability.	Research & Ecosystem Assessment	NPS	Status and trends of Assateague Island groundwater resources	Ecosystem prediction and response.
WQ 1.6.5 EPA will provide environmental data and analyses collected offshore to inform coastal researchers and local decision-makers about nutrient loading dynamics, particularly from ocean wastewater outfalls.	Within Existing Resources	EPA	Ecosystem data & reports	Integration of off-shore federally collected ecosystem data.
WQ 1.6.6 MCBP STAC will investigate changes to water quality parameters (nutrients, sediment, harmful algal blooms, etc.,) that affect the Coastal Bays through inlet flushing.	Research & Ecosystem Assessment	MCBP	Analysis and reports of water quality exchanges with the ocean	Recommendations for monitoring to better understand ecosystem linkages.
WQ 2.1.5 NPS-ASIS will continue to pursue saltmarsh restoration and monitoring projects such as ditch plugging and filling, marsh elevation studies and nekton monitoring to restore natural conditions and document long term changes within salt marshes along Assateague Island.	Within Existing Resources	NPS	Summary of natural salt marsh status and trends, including monitoring of PCBs, PAHs and DDT	Restore saltmarsh hydrology and ecological function, build resiliency, document long-term change.
WQ 2.1.7 WC will continue to hold hazardous waste disposal programs for farm and residential hazardous materials, including pesticides and fouled gasoline.	Within Existing Resources	WC	Indicator tracking: Volume & types of waste collected	Program evaluation, fish tissue & sediment monitoring for toxins, pharmaceuticals and household products.
WQ 3.1.2 MCBP will ask EPA (Office of Water) to assist Program efforts by conducting a Recovery Potential Screening for the Coastal Bays. The screening process will be based on ecological, stressor and social indicators, and measured by landscape datasets, impaired water attributes and monitoring data to prioritize restoration projects.	Research & Ecosystem Assessment	MCBP	Recovery Potential Screening Report for the Coastal Bays	Priority planning for conservation or restoration projects.

Action item	Category	Lead partner	Outputs (deliverables)	Outcomes (knowledge & behavior)
WQ 3.1.5 DNR will compile the results and determine trends in air pollution inputs from the National Atmospheric Deposition Program monitoring site on Assateague Island. Disseminate information via the "State of the Bay" report every five years.	Research & Ecosystem Assessment	DNR	Air pollution data analysis and trends	Data provides feedback on air pollution reduction policies and programs.
FW 1.1.2 DNR will continue to provide data needed for stock assessments via the Coastal Bays Fisheries Investigation Surveys. Data include finfish, macroalgae, offshore trawl data, seafood dealer port sampling, volunteer angler summer flounder surveys, etc.).	Within Existing Resources	DNR	Annual updates on stock status	Assessment, monitoring and reporting on the status of fishery resources and impacts on them.
FW 1.1.3 DNR will provide annual updates on the stock status of key fish species in relationship to established targets and thresholds.	Research & Ecosystem Assessment	DNR	Annual trends & status reports that relate to thresholds and targets from a designated baseline year(s).	Knowledge to support and predict sustainable harvests.
FW 1.2.1 DNR will annually complete a survey of the shellfish resources within Maryland's Coastal Bays.	Within Existing Resources	DNR	Shellfish surveys	Assessment, monitoring & reporting on Impact
FW 1.4.5 DNR will continue to work with recreational and commercial stakeholders to ensure that services provided to each sector, (such as monitoring stock assessments, harvest monitoring and outreach, etc.,) are recovered from each sector.	Within Existing Resources	DNR	Balanced Fisheries budget	Improved understanding of the function of the Fisheries Service.
FW 1.5.1 DNR and MCBP will protect horseshoe crab populations by promoting the protection of bay beaches and other bottom habitats and promote volunteer monitoring of spawning populations throughout the coastal bays.	Within Existing Resources	MCBP	Annual spawning survey report	Protection of beach habitats, public stewardship & involvement, HSC management plan data.
FW 1.5.3 MCBP will continue terrapin counts and promote the use of cull rings and Turtle Exclusion Devices (TEDs) on all recreational pots. Data will be shared with the Terrapin Work Group	Research & Ecosystem Assessment	MCBP	Terrapin counts & promotion of excluders for retailers/ public	Increased public participation & stewardship, improved population estimates.
FW 1.5.7 DNR will provide information regarding Highly Migratory Marine Species (population estimates, sustainable harvest, economic value of local tournaments, protection efforts)	Within Existing Resources	DNR	Linkages between bay and ocean ecosystems	Public awareness. Tie near-shore and off-shore data together for adaptive management.
FW 1.5.8 MCBP will continue to assist the Marine Mammal Stranding Program, the National Aquarium, DNR and other groups with local educational and volunteer efforts (ex. seal sightings, dolphin counts, Coastal Clean-ups,etc.)	Education & Outreach	MCBP	Data and education & outreach products	Coordination with partner efforts, shared data. Increased public stewardship & volunteer opportunities.
FW 2.1.2 MCBP, DNR, MDE and NPS will ground-truth SAV beds during routine monitoring or other on-the-water efforts.	Within Existing Resources	MCBP	Acres & extent of sea grasses	Resource sharing & coordination.
FW 2.2.2 MCBP will continue to assist DNR with near shore species and habitat monitoring (including colonial nesting birds, horseshoe crabs, terrapins, shorebirds, sea turtles, waterfowl, marsh birds, mosquito ditch restoration, vegetation, etc.)	Within Existing Resources	MCBP	Biometric data	Monitoring assistance.
FW 2.2.8 MCBP will work with EPA, NOAA, ACOE and UMCES to develop "user-friendly" indicators of storm severity (ex. hours/days above predicted high tide, king tide affects)	Within Existing Resources	MCBP	Storm severity indicators	Coastal Resiliency information.
FW 2.3.6 MDE will review known local wetland gains (mitigation & creation) and net loss (permitting) since 2000. Track tidal and non-tidal impacts & gains and maintain a list of previous and future restoration sites.	Within Existing Resources	MDE	Local tracking of ongoing net loss or gain, compare impact data to MDE authorization records	Indicator for the 10,000-acre goal attainment.

Action item	Category	Lead partner	Outputs (deliverables)	Outcomes (knowledge & behavior)
FW 2.3.7 MDE will annually monitor and report on the success of wetland mitigation sites and compile the most current wetland inventory for the Coastal Bays. The inventory will include voluntary and mitigated wetland gains and losses over time.	Research & Ecosystem Assessment	MDE	Ecological monitoring, updated wetland inventory	Return on investment for mitigation dollars. BMP cost estimates will be used for project planning.
FW 3.1.1 MCBP will facilitate discussions with USGS and MGS to fully fund the watershed's two stream gauges at Birch Branch and Bassett Creek. The long-term data sets generated by these gauges are necessary for determining water and nutrient budgets as well as supporting project evaluation and ecosystem changes.	Policy Issue	MCBP	MOU to fully fund stream gauge stations and/or a commitment to secure funding	Decreased nutrient and bacteria levels to meet TMDL allocations and/or state water quality criteria. Ecosystem response evaluation for watershed changes due to projects and climate.
FW 3.1.2 DNR will characterize the health of streams within the Coastal Bays watershed.	Within Existing Resources	DNR	Coastal Bays Streams Characterization Report, data for Terrestrial Monitoring Plan	Status of local streams, StreamStat, State of the Coastal Bays.
FW 3.1.6 MCBP will continue annual stream surveys for water quality and rapid assessment of habitat conditions. Special consideration will be given to biometrics and chemistry spectrums in brackish, tannic and freshwater habitats.	Research & Ecosystem Assessment	MCBP	Data for state and local consideration	Stream health monitoring.
FW 3.1.7 MCBP and MCC-Assateague will participate in Stream Wader collection opportunities as they become available through DNR	Research & Ecosystem Assessment	MCBP	Data for state and local consideration	Stream health monitoring and volunteer participation.
FW 3.2.1 DNR (ad hoc forest committee) will use the most current GIS layer of Forest Interior Dwelling Species (FIDS) to determine forested parcels that are 50 acres or more in size, with at least 10 acres of FIDs habitat. Calculate canopy cover, composition and stream widths through field surveys.	Research & Ecosystem Assessment	DNR	Data for Terrestrial Monitoring Plan, FIDS layer	Multiagency coordination.
FW 3.2.2 DNR will use current high-resolution imagery to assess forest and tree cover.	Research & Ecosystem Assessment	DNR	Mapping exercise	Data on change in percent forest cover over time.
FW 3.3.1 DNR Wildlife & Heritage Service will characterize the terrestrial areas within the Coastal Bays watershed using existing indicators, monitoring data and game harvest information. Data will include colonial waterbird nesting sites, bird migratory stopover areas, presence and abundance of rare and endangered species, location and productivity of terrapin nesting beaches and natural communities	Research & Ecosystem Assessment	DNR	Data for Coastal Bays Terrestrial Monitoring Plan	Wildlife characterization. Project areas and priorities change over time in sensitive habitats and species.
FW 3.3.2 NPS will continue to monitor barrier island threatened and endangered species including piping plover Charadrius melodus, seabeach amaranth Amaranthus pumilus, sea turtles and tiger beetles (Cicindelinae).	Research & Ecosystem Assessment	NPS	Information and annual reports	Conservation and population trends of threatened and endangered species.
FW 3.3.4 USDOI and DNR will compile information for forest interior songbirds, neotropical migrants, colonial waterbirds, waterfowl and shorebirds in the watershed from existing databases and produce a status and trends report as well as habitat improvement recommendations.	Research & Ecosystem Assessment	DNR	Status & Trends report for birds	Change in acres designated for habitat services.
FW 3.3.5 MCBP will promote citizen participation in the Audubon Christmas Bird Count, eBird compilations, Backyard Bird Count, Project Feeder Watch and Breeding Bird Surveys.	Within Existing Resources	MCBP	Species counts	Citizen involvement.
FW 3.3.6 MCBP will continue to train volunteers and promote annual herpetology surveys for field data compilation, targeted conservation and community stewardship.	Within Existing Resources	MCBP	Species counts for Herp Atlas	Citizen involvement.

Action item	Category	Lead partner	Outputs (deliverables)	Outcomes (knowledge & behavior)
FW 3.3.9 Where appropriate, MCBP will coordinate volunteer efforts to assist with tree planting, non-native species removal, buffer planting and monitoring of projects for long-term success evaluation.	Within Existing Resources	MCBP	Citizen involvement	Evaluation of habitat improvement success.
FW 4.1.1 MCBP STAC will hold workshops to formally adopt the Coastal Bays Terrestrial Monitoring Plan. The plan will consist of a 3 tiered approach: landscape/GIS assessment, rapid site assessment and field surveys. A monitoring frequency schedule, a list of indicators and responsible parties will be produced. Finding will be incorporated into the five-year Coastal Bays Ecosystem Health Assessment Reports.	Research & Ecosystem Assessment	MCBP	Detailed offerings of enhancement techniques	Project areas and priorities.
FW 4.1.2 MCBP and partners will collect, manage and share GIS data layers that are publicly available for the watershed.	Within Existing Resources	MCBP	Data layer inventory	Spatially related decision making.
FW 4.1.3 DNR (Coastal & Chesapeake Services) and MARCO, the Mid-Atlantic Regional Council for the Ocean, will characterize critical offshore habitat, migratory pathways, biological populations and ecological processes.	Research & Ecosystem Assessment	DNR	Data posted to the MARCO Portal and a characterization report for managers and the public.	Information for long-term ecosystem-based management.
FW 4.2.1 MCBP will compile all CCMP actions that are categorized as Research and Ecosystem Monitoring for STAC review and input. Identify roles and responsibilities for partners and a research schedule.	Within Existing Resources	MCBP	CCMP related STAC Science Agenda	Process for identifying research needs.
FW 4.2.3 NPS, DNR and MCBP will continue to collaborate and maintain bay water quality monitoring programs to assess nutrient loading and living resource responses.	Research & Ecosystem Assessment	NPS	Spatially related estuarine water quality data	Ecosystem stressors and biotic impacts. Leveraging of limited resources to prevent duplication of effort.
FW 4.2.4 MCBP will produce and distribute Report Cards that provide updates on watershed status and major partner accomplishments.	Education & Outreach	MCBP	Report Cards on the health of Coastal Bays	Improve community feedback.
FW 4.2.5 MCBP STAC and partners will publish a comprehensive State of the Bays report every five years. The reports are based upon watershed status and trends, research findings, partner accomplishments and emerging issues of concern.	Within Existing Resources	MCBP	State of the Bays Report	Record and review changes over time.
CE 2.2.11 MCBP STAC will track changes in the ecosystem from climate change through monitoring chemical, ecological and spatial trends.	Research & Ecosystem Assessment	MCBP	Indicator species, chemical parameter and range of physical changes in the ecosystem	Data and trends will be useful for predictions and projections of future conditions. Use information for adaptive management.
CE 3.1.4 DNR will explore the feasibility and potential of expanding precipitation chemistry parameters at the National Atmospheric Deposition site at Assateague State Park to include greenhouse gases. Consider the utility of collecting data for carbon dioxide, ozone, particulates, nitrous oxide, methane, fluorinated gases, etc. Assateague NPS will continue to operate the NADP site which is part of the partnership between NPS, DNR and Worcester County.	Research & Ecosystem Assessment	DNR	Status and trends of atmospheric deposition since 2000. Expanded monitoring parameters to measure change over time	Reduction in greenhouse gases (25% by 2020 GGRP).

10. Science Agenda

Research is formalized curiosity. It is poking and prying with a purpose.
—Zora Neale Hurston

Researchers from the University of Maryland, Center for Environmental Science, Maryland Department of Natural Resources, Assateague Island National Seashore and Maryland Coastal Bays Program discuss the causes and effects of nutrient overloading in the bays. Photo by Roman Jesien.

The Maryland Coastal Bays Program benefits from the collective wisdom and curiosity of regional scientists who voluntarily serve on the Science and Technical Advisory Committee. This group serves as a backstop to policy by providing science-based policy recommendations for natural resources managers and governmental decision-makers. The periodic Ecosystem Health Assessment is a compendium of known ecological status and trends and the following actions serve as a list of potential research activities.

A periodic gap analysis is necessary to stay abreast of emerging issues of concern. To facilitate those discussions we have identified the following actions for consideration:

CCMP ACTIONS THAT ADDRESS RESEARCH				
Action item	**Category**	**Lead partner**	**Outputs (deliverables)**	**Outcomes (knowledge & behavior)**
WQ 1.1.5 MCBP will seek help from University of MD Sea Grant to determine the most appropriate TMDL credit for septic pumping.	Research & Ecosystem Assessment	MCBP	TMDL nutrient reduction credits	Documented change over time.
WQ 1.2.1 MCBP will work to revive interest and funding for the proposed "Sustainability of the Ground Water Resources in the Atlantic Coastal Plain" study to produce a regional groundwater flow model of the Coastal Plain deep aquifer as well as a local model for Worcester County. The model could also be used to simulate the impacts of changes in groundwater recharge and discharge patterns induced by climate change and sea-level rise.	Research & Ecosystem Assessment	MCBP	Groundwater sustainability model for the Coastal Bays region	Ecosystem prediction and response.
WQ 1.2.2 MCBP STAC will compare the USGS surficial aquifer model with other known studies such as thermal imaging to prescribe solutions for water protection and improvements.	Research & Ecosystem Assessment	MCBP	Comparative studies review	Recommendations for ecosystem improvements, better understanding of nutrient flow paths and consequences.
WQ 1.2.3 USGS and NPS will investigate funding resources to continue monitoring nutrient inputs to the Coastal Bays from groundwater. They will study variations in nitrogen concentrations and residence times along surficial groundwater flow paths. This work will provide information on the effects of land use on water quality and provide a basis for planning for conservation areas.	Research & Ecosystem Assessment	USGS	Groundwater monitoring plan. Update the 1955 Mines & Water Resources Bulletin referenced in WC Water Resources Element	Assess flow volumes, groundwater age and percentage nutrient contribution by land use sector.
WQ 1.2.4 NPS will identify baseline groundwater conditions and develop a protocol to monitor and assess changes in the island's groundwater resources related to climate variability.	Research & Ecosystem Assessment	NPS	Status and trends of Assateague Island groundwater resources	Ecosystem prediction and response.
WQ 1.2.5 MDE will work with appropriate state and federal agencies to determine quantity and quality of groundwater resources available for the watershed. Review the source water protection reports' recommendations for each system and determine what is feasible for implementation on a local level.	Research & Ecosystem Assessment	MDE	Source water protection reports with wellhead protection audits	Planning recommendations and priority levels for the Water Resources Element chapter of the County Comprehensive Plan.
WQ 1.4.4 MDP and WC will monitor changes in total impervious surfaces over time. Sub-watersheds with more than 10% impervious surface should be ranked for restoration. Areas ranked as <10% should be targeted for preservation.	Research & Ecosystem Assessment	MDP	Baseline of imperviousness	Percent change over time, effectiveness of effort.
WQ 1.5.3 MDA and SU will consider the extent of phosphorus saturated soils in the Coastal Bay watershed, while researching the utility of adopting the Phosphorus-Index and the potential economic implications to local farmers.	Research & Ecosystem Assessment	MDA	Analysis of soil Phosphorous saturation, leaching potential and economic impacts to farmers	Management decisions to jointly support TMDL reduction goals and sustainable farming practices.
WQ 1.5.4 MDA and NRCS will track existing agricultural best management plans that are in place and suggest areas that would benefit from increased projects.	Research & Ecosystem Assessment	MDA	Soil Conservation & Water Quality Plan watershed acreage targets and goals.	Effort evaluation & setting future goals. Use of existing statewide Watershed Implementation Plan procedures and staff to track, compile and analyze BMP data.
WQ 1.5.10 MGS, subject to available funding, will quantify the volume of water and nutrients delivered from watershed ditches to the Coastal Bays. Results will be utilized to establish priority areas for appropriate nutrient reduction strategies.	Research & Ecosystem Assessment	MGS	Priority plans for water storage and nutrient reduction	Ecosystem predictions/ water budget.
WQ 1.6.6 MCBP STAC will investigate changes to water quality parameters (nutrients, sediment, harmful algal blooms, etc.) that affect the Coastal Bays through inlet flushing.	Research & Ecosystem Assessment	MCBP	Analysis and reports of water quality exchanges with the ocean	Recommendations for monitoring to better understand ecosystem linkages.

Action item	Category	Lead partner	Outputs (deliverables)	Outcomes (knowledge & behavior)
WQ 3.1.2 MCBP will ask EPA (Office of Water) to assist Program efforts by conducting a Recovery Potential Screening for the Coastal Bays. The screening process will be based on ecological, stressor and social indicators, and measured by landscape datasets, impaired water attributes and monitoring data to prioritize restoration projects.	Research & Ecosystem Assessment	MCBP	Recovery Potential Screening Report for the Coastal Bays	Priority planning for conservation or restoration projects.
WQ 3.1.5 DNR will compile the results and determine trends in air pollution inputs from the National Atmospheric Deposition Program monitoring site on Assateague Island. Disseminate information via the "State of the Bay" report every five years.	Research & Ecosystem Assessment	DNR	Air pollution data analysis and trends	Data provides feedback on air pollution reduction policies and programs.
FW 1.1.3 DNR will provide annual updates on the stock status of key fish species in relationship to established targets and thresholds.	Research & Ecosystem Assessment	DNR	Annual trends & status reports that relate to thresholds and targets from a designated baseline year(s).	Knowledge to support and predict sustainable harvests.
FW 1.1.6 DNR will investigate the feasibility of developing alternative methods of volunteer recreational harvest sampling including but not limited to logbooks and web-based surveys.	Research & Ecosystem Assessment	DNR	Volunteer input regarding recreational harvest	Stakeholder involvement and volunteer opportunities.
FW 1.2.5 DNR and MCBP will support efforts to monitor and assess Harmful Algae.	Research & Ecosystem Assessment	DNR	Species, frequency, duration and effects (i.e.. hypoxia, human illness, living resource degradation)	Protection of public health, aquaculture and sea grass growth.
FW 1.5.3 MCBP will continue terrapin counts and promote the use of cull rings and Turtle Exclusion Devices (TEDs) on all recreational pots. Data will be shared with the Terrapin Work Group	Research & Ecosystem Assessment	MCBP	Terrapin counts & promotion of excluders for retailers/ public	Increased public participation & stewardship, improved population estimates.
FW 2.1.5 DNR will research the effects of warming temperatures, brown tide and sea level rise on seagrass abundance.	Research & Ecosystem Assessment	DNR	Impact study	Coastal resiliency information.
FW 2.2.1 DNR will contract with VIMS to repeat the shoreline inventory of 2004 to determine the change in hardened versus soft shorelines. Set a target for reducing hardened shoreline throughout the watershed.	Research & Ecosystem Assessment	MCBP	Shoreline study (baseline = 52% hardened as of 2004)	Change in landscape over time.
FW 2.2.3 DNR and others will determine the extent of marshes, the potential for marsh migration in response to sea level rise, and the economic value of ecosystem services.	Research & Ecosystem Assessment	DNR	Ecosystem valuation	Return on investment data.
FW 2.2.5 DNR will continue to expand and update data and information via the Coastal Atlas.	Research & Ecosystem Assessment	DNR	Comprehensive database and resource maps for the Coastal Bays. Expanded Coastal Atlas and/or iMap.	Planning resources.
FW 2.3.7 MDE will annually monitor and report on the success of wetland mitigation sites and compile the most current wetland inventory for the Coastal Bays. The inventory will include voluntary and mitigated wetland gains and losses over time.	Research & Ecosystem Assessment	MDE	Ecological monitoring, updated wetland inventory	Return on investment for mitigation dollars. BMP cost estimates will be used for project planning.
FW 3.1.5 DNR-MBSS will assist MCBP in identifying aquatic areas that are most vulnerable to climate change and make recommendations for protection.	Research & Ecosystem Assessment	DNR	Identification of sensitive areas	Climate change projections.
FW 3.1.6 MCBP will continue annual stream surveys for water quality and rapid assessment of habitat conditions. Special consideration will be given to biometrics and chemistry spectrums in brackish, tannic and freshwater habitats.	Research & Ecosystem Assessment	MCBP	Data for state and local consideration	Stream health monitoring.

Action item	Category	Lead partner	Outputs (deliverables)	Outcomes (knowledge & behavior)
FW 3.1.7 MCBP and MCC-Assateague will participate in Stream Wader collection opportunities as they become available through DNR.	Research & Ecosystem Assessment	MCBP	Data for state and local consideration	Stream health monitoring and volunteer participation.
FW 3.2.1 DNR (ad hoc forest committee) will use the most current GIS layer of Forest Interior Dwelling Species (FIDS) to determine forested parcels that are 50 acres or more in size, with at least 10 acres of FIDs habitat. Calculate canopy cover, composition and stream widths through field surveys.	Research & Ecosystem Assessment	DNR	Data for Terrestrial Monitoring Plan, FIDS layer	Multiagency coordination.
FW 3.2.2 DNR will use current high-resolution imagery to assess forest and tree cover.	Research & Ecosystem Assessment	DNR	Mapping exercise	Data on change in percent forest cover over time.
FW 3.2.11 DNR and the Maryland Sustainable Forestry Council will identify options to improve long term viability and environmental benefits of forest industries and utilization of renewable wood products.	Research & Ecosystem Assessment	DNR	Economic status & sustainability of forestry operations in WC	Determine and support the economic sustainability of forestry.
FW 3.3.1 DNR Wildlife & Heritage Service will characterize the terrestrial areas within the Coastal Bays watershed using existing indicators, monitoring data and game harvest information. Data will include colonial waterbird nesting sites, bird migratory stopover areas, presence and abundance of rare and endangered species, location and productivity of terrapin nesting beaches and natural communities	Research & Ecosystem Assessment	DNR	Data for Coastal Bays Terrestrial Monitoring Plan	Wildlife characterization. Project areas and priorities change over time in sensitive habitats and species.
FW 3.3.2 NPS will continue to monitor barrier island threatened and endangered species including piping plover Charadrius melodus, seabeach amaranth Amaranthus pumilus, sea turtles and tiger beetles (Cicindelinae).	Research & Ecosystem Assessment	NPS	Information and annual reports	Conservation and population trends of threatened and endangered species.
FW 3.3.3 DNR, NRCS and MCBP will identify and implement appropriate enhancement techniques for landowners interested in providing habitat for songbirds and other species through native plantings and other restoration techniques.	Research & Ecosystem Assessment	DNR	Detailed offerings of restoration and enhancement techniques	Project areas and priorities.
FW 3.3.4 USDOI and DNR will compile information for forest interior songbirds, neotropical migrants, colonial waterbirds, waterfowl and shorebirds in the watershed from existing databases and produce a status and trends report as well as habitat improvement recommendations.	Research & Ecosystem Assessment	DNR	Status & Trends report for birds	Change in acres designated for habitat services.
FW 3.3.8 DNR will help WC, Ocean City and Berlin to establish urban tree canopy goals and identify areas for projects. The 2013 Forest Preservation Act commits Maryland to maintaining or tree canopy cover at 40 percent.	Research & Ecosystem Assessment	DNR	Comparison of local tree canopy cover to state wide percentage and established goals at or above 40%	Project areas and priorities, mitigation of carbon emissions.
FW 4.1.1 MCBP STAC will hold workshops to formally adopt the Coastal Bays Terrestrial Monitoring Plan. The plan will consist of a 3 tiered approach: landscape/GIS assessment, rapid site assessment and field surveys. A monitoring frequency schedule, a list of indicators and responsible parties will be produced. Finding will be incorporated into the five-year Coastal Bays Ecosystem Health Assessment Reports.	Research & Ecosystem Assessment	MCBP	Detailed offerings of enhancement techniques	Project areas and priorities.
FW 4.1.3 DNR (Coastal & Chesapeake Services) and MARCO, the Mid-Atlantic Regional Council for the Ocean, will characterize critical offshore habitat, migratory pathways, biological populations and ecological processes.	Research & Ecosystem Assessment	DNR	Data posted to the MARCO Portal[3] and a characterization report for managers and the public.	Information for long-term ecosystem-based management.
FW 4.2.3 NPS, DNR and MCBP will continue to collaborate and maintain bay water quality monitoring programs to assess nutrient loading and living resource responses.	Research & Ecosystem Assessment	NPS	Spatially related estuarine water quality data	Ecosystem stressors and biotic impacts. Leveraging of limited resources to prevent duplication of effort.

Action item	Category	Lead partner	Outputs (deliverables)	Outcomes (knowledge & behavior)
RN 2.1.1 DNR will revisit the Sensitive Areas research gaps and needs outlined by the technical task force and create a plan for addressing and prioritizing those needs. (e.g. shoreline changes, fish blockages, island habitats, harmful algae blooms, sea level rise, etc.).	Research & Ecosystem Assessment	DNR	Updated Sensitive Areas/Blue Infrastructure Report with management recommendations	Informed planning for adaptive management, increased use of DNR Coastal Atlas mapping tool for estuaries.
CE 1.1.1 UME, WC and SU-BEACON will analyze the economic contributions of farming, forestry, commercial & recreational fishing, (traditional and low impact) tourism and other natural resource dependent economic sectors in the watershed. Include value of farmers markets, direct to farm products, historical assets and marine related businesses, etc.	Research & Ecosystem Assessment	UME	Economic sector/ resource-based industries report with indicators for measuring change over time.	Better understanding of natural resource related industry.
CE 2.2.11 MCBP STAC will track changes in the ecosystem from climate change through monitoring chemical, ecological and spatial trends.	Research & Ecosystem Assessment	MCBP	Indicator species, chemical parameter and range of physical changes in the ecosystem	Data and trends will be useful for predictions and projections of future conditions. Use information for adaptive management.
CE 3.1.4 DNR will explore the feasibility and potential of expanding precipitation chemistry parameters at the National Atmospheric Deposition site at Assateague State Park to include greenhouse gases. Consider the utility of collecting data for carbon dioxide, ozone, particulates, nitrous oxides, methane, fluorinated gases, etc. Assateague NPS will continue to operate the NADP site which is part of the partnership between NPS, DNR and Worcester County	Research & Ecosystem Assessment	DNR	Status and trends of atmospheric deposition since 2000. Expanded monitoring parameters to measure change over time.	Reduction in greenhouse gases (25% by 2020 GGRP[2]).
CE 3.2.13 MCBP Scientific and Technical Advisory Committee will develop a long-term Science Agenda and the State of the Coastal Bays report every five years.	Research & Ecosystem Assessment	MCBP	MCBP Science Agenda, Maryland Coastal Bays Report	Technical transfer, leveraging knowledge and resources, science based information for decision making.

11. Habitat Plan

Tug on anything at all and you'll find it connected to everything else in the universe.
John Muir

Coastal dune mushrooms on Assateague Island. Photo by Travis Turnbaugh.

Protecting and restoring the natural habitats in the watershed is a core mission of every National Estuary Program. Each year, information about every conservation easement and restoration project in the watershed is collected. Be it sand nourishment of eroded islands, shoreline or tree plantings, wetland creations or farmland preservation, each project is one step closer to maintaining the biological diversity and beauty of the region.

The Coastal Bays Program has been adept at working with partners to preserve and restore land. Since its inception in 1996, the Program has protected or restored some 12,000 acres of forest, wetlands, farmland, islands and grasslands. The Habitat Protection & Restoration Plan will continue to utilize local, state and federal sources for both research and funding to target the most appropriate areas for conservation.

In the northern bays the focus is on restoration. Slowing, holding and treating water from ditches, Public Drainage Associations, stormwater infrastructure and other conveyances is critical here. Converting marginal agricultural land to forest, native grasses and wetlands is a top priority. The northern bay watersheds have lost much of their biological diversity and nutrient reductions (30-40% of current loads) are necessary to meet TMDL goals.

Protection and restoration efforts will be targeted towards the Newport, Sinepuxent and Chincoteague Bay watersheds. In 2008, the MCBP Policy Committee approved the Newport–Chincoteague Land Conservation Area with a goal of protecting 20% of the 64,000-acre area with 3,300 additional acres by 2015. By 2014, partners had worked with MCBP to protect 3,394 acres there. In 2015, MCBP set a new goal of protecting 3,200 additional acres by 2020 or 25% of the target area.

In all areas, dam removal and island restoration will continue to be top priorities. Near shore area conservation will continue too as the program seeks to protect bay beaches and tidal marsh and to allow natural shoreline migration as a critical step in adapting to climate change. Both an assessment of climate vulnerability and value towards resilience will help determine location and type of all projects pursued. The Program will canvas

and coordinate with local, state and federal programs for projects and research wherever and whenever possible with a combination of willing landowners and available pots of money. These include funding and technical assistance from various sources such as;

1) Maryland Rural Legacy Program
2) Maryland Agricultural Land Preservation Foundation
3) Maryland Program Open Space
4) Chesapeake and Atlantic Coastal Bays Trust Fund
5) NOAA Coastal and Estuarine Land Conservation Program
6) US Fish & Wildlife Service Coastal Wetlands Program
7) US Fish & Wildlife Service North American Wetlands Conservation Fund
8) USDA Permanent Wetland Reserve Program Easements
9) USDA Permanent Conservation Reserve Enhancement Program Easements
10) USDA Forest Legacy Program
11) USDA Agricultural Land Easement Program
12) Local, county and state matching sources of money
13) Non-profit sources of money
14) Donated easements

The rigorous research the program has done with wildlife populations, including colonial nesting birds, forest interior dwelling species and reptiles and amphibians will continue to help target parcels. New actions called for in this CCMP are an integral part of this habitat protection and restoration plan and are compiled below.

CCMP ACTIONS THAT ADDRESS HABITAT PROTECTION AND RESTORATION

Action item	Category	Lead partner	Outputs (deliverables)	Outcomes (knowledge & behavior)
WQ 1.3.4 MCBP will encourage chemical-free vegetation and buffers to reduce sediment, pesticide and fertilizer runoff from properties. Identify all funding opportunities and encourage participation.	Restoration & Conservation	MCBP	Summary of resources	Change in buffer coverage over time.
WQ 1.4.7 MCBP will promote the retention of wetlands and buffers in riparian zones and along existing stream contours. Existing developed areas (ex. parking lots) will be targeted for pervious retrofits or other infiltration practices.	Education & Outreach	MCBP	Public workshops, native vegetation plantings opportunities, and sponsoring of impervious retrofits. Continued beach, shoreline and wetland clean-ups	Increase in buffer areas and infiltration practices.
WQ 1.5.7 MCBP, MDA, NRCS and other partners will encourage and pursue grant funding for BMPs, farmland conservation and other programs in most affected watersheds to support local agriculture.	Policy Issue	MCBP	Funding directed to the watershed (including from MDA Animal Waste Technology Fund, Ag Energy Efficiency Program, etc.)	Economic Development and community resiliency.
WQ 1.5.8 MCBP will establish a workgroup comprised of MDA, SHA, WC, WSCD, NRCS, Public Drainage Association managers and landowners to determine site specific opportunities for innovative ditch design and/or restoration opportunities as well as Public Drainage Association improvements and water control structures. Continue to educate landowners on proper ditch maintenance practices.	Restoration & Conservation	MCBP	Priority projects list and outreach to promote new BMPs and management technologies	Number of BMPs or other technologies to benefit Public Drainage Associations.
WQ 1.5.9 LSLT and MCBP will work with partners and landowners to protect, restore and plant non-tidal wetlands and forest/grass buffers on agricultural land using MALPF, WRE, MACS, CREP, EQIP, NAWCA, CELCP, Coastal Wetlands, Rural Legacy and other state and federal program funding.	Restoration & Conservation	MCBP	Funding for BMPs, wetland restoration projects and farm land preservation	Meet goal to preserve, protect or enhance 1,000 of farmland by 2016. Set goals for future efforts.

Action item	Category	Lead partner	Outputs (deliverables)	Outcomes (knowledge & behavior)
WQ 2.1.5 NPS-ASIS will continue to pursue saltmarsh restoration and monitoring projects such as ditch plugging and filling, marsh elevation studies, and nekton monitoring to restore natural conditions and document long-term changes within salt marshes along Assateague Island.	Within Existing Resources	NPS	Summary of natural salt marsh status and trends, including monitoring of PCBs, PAHs, and DDT	Restore saltmarsh hydrology and ecological function, build resiliency, document long-term change.
FW 1.5.1 DNR and MCBP will protect horseshoe crab populations by promoting the protection of bay beaches and other bottom habitats and promote volunteer monitoring of spawning populations throughout the coastal bays.	Within Existing Resources	MCBP	Annual spawning survey report	Protection of beach habitats, public stewardship and involvement, HSC management plan data.
FW 1.5.2 MCBP will continue to aid the Oyster Recovery Partnership in oyster gardening, shell recycling and reef enhancement.	Restoration & Conservation	MCBP	Number and success of oyster gardens and community interest	Enhanced community stewardship and ecosystem enhancement.
FW 2.2.4 DNR (Chesapeake & Coastal Services) will coordinate with WC to implement protections identified in the Blue Infrastructure Near-Shore Assessment; a detailed spatial evaluation of coastal habitat, critical natural resources and associated human uses in tidal waters and near-shore areas. Consider ways to monitor sea level rise and implement protective measures to maintain habitats.	Restoration & Conservation	DNR	Technical assistance (GIS data, training, maps, etc.)	Protection and maintenance of near shore habitats to permit species and habitat migration.
FW 2.2.7 WC will continue to work with existing partners and programs such as Rural Legacy, Forest Legacy, Program Open Space and the Nature Conservancy to protect natural shorelines and adjacent landward areas through the purchase of development rights, shoreline easements or "fee simple" purchases.	Within Existing Resources	WC	Acres or linear feet of protection	Natural shorelines will be able to naturally migrate as sea level rises.
FW 2.3.1 MDE will compare the Watershed Resources Registry analysis with the priority projects identified for Priority Areas for Wetland Restoration, Preservation and Mitigation in Maryland's Coastal Bays (MDE 2004). Outline examples of how WC can use the information for planning purposes and what resources are available for implementation of projects.	Restoration & Conservation	MDE	Wetland implementation plan	EPA Habitat Restoration goals, carbon/nutrient/ sediment sinks.
FW 2.3.2 MCBP will convene a workshop with EPA, NRCS, DNR, NOAA, ACOE, SHA, MDE, USFW, WC, TNC, Ducks Unlimited and other interested partners to develop a system of tracking wetland gains and losses, mitigation success and high priority conservation areas. Create a list and map of all known projects & impacts since 2000. Federal, state and local regulatory personnel will develop a comprehensive wetlands plan for the region to provide additional guidance for wetlands protection.	Restoration & Conservation	MCBP	Wetland net gain vs. net loss tracking system.	Percent attainment of 10,000 acre protection & restoration goal since 2,000.
FW 2.3.4 MDE and WC will work together to explore opportunities for the creation of wetlands to treat waste water (both urban and agricultural), retain sediments, aid storm water management and provide wildlife habitat.	Policy Issue	MDE	Formulate and adopt work plan and a list of opportunities for wetland creation as a BMP	Leveraging of resources for BMPs.
FW 3.1.4 DNR will consider the Coastal Bays for potential aquatic habitat management and restoration projects. Consider areas that may be designated as Stronghold Watersheds or that are identified in BioNet.	Within Existing Resources	DNR	Habitat Management Plans	Recommendation for restortaion, conservation, and protection.
FW 3.1.5 DNR-MBSS will assist MCBP in identifying aquatic areas that are most vulnerable to climate change and make recommendation for protection.	Research & Ecosystem Assessment	DNR	Identification of sensitive areas	Climate Change projections.
FW 3.1.8 NRCS will collaborate with state agencies, local entities and landowners to facilitate stream restoration and protection efforts, particularly problems identified in DNR Stream Corridor Assessments (fish blockages, inadequate buffers, trash, erosion sites, etc.).	Restoration & Conservation	NRCS	Project plans and funding	Improved habitat and water quality.

Action item	Category	Lead partner	Outputs (deliverables)	Outcomes (knowledge & behavior)
FW 3.1.9 NRCS, WSCD and MDA will encourage use of habitat enhancing BMPs in management plans (buffers, wetlands, meadows, headwater forests, etc.).	Within Existing Resources	NRCS	Tracking of BMPs	Increased landowner interest.
FW 3.2.3 WC, DNR LSLT, TNC, USFWS and others will maintain a coastal land conservation group that meets once or twice per years to share information on projects, goals, funding etc.	Within Existing Resources	WC	Meeting minutes outlining the status of ongoing and potential conservation projects with the potential for collaboration	Collaboration, information sharing and leveraging resources for conservation. Alignment of local and state no net loss policy.
FW 3.2.4 DNR will determine areas in need of afforestation (e.g., creeks, streams and wetland buffers). Determine a protection goal to meet by 2025. Conduct outreach to owners of these properties with information about opportunities for restoration of their land with tree planting.	Within Existing Resources	DNR	Baseline of forested acres and goal to increase those acres by 2025	Conservation targets and priority planting sites with willing landowners.
FW 3.2.5 WC will direct forest mitigation fees to restoration projects identified through collaborative restoration planning. They will determine if funds can be leveraged through other existing programs such as Stream ReLeaf, Forest Legacy, Stream Restoration Challenge, etc.	Restoration & Conservation	WC	Priority Planning	Fund leveraging
FW 3.2.6 UME, DNR and NRCS will coordinate efforts to maintain forest health and extent via land conservation efforts, forest management, outreach and education, cost share programs and forest stewardship plans. Forest management plans should strive to be in place for at least 75% of watershed acreage within 10 years.	Education & Outreach	UME	Strategic acreage goal for forest stewardship by 2025	Multiagency coordination.
FW 3.2.7 NRCS will ensure coordination among cost-share programs such as EQIP, WHIP, WRE, CREP, and MACS.	Within Existing Resources	NRCS	Implementation of existing programs	Amount of cost-share and acres treated.
FW 3.2.9 DNR, MCBP, WC, LSLT, TCF and TNC will target parcels containing deciduous forests for conservation. Define criteria for these forested areas and promote easements and/or plans that support hardwood succession.	Within Existing Resources	DNR	Define and set criteria for deciduous forest conservation. Map existing areas that meet the criteria and make recommendations for where to target conservation of 300 acres of hardwoods per year	Promotes wildlife diversity and conservation.
FW 3.3.7 MCBP and WC will review all county owned lands, including grounds of public facilities such as schools and parks, to determine areas where native habitat enhancement is feasible through alternative management strategies and/or planting native vegetation.	Within Existing Resources	MCBP	Mapping exercise	Change in acres designated for habitat services.
FW 3.3.8 DNR will help WC, Ocean City and Berlin to establish urban tree canopy goals and identify areas for projects. The 2013 Forest Preservation Act commits Maryland to maintaining or tree canopy cover at 40%.	Research & Ecosystem Assessment	DNR	Comparison of local tree canopy cover to state wide percentage and established goals at or above 40%	Project areas and priorities, mitigation of carbon emissions.
FW 3.3.9 Where appropriate, MCBP will coordinate volunteer efforts to assist with tree planting, non-native species removal, buffer planting and monitoring of projects for long term success evaluation.	Within Existing Resources	MCBP	Citizen involvement	Evaluation of habitat improvement success.
FW 3.3.10 DNR (Wildlife and Heritage) will present findings from BioNet that prioritizes areas for terrestrial and freshwater biodiversity conservation. The tier mapping is meant for targeting land conservation activities, acquisitions, easements, mitigation sites and habitat restoration.	Restoration & Conservation	DNR	Discussion at Implementation Committee, list of potential restoration/conservation sites	Change over time in sensitive habitats & species.

Action item	Category	Lead partner	Outputs (deliverables)	Outcomes (knowledge & behavior)
FW 3.3.11 Using tools such as DNR's BioNet, WC and DNR will work together to identify land conservation priorities within the Newport – Chincoteague Land Conservation Area, with a goal of protecting 500 acres annually through conservation easements and other means.	Within Existing Resources	WC	Conserve 500 acres per year through 2018	Comparison of conservation efforts, targeting and leveraging opportunites.
FW 4.1.7 Ocean City will continue to sponsor permits for the Ocean City Reef Foundation to support sustained improvements in reef enhancements.	Within Existing Resources	OC	Permits and technical advice to support nonprofit efforts	Sustained improvement in offshore habitats and marine species.
RN 3.1.1 MCBP and WC will develop public and political support for the ACOE Ocean City Water Resources Study recommended habitat projects and long-term sand bypassing program at the Ocean City Inlet through planning, monitoring and outreach publicizing existing problems and explaining potential benefits. Seven projects were identified in the OCWRS: Revisit the study process for additional projects & needs. 1. Ocean Pines Saltmarsh Restoration (done—8.5 acres of salt marsh restored). 2. Isle of Wight Saltmarsh Restoration (done—12 acres of salt marsh restored). 3. Ocean City Harbor and Inlet Deepening (conducted twice yearly). 4. Assateague Island Short-Term Restoration (done 2002—1.4 million cubic meters). 5. Assateague Island Long-Term Nourishment (2004 & on-going—144,000 cubic meters per year). 6. Dog Island Shoals Restoration—to be done. 7. South Point Spoils Island Restoration—to be done. 8. Skimmer Island—needs to become institutionalized.	Restoration & Conservation	MCBP	Acres of habitat enhanced or created. Monitor the effectiveness of projects over time.	Reevaluate local sediment needs & opportunities.
RN 3.1.2 ACOE and NPS will continue to facilitate the Assateague Island North End Restoration Project to restore the natural sediment supply to the barrier island.	Restoration & Conservation	ACOE	Documented sand volume net gain	Reduced unnatural sedimentation within the Ocean City Inlet and Coastal Bays. Restoration of the sand supply to Assateague Island.
CE 1.2.2 MDE will implement supplemental environmental projects in the location where environmental damage to be mitigated has occurred, preferably in the same subwatershed.	Restoration & Conservation	MDE	Mitigation projects	No net loss of ecosystem services.
CE 2.1.3 WC will continue to retain strong A-1 and Rural Preservation zoning to protect natural and cultural resources.	Within Existing Resources	WC	Zoning principles	Protection of agricultural and cultural land uses.

Maryland Coastal Bays Program accomplishments

Over the past 15 years, the CCMP has directed work in a variety of arenas to stop declines in water quality, improve navigation, protect fish and wildlife and refine development practices. Below are some highlights of that work.

Improving Water Quality

- MCBP partnered with Berlin to take 36,000 pounds of debris out of Hudson Branch that runs through an underprivileged neighborhood. Now, the program is working with the town of Berlin to beautify the branch and improve water quality.
- 12,000 copies of MCBP's Homeowner's Guide to the Coastal Bays, along with free soil testing kits, rain barrels and energy efficiency kits have been distributed to residents.
- MCBP worked with Berlin and Worcester County to get point source discharges of effluent permanently removed from the St Martins River and Newport Bay.
- MCBP issued the first State of the Coastal Bays Report in 2004, again in 2009 and now issues an annual report card on the state of the bays.
- MCBP developed a water quality monitoring program, staffed by volunteers. We aggregate monthly testing and analysis done in all parts of the bays by DNR, the Park Service, MDE and volunteers.
- MCBP worked with Berlin to educate residents and assist the town in developing a stormwater utility which identifies drainage areas, outfalls and highest priority areas for storm drain retrofits.
- MCBP worked with partners to complete more than 15 living shorelines projects where bulkheads and riprap were traded for native plants and beaches.
- MCBP helped pass the "Critical Areas law" that creates a 1,000-foot shoreline buffer in undeveloped areas of the watershed and calls for water quality improvement activities, like tree planting and stormwater treatment, in more developed areas.
- MCBP continues to enjoy one of the most highly regarded outreach programs as evidenced by the number of followers, Klout score (a measure of social media effectiveness), MCBP blog, website, monthly e-newsletter to 6,200 subscribers, Facebook (2,000+ members), Twitter and other social media accounts. Educating residents about water quality and climate change is paramount to the restoration of the watershed.

Improving Recreation and Navigation

- 10,000 copies of our Boater's Guide to the Coastal Bays are in the hands of local boaters. MCBP's "Helpful Hints for protecting your canals and waterways" was also distributed to 7,000 residents.
- MCBP partnered with Ocean City and DNR to create a kayak launch with interpretive trails on 37 acres of a former brownfield owned by the resort.
- MCBP fought for funding of the Ocean City and Vicinity Water Resources plan which is replenishing sand on Ocean City and Assateague Island and creating and restoring islands for the beneficial use of spoil to help declining colonial nesting birds.
- MCBP established the Clean Marina Program in the watershed, which certifies marinas for taking on measures to reduce chemical and nutrient pollution while working to create a "No Discharge Zone," prohibiting the dumping of boat sewage into the bays.
- MCBP distributed thousands of free oil-absorbing bilge socks for boat engines and circle fishing hooks, which significantly reduce mortality of released fish.

Protecting Fish and Wildlife

- MCBP convinced the state to manage fish, clams, oysters, scallops and blue crab stocks in the Coastal Bays separately from those in the Chesapeake, creating Hard Clam and Blue Crab Management Plans for the Coastal Bays.
- MCBP helped permanently protect 11,500 acres of farms and forest in the watershed, including the creation of two public nature parks totaling more than 1,000 acres.
- MCBP and its partners helped restore 10,200 acres of grass and forest buffers and 2,000 acres of wetlands.

- To properly manage populations, MCBP conducts an annual horseshoe crab, wading bird and terrapin monitoring program.
- MCBP partnered with the Army Corps of Engineers to fund and restore hundreds of acres of saltmarsh at both Isle of Wight and EA Vaughn Wildlife Management Areas.
- MCBP worked with partners to complete the removal of the Bishopville dam. The restoration of Bishopville Prong removes 53 lbs of nitrogen/year and now gives anadromous fish access to seven miles of freshwater breeding habitat. The nearby conversion of a 40-acre sand pit to rare Atlantic white cedar swamp enhanced the restoration.
- MCBP's Coastal Stewards program has employed some 90 students from diverse backgrounds to do restoration projects and educate the community, ensuring that people of color have a stake in protecting the environment.

Improving Development Practices

- Through its Mini-Grant Program, MCBP has provided $350,000 since 2000 for local community groups to conduct environmental projects in the coastal bays. The match from these projects totals $21 million more dollars the Coastal Bays Program has brought to the watershed.
- MCBP jumpstarted work with developers with the Builders for the Bay Program in 2003. The group of planners and developers devised the 25-page "Recommended Model Development Principles for Worcester County" detailing ways developers can protect the environment and improve their bottom line.
- Ocean City and MCBP started the "Clean Streets, Clean Waters" program with pollution prevention messages on garbage cans, busses and storm drains.
- MCBP helped develop the 20-year Worcester County Comprehensive Plan that calls for growth around Berlin, Pocomoke, Snow Hill and Showell. The plan keeps new development away from sensitive areas, like forests and wetlands, and limits land consuming sprawl.
- MCBP facilitated the creation of biking and kayaking trails, an African American Heritage Trail and facilitates birding and other outdoor events annually.
- MCBP created the Delmarva Atlantic Watershed Network (DAWN), a group of Sussex, Worcester, Accomack and Northampton county planners, scientists and decision-makers who shared water quality successes and best practices in growth management. An offshoot of the work included the opening up of an important dialogue with the town of Chincoteague about septic pollution.
- MCBP teamed up with local conservation partners and the Town Creek Foundation to educate Berlin residents about green building, energy conservation, spray irrigation, compact development and backyard wildlife. The effort helped Berlin become "America's coolest small town."

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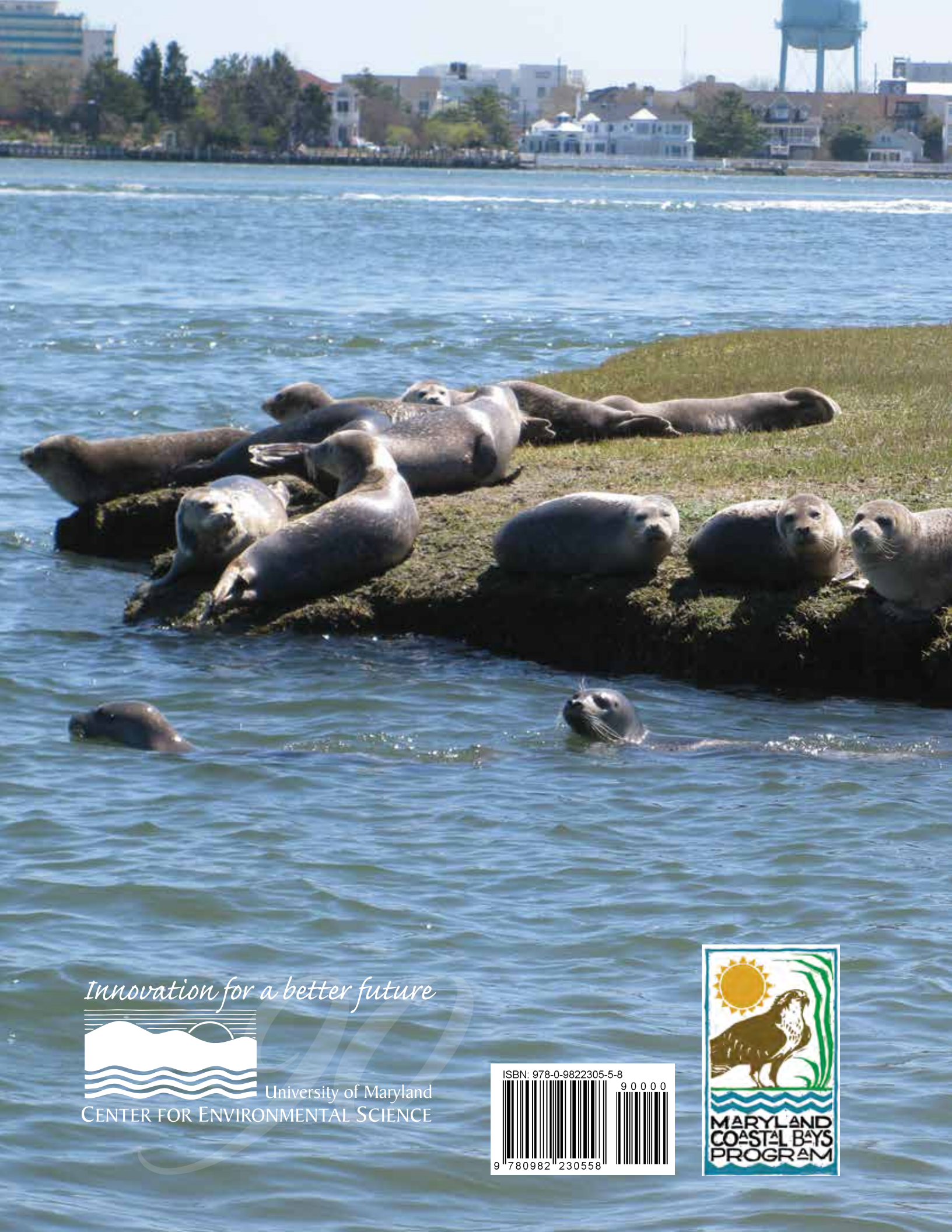

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