Water Resources Inventory / Baseline Conditions Report

State and District of Columbia Appendix

Existing Watershed Conditions and Threats Report

Chesapeake Bay Comprehensive Water Resources and Restoration Plan Results to Guide 2014 Chesapeake Bay Agreement Progress

CHESAPEAKE BAY COMPREHENSIVE WATER RESOURCES AND RESTORATION PLAN

June 2018

US Army Corps of Engineers®

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Section 1
Introduction

The Chesapeake Bay Comprehensive Water Resources and Restoration Plan (CBCP) is a watershed assessment intended to inform multiple audiences and decision-makers at all levels of government, and provide a strategic roadmap for future investments into aquatic ecosystem restoration. The CBCP was undertaken in cooperation with Chesapeake Bay stakeholders and partners and employed a collaborative approach to watershed planning, seeking to avoid duplication of any ongoing or planned actions by other federal, state, or local governmental agencies or non-governmental organizations (NGOs) in the Chesapeake Bay Watershed (past or present).

Geospatial analyses were the primary method used to investigate the problems, needs and restoration opportunities in the Chesapeake Bay Watershed. The intent of the CBCP analyses was to identify high-quality areas for potential conservation, degraded areas for restoration, gaps in restoration actions, and duplication of efforts. Geospatial analyses of the watershed were conducted at three scales: 1) a baywide analysis (*Restoration Roadmap*), (2) a jurisdiction analysis (State and District of Columbia jurisdictional boundary) (State and the District of Columbia Appendix), and (3) a watershed analysis (State-Selected Watershed Action Plans).

The objective of the baywide analysis was to identify focal locations for undertaking opportunities to meet the *2014 Chesapeake Bay Watershed Agreement* (2014 Bay Agreement) goals and outcomes, and to help achieve an environmentally and economically sustainable and resilient Chesapeake Bay Watershed. The results of the baywide analyses are presented in a *Restoration Roadmap*, which identifies the hydrologic unit code (HUC) 10 subwatersheds (hereafter referred to as subwatersheds) that have the highest potential to holistically meet the 2014 Bay Agreement goals. The Planning Analyses Appendix presents the baywide analysis.

In addition to the information generated that would assist multiple audiences and contribute to ongoing Chesapeake Bay Program Partnership (Partnership) (consists of federal, state and local governmental agencies, NGOs and academic institutions) actions, opportunities identified in the CBCP may be considered for U.S. Army Corps of Engineers (USACE) assistance through USACE authorities and programs. Some opportunities that fall within USACE mission areas can be addressed by USACE, while some will require action by others. 2014 Bay Agreement goals that most closely align with USACE mission areas include sustainable fisheries, vital habitats, healthy watersheds, and climate resiliency.

Results of the CBCP technical analyses are also presented for each jurisdiction in the Chesapeake Bay Watershed including Virginia, West Virginia, Maryland, Delaware, Pennsylvania, New York and the District of Columbia in the State and District of Columbia Annexes of this appendix. These state analyses are the result of the baywide analysis "clipped" per jurisdiction.

State-selected watersheds were identified by each jurisdiction for finer-scale analyses. The State-Selected Watershed Action Plans build upon the baywide and state analyses, with additional

geospatial analysis at the local watershed scale to further define ecological problems, needs, and opportunities in each state-selected watershed. Each action plan identifies potential projects to pursue within the state-selected watershed at a conceptual level of detail. The State-Selected Watershed Action Plans are attached to their corresponding state annex in this appendix.

Section 2 of this report describes the existing conditions and future threats to the Chesapeake Bay Watershed. Sections 3 through 10 describes the following 2014 Bay Agreement goals and how the CBCP analysis informs outcomes under these goals: Vital Habitats, Sustainable Fisheries, Toxic Contaminants, Healthy Watersheds, Land Conservation, Public Access, and Climate Resiliency. Not all 2014 Bay Agreement goals or outcomes were investigated in the CBCP because of lack of data, lack of connection to USACE missions, or inability to define a geospatial analysis to investigate opportunities. Section 11 describes available funding and implementation programs/resources and Section 12 briefly describes state and agency coordination and collaboration.

1.1 Authorization

USACE Baltimore and Norfolk Districts were authorized to develop a comprehensive and integrated restoration plan to guide implementation of projects affecting the Chesapeake Bay Watershed. The CBCP was conducted under the authority provided by the United States (U.S.) Senate Committee on Environment and Public Works, Committee Resolution adopted September 26, 2002. The study resolution reads as follows:

> *"Resolved by the Committee on Environment and Public Works on the United States Senate, that the Secretary of the Army is requested to review the report of the Army Corps of Engineers on the Chesapeake Bay Study, dated September 1984, and other pertinent reports, with a view to developing a coordinated, comprehensive master plan within the Corps mission areas for restoring, preserving, and protecting the Chesapeake Bay ecosystem. The plan shall focus on integrating existing and future work of the Corps of Engineers, shall be developed in cooperation with State and local governments, other Federal agencies, the Bay Program, the Chesapeake Bay Commission, and the Chesapeake Executive Council, and shall encompass all Corps actions necessary to assist in the implementation of the goals of the 2000 Chesapeake Bay Agreement. The plan shall identify additional feasibility studies and research efforts required to better understand and solve the environmental problems of the Chesapeake Bay."*

The CBCP was also conducted under supplemental authority provided by Section 4010(a) of the Water Resources Reform and Development Act of 2014 (WRRDA 2014), which links the CBCP to Section 510, a design and construction authority entitled "Chesapeake Bay Environmental Restoration and Protection Program." Section 4010(a) directs development of a "comprehensive Chesapeake Bay restoration plan" no later than 2 years after the enactment of WRRDA 2014. Section 510 provides for design and construction, cost-shared 75 percent federal and 25 percent non-federal, of water-related resources protection and restoration projects, and is to be based on the comprehensive plan. Types of projects eligible for assistance include those for sediment and erosion control; protection of eroding shorelines; aquatic ecosystem restoration, including restoration of submerged aquatic vegetation (SAV); protection of essential public works; beneficial uses of dredged material; and other related projects that may enhance the living

resources of the estuary. Non-federal sponsors for Section 510 can include federal, state and local governmental agencies.

The CBCP was completed with consideration of the following policy documents:

- USACE Planning Bulletin 2016 Watershed Studies – September 30, 2016
    - This planning bulletin, PB 2016-3 (https://planning.erdc.dren.mil/toolbox/library/pb/PB2016_03.pdf) provides guidance on USACE watershed assessments, integrating recent updates in law and advancing the concepts of watershed planning described in Engineering Circular (EC) 1105-2-411 (Watershed Plans).
- Executive Order 13508, Chesapeake Bay Protection and Restoration – May 12, 2009
    - President Obama issued Executive Order (EO) 13508 to protect and restore the Chesapeake Bay and its watershed (http://executiveorder.chesapeakebay.net/page/About-the-Executive-Order.aspx). The EO declared the Chesapeake Bay a national treasure and recognized that there are many nationally significant assets owned by the federal government in the Chesapeake Bay and its watershed, such as public lands, facilities, military installations, parks, forests, wildlife refuges, monuments, and museums.
- The Clean Water Act (CWA) of 1972, as amended
    - The CWA regulates discharges of pollutants into U.S. waters and sets water quality standards for surface waters. Although there are many components of the CWA, Section 303(d) and the Total Maximum Daily Load (TMDL) program are primary focuses of current Chesapeake Bay restoration efforts (https://www.epa.gov/chesapeake-bay-tmdl).
- Chesapeake Bay Program (CBP)
    - The Chesapeake Bay was the first estuary targeted by the U.S. Congress for restoration and protection. In the early 1980's, a congressionally-funded study to analyze the bay's rapid loss of wildlife and aquatic habitat identified excess nutrient pollution as the main source of the bay's degradation. These initial research findings led to the formation of the CBP as a means to restore the bay (CBP 2018). More information on the CBP is available online at: http://www.chesapeakebay.net/.
- 2014 Bay Agreement
    - Since 1983, there have been many agreements guiding Chesapeake Bay restoration. These agreements include the Chesapeake Bay Agreement of 1983, the 1987 Chesapeake Bay Agreement, Chesapeake 2000, and the 2014 Bay Agreement. Through the 2014 Bay Agreement, the partnership has recommitted its efforts to restoration of the bay and its watershed. The 2014 Bay Agreement is available online at:

https://www.chesapeakebay.net/documents/FINAL_Ches_Bay_Watershed_Agreement.withsignatures-HIres.pdf. The 2014 Bay Agreement goals are to:

- *Protect, restore and enhance finfish, shellfish and other living resources, their habitats and ecological relationships to sustain all fisheries and provide for a balanced ecosystem in the watershed and Chesapeake Bay.*
- *Restore, enhance and protect a network of land and water habitats to support fish and wildlife and to afford other public benefits, including water quality, recreational uses and scenic value across the watershed.*
- *Reduce pollutants to achieve the water quality necessary to support aquatic living resources and protect human health.*
- *Ensure the Chesapeake Bay and its rivers are free of the effects of toxic contaminants on living resources and human health.*
- *Sustain state-identified healthy waters and watersheds, recognized for their high quality and/or high ecological value.*
- *Conserve landscapes treasured by citizens in order to maintain water quality and habitat; sustain working forests, farms and maritime communities; and conserve lands of cultural, indigenous and community value.*
- *Expand public access to the Chesapeake Bay and its tributaries through existing and new local, state and federal parks, refuges, reserves, trails and partner sites.*
- *Enable students in the region to graduate with the knowledge and skills needed to act responsibly to protect and restore their local watersheds.*
- *Increase the number and diversity of local citizen stewards and local governments that actively support and carry out the conservation and restoration activities that achieve healthy local streams, rivers and a vibrant Chesapeake Bay.*
- *Increase the resiliency of the Chesapeake Bay watershed, including its living resources, habitats, public infrastructure and communities, to withstand the adverse impacts from changing environmental and climate conditions.*

1.2 Study Area

The Chesapeake Bay Watershed covers 64,000 square miles (mi) (165,760 square kilometers (km)) and includes parts of six states (Virginia, Maryland, Delaware, West Virginia, Pennsylvania and New York) and all of the nation's capital (**Figure 1**). The watershed extends about 500 miles north to south from the headwaters of Otsego Lake, near Cooperstown, New York, to Suffolk, Virginia, and west to east from near Blacksburg, Virginia, to Berlin, Maryland (near Ocean City, Maryland). The watershed has 11,684 miles of shoreline, including tidal wetlands and islands. The watershed's rivers all drain into one shallow tidal basin, the Chesapeake Bay, and the bay's tidal tributaries. The Chesapeake Bay is the nation's largest estuary and the third largest in the world and one of the world's most productive ecosystem. It is in the middle Atlantic Coastal Plain

Province and was formed when the lower valley of the Susquehanna River was drowned during the post-Wisconsin rise in sea level.

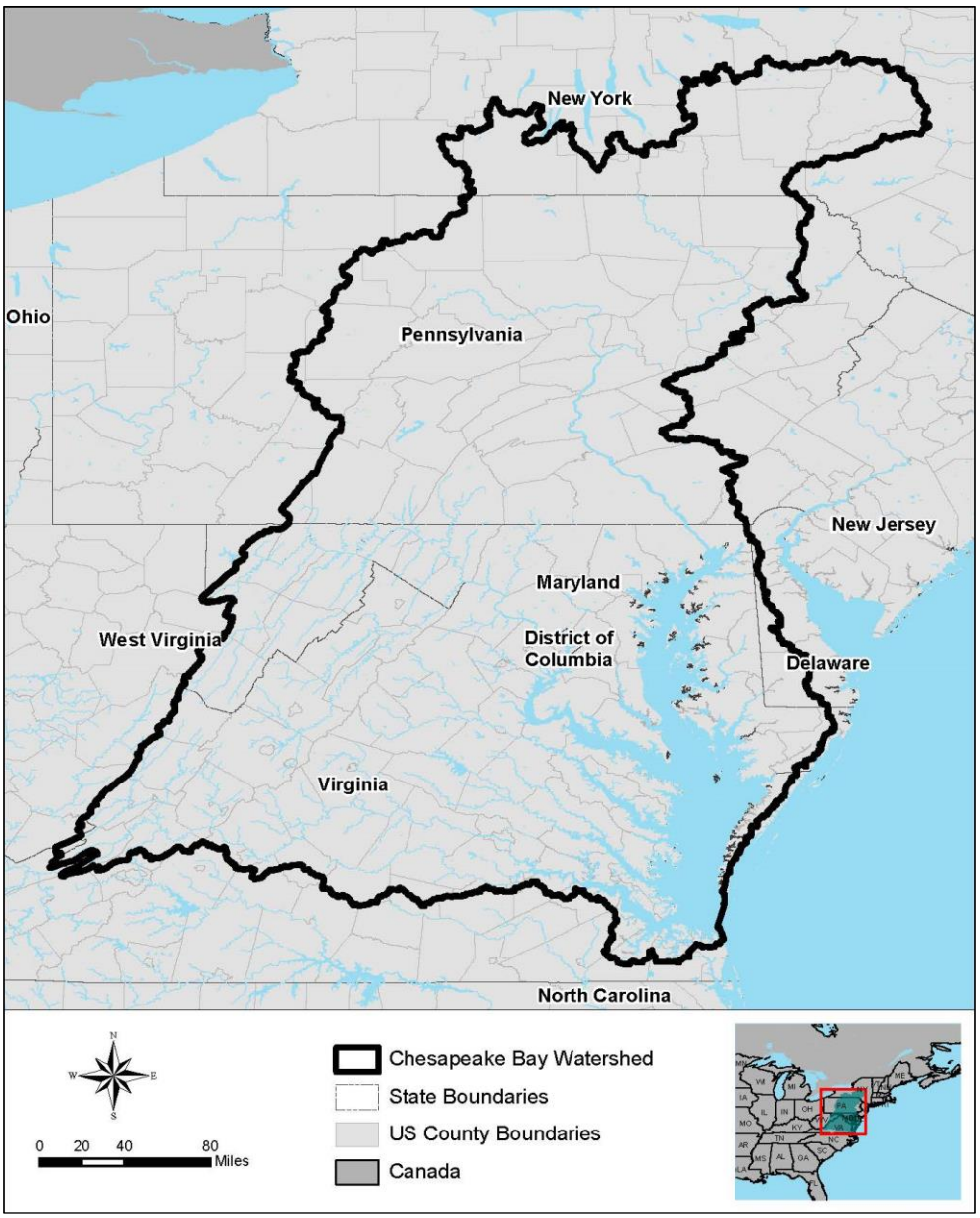


Figure 1. Chesapeake Bay Comprehensive Water Resources and Restoration Plan Study Area (Chesapeake Bay Watershed)

1.3 Sponsor

For the CBCP, USACE is the lead federal agency, with a 75 percent cost share, and the National Fish and Wildlife Foundation (NFWF) is the non-federal sponsor, with a 25 percent cost share. The U.S. Congress chartered NFWF in 1984 as a charitable and non-profit organization registered as a 501(c)(3) corporation (NFWF; http://www.nfwf.org/whoweare/Pages/home.aspx#.WvrtYjcpCUk).

Within the northeastern regional office, the NFWF Chesapeake Bay Program administrators grant awards, ranging from $8 million to $12 million annually, from the Chesapeake Bay Stewardship Fund, through two competitive grant programs: Innovative Nutrient and Sediment Reduction Grant Program and Small Watershed Grant Program[1]. The grants awarded from this fund are used to assist local communities with restoring polluted rivers and streams through a myriad of conservation and restoration projects (NFWF; http://www.nfwf.org/chesapeake/Pages/home.aspx).

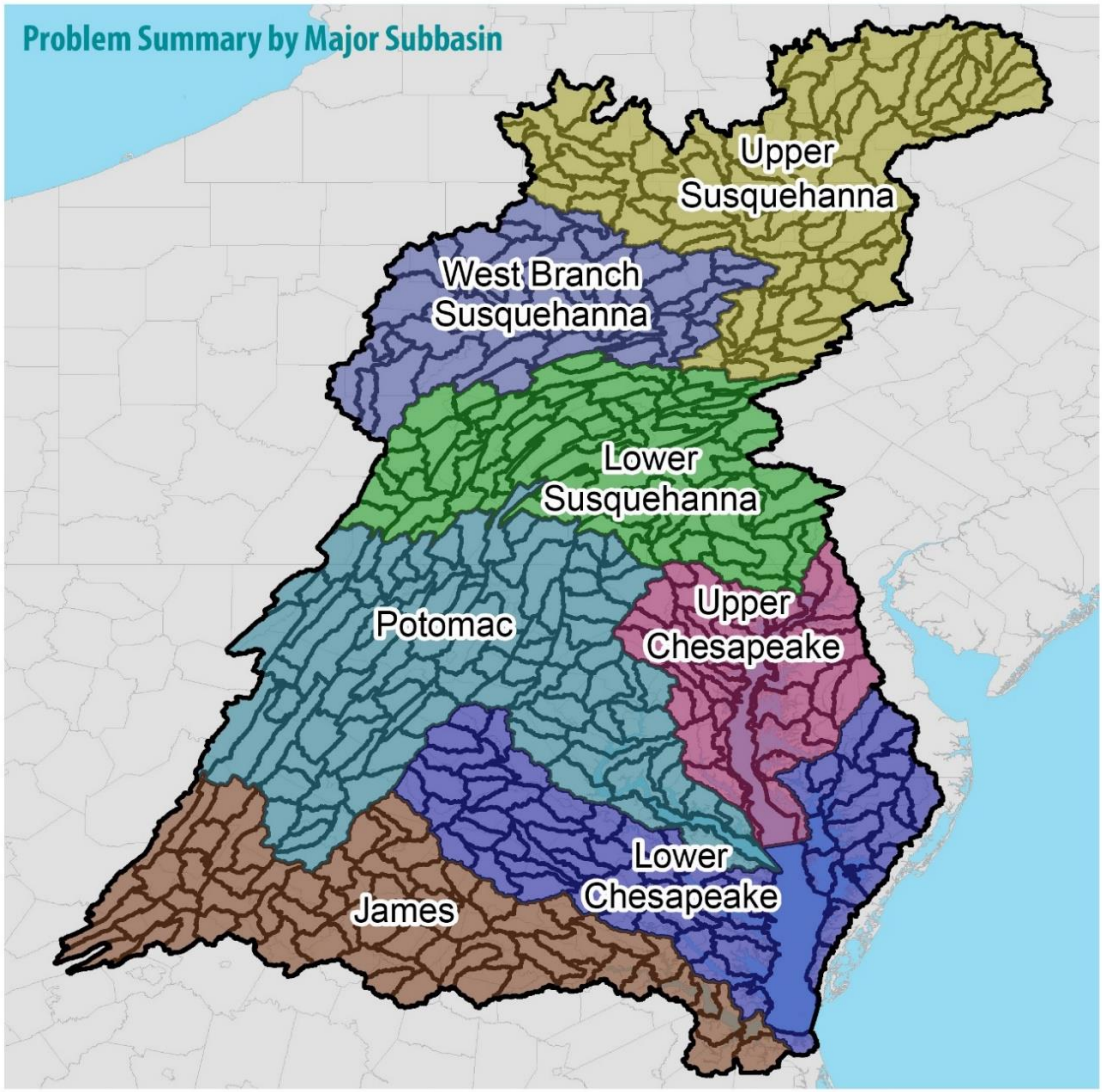
1.4 Primary Problem

The primary problem affecting the Chesapeake Bay Watershed is degradation of the structure and function of the aquatic ecosystem from human actions that has led to a less resilient Chesapeake Bay.

Solutions to the problem are two-fold, requiring both implementation and coordination. For solutions to succeed within an integrated water resources framework, it is necessary to (1) enhance interagency collaboration between agency programs and projects to streamline data sharing, reduce costs, and increase implementation of restoration and conservation actions, and (2) identify strategies and projects for ecosystem restoration that may also reduce flood risk, increase ecosystem and community resilience, support sustainable fisheries, promote environmental education and stewardship, and provide recreation and public access. The CBCP seeks to facilitate both needs.

[1] With a request for proposals for the Innovative Nutrient and Sediment Reduction Grants Program, specifically intended to identify potential projects that dramatically accelerate quantifiable pollutant reduction, NFWF evaluates project proposals with criteria that consider potential projects within NFWF's Targeted Rivers and Watersheds that support the co-benefits of improved water quality, habitat restoration, and species recovery outcomes. Similarly, the Small Watershed Grants Program, which is intended to award projects that promote community-based efforts, also awards grants for potential projects that support co-benefits. This grant-making evaluation and award process follows an integrated water resources management approach—like the integrated approach used to complete the CBCP—to identify conservation and restoration opportunities that would meet multiple objectives within a prioritized geographic area of relatively smaller scale to achieve measurable results.

Based on existing information, a broad overview of the regional-scale problems affecting the Chesapeake Bay Watershed is provided in **Table 1**. This table presents a snapshot of the problems in the watershed at a major subwatershed boundary scale (HUC 6). Only a select group of land cover metrics that are connected to watershed health are provided: riparian forest buffers, agriculture, forest, and imperviousness. Lack of forests and forest buffers, extent of agricultural lands, and amount of impervious surface are major drivers of a watershed's health. The 2014 Bay Agreement forest buffer goal is to restore 900 miles of riparian forest buffers per year and to conserve existing buffers until at least 70 percent of riparian areas in the watershed are forested. **Table 1** provides a snapshot of the HUC 6 subwatersheds that are below these goals. Agriculture and imperviousness (paved areas) are linked to altered hydrology, increased runoff and pollutants, reduction of groundwater infiltration, and loss and disconnection of habitats. Although natural areas are sensitive to any increase in imperviousness, negative impacts from impervious cover become widespread once approximately 10 percent of the landscape has been paved. It may be necessary to view land cover data, specifically imperviousness, at a smaller action plan scale to understand local conditions.



	VULNERABILITY				LAND COVER PERCENTAGE[a]				ABANDONED MINE LAND PROBLEM AREA[b]	PRE-DOMINANT IBI[c]	IMPAIRED STREAM MILES LISTED ON 303(D)
	Future Development	Flood Concerns	Shorelines	Future Wetland Loss	Forested Buffer	Agriculture	Forested	Impervious			
Upper Susquehanna	NO	!	NO	! nontidal	62	6	57	3	!	2	2383
West Branch Susquehanna	NO	!	NO	! nontidal	78	5	72	2	!	2	1266
Lower Susquehanna	!	!	NO	! nontidal	58	15	49	5	!	2	1660
Upper Chesapeake	!	!	!	! both	62	15	27	8	NO	1	1446
Potomac	!	!	!	! both	66	7	53	5	!	2	3350
Lower Chesapeake	!	!	!	! both	71	11	44	3	NO	2	3209
James	!	!	!	! both	81	2	69	4	NO	2	2334

Table 1. Problem Summary by Major Subbasin

N = Identifies that this category is not a problem in the HUC 6 subwatershed

! = Identifies that a problem exists in the HUC 6 subwatershed

Data sources: Land cover data from the Chesapeake Bay Conservancy (2016)

Abandoned Mine Land Problem Areas provided by the Pennsylvania Department of Environmental Protection (PADEP)

Pre-Dominant Index of Biotic Integrity (IBI) from the CBP Benthic IBI (B-IBI)

1.5 Future Stressors

The U.S. Fish and Wildlife Service (USFWS) prepared a Planning Aid Report (PAR) (Planning Analyses Appendix) as a product to inform the broader CBCP effort. USACE requested USFWS assist with identifying future stressors and evaluating impacts to resources under USFWS jurisdiction. The following stressors were identified: climate change; urbanization and development of natural vegetative landscapes; invasive species; agricultural impacts (sediment loading and nutrients from fertilizers and livestock); silviculture[2]; oil and gas development; mining; hydropower, dams, road crossings, and culverts; and water withdrawal for consumptive use (USFWS 2017).

1.6 Vision, Primary Goal and Objectives

1.6.1 Vision

The Chesapeake Bay is a watershed of national significance. The preamble of EO 13508 states that the Chesapeake Bay is a national treasure constituting the largest estuary in the U.S. and one of the largest and most biologically productive estuaries in the world. The EO identifies that to restore the health of the Chesapeake Bay will require protecting and restoring habitat and living resources, and conserving lands and improving management of the natural resources. The CBCP integrates the EO's strategies into the CBCP's overall watershed vision, which is aligned with the 2014 Bay Agreement vision. The CBCP therefore integrated the 2014 Bay Agreement vision, including the term "resilient into the CBCP vision statement, aligning it with the need to adapt the health of the watershed to future stressors of the restoration effort.

> *We envision an environmentally and economically sustainable and resilient Chesapeake Bay Watershed with clean water, abundant life, conserved lands and access to the water, a vibrant cultural heritage, and a diversity of engaged citizens and stakeholders.*

[2] Silviculture is the art and science of controlling the establishment, growth, composition, health, and quality of forests and woodlands to meet the diverse needs and values of landowners and society such as wildlife habitat, timber, water resources, restoration, and recreation on a sustainable basis. https://www.fs.fed.us/forestmanagement/vegetation-management/silviculture/index.shtml

The CBCP is responsive to and complies with many EOs. Primarily, the CBCP has been developed in alignment with EO 13508. Additionally, the CBCP is consistent with the Efficient Federal Operations Executive Order (EO 13834), which directs federal agencies to operate in a manner that increases efficiency, optimizes performance, eliminates unnecessary use of resources, and protects the environment. Actions to be prioritized are actions that reduce waste, cut costs, enhance the resilience of federal infrastructure and operations, and enable more effective accomplishment of an agency's mission. The CBCP recognizes that the policy of the U.S. is to protect the environment and sets goals to reduce potable and non-potable water consumption and comply with stormwater management requirements. The CBCP also aligns with EO 13805, The Presidential Advisory Council on Infrastructure, which sets the policy of the executive branch to advance infrastructure projects that protect the environment and sets a mission to increase public-private partnerships (P3) for infrastructure projects for the council.

1.6.2 Primary Goal and Objectives

The CBCP's primary goal is to provide a comprehensive and integrated water resources management plan to assist with implementation of the 2014 Bay Agreement. Throughout the CBCP effort, USACE and NFWF staff engaged stakeholders to identify problems, needs, and opportunities and to avoid duplication of ongoing or planned actions by others. Integrated water resources management requires the understanding of ongoing, collaborative actions occurring among the Partnership to identify those actions that have been completed or are planned for implementation by others. The CBP, especially the 2014 Bay Agreement Goal Implementation Teams (GITs), was instrumental in providing feedback during development of the CBCP. Because of the collaborative efforts and based on the geospatial analyses, the results include a *Restoration Roadmap* to inform where and how USACE mission areas can be used to support and complement the ongoing efforts to achieve the 2014 Bay Agreement goals. The *Restoration Roadmap* can also be used by all partners to inform future investment decisions. **Table 2** summarizes the objectives of the CBCP to achieve the 2014 Bay Agreement goals.

Table 2. Chesapeake Bay Comprehensive Water Resources and Restoration Plan Objectives

CBCP Objectives
1. Develop a comprehensive, strategic, and integrated water resources plan to guide the implementation of projects to assist in meeting the 2014 Bay Agreement objectives.
2. Identify areas for ecosystem restoration, protection, or preservation to assist in meeting the 2014 Bay Agreement objectives.
3. Identify at least one project in each of the six states and District of Columbia that can be considered for implementation or technical assistance by USACE and that supports the 2014 Bay Agreement objectives.
4. Identify new policies or programs or improve upon existing policies and programs that will help achieve an environmentally and economically sustainable and resilient Chesapeake Bay Watershed.

Objectives 1 and 2 are fulfilled by the content of the CBCP and it various products. Objective 3 is met by the State-Selected Watershed Action Plans and the candidate restoration projects. Objective 4 is addressed in the *Implementation Strategy* (Main Report).

1.7 Historical Context

The Chesapeake Bay is a place where fresh water from rivers meets the salt water of the Atlantic Ocean, creating a unique landscape and resource. This estuary is more than just a body of water—it has shaped the history, economy, and culture of the region. The bay attracted European exploration and settlement beginning in the 1500s, and much of U.S. history and development began along its shores.

There are many American Indian groups and cultures who have called the Chesapeake Bay Watershed home. Stemming from this long history of habitation, there are abundant prehistoric, historic, and cultural resources throughout the bay and its watershed. The following links provide more information on American Indians in the Chesapeake Bay Watershed:

- http://www.chesapeakebay.net/discover/bayhistory/archaeology
- https://www.nps.gov/cajo/learn/historyculture/index.htm
- http://www.visitmaryland.org/info/first-marylanders

Spanish and French explorers reached the bay in the early 1500s, but the first arrival of English colonists occurred in the late 16th century. The Colony of Virginia was founded in 1607 as a port and trading center. Tangier and Smith Islands (in the middle of the lower Chesapeake Bay) were settled by Europeans in 1609. Between 1640 and 1675, there was mass migration from southern England to the Chesapeake Bay region, resulting in settlements near large navigable rivers within the watershed.

From 1607 to 1609, Captain John Smith of England explored and mapped the bay and published *A Map of Virginia* in 1612. Captain Smith played an important role in the exploration and settlement of the U.S. His contacts with American Indians and his voyages of the Chesapeake Bay region are documented in his maps and journals. The following links provide more information on Captain Smith and his exploration of the Chesapeake Bay region:

- http://www.chesapeakebay.net/discover/bayhistory/johnsmith
- https://www.nps.gov/jame/learn/historyculture/life-of-john-smith.htm

The Chesapeake Bay and its watershed have a rich colonial history (1500–1775). The bountiful resources of the watershed enabled the birth of our nation and its industrialization. The following links provide more information on the colonial history of the Chesapeake Bay Watershed:

- http://www.marinersmuseum.org/sites/micro/cbhf/colonial/col007.html
- https://anthropology.si.edu/writteninbone/comic/activity/pdf/17_Colonization_Chesapeake.pdf

The 1700s brought development, logging, and the establishment of industry, agricultural farms, and towns. Many rivers and streams were dammed and diverted to provide energy for mills. This deforestation and land development resulted in the accumulation of sediments in the bay tributaries from erosion.

The Chesapeake Bay Watershed played an integral part in military battles both by land and sea since colonization. The following links provide more information on how the Chesapeake Bay Watershed played a role in the Revolutionary War, the War of 1812, and the Civil War:

- https://www.myrevolutionarywar.com/battles/810905-chesapeake-capes/
- https://www.nps.gov/subjects/warof1812/chesapeake-bay.htm
- http://www.chesapeakebay.net/discover/bayhistory/civilwar

Given its maritime history, shipwrecks in the Chesapeake Bay are a significant archaeological resource. The following CBP website identifies over 1,800 documented shipwrecks:

- http://www.chesapeakebay.net/discover/bayhistory/shipwrecks

In the latter 20th century, the Chesapeake Bay Bridge and the Chesapeake Bay Bridge Tunnel were built to connect the Eastern Shore of Maryland to Baltimore, Maryland and Hampton Roads, Virginia. Development continued and rural areas within the watershed were transformed into urban and suburban corridors.

The economy of the Chesapeake Bay region has always been tied to the accessibility of convenient transportation for goods and people. The region's fertile soil, plentiful supplies of fresh water, and situation on the bay make this an ideal location for agricultural production, the seafood industry, import and export facilities, recreation, tourism, and other industries dependent on fast, economical transportation. Roughly 90 million tons of imports and exports pass through the major ports of Baltimore, Maryland; Norfolk, Virginia; and Hampton Roads, Virginia each year. Nearly 50 military bases representing every branch of the armed forces are located in the Chesapeake Bay region.

Scientists estimate that there are at least 100,000 archeological sites in the Chesapeake Bay Watershed. Just a small percentage of these are documented. Most archaeological sites are susceptible to destructive natural and man-made factors, such as development, farming practices, and sea level rise.

The majority of known prehistoric sites (past settlements) are located along the Chesapeake Bay shoreline; many are now inundated or threatened by erosion. In 2009, the CBP completed a cultural assessment for the Chesapeake Bay Watershed. The effort mapped National Historic Landmarks, National Historic Districts, National Historic Register Sites, state-inventoried sites, and archaeological sites to identify and rank cultural resources throughout the watershed. The CBP Cultural Assessment Model is located at the following link: https://www.chesapeakebay.net/what/programs/resource_lands_assessment

The National Register of Historic Places (NRHP) is the federal government's official list of districts, sites, buildings, structures, and objects deemed worthy of preservation. The National Park Service (NPS) NRHP Program has compiled data for national historic landmarks and properties listed on the National Register of Historic Places. These data are located at the following link: https://www.nps.gov/nr/research/index.htm

In 2009, the District of Columbia inventory of historic sites contained more than 700 designated historic sites, encompassing nearly 25,000 properties. The inventory includes 500 historic landmark designations, covering more than 800 buildings; 150 historic landmark designations of other structures, including parks, engineering structures, monuments, building interiors, artifacts, and archaeological sites; and 50 historic districts, including 28 neighborhood historic districts. The inventory of historic sites in the District of Columbia is located at the following link: https://planning.dc.gov/page/dc-inventory-historic-sites

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Section 2

Existing Watershed Conditions and Threats

2.1 Physiography and Topography

Two out of the eight major U.S. physiographic regions fall within the Chesapeake Bay Watershed; the Atlantic Plains and Appalachian Highlands. Within these regions, there are eight provinces with the bay watershed: the Appalachian Plateau, Appalachian Mountain, Blue Ridge, Great Valley, Mesozoic Lowland, Piedmont Upland, Piedmont Lowland, and Coastal Plains (CBP; https://www.chesapeakebay.net/what/maps/chesapeake_bay_watershed_physiography).

The estuary was formed when the lower valley of the Susquehanna River was drowned during the post-Wisconsin rise in sea level. The Chesapeake Bay is approximately 186 mi (300 km) long extending from the mouth of the Susquehanna River (northern bay) to the Cape Charles-Cape Henry entrance (southern bay). The bay ranges in width from 3 to 35 mi (5 to 56 km). The tidally influenced shoreline of the bay is extremely irregular and is nearly 11,684 mi long, including more than a dozen tributary estuaries and 150 major rivers and streams. The bay encompasses an area of 2,870,000 ac (1,161,447 hectares (ha)) and has an average water depth of 26 to 33 ft (8 to 10 m). The main channel of the bay is the former Susquehanna River and reaches water depths of 164 ft (50 m). The Chesapeake Bay is in the northern temperate zone and is subject to a highly variable temperate climate regime. This Chesapeake Bay region experiences on average mild winters and hot, humid summers. The highest wind speeds are experienced in the winter months while more gentle winds occur during the summer months (USACE 2015).

Impacts to physiography and topography include the following:

- Precipitation and temperature changes
- Land subsidence from natural causes and groundwater extraction
- Climate change: sea level rise, changes in precipitation patterns, changes in temperature
- Land use changes from human development
- Coastal erosion

2.2 Precipitation and Temperature

Climate change simulations for the Chesapeake Bay Watershed forecasted to 2100 predict increased precipitation amounts in the winter and spring, as well as increased intensities of precipitation, tropical storms, and northeasters (though their frequency may decrease). On average, river flows would increase in winter, but be reduced in summer (Najjar et al. 2010). The delivery of fresh water, nutrients, and sediment to the bay is mainly driven by the amount and intensity of precipitation in the watershed. Thus, bay circulation and water quality strongly respond to changes in watershed precipitation (CBP 2016). Estimates show projected

precipitation by the year 2070 could reduce summertime precipitation by 4 to 5 percent and increase wintertime precipitation by 15 to 20 percent (Najjar et al. 2010).

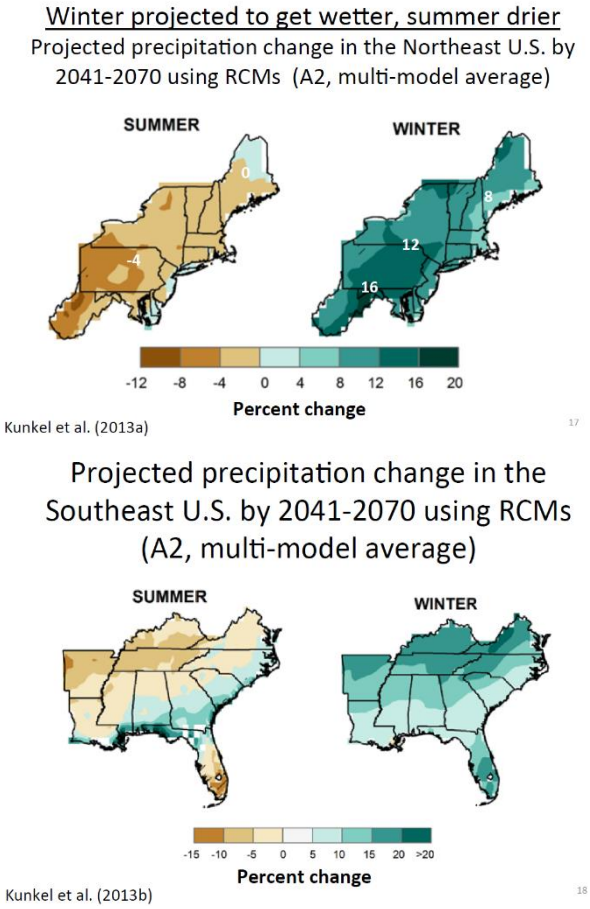

Figure 2. Forecasted climate change impacts to precipitation in the northeastern United States (Kunkel et al. 2013)

The Chesapeake Bay region can expect to see an increase in temperature. The Intergovernmental Panel on Climate Change (IPCC) estimates a further increase in average air temperatures of 2.5 to 10.4° Fahrenheit (F) before 2100 (CBF 2007). Warming of the bay could have substantial negative implications on dissolved oxygen (DO) as continued warming of the bay can cause low DO conditions to occur substantially earlier or end substantially later in the year. Bay water temperatures are expected to continue to warm. Ultimately, aquatic life characteristics of warmer regions to the south along the Atlantic Coast would be favored in the Chesapeake Bay (Najjar et al. 2010).

2.3 Local Land Subsidence

A prominent fill structure has only recently been discovered beneath the lower Chesapeake Bay and surrounding area. About 35 million years ago, a bolide (comet or asteroid), 3 to 5 km in diameter, hit the area that is now the Delmarva Peninsula, near Cape Charles, Virginia. This structure, the Chesapeake Bay Impact Crater, is buried 300 to 500 m beneath the southern part of Chesapeake Bay and the peninsulas of southeastern Virginia. Although this bolide did not create

the Chesapeake Bay, it helped determine the eventual location of the bay. Evidence of accelerated land subsidence is reflected in the geology and topography of the modern-day land surfaces around the crater. Crater-related ground subsidence may play a role in the high rate of relative sea-level rise documented for the Chesapeake Bay region (USGS 2018).

Figure 3. Location of bolide impact and of the shoreline when bolide hit (USGS 2018)

2.4 Sea Level Change

The Chesapeake Bay will experience increased rates of relative sea level rise due to the combination of increased water surface elevations and land subsidence (USACE 2015). The region can expect to see an increased frequency of nuisance tidal flooding. Based on sea level rise scenarios contained in USACE engineering circular 1165-2-212, starting in 2015, sea level would be expected to rise by 0.5 to 2.3 ft in 50 years in the Chesapeake Bay, depending on whether sea level rise continues at current rates or accelerates to intermediate or high rates (USACE 2011).

Projected sea level rise will cause the erosion and retreat of shorelines and, ultimately, the inundation of presently dry land. Rates of sea level rise in the Chesapeake Bay range from about 3.2 to 4.7 millimeters (mm) per year depending on the location and period of record for each tide gauge (USGS; https://chesapeake.usgs.gov/sciencesummary-sealevelrise.html). Maryland is projected to face from 0.7 m to 1.7 m in relative sea level rise by the year 2100 due to a combination of rising seas and sinking land (TNC 2016). USGS forecasts inundation of the Blackwater National Wildlife Refuge by the year 2100 (USGS; https://chesapeake.usgs.gov/sciencesummary-sealevelrise.html).

Sea level rise will create negative outcomes for some species that rely on aquatic habitats. The rate of sea level rise is expected to accelerate, and it is unknown if the ecosystems will be able to adapt and keep pace with this rate of change. Ongoing sea level rise is anticipated to increase the rate of conversion of bay tidal wetlands to open water and lead to a substantial net loss of tidal wetlands over the next century (USGS 2007). Loss of tidal wetlands are expected due to their landward migration into areas occupied by people, and because of steeper topography landward of many existing tidal wetlands (USCCSP 2009). Tidal wetlands restoration should focus on areas where wetland migration to higher ground will have a high chance for success. With increasing sea levels, fish and other aquatic species will need to be able to migrate with changing

environmental conditions. Identifying and solving connectivity problems in areas where sea level change is occurring will be important for allowing fish and other aquatic species to migrate.

2.5 Shoreline Erosion

Tidal erosion is the combination of both fastland erosion (land above tidal water, often called shoreline erosion) and nearshore erosion or the shallow water close to an eroding shoreline. It is estimated that of the total sediment delivered to the bay by tidal erosion, nearshore erosion contributed 57 percent and fastland erosion contributed 43 percent. Sea level rise, land subsidence, and increasing rates of shoreline development intensify tidal erosion, causing property loss and water quality degradation. Private landowners control approximately 85 percent of Chesapeake Bay's shoreline. Although tidal erosion is a natural process, anthropogenic activities make tidal erosion worse. At the same time, man-made shoreline development inhibits the bay shoreline's natural progression. Bulkheads usually increase nearshore erosion (CBP 2005).

Not all portions of the shoreline in Chesapeake Bay are eroding at equal rates, and, in the short term in some regions, shorelines are accreting (e.g., gaining new sediment deposits). Over long-time scales, all of the bay's shoreline will continue to erode as long as sea level continues to rise, but localized exceptions occur (CBP 2005).

2.6 Land Use

Nearly 30 percent of the Chesapeake Bay Watershed is agricultural land (NRCS; https://www.nrcs.usda.gov/wps/portal/nrcs/detailfull/national/home/?cid=stelprdb1047323). There are over 87,000 farms and 8.5 million acres of cropland within the watershed resulting in over $10 billion of agricultural production annually. More than 50 commodities are produced within the watershed. Primary crops include corn, soybeans, wheat, hay, pasture, fruits, and vegetables (EPA 2010). Dairy and poultry farming are significant activities in the watershed.

2.7 Land Development

The Chesapeake Bay and its watershed have been degraded by development of the watershed within the past 350 years. Deforestation and land use alterations were the agents of change. The watershed was almost completely forested (95 percent) prior to European colonization in the 17th century. Forest cover was reduced to approximately 40 percent by the late 1800s as land was cleared for agriculture. Since then, forest cover has increased substantially from natural afforestation of abandoned agricultural lands, as well as the institution of modern forestry and soil conservation practices, which include planting trees. Today, forest cover is 55 percent of the watershed (USDA 2017).

As more people move into the Chesapeake Bay Watershed, more land is cleared for the development of roads, homes, and businesses. Residents have expanded out of traditional urban centers and into bigger houses on larger lots, turning forests, farms and other valuable landscapes into subdivisions, shopping centers and parking lots, and impacting the health of our rivers and streams. When low-density residential and commercial areas are built far from existing cities and towns, new infrastructure—schools, roads, shopping centers—is built along with them. Over time, the once-open areas between these new developments and existing cities

and towns are filled in. This type of development, called sprawl, chews up forests, farms and shorelines, and degrades land and water habitats (CBP; https://www.chesapeakebay.net/issues/development).

The landscape of the region continues toward the development of suburban and urban areas, which results in a loss of forests, wetlands, and agricultural lands in the future, with the potential to increase stormwater runoff and associated pollutant inputs. Urban areas that are already built-out would likely see a decrease in pollutant inputs as management measures are implemented to control stormwater. As the overall population numbers increase within the Chesapeake Bay Watershed, it is likely that there will be an increase in the amount of coastal storm and flood damages. This may provide an opportunity to blend ecosystem restoration efforts and resilience measures via integrated water resource management (IWRM).

2.8 Population

The Chesapeake Bay Watershed is currently home to more than 18 million people and the population is expected to continue to increase in the future (CBP; https://www.chesapeakebay.net/state/population). According to *A Socioeconomic Atlas for the Chesapeake Bay Watershed and Its Region* (NPS 2009), the region's population increases by over 150,000 residents a year, with an anticipated population of over 20 million by 2030. The Socioeconomic Atlas also provides projections for population density change, and change in employment by industry. Baltimore, Maryland and Norfolk/Hampton Roads, Virginia, two of five major east coast U.S. ports as well as several major cities, including the Nation's Capital, are located within the bay watershed, contributing to the increasing population, energy consumption, and development of the region.

2.9 Geology and Soils

The Chesapeake Bay is a coastal plain estuary that was formed at the end of the last ice age approximately 18,000 years ago. As glaciers receded and melted, sea levels rose and inundated the ancient Susquehanna River valley. Remnants of the ancient Susquehanna River still exist today in a few troughs that form a deep channel along much of the Bay's bottom (CBP; https://www.chesapeakebay.net/what/maps/chesapeake_bay_watershed_physiography).

Two out of the eight major U.S. physiographic regions fall within the Chesapeake Bay Watershed; the Atlantic Plains and Appalachian Highlands. Within these regions, there are eight provinces with the bay watershed: the Appalachian Plateau, Appalachian Mountain, Blue Ridge, Great Valley, Mezosoic Lowland, Piedmont Upland, Piedmont Lowland, and Coastal Plains. Provinces are categorized by rock type, terrain texture, and geologic structure and history (CBP; https://www.chesapeakebay.net/what/maps/chesapeake_bay_watershed_physiography).

Information on each physiographic province in the Chesapeake Bay Watershed can be found at: https://www.nps.gov/subjects/geology/physiographic-provinces.htm (NPS 2017).

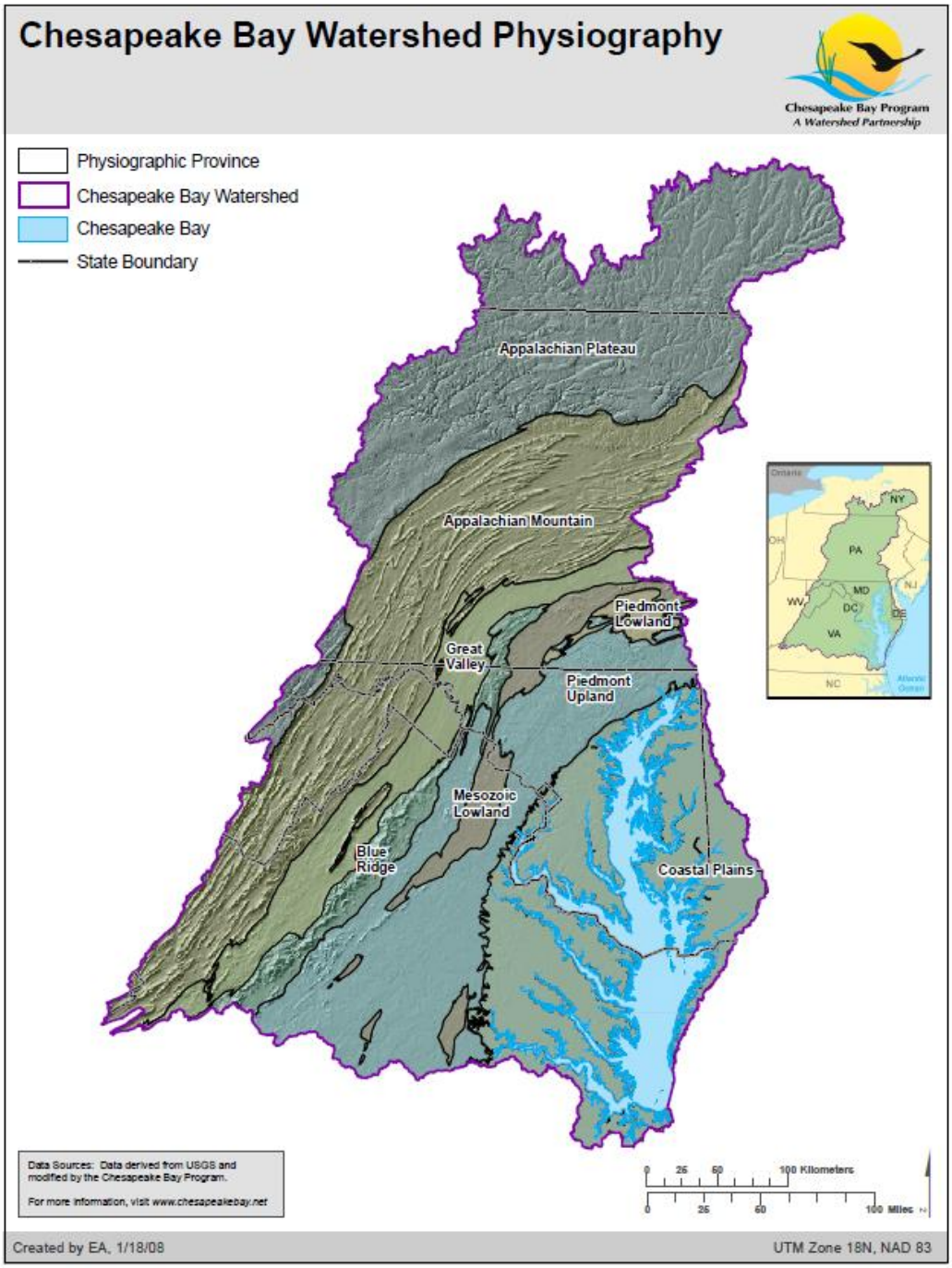

Figure 4. Chesapeake Bay Watershed Physiography (CBP; https://www.chesapeakebay.net/what/maps/chesapeake_bay_watershed_physiography)

2.10 Climate Change

The northeastern and southeastern U.S. are projected to become warmer and wetter due to climate change. Impacts will include wetter winters and drier summers, which will intensify floods and exacerbate droughts. Precipitation intensity is expected to increase across the

Chesapeake Bay Watershed (NOAA 2013). Increased air temperatures will lead to an increase in evapotranspiration throughout the region. An increase in evapotranspiration can offset increased precipitation and potentially lead to lower overall flows in streams and rivers during drought periods. The changes in temperature and precipitation are likely to have the following hydrologic impacts:

- Increased flooding during the winter and more frequent and intense droughts during the summer;
- Increased stream flashiness, which can destabilize aquatic habitats and increase sedimentation and pollutant inputs;
- Increased stream temperatures due to air temperature increases; and
- Increased evapotranspiration can lead to overall lower flows and lower recharge rates for groundwater during the growing season.

Between 1958 and 2012, the northeastern U.S. saw more than 70 percent increase in the amount of rainfall measured during heavy precipitation events (CBP; https://www.chesapeakebay.net/issues/climate_change). The more coastal and riverine storms the Chesapeake Bay Watershed experiences, the more sediment will be delivered into the navigation channels throughout the bay. This increase in sediment coming into the channels means more operation and maintenance efforts needed to keep navigation operations going. However, there are opportunities to manage sediment from upstream sources by using programs such as natural- and nature-based features, regional sediment management, and beneficial use of dredged material (USACE 2015).

2.11 Legacy Sediments

The Legacy Sediment Workgroup (2006–2007), established by the Pennsylvania Department of Environmental Protection (PADEP), defined legacy sediment as follows:

> *Sediment that was eroded from upland hill slopes after the arrival of early Colonial American settlers and during centuries of intensive land uses; that was deposited in valley bottoms along stream corridors, burying pre-settlement streams, floodplains, wetlands and valleys; and that altered and continues to impair the hydrologic, biologic, aquatic, riparian, and chemical functions of pre-settlement and modern environments. Legacy sediment often accumulated behind ubiquitous low-head mill dams and in their slackwater environments, resulting the thick accumulations of fine-grained sediment.*

The most important cause of the widespread, prolonged, and thick accumulation of sediment in stream corridors was the widespread, prolonged alteration of streams for water-powered milling (Walter et al. 2007). Dam building for water power in the eastern U.S. began in the late 1600s and persisted until the early 1900s. Water-powered milling was especially intensive in the mid-Atlantic Piedmont region (**Figure 5**). In the past 100 years, many historic dams have been breached as mills were abandoned. Breaching has led to incision of streams into milldam reservoir sediments and to locally heavy erosion of steep stream banks (Walter and Merritts

2008). For more information on legacy sediments, please refer to the following PADEP publication:
http://www.dep.pa.gov/PublicParticipation/AdvisoryCommittees/WaterAdvisory/ChesapeakeBayManagementTeam/Documents/padeplegacysedimentreport2007waltermerrittsrahnisfinal.pdf

A PADEP publication concluded that stream bank erosion is an important source of sediment and nutrients to tributaries of the Chesapeake Bay. The paper also concluded that legacy sediment removal is a viable and effective means to reduce sediment and nutrient loads to the Chesapeake Bay (Walter et al. 2007).

The Commonwealth of Pennsylvania has voiced interest in addressing the large number of dams and associated legacy sediments in mill ponds associated with those dams. Additionally, county-level input received through watershed implementation plan (WIP) development identified excess erosion as a primary contributor of nutrients and sediment in Bradford and Sullivan Counties, Pennsylvania. There is an opportunity to evaluate dams throughout Pennsylvania to identify the best candidates for removal; where the greatest opportunities are to restore stream habitat by addressing legacy sediments; in conjunction with stabilizing stream banks (USACE 2015). The CBCP acknowledges the need to restore stream habitat by addressing legacy sediments. However, due to the lack of data that was able to be collected on legacy sediments, the CBCP does not include a specific reommendation to address legacy sediments.

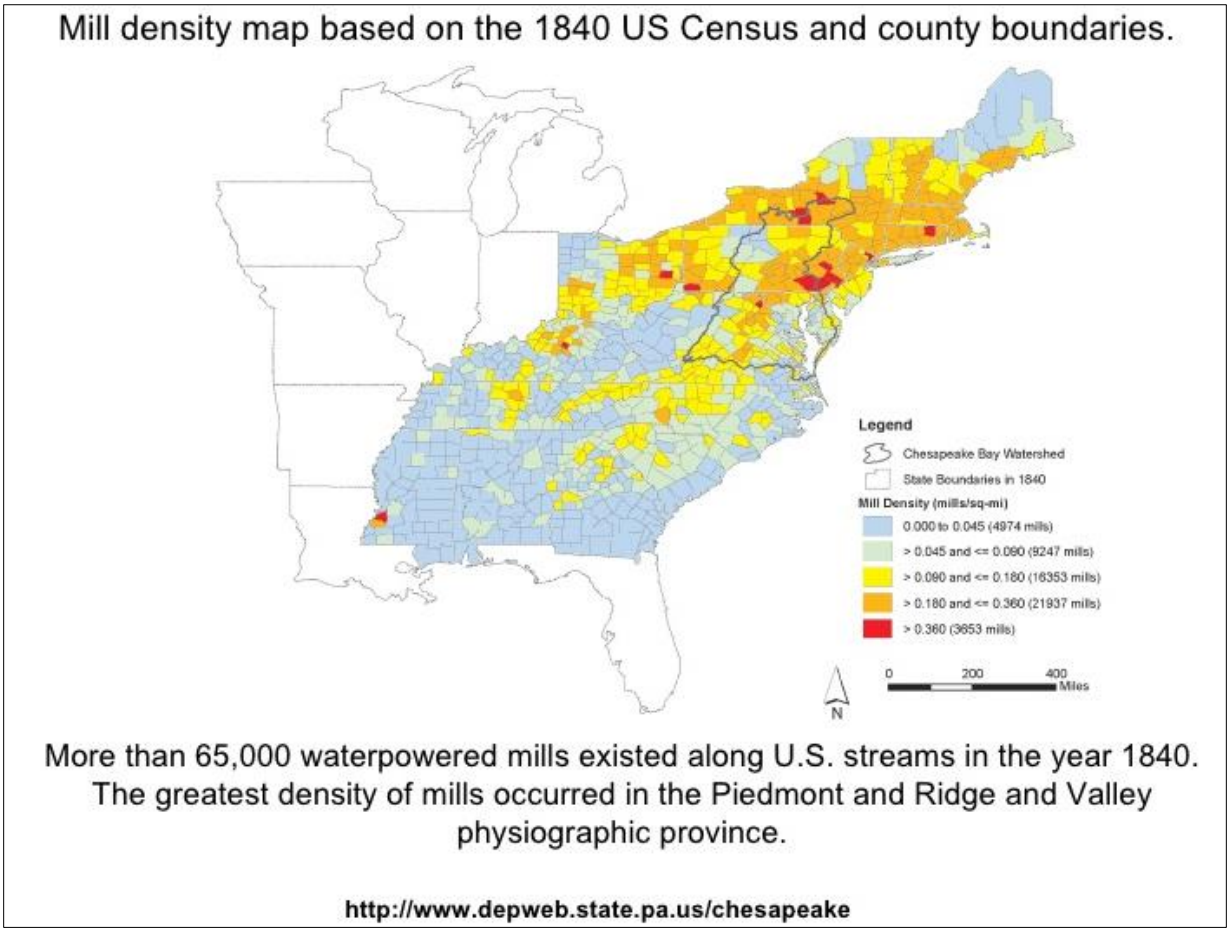

Figure 5. Milldam density in the Chesapeake Bay Watershed

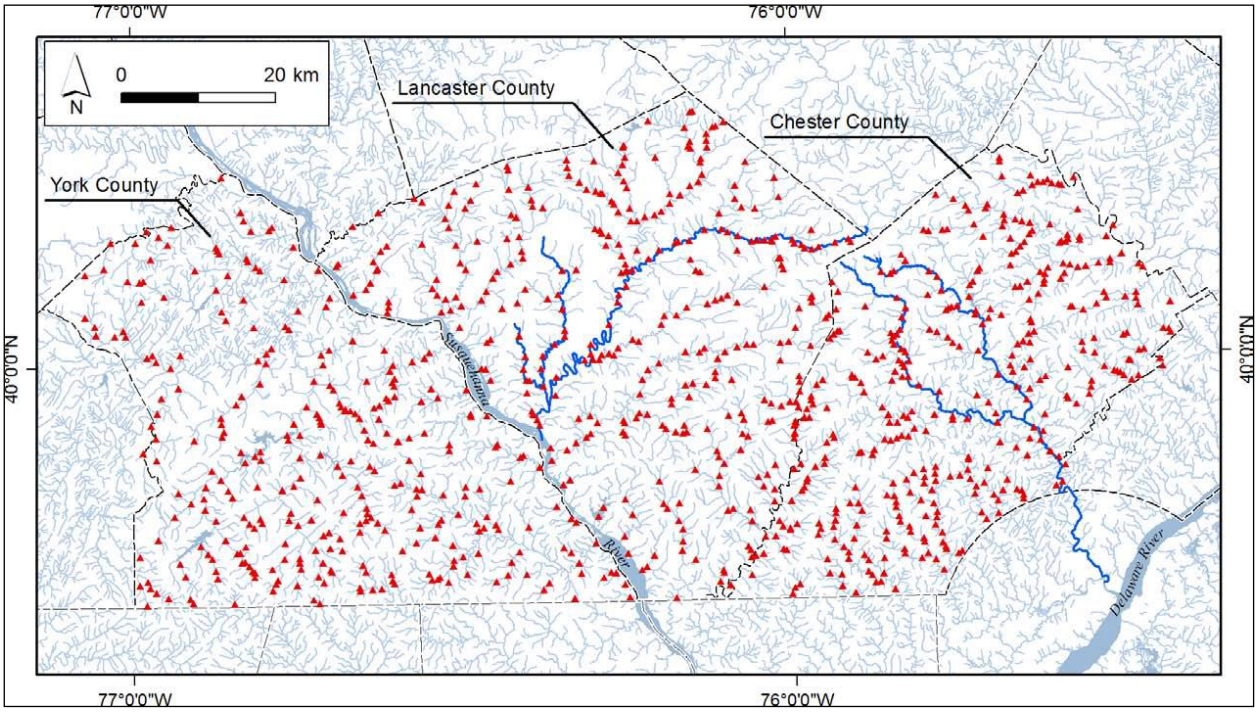

Figure 6. Location of milldams in York, Lancaster and Chester Counties, Pennsylvania (Walter and Merritts 2008)

2.12 Human Water Resources

The Chesapeake Bay Watershed is rich in water resources; however, balancing the needs of humans and the environment requires careful water resources management as the human population grows. Human water resource uses include safe drinking water, agriculture, electric power generation, commercial and industrial uses, navigation, and recreation. Future climate change and land use are expected to alter the hydrology of the watershed. The predictions show increased occurrences in large floods and low-flow periods. The increase in this hydrologic variability will increase the stressors on water resources. Future ecosystem restoration efforts in the Chesapeake Bay Watershed can serve to improve water quality and mitigate against the effects of human water uses and climate change.

The following are links to bay state water management planning websites:

- Delaware: http://www.dnrec.delaware.gov/wr/Pages/Default.aspx
- Maryland: http://www.mde.state.md.us/programs/Water/Water_Supply/Pages/waterresourcemanagement.aspx
- New York: http://www.dec.ny.gov/lands/25563.html
- Pennsylvania: http://www.dep.pa.gov/Business/Water/Pages/default.aspx

- Virginia: http://www.deq.virginia.gov/Programs/Water/WaterSupplyWaterQuantity/WaterSupplyPlanning/StateWaterResourcesPlan.aspx
- District of Columbia: https://doee.dc.gov/service/watershed-protection-planning-and-restoration-branch
- West Virginia: https://dep.wv.gov/WWE/Pages/default.aspx

The following are links to water management organizations for significant basins of the Chesapeake Bay Watershed:

- Susquehanna River Basin Commission: http://www.srbc.net/planning/cwuas.htm
- Interstate Commission on the Potomac River Basin: http://www.srbc.net/planning/cwuas.htm
- York River & Small Coastal Basins Roundtable: https://www.potomacriver.org/
- James River Basin Partnership: https://www.jamesriverbasin.com/
- Rappahannock River Basin Commission: https://rrbcnews.wordpress.com/

State WIPs can be found on the CBP website at the following link: http://www.chesapeakebay.net/about/programs/watershed

Dams and reservoirs are significant infrastructure that alter the hydrology of the watershed while they fulfill flood control, water quality control, water supply, recreation, and hydropower purposes. Future climate change will alter the regions hydrologic characteristics and will increase the extremes between floods and droughts. This change makes water management more difficult and harder to predict. For example, higher air temperatures will increase evaporation from reservoirs and more extreme floods, and low flows will put greater stress on providing flood protection and environmental flows. There may be opportunities to construct ecosystem restoration projects adjacent to these facilities to not only mitigate against their impacts, but also to provide increased resiliency to the structures and purposes. For example, ecosystem restoration projects that improve water quality will improve the quality of source water for water supply projects.

Healthy watersheds are important for delivering benefits for environmental and human needs. Healthy watersheds within the Chesapeake Bay Watershed have been identified. Portions of the identified healthy watersheds lie within publicly owned lands. Currently healthy watersheds that do not lie within publicly owned lands could be identified for conservation projects. Also, it may be prudent to prioritize potential ecosystem restoration projects in areas that are not identified as healthy watersheds in order to create greater uplift in environmental benefits. **Figure 7** below shows a map of identified healthy watersheds of the Chesapeake Bay (CBP; http://www.chesapeakeprogress.com/clean-water/healthy-watersheds).

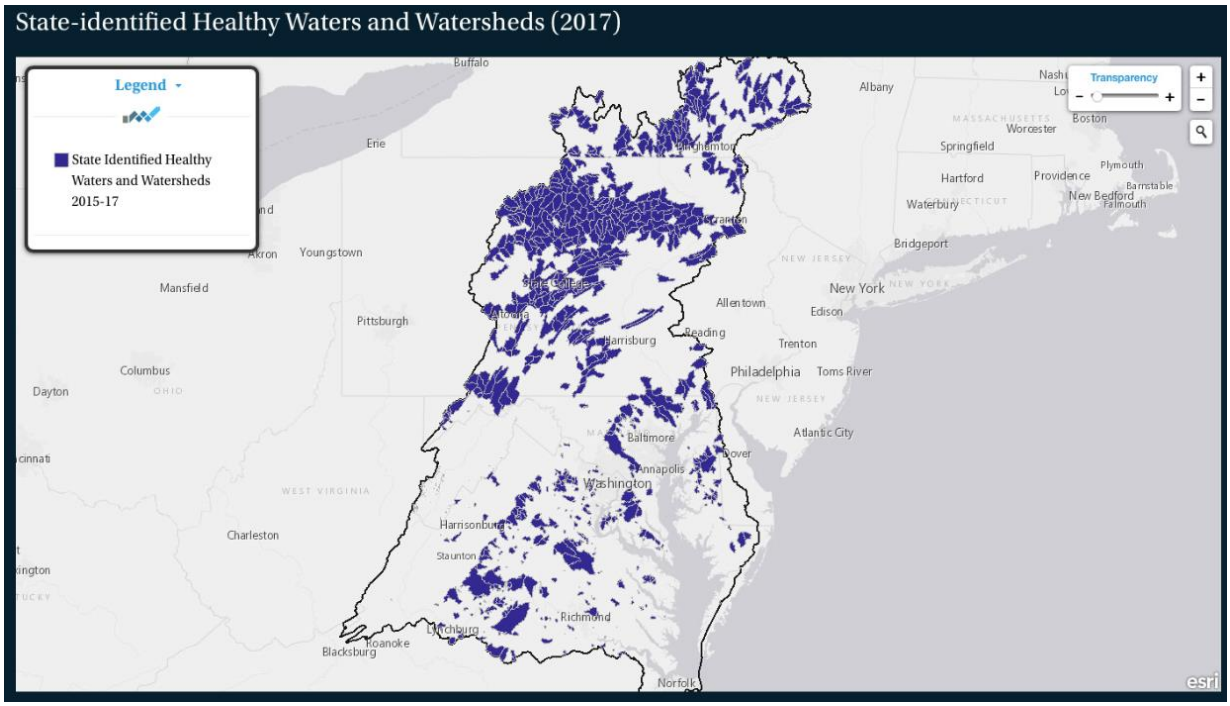

Figure 7. State-identified healthy waters and watersheds (CBP; http://www.chesapeakeprogress.com/clean-water/healthy-watersheds)

Susquehanna River

The Susquehanna River Basin covers almost half of the Chesapeake Bay Watershed and has a major influence on flows and loads into the Chesapeake Bay. TNC and USACE have worked with the Susquehanna River Basin Commission (SRBC) on flow management strategies for the Susquehanna River. SRBC reports on water availability for the watershed. The analysis demonstrates, to the HUC 10 level, those subwatersheds that will have future problems with water availability. These areas could be opportunities for ecosystem restoration or specific water management strategies. **Figure 8** below shows predicted water availability levels for the Susquehanna River Basin. SRBC is currently analyzing measures to increase water availability through the implementation of various protection, mitigation, and enhancement measures. Further information can be found in the SRBC Cumulative Water Use and Availability Study located at: http://www.srbc.net/planning/cwuas.htm.

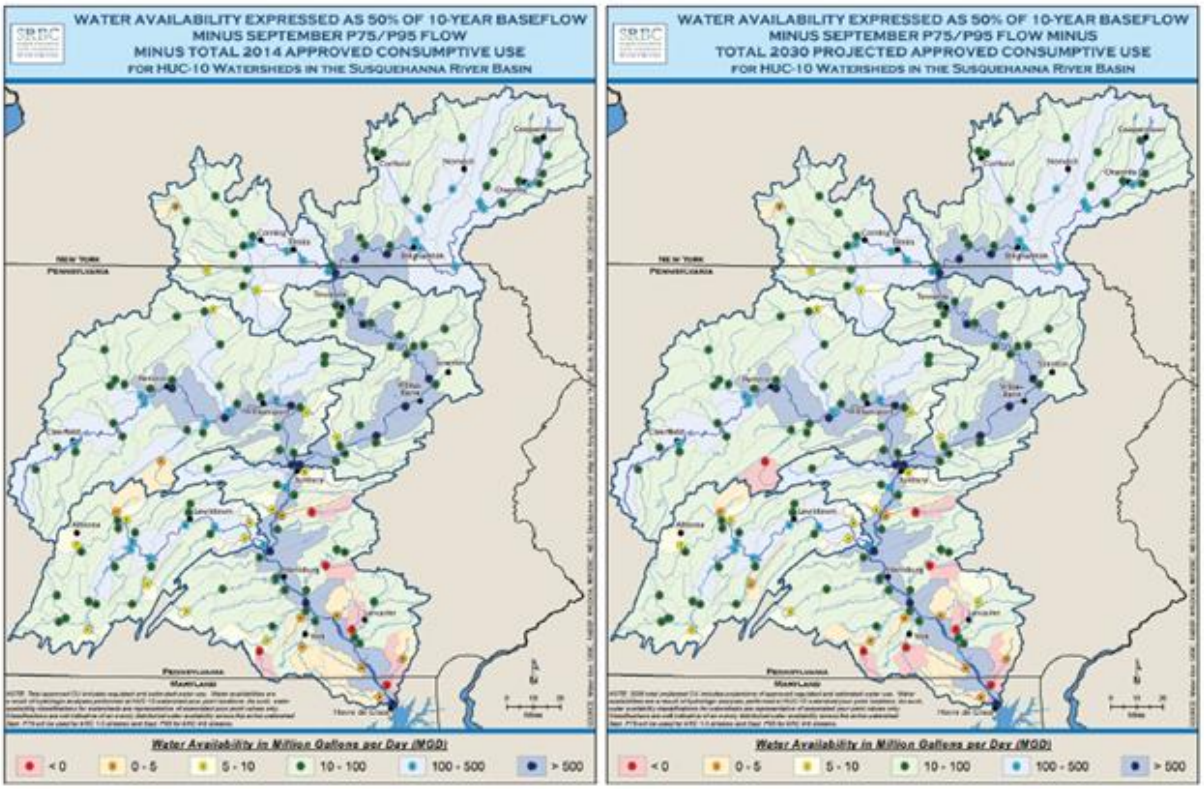

Figure 8. Water Availability and Consumptive Use Projections (SRBC 2018)

Potomac River

The Potomac River is the second greatest source of fresh water flow to the Chesapeake Bay. The Interstate Commission on the Potomac River Basin (ICPRB) report on the Washington, D.C. area water supply reports (https://www.potomacriver.org/wp-content/uploads/2014/12/COOPClimateChangeFactsheet_Apr22-2013.pdf) that climate change impacts by 2040 could show the following impacts to the basin area:

- Average temperature increase of 1.4 to 4.1°F
- Altered precipitation
- Higher evapotranspiration rates causing average stream flows to decrease up to 35 percent
- A rise in summertime water demand
- Depleted reservoirs
- Potential inability to maintain environmental flows in the Potomac River

Virginia Basins

The 2015 Virginia Water Resources Plan (http://www.deq.virginia.gov/Programs/Water/WaterSupplyWaterQuantity/WaterSupplyPlanning/StateWaterResourcesPlan.aspx) reports that August flows are considered by biologists to represent a critical condition for many fish species, with various studies indicating declines in aquatic ecosystem health due to significant alterations in August flows. August low flows (ALF) for Virginia were analyzed out to year 2040. Basins with significant decreases in ALF are reported as follows:

- Potomac-Shenandoah River Basin
  - Shenandoah River North and South Fork: Reaches in this basin are projected to have a median change in ALF of less than 5 percent, but with individual streams projected to experience reductions of 10 to 20 percent.
  - Middle and lower Potomac River streams are predicted to have a median change of less than 1 percent; however, reductions of 10 to 20 percent are predicted in select streams. The main stem of the Potomac River above the fall line has predicted decreases of less than or equal to 5 percent.
- James River Basin
  - Represents a diverse set of conditions with small increases or no change in ALF predicted in much of the upper reaches of the watershed above Lynchburg, with median decreases of less than 5 percent in the nontidal reaches in the middle and lower portion of the watershed. Approximately 10 percent of individual stream reaches are expected to see decreases of between 10 to 20 percent.
- York River Basin
  - Increased withdrawals from unregulated impoundments on the Ni River are expected to decrease downstream ALF by 10 to 20 percent in reaches of the Mattaponi unless specific reservoir management rules and releases are in place to preserve in-stream flows.

2.13 Recreation, Education, and Stewardship

USACE projects in mission areas such as flood risk management and ecosystem restoration often have elements of recreation, education and stewardship incorporated into the design. Visitors to USACE properties and projects can enjoy traditional activities like hiking, boating, fishing, camping, and hunting and more adventurous activities depending upon location. While these beneficial elements of recreation can be a small component compared to the entirety of a project, these features add value for the public and provide tangible benefits. While recreation is not a primary USACE mission area, there are opportunities to work with non-federal sponsors on projects that could incorporate recreational features. Recreational features such as boardwalks would provide public access opportunities in the Chesapeake Bay Watershed.

These federal areas are identified and should be considered as a setting for other state, local, non-profit, and tribal opportunities where recreation activities are present. These areas provide value in the watershed and connect the public to the bay. The Chesapeake Bay Watershed currently includes 55 national parks, 16 national wildlife refuges, 5 national trails including the Captain John Smith Chesapeake National Historic Trail and the Appalachian National Scenic Trail, two national forests, two Bureau of Land Management (U.S. Department of the Interior) areas, and multiple America's Great Outdoors (U.S. Department of Interior) projects. Recreation throughout Chesapeake Bay is extensive and speaks to the public value placed on the bay and its ecosystem. The 18 million residents of the Chesapeake Bay Watershed have over 1,150 existing public access points (as of September 2011) in the watershed and 770 of those are located along the shoreline of the Chesapeake Bay and the tidal portions of its tributaries. Designated water trails cover more than 3,200 miles of river and the open bay in the Chesapeake Bay Watershed, many of these a relatively rural areas (NPS 2013).

Recreational economic benefits extend to all watershed states. In Pennsylvania, nearly 2 million people go fishing each year, which contributes $1.6 billion to the economy (CBF 2012). Additionally, Pennsylvanians spends $1.7 billion on boating yearly. In Virginia, visitors to recreational facilities and heritage sites produced $18 billion in 2007. Tourism and recreation generate jobs. Approximately, 350,000 workers in Virginia were employed in tourist and leisure industries in 2010 (CBF 2010). Lipton (2007) documented that 32,025 people are employed in the recreational boating industry in Maryland, which generates $2.03 billion per year. Wildlife viewing is another area that produces economic benefits. In 2006, approximately 8 million wildlife watchers spent $636 million, $969 million, and $1.4 billion in Maryland, Virginia, and Pennsylvania, respectively (USFWS 2006).

Environmental literacy is a goal of the 2014 Bay Agreement that could be addressed through recreation. Recreation sites offer the opportunity to post educational signage and provide information about the bay and its resources.

Education

Educating and engaging the public about the bay and its local waterways are critical components for reaching success of the 2014 Bay Agreement. CBP partners are working to educate and engage residents in the rich natural, cultural, historical, and recreational experiences of the bay through formal curriculum-based instruction in schools and through informal programs at parks and other recreational sites. CBP partners are coordinating the effort to support, provide, and improve curriculum-based environmental education programming (both class and field experiences) in elementary, middle, and high schools throughout the bay watershed.

Meaningful watershed educational experiences (MWEEs) are a critical part of formal bay education. MWEEs are in-depth investigations and analyses of ecological concepts, environmental interrelationships, and human implications. These studies help heighten understanding of bay-related issues. Informal education opportunities provide bay watershed citizens with life-long environmental learning opportunities. Place-based interpretation at CBP partner sites, such as Bay Gateways, Chesapeake Bay Interpretive Buoy System (CBIBS), and Captain John Smith Chesapeake National Historic Trail, provide visitors with first-hand experiences that reveal the

meaning of the bay watershed's many resources by connecting with people's personal interests and values.

Sustainable schools are built around reducing environmental impact, improving human health, and strengthening environmental literacy. Because certification programs often require progress in each of these three pillars of sustainability, the benefits of sustainable schools are varied from the conservation of water and energy to improved test scores that have been linked to hands-on environmental education.

Certified sustainable schools include those public and charter schools that are located within the watershed and have been recognized as sustainable by the following programs: U.S. Green Ribbon Schools, National Wildlife Federation Eco-Schools USA, Maryland Green Schools, and Virginia Naturally Schools (**Figure 9**) (CBP; http://www.chesapeakeprogress.com/engaged-communities/sustainable-schools).

Other stakeholders also have education programs that engage the public in learning about the Chesapeake Bay. To highlight a few, the National Oceanic and Atmospheric's (NOAA) Chesapeake Office manages the Bay Watershed Education and Training (B-WET), Environmental STEM Education, Environmental Science Training Center, and Emerging Scientist project. The Chesapeake Bay Foundation (CBF) directs Chesapeake Classrooms, and there are multiple agencies at the local level that are contributing to the education component of the 2014 Bay Agreement.

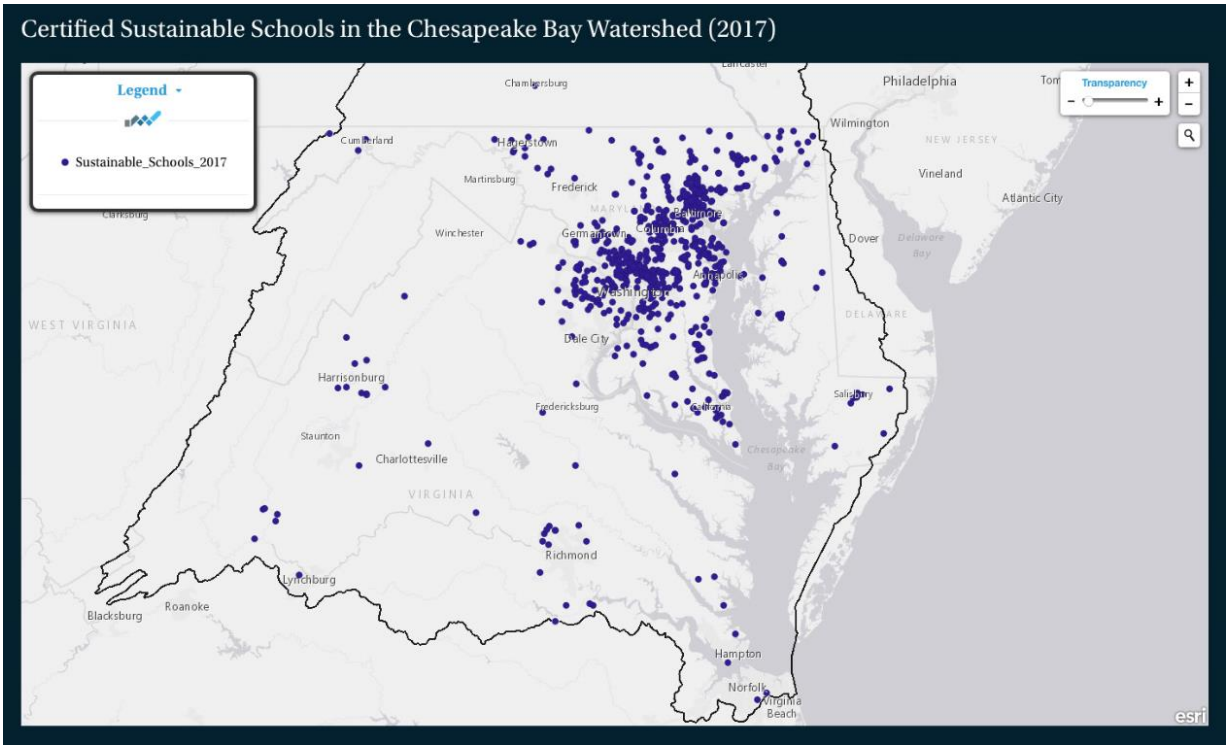

Figure 9. Certified Sustainable Schools in the Chesapeake Bay Watershed (CBP; http://www.chesapeakeprogress.com/engaged-communities/sustainable-schools)

Stewardship

The long-term success of the Chesapeake Bay restoration effort will depend on local leadership, and local action will depend on strong citizen stewardship. Building a larger, broader, more diverse community of stewards for watershed restoration is needed to achieve the goals and outcomes in the 2014 Bay Agreement, as it is stewards who bring the action element that will move our work forward. There are more than 600 conservation and watershed organizations in our region that are educating and empowering citizens to restore and protect local rivers and streams (**Figure 10**) (CBP; http://www.chesapeakeprogress.com/conserved-lands/protected-lands). There are tens of thousands of local volunteers who donate their time and talent to shared goals for the bay. EO 13508 specified that strategies to expand public access, conserve landscapes, and increase citizen stewardship should be coordinated with the partners for programs such as the Captain John Smith Chesapeake National Historic Trail, the Star-Spangled Banner National Historic Trail, and the Chesapeake Bay Gateways and Watertrails Network, administered and managed by the NPS Chesapeake Bay office. NPS has long-held interest in the unique natural and cultural resources of Chesapeake Bay (EO 13508 2009).

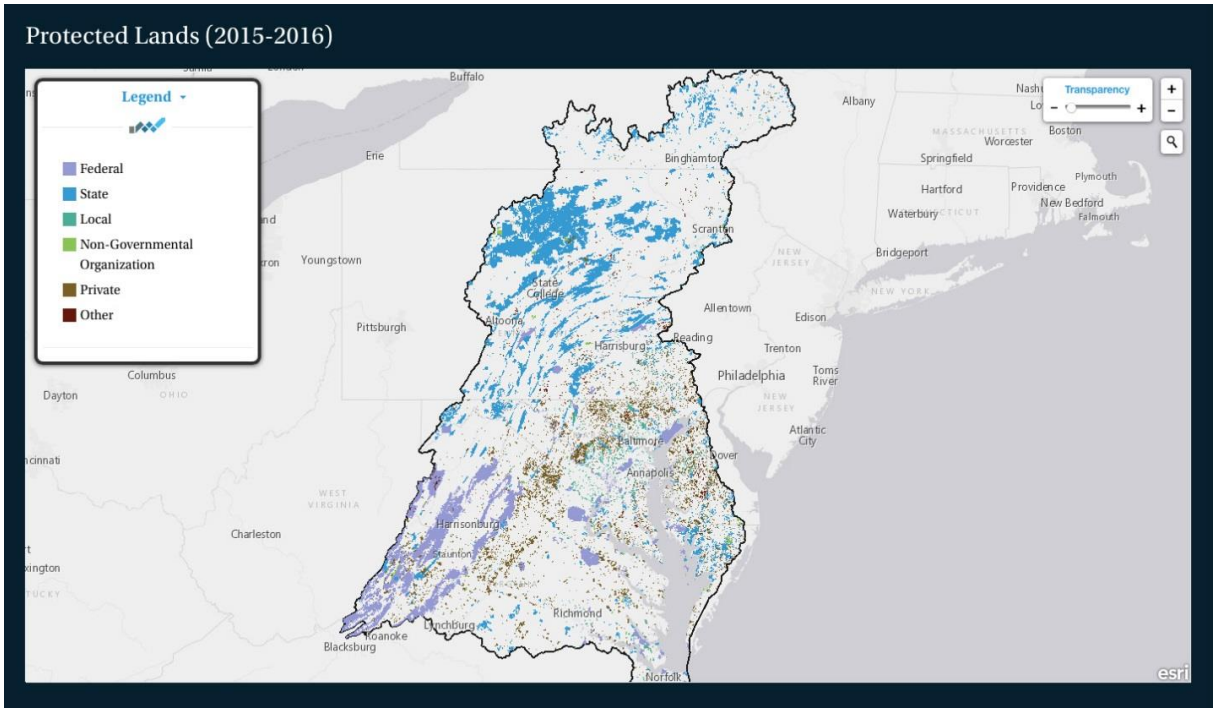

Figure 10. Protected Lands in the Chesapeake Bay Watershed (CBP; http://www.chesapeakeprogress.com/conserved-lands/protected-lands)

NFWF is a conservation grant-making organization that works with public and private sectors to protect and restore the nation's fish, wildlife, plants, and habitats. NFWF's Chesapeake Bay Stewardship Fund is centered on protecting and restoring the bay by providing restoration assistance to local communities. NFWF has developed a business plan for the Chesapeake Bay Stewardship Fund that outlines a strategy to guide conservation investments through 2025. The business plan outlines targeted watersheds for brook trout and river herring habitat restoration

and oyster restoration priority areas. Other examples of stewardship programs within the watershed are:

Table 3. Examples of stewardship programs in the Chesapeake Bay Watershed

Agency	Initiative
U.S. Department of Agriculture (USDA)/EPA	Chesapeake Bay Watershed Initiative
USDA	Conservation Stewardship Program
U.S. Department of Housing and Urban Development (HUD)	Sustainable Communities
U.S. Department of Transportation (DOT)	Sustainable Communities
EPA	Citizen Stewardship
NOAA	GIT 5: Public Access Goal Implementation Team
U.S. Department of Interior (DOI)	Chesapeake's Treasured Landscapes
NFWF	Chesapeake Bay Stewardship Fund
Conservation Fund	SAGE Study

Progress and Trends

There has been continued progress in the 2014 Bay Agreement Public Access goal (CBP; http://www.chesapeakeprogress.com/engaged-communities#public-access). Linking the public with bay resources is a key component to mobilizing citizens for restoration efforts.

Continued education efforts should be aimed at each state, its distinct bay issues, and its ties to the historical, cultural, and environmental legacy of the bay. The baseline for the Student and Sustainable Schools Education outcome is the 2014–2015 school year. These efforts have just begun and can be evaluated more fully in the years to come. With 82 percent of Maryland's schools certified as sustainable, efforts in Virginia, Pennsylvania, Delaware, West Virginia, and the District of Columbia should be prioritized for achievement across the watershed for this outcome in the future. CBP reported that 130 access sites opened between 2010 and 2016, documenting progress of the 2014 Bay Agreement Public Access Goal. With a goal of adding 300 public access points by 2025, the partners in bay restoration are making substantial progress, but efforts need to continue to achieve this goal.

2.14 Navigation

USACE Baltimore and Norfolk Districts maintain hundreds of channels in the Chesapeake Bay Watershed. USACE Philadelphia District maintains the Chesapeake and Delaware Canal (C&D Canal), part of which is within the Chesapeake Bay Watershed, along with 20 miles of the Baltimore Harbor Approach Channels in the Elk River and the Upper Chesapeake Bay. Along with federally authorized channels, there are state and local controlled channels. Many of these are solely for recreational use and aid in gaining navigation to local marinas.

Annually Dredged Channels

Annually, the Baltimore Harbor and Channels project is dredged with different project channels maintained on a rotating basis. USACE Baltimore District conducts maintenance dredging, removing approximately 3 million cubic yards of material (2.5 million cubic yards from Maryland channels and 0.5 million cubic yards from Virginia channels) at a historic average annual cost of about $17 million. Channels and small draft navigation projects are dredged as needed based on shoaling rates (USACE; (http://cdm16021.contentdm.oclc.org/cdm/ref/collection/p16021coll11/id/541).

In the Norfolk District, the Virginia and Norfolk approach channels are dredged annually on a rotating basis. Other channels are dredged based on available funding throughout Virginia. Shallow draft navigation projects are maintained to depths shallower than 16 ft and have low commercial use (less than 1 million tonnes annually) (USACE; http://www.nao.usace.army.mil/Missions/Civil-Works/Navigation/).

The Philadelphia District maintains the C&D Canal and approach channels. In most years, maintenance dredging only takes place in the approach channels, as the canal tends to be "self-scouring" and thus requires no additional maintenance.

Dredged material placement sites are established federal navigation channels in the Chesapeake Bay Watershed. Dredged material is authorized to be placed at the Cox Creek Dredged Material Containment Facility (Baltimore Harbor material), Pearce Creek Dredged Material Containment Area (C&D Canal Approach Channel material; managed by USACE Philadelphia District), Paul S. Sarbanes Ecosystem Restoration Project at Poplar Island (Maryland Approach Channels), Rappahannock Shoal Open Water site (Rappahannock Shoal Channel), Wolf Trap Open Water site (York Spit Channel), Dam Neck Open Water Site (Virginia Approach Channels), Norfolk Ocean Open Water Site (NODS) (Virginia Approach channels), Dam Neck Open Water site, and the Craney Island Dredged Material Management Area (for material dredged from the channels and ports in the Hampton Roads, Virginia area) (USACE; http://cdm16021.contentdm.oclc.org/cdm/ref/collection/p16021coll11/id/541 and http://www.nao.usace.army.mil/About/Projects/Craney-Island/).

Shallow draft dredging typically requires new dredged material placement sites on a case-by-case basis. While some shallow draft dredging operations use upland sites multiple times, often the material must be used at a new location each time the channel is dredged. Many shallow draft dredging projects use the dredged material beneficially. Beneficial use can include habitat restoration and creation, beach nourishment, aquaculture, forestry, agriculture, mine reclamation, and industrial and commercial development. Throughout USACE, it is estimated that approximately 20 to 30 percent of dredged material is used beneficially (EPA and USACE 2007).

While beneficial use of dredged material is ongoing throughout the Chesapeake Bay Watershed, there is limited to no funding for monitoring of these sites once placement has been completed. With a current lack of funding for monitoring, there can be no adaptive management to improve future projects. Monitoring would best be accomplished at the state level, by NGOs, or by academia. Once beneficial use monitoring becomes common practice for the Chesapeake Bay Watershed, any improvements can be used to place material in degraded or eroded areas or areas

needing coastal resilience or storm surge protection. The placement of beneficially used dredged material can support the ecosystem restoration goal of this study by providing ample material.

2.16 Population and Economy

An integrated set of socioeconomic indicators can be effective in presenting the basic facts about the people of a region. Such basic facts are important and can be used in many ways—assessing the potential impact of government policies, developing sound resource management strategies, designing effective interpretive programs, and increasing public involvement in the planning process. Socioeconomic indicators are regularly collected economic or social statistics that describe or predict changes and trends in the general state of society.

The current human population in the Chesapeake Bay Watershed has grown from 8.1 million in 1950 to more than 18 million, and it continues to increase by more than 157,000 residents annually; anticipated to reach 20.3 million by 2030. Population growth, development, landscape changes, and other factors are current stressors on the bay (NPS 2009).

The Chesapeake Bay Watershed can be described as a regional human ecosystem. A natural ecosystem can be understood in terms of factors such as flora, fauna, rainfall, temperature, elevation, and soil. Similarly, a human ecosystem can be understood in terms of factors such as population changes, commercial activities, social and cultural practices, recreational activities, politics, and land-use patterns.

Earnings by industry are indicative of the overall size of a local economy and the relative importance of each major industrial sector within that economy. The diversity of economic activities in the region presents an array of challenges to park management. Within the Chesapeake Bay Watershed region (2003), the leading sector of earnings in 159 of 187 counties and independent cities is sales and services. The second-ranking sector is construction and manufacturing (NPS 2009).

Change in the proportion of people employed by various industries within an economy can create a cascading set of impacts. A declining industry's displacement of workers whose skills are in less demand can generate stress within households and communities. A growing industry's demand for new sets of skills can influence migration patterns and educational priorities. Local and regional political decisions often place priority on protecting existing jobs or attracting new employment opportunities. Within the Chesapeake Bay Watershed region (1995–2005), employment decreased in construction and manufacturing in 34 counties (biggest change across sectors) while sales and services had the greatest number of counties with increases in employment (NPS 2009).

Poverty is officially defined as the condition of living in a household with income below the federally determined poverty threshold. Poverty thresholds vary according to the size of the family and number of children. For example, $19,484 was the poverty threshold in 2004 for a family of four people. The extent of poverty can be measured as the percentage of the total population living below that threshold. The level of poverty in the region necessarily becomes significant to management decisions and priorities. Within the Chesapeake Bay Watershed

region, the incidence of poverty (2004) ranges from 2.6 percent (Falls Church, VA) to 23.1 percent (Baltimore, Maryland) (NPS 2009).

Median household income is indicative of the general level of income among households in a county. The median value is the central value in a ranked dataset, with an equal number of observations both above and below the median. Within the Chesapeake Bay Watershed region, median household income (2004) ranges from $29,419 (Petersburg, Virginia [city]) to $94,225 (Loudoun County, VA).

2.17 Tourism

The recreation and tourism industry is measured using two categories: (1) arts, entertainment, and recreation sector (ranging from museums and concerts to sporting events and amusement parks) and (2) accommodation and food services sector (ranging from hotels to campsites). The size of these sectors is a broad indicator of a county's economic reliance on recreation and tourism relative to the other sectors of the economy. Recreation and tourism establishments can be proponents of actions that enhance their area's attractiveness as a visitor destination (such as transportation improvements, protection of scenic or cultural landmarks, or marketing campaigns). Recreation and tourism establishments also can be vulnerable to, and thus wary of, actions, policies, or chance events, such as visitor use restrictions, fires, or economic downturns, that affect business. Within the Chesapeake Bay Watershed, the percentage of total establishments in arts, entertainment, and recreation and accommodation and food services (2005) ranges from 1.6 percent (King and Queen County, VA) to 23.3 percent (Williamsburg, VA [city]) (NPS 2009).

The significance of the recreation/tourism industry to a county economy can be indicated by the percentage of county workers it employs. Workers counted as recreation and tourism employees include country club managers, blackjack dealers, campground employees, fishing guides, motel attendants, and other providers of recreation services. A high level of recreation/tourism employment may mean that residents have more disposable income or that the area attracts visitors or vacationers. Within the Chesapeake Bay Watershed, the percentage of total paid employees in arts, entertainment, and recreation and accommodation and food services (2005) ranges from 3.4 percent (Lunenburg County, VA) to 50.4 percent (Williamsburg, VA [city]) (NPS 2009).

Recreation and tourism revenue can be expressed as a percentage of total sales and service receipts. Recreation and tourism establishments can occupy an important position within a county economy because they attract visitor dollars from elsewhere. Secondary economic benefits are realized when these dollars are re-spent within the local economy or deposited in banks, where they provide capital to other businesses. Within the Chesapeake Bay Watershed region, the percentage of total sales from arts, entertainment, and recreation and accommodation and food services (2002) ranges from 0.4 percent (Covington, VA [city]) to 24.2 percent (Worcester County, Maryland) (NPS 2009).

2.18 Environmental Justice

Environmental justice is the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and

enforcement of environmental laws, regulations, and policies. Fair treatment means no group of people should bear a disproportionate share of the negative environmental consequences from industrial, governmental, and commercial operations or policies.

The 2014 Bay Agreement developed a guiding principle on environmental justice, which aligns with the above definition. A goal was established to "increase the number and diversity of local citizen stewards and local governments that actively support and carry out conservation and restoration activities that achieve healthy local streams, rivers, and a vibrant Chesapeake Bay." The outcomes for this goal consist of citizen stewardship, local leadership, and diversity. There are additional goals and outcomes that relate to public access and environmental literacy that are applicable to environmental justice.

The 2014 Bay Agreement stewardship outcomes and goals are defined below with the latest corresponding status reported from ChesapeakeProgress, which is designed to track progress of the 2014 Bay Agreement. This information is found on the ChesapeakeStat website, which tracks progress, decisions, and data within the Chesapeake Bay Watershed (www.chesapeakestat.com).

Table 4. 2014 Chesapeake Bay Agreement: Stewardship Goals, Outcomes and Progress

Outcome	Goal	Progress Reported 2016
Citizen Stewardship	Increase the number and diversity of trained and mobilized citizen volunteers with the knowledge and skills needed to enhance the health of their local watersheds.	Progress: Even. There are 600+ conservation and watershed organizations in our region that are educating and empowering citizens to restore and protect local rivers and streams. There are tens of thousands of local volunteers who donate their time and talent to our shared goals.
Local Leadership	Continually increase the knowledge and capacity of local officials on issues related to water resources and in the implementation of economic and policy incentives that will support local conservation actions.	Progress: Even. The baseline for this outcome has not been determined, as the outcome measure has not been developed.
Diversity	Identify minority stakeholder groups that are not represented in the leadership, decision-making and implementation of conservation and restoration activities and create meaningful opportunities and programs to recruit and engage them in the partnership's efforts.	Progress: Even. In a recent survey of CBP leadership, of the 112 people said to hold leadership positions, 89% identified themselves as white and 11% identified themselves as non-white.
Environmental Literacy Planning	Each participating bay jurisdiction should develop a comprehensive and systematic approach to environmental literacy for all students in the region that includes policies, practices, and voluntary metrics that support the environmental literacy goals and outcomes of the 2014 Bay Agreement.	Progress: Even. The baseline for this outcome will be established from data gathered during the 2014–2015 school year. Data were collected through a survey instrument that measured local education agency progress and capacity to implement the environmental literacy goals and outcomes of the 2014 Bay Agreement.
Public Access	By 2025, add 300 new public access sites, with a strong emphasis on providing opportunities for boating, swimming, and fishing, where feasible.	Progress: Increased. 130 access sites were opened between 2010–2016, and total number of sites in the region is 1,269.

EO 12898 provides guidance to federal agencies about social vulnerability and directs federal agencies to develop environmental justice strategies to help federal agencies address disproportionately high and adverse human health or environmental effects of their programs on minority and low-income populations. For the full text on this executive order, go to (https://www.archives.gov/files/federal-register/executive-orders/pdf/12898.pdf).

In its broadest sense, social vulnerability is one dimension of vulnerability to multiple stressors and shocks, including abuse, social exclusion, and natural hazards. Social vulnerability refers to the inability of people, organizations, and societies to withstand adverse impacts from multiple stressors to which they are exposed. This is an important environmental justice issue that should be addressed within the watershed.

The Social Vulnerability Index (SoVI) 2006–2010, assesses the vulnerability of U.S. counties to environmental hazards (HVRI 2010). The index is a comparative metric that facilitates the examination of the differences in social vulnerability among counties. SoVI is a valuable tool for policymakers and practitioners. It graphically illustrates the geographic variation in social vulnerability. It shows where there is uneven capacity for preparedness and response and where resources might be used most effectively to reduce the pre-existing vulnerability. SoVI also is useful as an indicator in determining the differential recovery from disasters.

The index synthesizes 29 socioeconomic variables, which the research literature suggests contributes to reduction in a community's ability to prepare for, respond to, and recover from hazards. SoVI data sources include primarily those from the U.S. Census Bureau. The data for calculation of the SoVI comes from a number of sources. The bulk of the data is drawn directly from the 2000 U.S. Census Bureau website, using American Fact Finder.

This is complicated further by sea level rise and climate change. The effects of climate change are expected to be more severe for some segments of society than others because of geographic location, degree of association with climate-sensitive environments, and unique cultural, economic, or political characteristics of particular landscapes and human populations. Social vulnerability and equity in the context of climate change are important because some populations may have less capacity to prepare for, respond to, and recover from climate-related hazards and effects. Such populations may be disproportionately affected by climate change.

2.19 Air Quality

The area of land over which airborne pollutants can travel to reach the Chesapeake Bay is known as the Chesapeake Bay airshed. The bay's airshed is approximately 570,000 square miles (**Figure 11**), nine times as large as the watershed itself (CBP; https://www.chesapeakebay.net/what/maps/chesapeake_bay_airshed). The characteristics of the airshed can impact the quality of aquatic and terrestrial resources of the bay. Regional air quality is affected by how air behaves as a result of the interaction of topography, weather, and physical and chemical properties of pollutants.

Figure 11. Chesapeake Bay airshed boundaries (CBP; https://www.chesapeakebay.net/what/maps/chesapeake_bay_airshed)

Four identified sources of air pollution within the Chesapeake Bay Watershed are:

- Stationary and Area Sources: Consists of power plants, chemical or manufacturing facilities.
- Mobile Sources: Cars, trucks, off-road vehicles, boats, airplanes, lawn mowers, farm, and construction equipment.
- Agricultural Sources: Livestock and poultry operations
- Natural Sources: Lightning, dust storms, and forest fires
- Airborne nitrogen from the atmosphere

Current Quality of the Chesapeake Bay Airshed

EPA regulates air emissions under the Clean Air Act. The EPA Green Book (EPA; https://www.epa.gov/green-book) provides detailed information about National Ambient Air Quality Standards (NAAQS) designations, classifications, and non-attainment status throughout the U.S. Data are aggregated by city, county, and state level.

Pursuant to the Clean Air Act, the EPA Office of Air Quality Planning and Standards has set National Ambient Air Quality Standards (NAAQS) for six air pollutants called "criteria pollutants." The six criteria pollutants and their status within the Chesapeake Bay Watershed can be found in **Table 5.**

Table 5. National Ambient Air Quality Standards in the Chesapeake Bay Watershed

Criteria Pollutants Monitored by EPA (NAAQS)	Location in Watershed	Status
Carbon Monoxide	Entire Watershed	Maintenance status
Nitrogen Dioxide	Entire Watershed	Maintenance status
Ozone (8hr)	Washington Metro Area Baltimore Metro Area Lancaster County, PA Dauphin County, PA Remainder of Watershed	Non-attainment Status Non-attainment Status Non-attainment Status Non-attainment Status Maintenance Status
Particulate Matter (2012-2.5)	Harrisburg, PA Remainder of Watershed	Non-attainment Status Maintenance Status
Lead (2008)	Entire Watershed	Maintenance Status
Sulfur Dioxide (2010)	Baltimore Metro Area Indiana County, PA Remainder of the Watershed	Non-attainment Status Non-attainment Status Maintenance Status

Note: Maintenance areas are those geographic areas that were classified as non-attainment, but are now consistently meeting the NAAQS. A non-attainment area has persistent air quality problems that exceed the NAAQS.

Land cover in the Chesapeake Bay Watershed is influenced by development and climate change. Forests are crucial to the health of Chesapeake Bay. Forests protect clean air and water, provide habitat to wildlife, store carbon, control floods, and support the region's economy. Human activities have altered the watershed's forests, reducing tree cover and fragmenting existing forests. When forests are destroyed by development, their ecological services and economic benefits are lost. Conserving and expanding forest cover is a critical, cost-effective way to reduce pollution and restore the bay. The process by which forests reduce the amount of pollutants in the air is called attenuation. Maintaining forest and canopy cover for the attenuation of nitrogen keeps this nutrient from entering the waterways and creating algae blooms.

Scientists estimate that about one-third of the nitrogen polluting the bay comes from the air, most often in the form of nitrogen oxides or ammonia (CBP; https://www.chesapeakebay.net/issues/air_pollution). These air pollution sources contribute to degradation of the bay waters. Nearly 75 percent of the airborne nitrogen that eventually ends up

in the bay is generated by sources within the airshed, and the remaining 25 percent is emitted from sources even farther away. Airborne nitrogen is one of the largest sources of pollution affecting Chesapeake Bay and its tributaries. Excess nitrogen can fuel the growth of algae blooms, which can block sunlight from reaching underwater grasses and create low-oxygen "dead zones" that suffocate marine life.

Air Quality Goals and Outcomes of the 2014 Chesapeake Watershed Agreement

Although the 2014 Bay Agreement did not define specific goals and outcomes under air quality, many of the established outcomes are intended to improve the airshed. Protecting and enhancing forested lands are related directly to future improvements in water quality. The specific outcomes, goals, and progress related to air quality are defined in **Table 6** and can be found at ChesapeakeStat (www.chesapeakestat.com), a tracking website designed to document progress, data, and decisions about the Chesapeake Bay watershed. ChesapeakeProgress, a subset of ChesapeakeStat, specifically links the Goals and Outcomes of the Chesapeake Watershed Agreement with reported progress (www.chesapeakeprogress.com).

Table 6. 2014 Chesapeake Bay Agreement: Air quality Goals, Outcomes and Progress

Outcome	Goal	Progress Reported 2016
Vital Habitats: Tree Canopy	Continually increase urban tree canopy capacity to provide air quality, water quality and habitat benefits throughout the watershed. Expand urban tree canopy by 2,499 acres by 2025.	Progress: Even. Each watershed jurisdiction will have annual and long-term planning targets that will contribute to the 2,400 acre goal. While these jurisdictions do report urban tree planting data to EPA, most do not have comprehensive or consistent tracking, reporting, or verification systems in place. A high-resolution aerial tree canopy assessment is in the process of being completed for the watershed.
Vital Habitats: Protected Lands	By 2025, protect additional two million acres of lands throughout the watershed—currently identified as high conservation priorities at the federal, state, and local level—including 225,000 acres of wetlands and 695,000 acres of forest land of highest value for maintaining water quality.	Progress: Increased. Data collected between 2015 and 2016 show that since 2010 approximately 1,004,577 acres of land in the Chesapeake Bay watershed have been permanently protected from development. This marks an achievement of 50% of the land conservation goal and brings the total amount of protected land in the watershed to 8.8 million acres.
Climate Resiliency Monitoring and Assessment	Continually monitor and assess the trends and likely impacts of the changing climatic and sea level conditions on the Chesapeake Bay ecosystem, including effectiveness of restoration and protection policies, programs, and projects.	Progress: Even. The baseline for this outcome has not been determined. Chesapeake Bay is one of the most vulnerable regions in the U.S. to impacts of climate change. Documenting and assessing these changes will allow us to better anticipate, withstand, and adapt to the threats facing our living resources, habitats, and communities.

Air Quality Goals and Trends in the Chesapeake Bay Total Maximum Daily Load (TMDL)

In the Chesapeake Bay, the largest TMDL ever established for a waterway was created by EPA (EPA; https://www.epa.gov/chesapeake-bay-tmdl). This document identifies the pollutant reductions (nitrogen, phosphorus, and sediment) necessary to meet water quality standards in the Bay. In this document, EPA committed to reducing air deposition of nitrogen to the tidal waters of the Bay from 17.9 to 15.7 million pounds per year through federal air regulations.

Atmospheric deposition of nitrogen is the major source of nitrogen to the Chesapeake Bay watershed, greater than other sources—fertilizer, manures, or point sources. For that reason, it is necessary to allocate an allowable loading of nitrogen from air deposition in the Chesapeake Bay TMDL. The nitrogen loadings come from many jurisdictions outside the Chesapeake Bay watershed. About 50 percent of the oxidized nitrogen (NOx) atmospheric deposition loads to the watershed and tidal bay come from the seven bay watershed jurisdictions.

By including air deposition in the bay TMDL load allocations, the bay TMDL accounts for the emission reductions that will be achieved by seven watershed jurisdictions and other states within the bay airshed. If air deposition and expected reductions in nitrogen loading to the bay were not included in the load allocations, other sources would have to reduce nitrogen discharges/runoff even further to meet the nitrogen loading cap. The TMDL developed for Chesapeake Bay will reflect the expected decreases in nitrogen deposition, and the 2-year federal milestones will track the progress of Clean Air Act regulations and programs.

Air Quality and Climate Change

The changes in greenhouse gases and aerosols caused by air pollution is predicted to lead to regional and global changes in temperature, precipitation, sea level rise, floods, droughts, and extreme temperatures. Climate change and sea level change will impact the future condition of the bay region. With forecast global climate change, simulations for the Chesapeake Bay watershed out to the year 2100 predict increased precipitation amounts in winter and spring and increased intensities of precipitation, tropical storms, and northeasters (though their frequency may decrease). On average, river flows would increase in winter but be reduced in summer (Najjar et al. 2010). The region can expect to see an increased frequency of nuisance tidal flooding. Large rainstorms could cause large amounts of pollutants to enter rivers and estuaries, as excess water may overwhelm wastewater systems and natural buffers. Increased pollution and increased water temperatures can cause algal blooms and potentially increase bacteria in water bodies.

Because annual precipitation changes are uncertain, the overall direction of salinity change in the bay is uncertain. Forecasts of likely winter and spring stream flow increases from climate change, in turn support forecasts that nutrient and sediment loading during winter and spring likewise will increase. Given no change in the annual flow regime, it is likely that phosphorus and sediment loading will increase due to the more intense and potentially less frequent rain events. Over a longer period, changes in land use and land cover across the bay watershed (in part caused by climate change) may dominate the change in nutrient and sediment flux to the bay (Najjar et al. 2010).

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Section 3

Chesapeake Bay Comprehensive Water Resources and Restoration Plan Results to Guide 2014 Bay Agreement Progress

Watershed planning is intended inform multiple audiences and decision makers at all levels of government and nongovernment, and to present a strategic roadmap to inform future direction of investment. Over the past 30 years, the Partnership, in its overall organization and restoration actions, has established much of the foundation for CBCP analyses. To achieve CBCP-specific objectives, further analyses were completed to identify high-quality areas for conservation, degraded areas for restoration, gaps in restoration actions or duplication of effort. Geospatial analyses were the primary methodology used to achieve this. Using existing spatial data layers obtained from many sources (federal, state, and local agencies; academia; and NGOs), specific questions were identified to provide responses to addressing the problems and opportunities within the bay watershed. Stakeholder meetings and webinars were used as question-answer platforms to identify, coordinate, and solicit feedback among NFWF, stakeholders, and other interested parties.

Following an initial inventory of existing datasets and coordination with the Partnership GIT, a wealth of geospatial data layers was available to conduct planning analyses. These data layers provide useful information to inform the purpose for which they were originally created. When overlaying multiple data layers in GIS, additional information could be derived. This derived information leads to the spatial component of the CBCP in which opportunities exist to maximize benefits from implementable actions.

The Planning Analyses Appendix presents more information on the CBCP geospatial analyses.

3.1 CBCP Results to Guide 2014 Bay Agreement Restoration Progress

The formulation of the CBCP baywide analyses had a primary focus on assisting to meet the 2014 Bay Agreement goals and outcomes. The state chapters provide a focused presentation of the baywide analyses for each jurisdiction. The following section presents a summary of the analyses completed for each 2014 Bay Agreement goal or outcome. This summary is a sampling of the discussion in the state chapters. Not all 2014 Bay Agreement goals or outcomes were investigated in the CBCP because of lack of data, lack of connection to USACE missions, or inability to define a geospatial analysis for which to investigate opportunities. The Planning Analyses Appendix contains a full description of all analyses completed for the CBCP.

Table 7 summarizes the analyses and formulations as they apply to the 2014 Bay Agreement. The CBCP analysis corresponds to the name assigned to the Restoration Opportunities Analysis in the Planning Analyses Appendix.

Table 7. CBCP Restoration: Alignment with 2014 Bay Agreement

CBCP Strategies	Problem/Opportunity Identification Question(s)	Opportunity Analysis Completed	2014 Bay Agreement Goal and Outcome Met
Habitat Restoration	*Where do opportunities exist to implement habitat restoration opportunities (streams, freshwater fish, submerged aquatic vegetation (SAV), oysters, black duck, riparian buffer) to further the 2014 Bay Agreement goals and outcomes, maximize/optimize aquatic ecosystem restoration, flood risk management, and community resilience benefits?*	Riparian Buffers Opportunities	◆ Vital Habitats – Forest Buffer (riparian), Stream Health, Brook Trout ◆ Sustainable Fisheries – Fish Habitat ◆ Water Quality
		Stream Restoration Opportunities	◆ Vital Habitats – Stream Health, Brook Trout ◆ Water Quality ◆ Sustainable Fisheries – Fish Habitat
		Fish Passage Removal Opportunities	◆ Vital Habitats – Fish Passage, Stream Health, Brook Trout ◆ Water Quality
		Oyster Restoration Opportunities	◆ Sustainable Fisheries – Oyster
		SAV Opportunities	◆ Vital Habitats – SAV ◆ Water Quality
Wetlands Restoration	*Where do opportunities exist to implement wetland restoration opportunities and protect existing wetlands to further the 2014 Bay Agreement goals and outcomes, maximize/optimize aquatic ecosystem restoration, flood risk management, beneficial use of dredged material, and community resilience benefits?*	Tidal Wetland Restoration and Enhancement Opportunities	◆ Vital Habitats – Wetlands ◆ Climate Resiliency
		Nontidal Wetland Restoration and Enhancement Opportunities	◆ Vital Habitats – Wetlands
		Wetland Restoration for Avian Wildlife Opportunities	◆ Vital Habitats – Wetlands, Black Duck
		Wetland Restoration (Beneficial Use of Dredged Materials) Opportunities	◆ Vital Habitats –Wetlands
		Wetlands Threats	◆ Climate Resiliency ◆ Vital Habitats- Wetlands
Improve Connectivity	*Where do opportunities exist to improve habitat connectivity and human connectivity to healthy habitats?*	Healthy Habitat at Risk to Future Threats	◆ Climate Resiliency ◆ Water Quality – Healthy Watersheds
		Improve and Maintain Human Connections to the Natural Environment	◆ Stewardship – Citizen Stewardship
Land Conservation	*Where do conservation opportunities exist to increase connectivity, enhance restoration success, and address social and economic vulnerabilities?*	Conservation Opportunities	◆ Water Quality – Healthy Watersheds
		Opportunities to Provide Added Societal Benefits	◆ Stewardship – Citizen Stewardship
		Threats Reduction Potential	◆ Climate Change – Climate Resiliency
Shorelines and Stream bank Stabilization	*Where can shoreline opportunities for restoration and conservation be implemented to maximize/optimize aquatic ecosystem restoration and community resilience?*	Opportunities to Reduce Habitat Loss due to Shoreline Erosion	◆ Climate Change – Climate Resiliency ◆ Vital Habitats – Wetlands
		Stream Restoration Opportunities to Reduce Risk to Future Threats	◆ Climate Resiliency; ◆ Water Quality ◆ Vital Habitats – Stream Health
Chemical Contaminant Remediation	*Consider remediation and conservation opportunities with respect to chemical contamination in the watershed.*	Chemical Contaminant Remediation Opportunities	◆ Toxic Contaminants ◆ Water Quality

Section 4
Vital Habitats Goal

"Restore, enhance, and protect a network of land and water habitats to support fish and wildlife and to afford other public benefits, including water quality, recreational uses, and scenic value across the watershed."

4.1 Outcome: Brook Trout

As identified in the 2014 Bay Agreement, the Brook Trout Outcome is "to restore and sustain naturally reproducing brook trout in the Chesapeake Bay's headwater streams, with an eight percent increase in occupied habitat by 2025."

Wild brook trout inhabit 33,200 km^2 of habitat in the Chesapeake Bay Watershed, of which 13,500 km^2 is allopatric or "wild brook trout only" streams spread across 990 distinct patches. Based on this baseline, the restoration goal is to establish and maintain 14,600 km^2 of habitat occupied only by wild brook trout. This amounts to an increase of 1,100 km^2 of allopatric habitat. **Table 8** presents the results of the CBCP Brook Trout Analysis. A formal indicator to document progress is in development by the CBP.

Table 8. Evaluation of Brook Trout Outcome

Current Status	13,500 km2 of allopatric (wild brook trout only) streams
Effort Needed to Meet Goal	Restore wild brook trout only populations to 1,100 km2
Description of CBCP Analyses	The watershed stressor score, location of brook trout only (allopatric) subwatersheds, potential for riparian buffer restoration, location of fish passage blockages prioritized for brook trout, and the Trout Unlimited brook trout conservation portfolio were analyzed geospatially to develop restoration and conservation strategies in subwatersheds.
Findings/Recommendations	Recommendations for actions that contribute to meeting the brook trout outcome are based on aligning restoration measures with the strategies identified in the Conservation Portfolio. Opportunities extend across PA, VA, WV, NY, and MD. USACE resources could assist with habitat restoration and fish passage blockage removal. Other stakeholders' capabilities could be applied to conservation, addressing watershed stressors tied to water quality and land use, habitat restoration, and fish passage blockage removal.
Authority/Program	USACE Continuing Authorities Program (CAP) 206 (Ecosystem Restoration); Section 510, General Investigations (GI)
Potential Partners	Jurisdictions holding brook trout habitat (MD, NY, PA, VA, and WV, along with local governments, local watershed organization, and a number of participating partners – USFWS, U.S. Geological Survey (USGS), NPS, USDA Forest Service, USDA Natural Resources Conservation Service (NRCS), Trout Unlimited, and the Eastern Brook Trout Joint Venture
Funding Requirements	Undetermined due to variety of actions that could be taken and need to tailor efforts to site-specific conditions.
Implementation Barriers	Funding and need for willing landowners; increasing temperatures with climate change; funding for monitoring; surveys to determine habitat extent
Integration with other 2014 Bay Agreement goals and outcomes	There is overlap with healthy watersheds, stream health, riparian buffers, fish passage, and resiliency to future climate changes.

Status of Problems and Needs

Brook trout inhabit clean cold streams and are sensitive to rising stream temperatures. They are an essential part of the headwater stream ecosystem. Brook trout habitat is impacted by water temperature, water quality, stream flow, and presence of one or more non-native trout species. Development of the landscape impairs brook trout stream occupancy by increasing water temperatures, increasing imperviousness, and increasing nutrient and sediment loads. Fish passage blockages, such as culverts, inhibit or prevent brook trout migration.

Brook Trout Analyses

The CBCP investigated opportunities to address stressors, and undertake conservation, stream restoration, riparian buffer restoration, and fish passage blockage removal within subwatersheds with the potential to support brook trout, which ties directly to the first key action in the Trout Unlimited brook trout work plan (available at: https://www.tu.org/sites/default/files/offline/science/Eastern%20Brook%20Trout%20Conservation%20Portfolio,%20Range-wide,%20and%20Focal%20Area%20Assessment%20v1_0.pdf) (Fesenmyer et al. 2017).

Within the CBCP formulation, existing brook trout habitat patches, existing healthy habitats, current watershed stressors, fish passage blockages prioritized through CBP for brook trout (Tier 1), and riparian buffer opportunity capacity (identified by CBP) were all considered. Separate geospatial analyses were completed to identify a unique set of opportunities for each of the following practices to benefit brook trout: riparian buffer restoration, stream restoration, and fish passage blockage removal. Maps in the Planning Analyses Appendix show each of these individual components.

The Trout Unlimited brook trout conservation portfolio assigned existing brook trout patches to one of the conservation strategies shown in **Figure 12**. A complete definition of each strategy is provided in the Planning Analyses Appendix or in Fesenmyer et al. 2017. The strategies are aimed to address stressors and habitat needs in patches to increase habitat integrity and achieve resilience. The strategies were incorporated into the CBCP analyses to guide identification of potential opportunities to benefit brook trout.

Figure 12 depicts stream restoration opportunities for brook trout with Trout Unlimited conservation strategies and fish passage blockages prioritized for brook trout by the CBP. Maps breaking down this compilation by individual conservation strategies are provided in the Planning Analyses Appendix. Actionable measures are proposed for the opportunities, using the conservation strategies and the CBCP Watershed Stressors Analysis. These actions incorporate the recommendations and strategies outlined in the CBP's management strategy for brook trout and opportunities for stream restoration, riparian buffer restoration, and fish passage blockage removal. A table of potential actionable measures for each opportunity is available in the Planning Analyses Appendix.

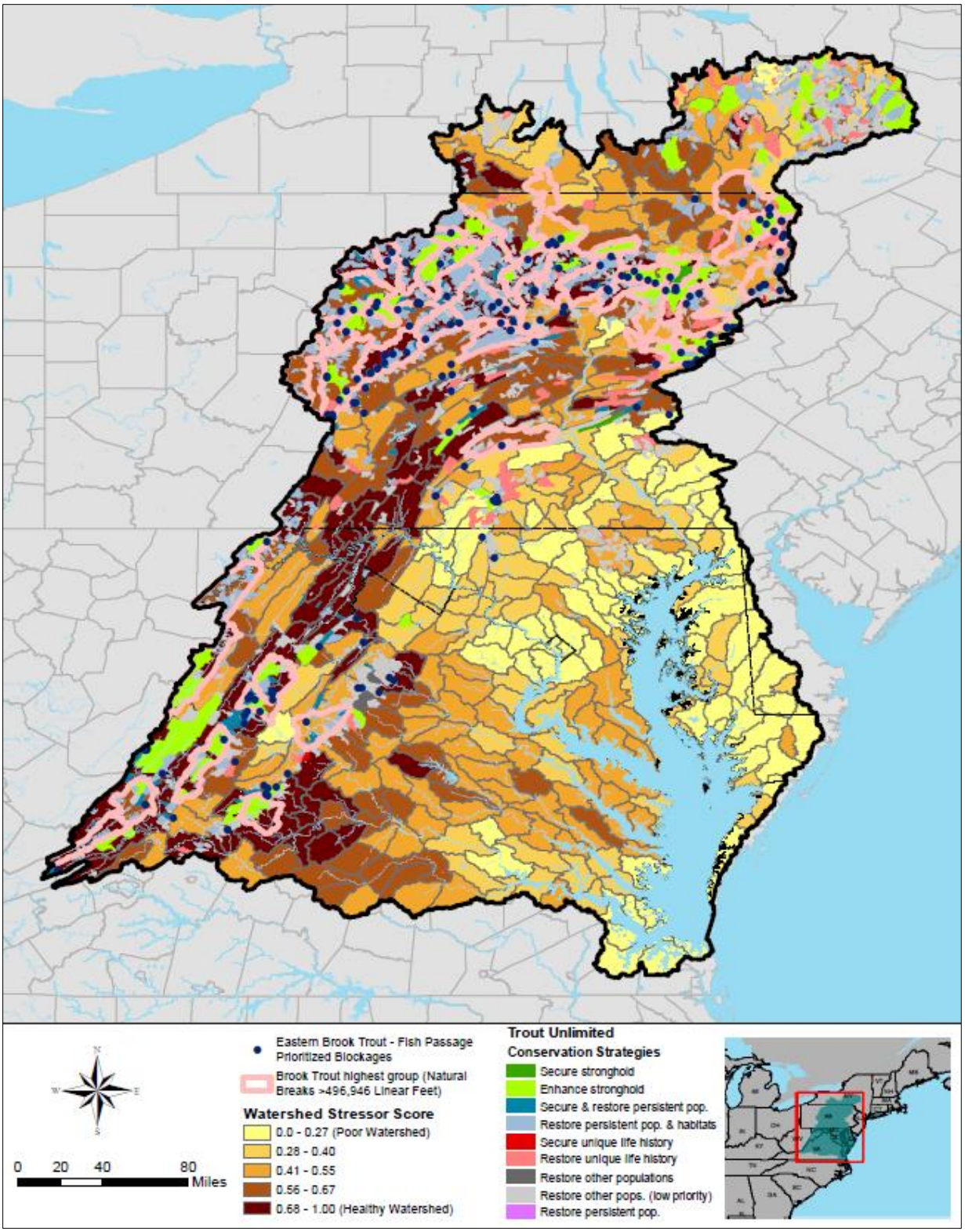

Figure 12. Stream restoration opportunities for brook trout with Trout Unlimited conservation strategies and prioritized fish passage blockages

Implementation

The brook trout management strategy distributes the area needed to achieve the goal of increasing brook trout habitat by 8 percent across the states (**Table 9**). These projections are valuable to determine the extent of effort needed in each jurisdiction.

Table 9. Projection of brook trout outcome by jurisdiction

State	2014 Area (km²) of Wild Brook Trout Only Patches	Area (km²) Needed to Achieve 8% Increase	Projected 2025 Area (km²) of Wild Brook Trout Only Patches
Maryland	604	48	652
New York	2,537	203	2,740
Pennsylvania	4,671	374	5,045
Virginia	4,651	372	5,023
West Virginia	1,032	83	1,115
Totals	13,495	1,080	14,575

4.1.1 Outcome: Black Duck

As identified in the 2014 Bay Agreement, the Black Duck outcome is "to restore, enhance, and preserve wetland habitat to support a wintering population of 100,000 black ducks and to refine population targets through 2025 based on best available science."

A decision support tool developed by the Atlantic Coast Joint Venture to inform black duck habitat delivery goals estimates that 151,272 ac of wetlands need to be restored or enhanced to support the black duck outcome (Jones et al. 2016).

The 100,000-bird target is based on goals of the USFWS North American Waterfowl Management Plan (available at: https://www.fws.gov/birds/management/bird-management-plans/north-american-waterfowl-management-plan.php) (USFWS 2012), which includes a goal to have a continental breeding population of 640,000 black ducks.

Table 10. Evaluation of Black Duck Outcome

Current Status	According to the USFWS Mid-Winter Waterfowl Survey (conducted annually in January), an average of 51,332 black ducks were observed in the Chesapeake Bay Watershed between 2013 and 2015. This represents a 5% increase from the average number of black ducks observed between 2012 and 2014 and 51% of the 100,000-bird goal.
Effort Needed to Meet Goal	To reach the 100,000 bird target, an average of 48,668 additional black ducks would need to be observed in the Chesapeake Bay Watershed by 2025. Alternatively, restore or enhance 151,272 ac of wetlands.
Description of CBCP Analyses	The CBP black duck focus areas were overlaid on the CBCP wetland restoration and enhancement maps to identify the subwatersheds that provide wetland restoration and enhancement opportunities with the potential to benefit black duck populations during the nonbreeding, over-wintering season.
Findings/Recommendations	The results of this analysis showed the highest priority areas for wetland restoration and enhancement that have the potential to benefit black duck populations during the nonbreeding, over-wintering season lie within the tidally influenced wetland areas of the Chesapeake Bay Mainstem and near the mouths of bay tributaries as these areas are the most important over-wintering habitats utilized by the black duck.

Authority/Program	USACE CAP 206/204; Section 510; GI; Construction General (CG) if large enough
Funding Requirements	Undetermined
Implementation Barriers	Habitat loss, degradation, and fragmentation (in the Chesapeake Bay Watershed and at other ends of the Atlantic Flyway population's range), shoreline disturbance and development, food availability, invasive species, climate impacts, funding, effective policy, knowledge on black duck habitat needs, and permitting.
Integration with other 2014 Bay Agreement goals and outcomes	There is an overlap with wetlands, forest buffers, healthy watersheds, conserved lands, and resiliency to future climate changes.

Status of Problems and Needs

Black ducks are found in fresh and brackish wetlands along the Chesapeake Bay and its rivers and generally avoid heavily populated areas. A range of factors including loss of habitat and pressures of climate change impact the ability to restore, enhance, and preserve wetland habitat to support a wintering population of 100,000 black ducks. Preserving habitat in the Chesapeake Bay Watershed is critical to the long-term sustainability of the species.

Black Duck Analyses

The CBP's black duck dataset, based on 2010 environmental conditions, shows the potential capability of the landscape in the Chesapeake Bay Watershed to provide habitat for the black duck during the non-breeding season. Landscape capability integrates factors influencing climate suitability, habitat capability, and other biogeographic factors affecting the species' prevalence in the area. The CBP black duck focus areas were overlaid on the CBCP wetland restoration and enhancement maps to identify subwatersheds that provide wetland restoration and enhancement opportunities with the potential to benefit black ducks. Habitat restoration for black ducks will benefit other waterfowl wintering in the Chesapeake Bay Watershed. Further discussion of the CBCP Black Duck Analysis is located in the Planning Analyses Appendix.

4.1.2 Outcome: Fish Passage

As identified in the 2014 Bay Agreement, the Fish Passage Outcome is "to continually increase habitat to support sustainable migratory fish populations in the Chesapeake Bay watershed's freshwater rivers and streams, and by 2025, to restore historical fish migration routes by opening 1,000 additional stream miles to fish passage."

Restoration success will be indicated by the consistent presence of alewife, blueback herring, American shad, hickory shad, American eel, and brook trout, which will be monitored in accordance with available agency resources and collaboratively developed methods.

Table 11. Evaluation of Fish Passage Outcome

Current Status	Progress toward this outcome is measured against a 2011 baseline of 2,510 stream miles open to the migration of fish. Between 2012 and 2016, 1,126 additional miles were opened to fish passage, surpassing the 1,000 mile goal. However, the methodology used to calculate stream miles opened by passage removal was changed in 2014 following adoption of the outcome. Because this outcome's mileage target was set under a previous method of calculation, it is an unfit benchmark against which to measure progress. Restoration partners are committed to continuing to work to address fish passage blockages.
Effort Needed to Meet Goal	Unclear. Accounting methods have changed, and therefore comparison to initial goal is not valid.
Description of CBCP Analyses	The intent of the CBCP's Fish Passage Blockage Analysis was to build upon the work by the CBP's Fish Passage Workgroup to identify where high prioritized blockages are co-located with opportunities for stream restoration to benefit resident fish, anadromous fish, and brook trout. The high-prioritized fish passage blockages from the CBP Fish Passage Workgroup was overlaid on the CBCP Stream Restoration Analysis.
Findings/Recommendations	The highest concentration of high-prioritized fish passage blockages to benefit anadromous fish are located in the Chester and Elk River Subwatersheds in the upper Eastern Shore of MD, the Lower and Upper Pamunkey River watersheds in VA, and the upper Patuxent in MD. The highest concentration of high-prioritized fish passage blockages to benefit resident fish populations are located in the upper Susquehanna River Subwatershed along the NY-PA border in eastern PA, similar but not identical to brook trout.
Potential Partners	Primary participants for implementation identified in the Fish Passage Management Strategy include NOAA, USFWS, Maryland Department of Natural Resources (MDNR), PA Fish and Boat Commission (PFBC), Virginia Department of Game and Inland Fisheries (VDGIF), American Rivers, USACE, and The Nature Conservancy (TNC).
Authority/Program	USACE CAP 206; Section 510; GI
Funding Requirements	Undetermined as blockage removal costs vary widely and are unique in each situation.
Implementation Barriers	Funding, landowner compliance/willing landowners, regulations that enforce state laws to provide passage at dams, and targeted fish species decline affect the expected benefits
Integration with other 2014 Bay Agreement goals and outcomes	There is overlap with brook trout, stream health, and fish habitat outcomes.

Status of Problems and Needs

Fish passage within the Chesapeake Bay Watershed is limited by a significant number of blockages that range from large hydroelectric power-generating dams to historical mill dams to road culverts and utility pipes that have been exposed by erosion. This is particularly significant where these barriers prevent fish from reaching spawning areas. Fish passage blockage removal has the potential to benefit not only fish populations, but also improve water quality and reduce sediment that has accumulated behind the barrier. Fish passage blockage removal is particularly important for anadromous (fish that is born in freshwater, but spends most of its life in saltwater then returns to freshwater to spawn; shad, herring, striped bass are some examples), and catadromous (fish that is born in saltwater, but spends most of its life in freshwater then returns to saltwater to spawn; American eel is an example) fish species that move between fresh and saltwater habitats. Fish passage blockages such as dams may also be an attractive nuisance that

posse public safety concerns, may exacerbate flooding, and limit public access to rivers and streams.

Fish Passage Analyses

The CBP Fish Passage Workgroup in conjunction with The Nature Conservancy has developed a Chesapeake Bay Fish Passage Prioritization Tool that documents hundreds of fish passage barriers. Independent prioritizations of blockages for removal have been completed separately to address the needs of brook trout, diadromous fish, and resident fish. The intent of the CBCP's Fish Passage Blockage Analysis is to build upon work completed by the CBP Fish Passage Workgroup to identify where high prioritized blockages are co-located with stream restoration opportunities. The CBCP analyses prioritized the Tier 1, 2, and 3 blockages separately for diadromous species, resident fish, and brook trout by the CBP Fish Passage Workgroup in conjunction with the stream restoration opportunities for brook trout, anadromous fish, and resident fish. Given the large number of blockages, the Tier 1, 2, and 3 blockages were limited to Tier 1 blockages to identify which stream restoration opportunities contain high-prioritized fish passage blockages (Tier 1 by the nomenclature of the prioritization tool). **Figure 13** portrays the distribution of the CBP Tier 1-3 blockages for each of the three prioritization schemes. Within the Planning Analyses Appendix, there are maps that quantify the number of Tier 1 blockages per subwatershed for each individual prioritization (resident fish, anadromous fish, and brook trout) and a map overlaying the blockages on the watershed stressor scores for each subwatershed. Fish passage blockage data within the prioritization tool does not include blockages in New York or West Virginia; therefore, neither do the CBCP analyses.

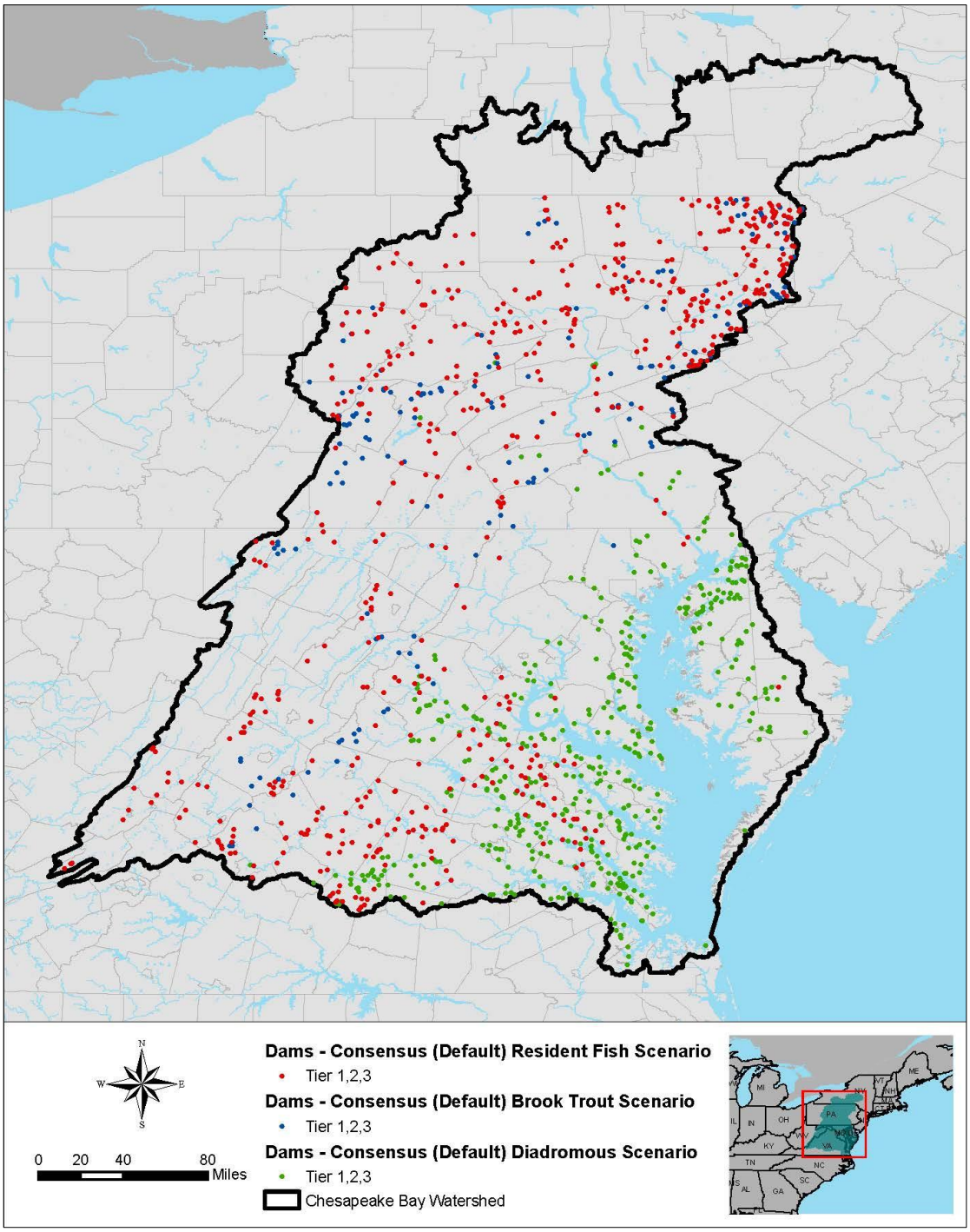

Figure 13. Fish passage prioritizations from the Chesapeake Bay Program's fish passage prioritization tool

Table 12 shows the subwatersheds that have the highest concentration of fish passage blockages. There is some overlap geospatially between blockages that impair resident and anadromous fish populations. Alternatively, focus could be placed on subwatersheds with the fewest blockages or work could commence in downstream subwatersheds and work upstream. The number of blockages in each subwatershed is provided in the CBCP Master Results Database.

Table 12. Fish passage opportunities based on number of Tier 1 blockages for each prioritization

Subwatershed Number	Subwatershed Name	States	Number of Chesapeake Bay Program (CBP) Tier 1 Blockages within Anadromous Fish Habitat	Number of CBP Tier 1 Blockages within Brook Trout Habitat	Number of CBP Tier 1 Blockages within Resident Fish Habitat
0206000204	Chester River	DE,MD	52		
0208010609	Upper Pamunkey River	VA	16		
0206000202	Elk River	DE,MD,PA	14		
0206000604	Upper Patuxent River	MD	13		
0208010611	Lower Pamunkey River	VA	12		
0205010701	Lackawanna River	PA		54	
0205010113	Lower Susquehanna River	NY,PA		43	38
0205010612	Tunkhannock Creek	PA		30	23
0205010703	Middle Susquehanna River	PA		24	22
0208020505	Lickinghole Creek-James River	VA			18

High-prioritized fish passage blockages are concentrated in the upper Susquehanna River in Pennsylvania, the West Branch Susquehanna River in Pennsylvania, in the Chester-Sassafras Watersheds on Maryland's Eastern Shore, and throughout the York, Rappahannock, and James River Watersheds in Virginia. The highest concentration of high-prioritized fish passage blockages to benefit brook trout are located in the upper Susquehanna River Watershed along the eastern New York-Pennsylvania border. The highest concentration of high-prioritized fish passage blockages to benefit anadromous fish are located in the Chester and Elk River Watersheds on the upper Eastern Shore of Maryland, the lower and upper Pamunkey River Watersheds in Virginia, and in the upper Patuxent River in Maryland. The highest concentration of high-prioritized fish passage blockages to benefit resident fish populations are located in the upper Susquehanna River Watershed along the eastern New York-Pennsylvania border.

If considering watershed stressor scores, fish passage blockages on the Eastern Shore and along the lower Susquehanna River in Pennsylvania are located in stressed subwatersheds; blockages in the upper, middle, and West Branch Susquehanna River and upper James River are located in low stress subwatersheds; and blockages in eastern Virginia are located in moderately stressed subwatersheds. **Figure 14** shows an overlay of high priority fish passage blockages and the watershed stressor score for each subwatershed. The Planning Analyses Appendix Fish Passage Blockages Analysis Section shows a map that combines this information with stream restoration opportunities with a distinction provided for resident fish, anadromous fish, and brook trout.

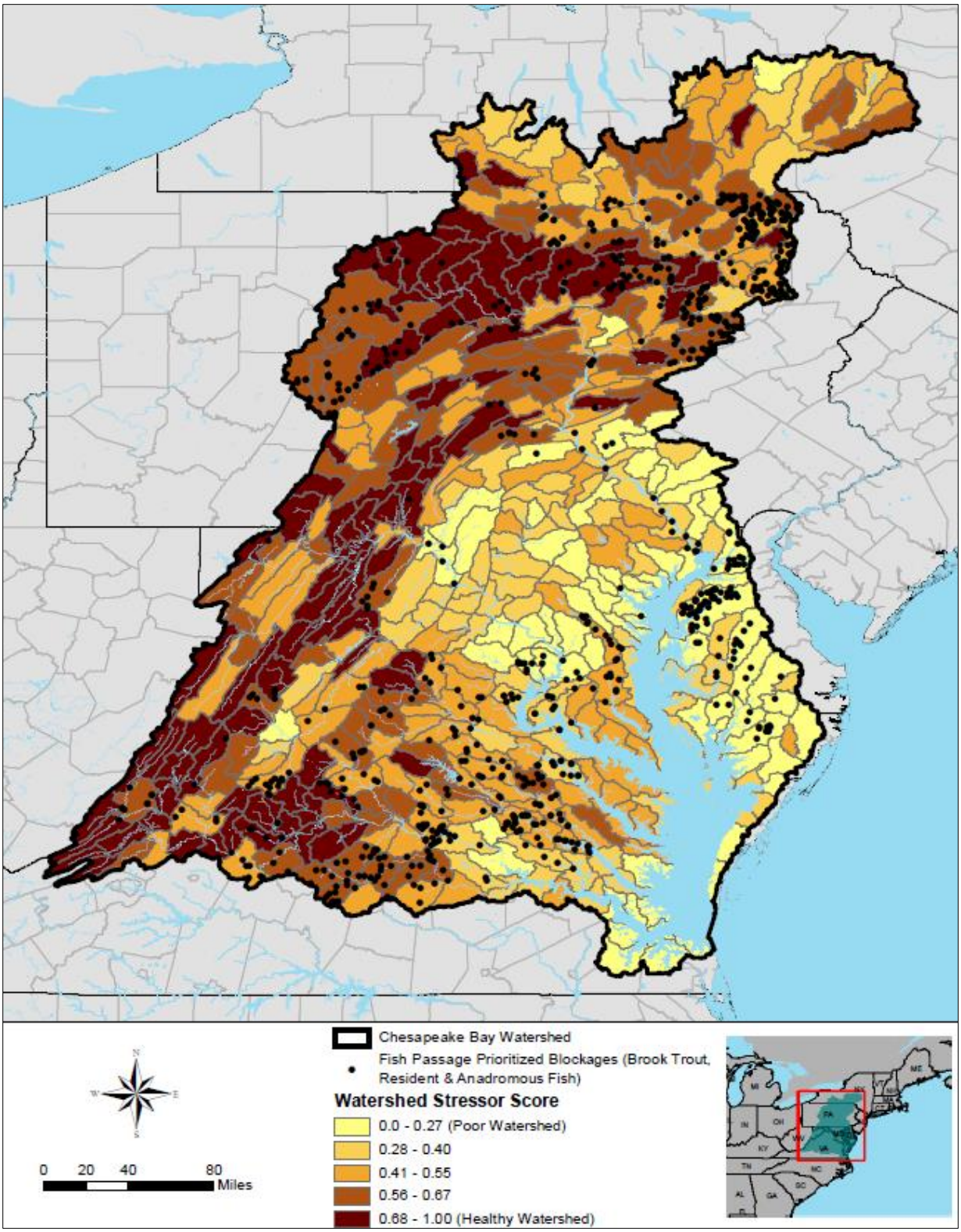

Figure 14. High-prioritized fish passage blockages (Tier 1 of three separate scenarios – brook trout, diadromous fish, and resident fish scenarios) and watershed stressor scores.

Implementation

It is unclear what metric needs to be reached to accomplish the broader goals of improved fish passage in the Chesapeake Bay Watershed. Barrier removal costs vary greatly based on the type of blockage and location. Therefore, it is not possible to project the level of effort or implementation costs.

4.1.3 Outcome: Forest Buffers

As identified in the 2014 Bay Agreement, the Forest Buffers Outcome is "to restore 900 miles of riparian forest buffers per year and conserve existing buffers until at least 70% of riparian areas in the watershed are forested. Only 64 miles of forest buffers were planted between 2014 and 2015, which is 826 miles short of the annual goal."

Table 13. Evaluation of Forest Buffers Outcome

Current Status	55% (158,400 mi) of the watershed's 288,000 miles of stream banks and shorelines have forest buffers in place.
Effort Needed to Meet Goal	43,200 miles of stream banks and shorelines require forest buffers.
Description of CBCP Analyses	The CBCP analyses identified forested riparian buffer restoration opportunities that have the potential to (1) address watershed stressors (i.e., high-yielding N and P subwatersheds), (2) improve brook trout habitat, and (3) support improving stream habitat for resident fish and migratory species. The CBCP riparian buffer restoration opportunities, high-yielding N and P subwatersheds, brook trout subwatersheds, the National Fish Habitat Assessment (compiled by the National Fish Habitat Partnership) and the Trout Unlimited conservation strategies for brook trout were overlaid to identify riparian buffer restoration opportunities.
Findings/Recommendations	In general, there are broad riparian buffer opportunities throughout the Chesapeake Bay Watershed spanning all jurisdictions. Concentrated areas are in eastern New York, northern and south-central Pennsylvania, West Virginia, western Maryland, Maryland's Eastern Shore, western Virginia, and subwatersheds in the James River in southern Virginia. There are opportunities to undertake riparian buffer restoration to benefit brook trout and resident fish in: ▪ the Susquehanna River Watershed in upper Pennsylvania ▪ the upper Potomac Watershed in West Virginia, Virginia, and Maryland ▪ the upper James Watershed in Virginia and West Virginia Opportunities to manage N and P loadings are isolated from opportunities to improve fish habitat with riparian buffer restoration. Riparian buffer opportunities to benefit brook trout also provide opportunities to conserve healthy/ high value habitats.
Potential Partners	All jurisdictions in the Chesapeake Bay Watershed can play a role in forested riparian buffer restoration. There is a diverse and large group of other key participants identified in the management strategy, including NRCS, USFWS, USGS, USDA, and NPS along with NGOs, state and local governments, and conservation districts.
Authority/Program	CAP 206, Section 510, GI
Funding Requirements	Undetermined
Implementation Barriers	Funding; lack of continuity and flexibility in federal programs; development of agricultural lands; fluctuations in commodity crop values; willingness and knowledge of landowners, maintenance; lack of matching funds for federal programs; education, outreach, and technical assistance to landowners; federal programs underutilized due to lack of matching funds (CBP – ChesapeakeProgress.com) and complexity.

Integration with other 2014 Bay Agreement goals and outcomes	There is overlap with water quality, brook trout, wetlands, healthy watersheds, stream health, tree canopy, and land protection.

Status of Problems and Needs

Forested riparian buffers are critical to the health of Chesapeake Bay and its watershed. Forested riparian buffers are important habitats for wildlife and play an important role in maintaining water quality. They provide many indirect benefits, including stabilizing stream banks, maintaining cool temperatures in streams, providing food to wildlife, providing woody debris to the stream network, and playing a significant role in pollution reduction. For all these benefits, riparian forest buffers are considered one of the most cost-effective best management practices to benefit the Chesapeake Bay (CBP; http://www.chesapeakeprogress.com/abundant-life/forest-buffers).

Historically, most streams in the Chesapeake Bay Watershed had forests along the stream banks, except where conditions were too wet, disturbed, or salty (CBP Riparian Forest Buffer Management Strategy 2015; https://www.chesapeakebay.net/channel_files/23500/va_riparian_forest_buffer_workplan.pdf). Buffers were converted from forest as lands were developed or used for agriculture. Currently, CBP status shows 55 percent of the watershed's 288,000 miles of stream banks and shorelines have forest buffers in place. However, this number is undergoing additional analyses using the high-resolution land cover dataset. Preliminary results of that work focused on the land cover within a 100-foot buffer along stream banks and shorelines and have identified 57 percent of the 100-foot buffer is forested. Approximately 24 percent (1,162,636 ac) is characterized as turf or agricultural lands that would be eligible for conversion to forest buffers. The goal of 900 mi per year equates to 10,737 ac of 100-ft buffer per year; this goal was reached once, in 2007. Between 2001 and 2010, 650 mi was restored on average. There is no mandated buffer width. Widths vary between 35 and 300 ft with a recommendation of 100 ft. The CBCP Masters Results Database provides the existing percentage that is forested within the 100-ft buffer for each subwatershed. Of the 425 subwatersheds, there are 236 subwatersheds that have less than a 70 percent forested buffer.

Table 11. Land cover within the 100-foot buffer throughout the Chesapeake Bay Watershed (data produced by CBP using high-resolution land cover dataset)

Land cover type	Acres within 100-foot buffer	Percent cover of buffer
Forest	2,713,434	57%
Wetland	605,556	13%
Impervious	172,422	4%
Tree Canopy	128,360	3%
Agriculture	847,000	18%
Turf	279,636	6%
Total	**4,746,408**	

Implementing riparian forested buffers can be undertaken to meet many objectives, such as water quality improvements, habitat restoration, or stream bank stabilization. The CBCP analyses identified forested riparian buffer restoration opportunities that have the potential to (1) address watershed stressors (i.e., high-yield N and P subwatersheds), (2) improve brook trout habitat, and (3) support improving stream habitat for resident fish and migratory species. The CBCP efforts can be used to assist with the need identified in the CBP Forest Buffer Management Strategy to target buffers that provide opportunities to benefit brook trout and improve water quality. The CBP Forest Buffers Workgroup provided the number of acres of riparian buffer opportunities within each subwatershed. Data were generated by the CBP to determine the number of acres of riparian buffer (opportunity) (30 m (100-ft) buffers) within each subwatershed. USACE developed a GIS layer and categorized subwatersheds based on the acreage of opportunity within a subwatershed using the Jenks method. The data were paired with (1) the highest yielding N and P watersheds to identify those subwatersheds where riparian buffer opportunities exist to address N and P inputs, (2) brook trout watersheds to identify subwatersheds where riparian buffer opportunities exist to improve brook trout habitat, and (3) National Fish Habitat Assessment locations at low risk of current habitat degradation to identify riparian buffer opportunities to benefit resident and migratory fish. **Figure 15** provides the results of the three evaluations. The Brook Trout Outcome discussion provides additional specifics regarding actions that could be undertaken along with riparian buffers to benefit brook trout.

In general, there are broad riparian buffer opportunities throughout the Chesapeake Bay Watershed spanning all jurisdictions. Opportunities are concentrated in eastern New York, northern and south-central Pennsylvania, West Virginia, western Maryland, Maryland's Eastern Shore, western Virginia, and in the James River in southern Virginia. The Riparian Buffer Analyses Section in the Planning Analyses Appendix provides a detailed discussion of the geographic description of riparian buffer restoration opportunities by objective.

When the riparian buffer restoration opportunities are considered for all three objectives (**Figure 15**), there are opportunities to undertake riparian buffer restoration to benefit both brook trout and resident fish in the:

- Susquehanna River Watershed in upper Pennsylvania
- Upper Potomac River Watershed in West Virginia, Virginia, and Maryland
- Upper James River Watershed in Virginia and West Virginia

Opportunities to manage N and P loadings are isolated from opportunities to improve fish habitat with riparian buffer restoration. On military lands, forest buffers could be maximized by engaging stewards of U.S. Department of Defense (DOD) lands.

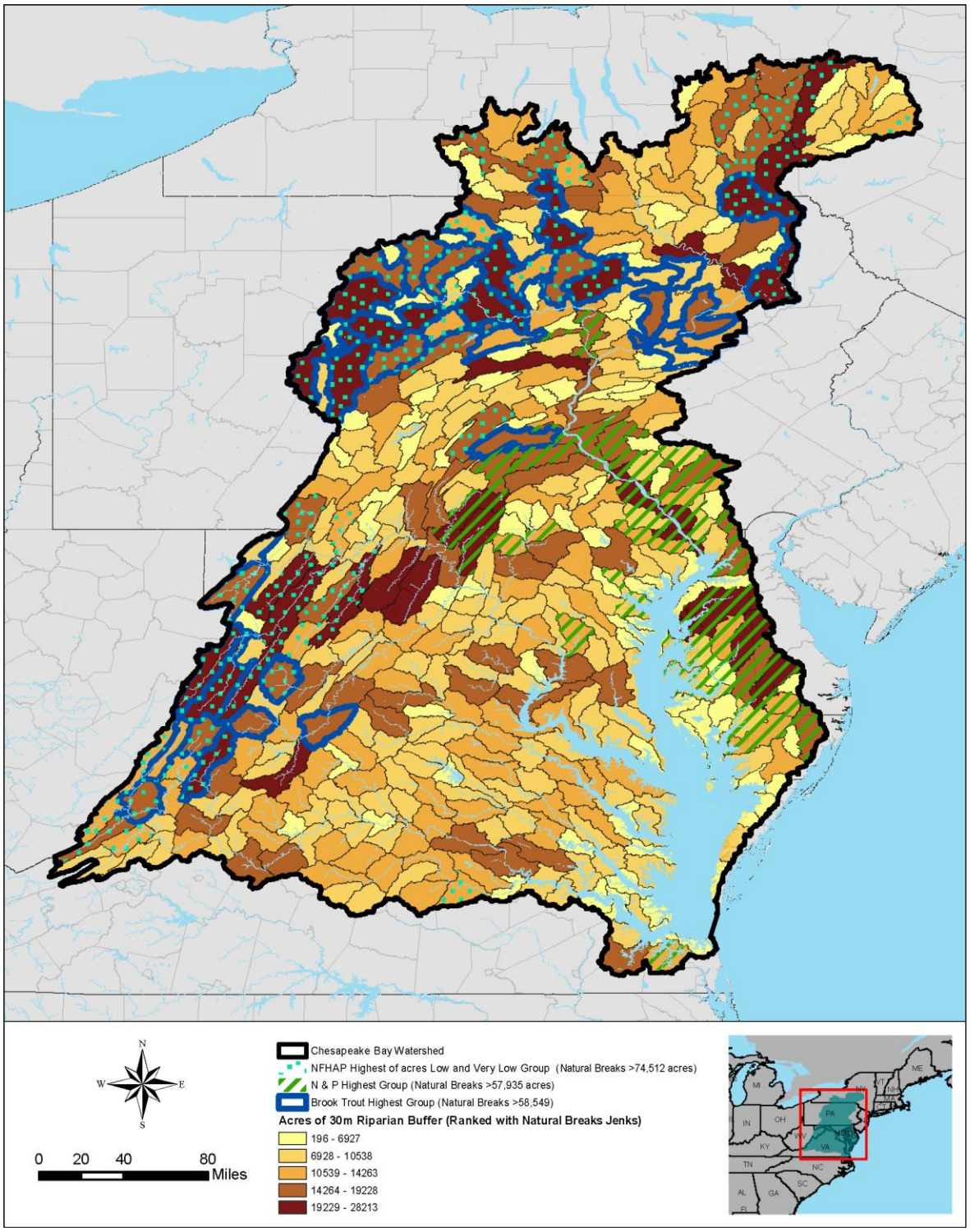

Figure 15. Compiled subwatersheds for riparian buffer restoration

4.1.4 Outcome: Stream Health

As identified in the 2014 Bay Agreement, the Stream Health Outcome is "to continually improve stream health and function throughout the watershed and to improve health and function of 10% of stream miles above the 2008 baseline for the Chesapeake Bay watershed."

Tracking of this outcome is based on improvements in the Chesapeake Bay Benthic Index of Biotic Integrity (Chessie B-IBI Workgroup). A metric is in development.

Table 12. Evaluation of Stream Health Outcome

Current Status	43% of streams in fair, good, or excellent condition. 57% in very poor or poor condition
Effort Needed to Meet Goal	A baseline is being developed to determine progress and effort needed to meet the goal. Stream restoration metrics are being tracked as part of the total maximum daily load (TMDL) implementation.
Description of CBCP Analyses	Analyses evaluated stream restoration efforts to benefit brook trout, anadromous fish, and resident fish populations. Data layers utilized include the CBCP Watershed Stressor Analysis, the National Fish Habitat Assessment, brook trout watersheds, the extent of anadromous fish habitat (CBP fish passage prioritization tool), and the Trout Unlimited conservation strategies for brook trout.
Findings/Recommendations	The analysis identified that watershed stressor scores were highest (least stressed subwatershed) in: 1) Subwatersheds with opportunities to benefit brook trout habitat in the upper Susquehanna River and West Branch Susquehanna River in Pennsylvania and western portions of the watershed in Virginia and West Virginia, 2) subwatersheds with opportunities to benefit resident fish in the Potomac River of western Maryland, Pennsylvania, and West Virginia; upper James River in Virginia; the Upper Susquehanna, western subwatersheds in the West Branch Susquehanna, and central subwatersheds in the Lower Susquehanna in Pennsylvania, and throughout the Upper Susquehanna in New York. HUC 10 exhibit higher stress levels in HUC 10 with opportunities to benefit habitat for anadromous fish along the mainstem of Maryland's Chesapeake Bay and the lower Susquehanna River in Pennsylvania. Subwatersheds on Maryland's Eastern Shore that have opportunities for stream restoration to benefit resident and anadromous fish also are stressed. Subwatersheds in Virginia in the lower Rappahannock, York, and James rivers for resident and anadromous fish have moderate stress levels. USACE would be most suited to pursue stream restoration for habitat improvements in those subwatersheds with low stressors such as those in New York, northern and western Pennsylvania portions of the bay watershed, western Maryland, West Virginia, and western half of Virginia. There are stream restoration opportunities in stressed subwatersheds that could target watershed stressors and greatly benefit the health of those watersheds. There are Trout Unlimited conservation strategies for brook trout within subwatersheds that have stream restoration opportunities. This information has potential for siting projects on a smaller scale by follow-up investigations.
Potential Partners	All watershed jurisdictions and local governments are each able to play a role in implementing actions to reach the 2014 Bay Agreement Stream Health Outcome. NFWF, USFWS, and USACE can each play a role in funding and implementing stream restoration. Other organizations, including EPA, USGS, Interstate Commission on the Potomac River Basin (ICPRB), academic institutions, Center for Watershed Protection (CWP), and the Chesapeake Bay Trust (CBT) are involved in monitoring and implementation on various levels.
Authority/Program	CAP 206; Section 510; GI
Funding Requirements	Undetermined

Implementation Barriers	Scale of problem, lack of defined baseline, costs, land ownership, ability to identify stressors and measure improvements, policies and regulations associated with some stressors, permitting process.
Integration with other 2014 Bay Agreement goals and outcomes	There is overlap with Healthy Watersheds, Brook Trout, Fish Passage, and Riparian Buffer Outcomes.

Status of Problems and Needs

The stream network serves as the natural infrastructure of the landscape, connecting terrestrial resources and habitats to the bay's mainstem. Human actions on the landscape have introduced many stressors to the stream network. As defined by the management strategy, a stressor is any factor limiting to aquatic life or stream processes resulting from current or past human actions. These range from physical, chemical, and biological factors that affect local stream quality and downstream waters. The full breadth of stressors is presented in the management strategy, but some of the primary concerns are excessive sediment and nutrients, toxic contaminants, instability, invasive species, loss of diversity, and altered hydrology.

Stream Restoration Analyses

The Stream Restoration Analysis identifies subwatersheds to focus stream restoration efforts to benefit resident fish, brook trout, and anadromous species. The National Fish Habitat Assessment was compiled with the CBCP Watershed Stressors Analysis to identify subwatersheds where stream restoration could benefit resident fish. The potential extent of brook trout habitat was compiled with the CBCP Watershed Stressors Analysis to identify subwatersheds where stream restoration could benefit brook trout. Subwatersheds that include anadromous fish habitats were compiled with the CBCP Watershed Stressors Analysis to identify subwatersheds where stream restoration could benefit anadromous fish.

The linear feet of stream of anadromous fish habitat was quantified for each subwatershed. The linear feet of National Fish Habitat Assessment habitat at moderate risk was quantified for each subwatershed. Additionally, the linear feet of stream within existing brook trout habitat was quantified for each subwatershed. For each fish habitat dataset, the data layers were classified into five categories using the Jenks method in ArcGIS based on summed linear feet of habitat. The categorized dataset was then intersected with those subwatersheds that received a watershed assessment score >0.45 suggesting moderate to good conditions or B-IBI of good or fair. These individual evaluations were then compiled together to produce one map that shows all the subwatersheds targeted for stream restoration. The subwatersheds targeted in this map are color coded to reflect the fish group that would benefit.

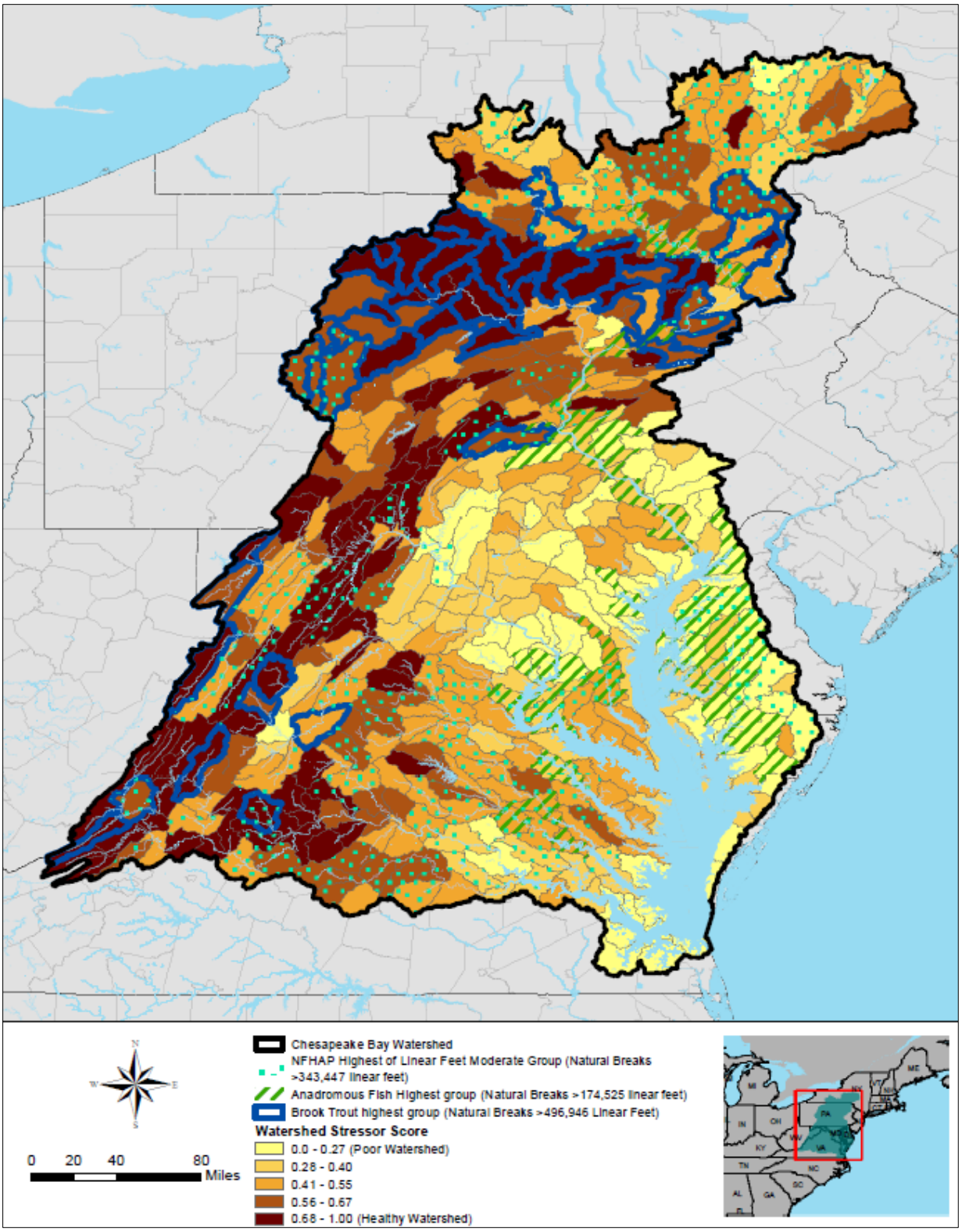

Figure 16. Stream Restoration Opportunities

Key points:

- Watershed assessment scores were highest (least stressed subwatersheds) in:
  - Subwatersheds with opportunities to benefit brook trout habitat in the upper Susquehanna River and West Branch Susquehanna River in Pennsylvania
  - Subwatersheds with opportunities to benefit resident fish in the Potomac River of western Maryland and West Virginia, the upper James River in Virginia, and the West Branch Susquehanna River in Pennsylvania
  - Subwatersheds in central New York
- Subwatersheds exhibit higher stress levels with opportunities to benefit habitat for anadromous fish along the mainstem of Maryland's Chesapeake Bay and the lower Susquehanna River in Pennsylvania and to benefit resident and anadromous populations on Maryland's Eastern Shore
- Subwatersheds in Virginia in the lower Rappahannock, York, and James Rivers for resident and anadromous fish have moderate stress levels
- USACE would be most suited to pursue stream restoration for habitat improvements in those subwatersheds with low stressors such as those in New York, northern and western Pennsylvania portions of the Watershed, western Maryland, West Virginia, and the western half of Virginia
- There are vast stream restoration opportunities in stressed subwatersheds that could target watershed stressors and benefit the health of those watersheds

The Stream Health Outcome is focused on improving the health of degraded streams. As such, the broad stream restoration opportunities identified by the CBCP analysis were narrowed further to identify those streams in the middle of the spectrum; that is, those with marginal health. Marginal health is defined by the CBCP as a Chessie-IBI of "good" or "fair" with a watershed stressor score of >0.45. This provided a subset of 71 subwatersheds with marginal health across the three objectives. The stream restoration section of the Planning Analyses Appendix provides a complete list of the subwatersheds with marginal health (a watershed stressor score >0.45 and an IBI of good or fair).

The watershed stressor score was significant as it is imperative to understand the stressors to stream function and health when undertaking stream restoration. There are opportunities in highly degraded streams (poor or very poor), and although those restoration efforts may only result in marginal improvements, those improvements are often associated with societal benefits in ultra-urban environments. As brook trout habitat are limited to healthy streams, stream restoration opportunities to benefit brook trout are presented in the brook trout section, and followed a separate process for identification.

The presence of prioritized fish passage blockages (Tier 1 by the CBP), acid mine drainage, and subwatersheds that provide riparian buffer restoration opportunities were considered to develop

a narrower list of subwatersheds that can address multiple impairments with stream restoration opportunities that have the potential to benefit anadromous fish and resident fish.

Table 16 lists the marginal stream restoration opportunities for anadromous fish and potential actions that could be taken to target improvements to benefit anadromous fish.

Table 16. Stream restoration opportunities of marginal health to benefit anadromous fish

Subwatershed Number	Subwatershed Name	State	Watershed Stressor Score	Anadromous Fish Habitat (linear feet)	Index of Biotic Integrity (IBI) Score	Number of Chesapeake Bay Program Tier 1 Anadromous Fish Blockages	Potential Actions	Riparian Buffer Opportunity	Acid Mine Drainage Problem Area
0205010614	Lower Susquehanna River	PA	0.5	281130	FAIR		Address watershed stressors, stream restoration	Y	N
0205030110	Susquehanna River	PA	0.5	216066	FAIR	3	Address watershed stressors, stream restoration, fish passage blockage removal	Y	N
0208010611	Lower Pamunkey River	VA	0.5	190304	FAIR	12	Address watershed stressors, stream restoration, fish passage blockage removal	N	N
0208010505	Chapel Creek-Mattaponi River	VA	0.5	181453	FAIR	8	Address watershed stressors, stream restoration, fish passage blockage removal	N	N

Broader opportunities exist to address stream health in marginal streams to improve resident fish habitat compared to anadromous fish. Of the 100 opportunities identified in the initial evaluation for resident fish, there are 49 opportunities considered "marginal." Four of those opportunities had watershed assessment scores of 0.8 and an IBI equal to "fair" (**Table 17**). Of those marginal resident fish opportunities with watershed assessment scores <0.8, **Table 18** identifies those subwatersheds that contain prioritized fish passage blockages for resident fish and are also riparian buffer opportunities.

Table 13. Stream restoration opportunities in low stressed subwatersheds

Subwatershed Number	Subwatershed Name	State	Watershed Stressor Score	National Fish Habitat Assessment (linear feet)	Index of Biotic Integrity (IBI) Score	Number of Chesapeake Bay Program Tier 1 Resident Fish Blockages	Potential Actions	Riparian Buffer Opportunity	Acid Mine Drainage Problem Area
0208020305	Upper Tye River	VA	0.8	446989	FAIR	1	Stream restoration, fish passage blockage removal	N	N
0208020306	Buffalo River	VA	0.8	417872	FAIR	5	Stream restoration, fish passage blockage removal	N	N
0207000307	Cacapon River	WV	0.8	413286	FAIR		Stream restoration, best management practices (BMPs) to address nitrogen and phosphorus, riparian buffers	Y	N
0207000302	Little Cacapon River	WV	0.8	345150	FAIR		Stream restoration, BMPs to address nitrogen, riparian buffers, address 303(d) listing	N	N

Table 18. Stream restoration opportunities to benefit resident fish

Subwatershed Number	Subwatershed Name	State	Watershed Stressor Score	National Fish Habitat Assessment (linear feet)	Index of Biotic Integrity (IBI) Score	Number of Chesapeake Bay Program Tier 1 Resident Fish Blockages	Potential Actions	Riparian Buffer Opportunity	Acid Mine Drainage Problem Area
0207000403	Licking Creek	MD,PA	0.7	608348	FAIR	1	Stream restoration, best management practices (BMPs) to address nitrogen (N) and phosphorus (P), riparian buffers, fish passage blockage removal, address 303(d) listing	Y	N
0205030409	Tuscarora Creek	PA	0.7	349682	FAIR	2	Stream restoration, BMPs to address N and P, riparian buffers, fish passage blockage removal, address 303(d) listing	Y	N
0207000404	Back Creek	VA,WV	0.7	754506	FAIR	7	Stream restoration, BMPs to address N and P and manage stormwater, riparian buffers, fish passage blockage removal, address 303(d) listing	Y	N
0205090501	Sherman Creek	PA	0.7	474366	FAIR	3	Stream restoration, BMPs to address N and P, riparian buffers, fish passage blockage removal, address 303(d) listing	Y	N
0208020105	Little Jackson River	VA	0.6	639472	GOOD	5	Stream restoration, BMPs to address N and P and manage stormwater, riparian buffers, fish passage blockage removal, address 303(d) listing	Y	N

0208020904	WreckIsland Creek-James River	VA	0.6	639472	FAIR	3	Stream restoration, BMPs to address N and P and manage stormwater, riparian buffers, fish passage blockage removal, address 303(d) listing	Y	N
0208010904	Hazel River	VA	0.6	407775	GOOD	3	Stream restoration, BMPs to address P, riparian buffers, address 303(d) listing	Y	N
0208010909	Robinson River	VA	0.6	407940	FAIR	4	Stream restoration, BMPs to address N and P, riparian buffers, fish passage blockage removal, address 303(d) listing	Y	N
0205010408	Cowanesque River	NY,PA	0.6	762883	GOOD	1	Stream restoration, BMPs to address N and P, riparian buffers, fish passage blockage removal, address 303(d) listing	Y	N
0205010409	Tioga River	NY,PA	0.6	451328	GOOD	8	Stream restoration, BMPs to address N and P and manage stormwater, riparian buffers, fish passage blockage removal, address 303(d) listing	Y	Y
0205010612	Tunkhannock Creek	PA	0.6	401037	FAIR	23	Stream restoration, BMPs to address N and P and manage stormwater, riparian buffers, fish passage blockage removal, address 303(d) listing	Y	N
0207000507	South River	VA	0.6	373001	FAIR	14	Stream restoration, BMPs to address N and P and manage stormwater, riparian buffers, fish passage blockage removal, address 303(d) listing	Y	N
0208020205	Lower Maury River	VA	0.6	370187	GOOD	4	Stream restoration, BMPs to address N and P, riparian buffers, fish passage blockage removal, address 303(d) listing	Y	N

0205010614	Lower Susquehanna River	PA	0.5	659645	FAIR	10	Stream restoration, BMPs to address N and P, riparian buffers, fish passage blockage removal, address 303(d) listing	Y	N
0205090110	Susquehanna River	PA	0.5	362818	FAIR	5	Stream restoration, BMPs to address N and P and manage stormwater, riparian buffers, fish passage blockage removal, address 303(d) listing	Y	N

Management actions to restore streams are not limited to restoration actions within the stream corridor. The watershed stressor score reflects conditions within the subwatershed. Measures are included for implementation outside of the stream itself to address stressors within the subwatershed affecting stream health.

Of the subwatersheds listed in the above tables, there are five subwatersheds that support threatened and endangered (T&E) species inhabiting streams – upper Tye River (VA 0208020305), Cacapon River (WV 0207000307), Back Creek (VA, WV 0207000404), Cowanesque River (NY, PA 0205010408), and Tioga River (NY, PA 0205010409). Stream restoration efforts could be undertaken in these subwatersheds to directly benefit the listed species. A map identifying all subwatersheds that support T&E species associated with stream habitats is provided in the Planning Analyses Appendix.

4.1.5 Outcome: Submerged Aquatic Vegetation (SAV)

As identified in the 2014 Bay Agreement, the SAV outcome is "to sustain and increase the habitat benefits of submerged aquatic vegetation (SAV) in the Chesapeake Bay and to achieve and sustain the ultimate outcome of 185,000 acres of SAV Bay-wide. Progress toward this outcome will be measured against a target of 90,000 acres by 2017 and 130,000 acres by 2025."

SAV is sensitive to pollution, but are quick to respond to improvements in water quality. After a record-breaking abundance in 2015, SAV continued to successfully expand upon its footprint in the Chesapeake Bay. In 2016, the abundance of SAV was the highest ever recorded by the Virginia Institute of Marine Science (VIMS). With an estimated 97,433 ac of SAV in the bay, the 2014 Bay Agreement goal of 90,000 acres was surpassed 1 year early. Widgeon grass (*Ruppia maritima*) has expanded prolifically within the past year, especially in areas with moderately salty waters. Even so, widgeon grass, being a "boom and bust" species whose abundance can rise and fall from year to year, makes it difficult to predict whether it will persist in future seasons (CBP: http://www.chesapeakeprogress.com/abundant-life/sav). Even with the success of widgeon grass, there has been a decline in eelgrass (*Zostera marina*) in the very salty areas of the lower bay, where beds had increased in recent years following losses that occurred during the hot summers of 2005 and 2010 (CBP: http://www.chesapeakeprogress.com/abundant-life/sav).

Table 19. Evaluation of Submerged Aquatic Vegetation Outcome

Current Status	As of 2016, approximately 97,433 acres of SAV have been restored in the bay
Effort needed to meet goal	Additional 32,567 ac by 2025 (based on 2016 estimates)
Description of CBCP analyses	The CBCP SAV Restoration Analysis compared areas that have experienced significant historical SAV loss and areas where SAV habitat is currently located (2015) to identify potential areas in the bay for SAV restoration. This analysis is focused on those subwatersheds with mainstem shoreline.
Findings/Recommendations	SAV restoration opportunities are positioned on the eastern shore of Maryland and Virginia, along the Potomac River in Maryland and Virginia, and along the lower York and Rappahannock Rivers in Virginia. USACE, VIMS, EPA, USFWS, and MDDNR could potentially implement SAV restoration projects.
Authority/Program	Estuary Restoration Act; GI; CAP 206; Section 510; USACE can do monitoring and SAV harvesting and plantings.
Funding Requirements	$10,000,000 federal spending limit for CAP Section 206; cost range is generally $6,894-$41,000

Implementation Barriers	Habitat Conditions, Human Impacts, Restoration Science Refer to the CBP Management Strategy, 'Factors Influencing Success,' at https://www.chesapeakebay.net/documents/22042/2f_sav_6-24-15_ff_formatted.pdf
Integration with other 2014 Bay Agreement goals and outcomes	Overlap with the oyster, fish habitat, and water quality outcomes..

Status of Problems and Needs

There are over a dozen SAV species that inhabit the shallow, sandy bottomed areas within the Chesapeake Bay, its rivers, and coastal lagoons (VIMS; http://web.vims.edu/bio/sav/AboutSAV.html). The leaves and stems absorb wave energy, help settle out sediments, provide food for waterfowl, and provide habitat for blue crabs and juvenile fishes. SAV uptake N and P and bind sediments together, which ultimately helps improve water quality (VIMS; http://web.vims.edu/bio/sav/AboutSAV.html). The main threat to SAV in the Chesapeake Bay is poor water quality. At its most pristine, it is estimated that SAV inhabited 600,000 acres of the bay, though with industrialization and expansion of cities in the Chesapeake Bay Watershed, increased pollution and run-off have detrimentally impacted SAV abundance.

The key to protecting and restoring SAV in the bay is improving the bay's overall water quality. Water clarity goals have been set to reduce sediment and nutrient inputs from upland areas, tidal shorelines, and tidal re-suspension and estuarine processes (VIMS; http://web.vims.edu/bio/sav/AboutSAV.html).

SAV Analyses

The goal of the CBCP SAV Restoration Analysis was to identify areas within the bay that have experienced the greatest amount of SAV loss without subsequent, natural reestablishment. USACE obtained geospatial survey data, from VIMS (1971 to 2015), to identify those areas that supported SAV in the past, but currently do not support SAV beds.

Figure 17 displays the areas where SAV is currently absent, but was historically present, identifying areas where SAV restoration actions have a higher probability of success.

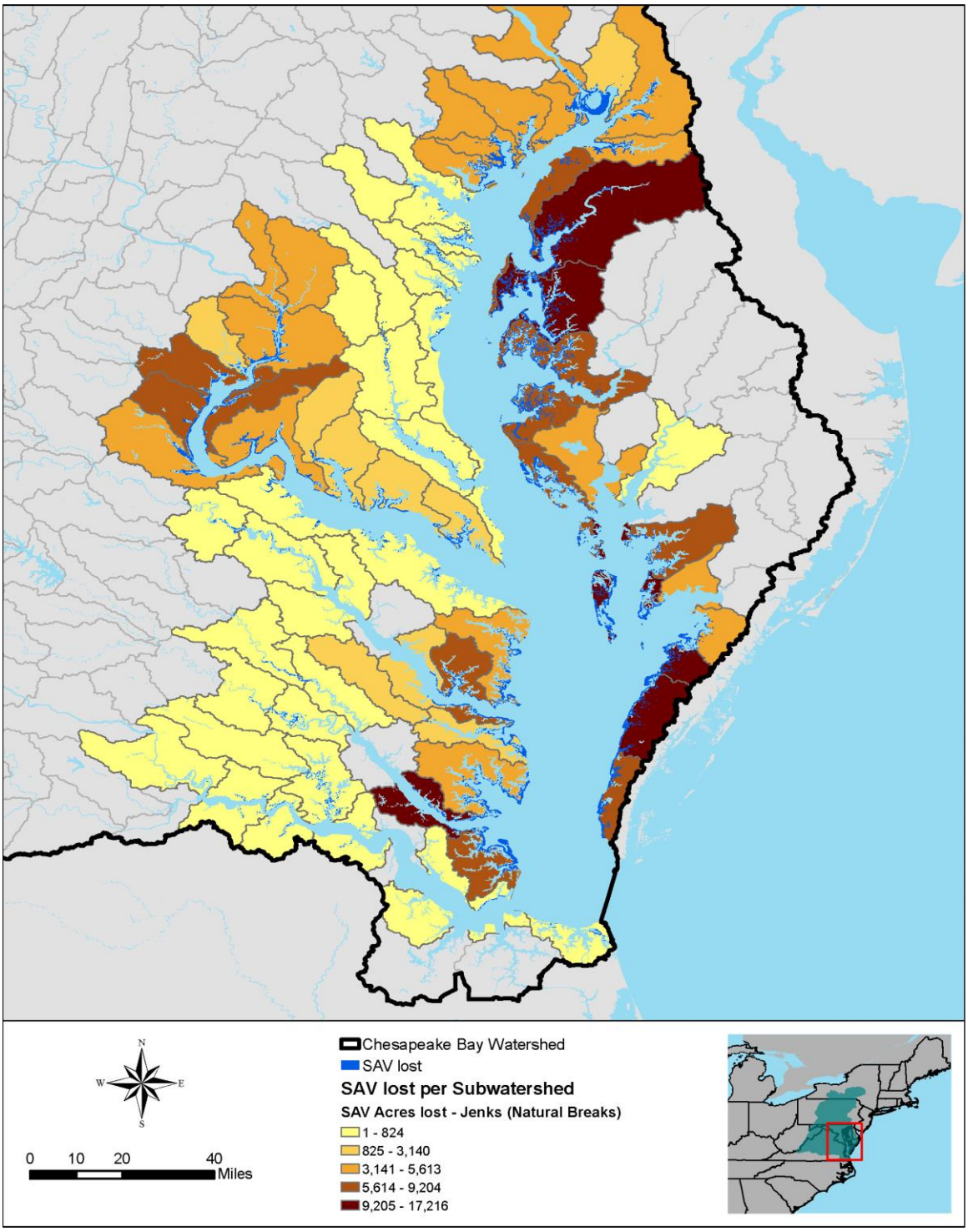

Figure 17. Submerged aquatic vegetation restoration opportunities

SAV restoration opportunities are positioned on the Eastern Shore of Maryland and in Virginia, along the Potomac River in Maryland and Virginia, and along the lower York and Rappahannock Rivers in Virginia. Subwatersheds with SAV restoration opportunities are identified in **Table 20**.

Table 20. Subwatersheds with the greatest amount of submerged aquatic vegetation loss from 1971 to 2015

Subwatershed Number	Subwatershed Name	States	Acres of SAV Lost
0208010100	Lower Chesapeake Bay	MD,VA	17216.0
0208011107	Deep Creek-Pocomoke Sound	MD,VA	14383.0
0206000204	Chester River	DE,MD	13681.0
0208011108	Pungoteague Creek-Lower Chesapeake Bay	VA	12413.0
0206000206	Eastern Bay	MD	11588.0
0208011005	Upper Tangier Sound	MD	11361.0
0208011006	Lower Tangier Sound	MD,VA	10741.0
0208010702	Lower York River	VA	10718.0
0206000506	Honga River-Chesapeake Bay	MD	9204.0
0206000504	Little Choptank River	MD	8431.0
0207001008	Occoquan River-Potomac River	MD,VA	8378.0
0208011109	Cherrystone Inlet-Lower Chesapeake Bay	VA	8351.0
0208010407	Corrotoman River-Rappahannock River	VA	8321.0
0207001101	Quantico Creek-Potomac River	MD,VA	6894.0
0206000505	Lower Choptank River	MD	6827.0
0208011004	Manokin River	MD	6679.0
0208010801	Back River-Lower Chesapeake Bay	VA	6606.0
0206000205	Upper Chesapeake Bay	MD	6124.0

Since monitoring began in the 1970s, the subwatersheds shown in the map and table above have lost the greatest amount of SAV without subsequent natural re-establishment. Conditions in these subwatersheds would need to be investigated to determine whether the lack of recovery is due to water quality or is associated with a deficient seed bank or if other factors are at play. If it is determined that water quality is the primary driver, efforts could be undertaken to address those impairments in the watershed prior to SAV restoration actions.

One constraint of the CBCP analysis is that the analysis considers acres lost rather than percent of SAV beds in certain areas that have not recovered. For example, along the eastern shore, there may have been thousands of acres lost, but the SAV beds in this area were extremely prolific. There are still hundreds of acres of SAV in this area. Conversely, in the Lynnhaven River, there may have been only a couple hundred acres of SAV to begin with. The loss of a small percentage of such valuable habitat can negatively impact those creatures living within the river system. Today, there are no known SAV beds in the Lynnhaven River system.

4.1.6 Outcome: Wetlands

As identified in the 2014 Bay Agreement, the Wetlands Outcome is "to continually increase the capacity of wetlands to provide water quality and habitat benefits throughout the watershed. Create or re-establish 85,000 acres of tidal and non-tidal wetlands and enhance the function of an additional 150,000 acres of degraded wetlands by 2025. These activities may occur in any land use (including urban) but primarily occur in agricultural or natural landscapes."

Table 21. Evaluation of Wetlands Outcome

Current Status	Wetland restoration has been slowly and steadily increasing. Progress toward meeting this outcome is measured against a 2010 baseline; between 2010 and 2015.Approximately 7,623 acres of wetlands were restored on agricultural lands. This marks a 9% achievement of the 83,000 acre goal. However, not all wetland projects, such as enhancement or restoration projects outside of former agricultural lands, are being tracked.
Effort Needed to Meet Goal	Restore approximately 75,377 additional acres of wetlands and enhance 150,000 acres of wetlands.
Description of CBCP Analyses	Potential wetland restoration and enhancement opportunities in subwatersheds were identified geospatially utilizing an approximation of historic wetlands that have been lost and existing wetlands. These opportunities were evaluated for their potential to: contribute to T&E species habitat and other avian wildlife habitat; serve as dredged material wetland beneficial use sites; and, serve as future simulated marsh migration areas. Additionally, the risk to these opportunities from future tidal and nontidal threats was considered.
Findings/Recommendations	Recommendations for potential wetland restoration and enhancement opportunities that contribute to meeting the wetlands outcome extend across Delaware, New York, Maryland, Pennsylvania, Virginia, West Virginia, and the District of Columbia. USACE could potentially implement wetland restoration and enhancement projects depending on the authorization and funding capability. Also, other stakeholders could conduct wetland restoration and enhancement projects.
Potential Partners	All jurisdictions along with local governments, local watershed organizations, and many participating partners—USEPA, USFWS, USGS, NPS, NOAA, US Forest Service, USDA NRCS, and USFWS—are each able to play a role in implementing actions to reach the Wetlands Outcome.
Existing USACE Authority/Program	CAP 204; CAP 206; Section 510; Section 1135; GI
Funding Requirements	Wetland restoration and enhancement projects range in cost from approximately $1,280 to $178,000/acre depending on existing site conditions and the scope of the restoration or enhancement project.
Factors Influencing Success	Per the CBP Wetland Outcome Management Strategy (2015–2025), social, political, and programmatic factors influence the success of achieving the wetlands outcome and these factors include: funding, landowner willingness/marketing and outreach, Inaccurate and incomplete reporting, understanding the importance of restoration among decision-makers, technical understanding among restoration practitioners, and climate change.
Integration with other 2014 Bay Agreement goals and outcomes	There is overlap with healthy watersheds, black duck, and resiliency of wetlands to future climate changes.

Status of Problems and Needs

Land use conversions and management practices have resulted in the substantive loss and degradation of wetlands in the Chesapeake Bay Watershed. More than 60 percent of historic wetlands in the watershed have been lost primarily due to increasing human populations. Currently, wetlands comprise approximately 1.7 million acres of the 64,000-square-mile Chesapeake Bay Watershed (NWF 2010).

In the past and prior to wetland protection regulations such as the Clean Water Act, wetlands were considered a nuisance and were converted to other land types. In some areas, wetlands were drained and were converted to agricultural lands. In other areas, large tracks of wetlands were filled to provide housing, industrial and commercial facilities, and landfills. Such development brought pollution into wetland systems throughout the watershed, bringing stormwater pollutants and chemical contaminants. Another ongoing threat and stressor to wetlands is invasive species that alter the native species composition and biomass in wetlands.

Wetlands are critical to the health and productivity of the Chesapeake Bay and its adjacent tributaries. Wetlands serve as a crucial component of the ecosystem, providing habitat for fish and wildlife including T&E species under the protection of the Endangered Species Act. Wetlands also act as filtration to pollutants and provide for flood control. Protection of wetlands is a crucial component of the Chesapeake Bay restoration effort and is further described in the conservation section (Section 8).

Wetland restoration in the Chesapeake Bay Watershed has been slowly and steadily increasing. Progress toward meeting the wetlands outcome is measured against a 2010 baseline; between 2010 and 2015, 7,623 acres of wetlands were restored on agricultural lands. This marks a 9 percent achievement of the 83,000 acre goal. However, not all wetland projects, such as wetland enhancements, are being tracked.

Wetland Analyses

The CBCP investigated opportunities to identify nontidal and tidal wetland restoration and enhancement opportunities within subwatersheds in the Chesapeake Bay Watershed. Wetland restoration is defined as the "process of transforming lands that are no longer characterized as wetlands but historically contained wetlands back to a more natural condition that is characterized by wetland hydrology, soils, and vegetation." Wetland enhancement refers to improving existing wetlands that are characterized as having wetland hydrology, soils, and vegetation. The geospatial evaluation presented here provides supporting analysis and findings to the CBP wetlands work plan, which recommends identifying areas where wetland restoration could benefit habitat and identification of opportunities to restore large wetland acreages.

Within the CBCP formulation, the following were considered:

- Existing nontidal and tidal wetland coverage
- Potential lost, historic wetlands; wetland habitats that support federally listed T&E species

- Wetlands that provide habitat for avian wildlife
- Imperiled species habitat
- Presence of rare, threatened, and endangered species
- Threats to potential wetland restoration and enhancement sites
- Presence of socioeconomic resources and focus populations (public access points, public parks, and areas with minority and low-income populations)
- Potential adaptability (i.e. marsh migration) of wetlands to the effects of sea level rise.

The intent of multiple, focused wetlands evaluations is to enable development of targeted restoration and enhancement projects depending on specific interests and objectives.

The Planning Analyses Appendix provides a description of the analyses completed for all these investigations. The results of the Wetland Restoration and Enhancement Opportunities Analyses are presented in the following sections. Tabular results of all wetland restoration investigations are provided in the CBCP Master Results Database.

Nontidal Wetlands

For nontidal wetland opportunities, the boundaries of the CBP hydric soils layer (2016) were used as potential project extent. Within those boundaries, the following classification categories were removed from the high-resolution land cover dataset: impervious nonroad, forest, impervious roads, water, and tree canopy over impervious surface, and three wetland categories. The areas that remained could potentially be restored as nontidal wetlands. The acreage of existing wetlands within those boundaries were proposed as potential nontidal wetland enhancement opportunities. For restoration and enhancement, the total acreage of each was calculated for each subwatershed. The total acreage of restoration opportunities was classified into five groups utilizing the Jenks method in ArcGIS. The top 2 groups of subwatersheds based on acreage of opportunity are identified as opportunities. The same classification was carried out for the enhancement opportunities. A layer was also created and classified to include all (both tidal and nontidal) wetlands restoration opportunities. A similar combined layer was developed for wetland enhancement opportunities.

Restoration

Nontidal wetland restoration opportunities are concentrated in the Eastern Shore in the Chester River Subwatershed located in Delaware and Maryland, followed by the Opequon Creek Subwatershed located in Virginia and West Virginia, and the lower Susquehanna River Subwatershed located in Maryland and Pennsylvania. The next largest concentration of nontidal wetland restoration opportunities are located in the Linville Creek-North Fork Shenandoah Subwatershed in Virginia, followed by subwatersheds on the Eastern Shore of Maryland and in Delaware (Upper Choptank River Subwatershed, Upper Nanticoke River Subwatershed, Marshyhope Creek Subwatershed), and in the middle Potomac River Subwatersheds (Antietam Creek and Conococheague Creek in Pennsylvania and Maryland). There are broad opportunities for nontidal wetland restoration in subwatersheds through the upper Susquehanna River in New

York and Pennsylvania and lower Susquehanna River and upper Chesapeake Bay in Pennsylvania and Maryland and scattered throughout western Virginia and into West Virginia. **Figure 18** shows the nontidal wetland restoration opportunities by subwatershed. A list of the subwatersheds that provide the highest concentration of nontidal wetland restoration opportunities is provided in **Table 22**.

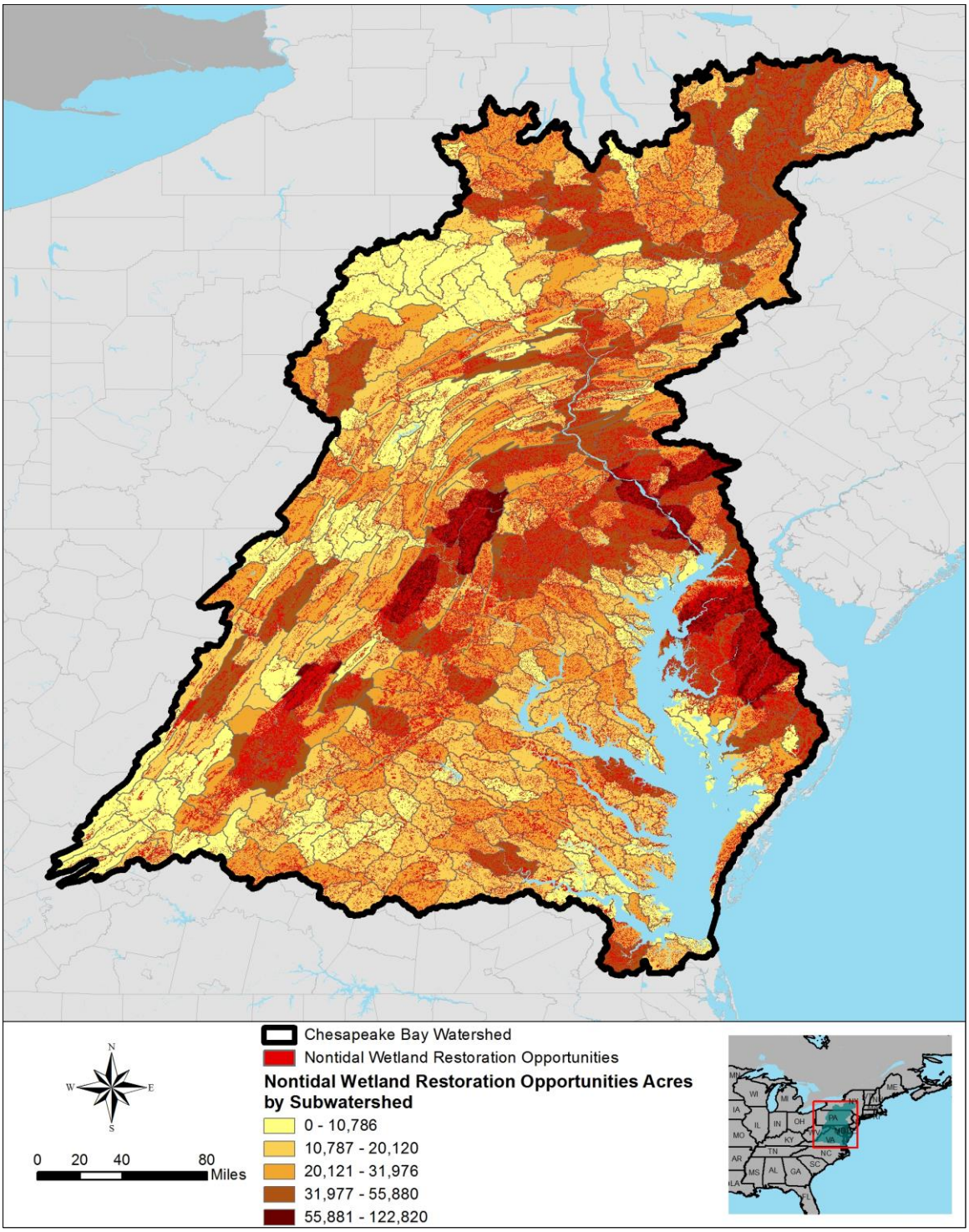

Figure 18. Nontidal wetland restoration opportunities

Table 22. Nontidal wetland restoration opportunities

Subwatershed Number	Subwatershed Name	States	NONTIDAL WETLAND RESTORATION OPPORTUNITIES (ACRES)
0206000204	Chester River	DE,MD	122,820
0207000409	Opequon Creek	VA,WV	89,949
0205030617	Susquehanna River	MD,PA	80,861
0207000603	Linville Creek-North Fork Shenandoah River	VA	75,508
0206000502	Upper Choptank River	DE,MD	72,163
0208010904	Upper Nanticoke River	DE	66,217
0208010903	Marshyhope Creek	DE,MD	62,209
0207000410	Antietam Creek	MD,PA	60,507
0205030611	Conestoga River	PA	59,796
0207000408	Conococheague Creek	MD,PA	57,649

Only a subset of the highest classified subwatersheds from the Jenks (natural breaks) analysis are listed. The full list of subwatersheds is available in the CBCP Master Results Database.

Enhancement

The greatest potential for nontidal wetland enhancement opportunities (existing nontidal wetlands) are subwatersheds located in the Delmarva Peninsula in Delaware, Maryland, and Virginia. There are opportunities to enhance wetlands in southern Virginia subwatersheds (Middle Chickahominy River, Mobjack Bay, Nansemond River, Elizabeth River, and Lynnhaven River). Wetland enhancement opportunities also exist throughout other subwatersheds in Maryland, Virginia, Delaware, Pennsylvania, New York, and West Virginia.

Figure 19 depicts the nontidal wetland enhancement opportunities in terms of potential wetland enhancement acreages by subwatershed.

Table 23. Nontidal wetland enhancement opportunities

Subwatershed Number	Subwatershed Name	States	EXISTING NONTIDAL WETLANDS (ACRES)
0208011102	Bald Cypress Branch-Pocomoke River	DE,MD	45,444
0208011103	Dividing Creek-Pocomoke River	MD	36,959
0206000204	Chester River	DE,MD	34,854
0206000502	Upper Choptank River	DE,MD	32,260
0208010903	Marshyhope Creek	DE,MD	28,708

Only a subset of the highest classified subwatersheds from the Jenks (natural breaks) analysis are listed. The full list of subwatersheds is available in the CBCP Master Results Database.

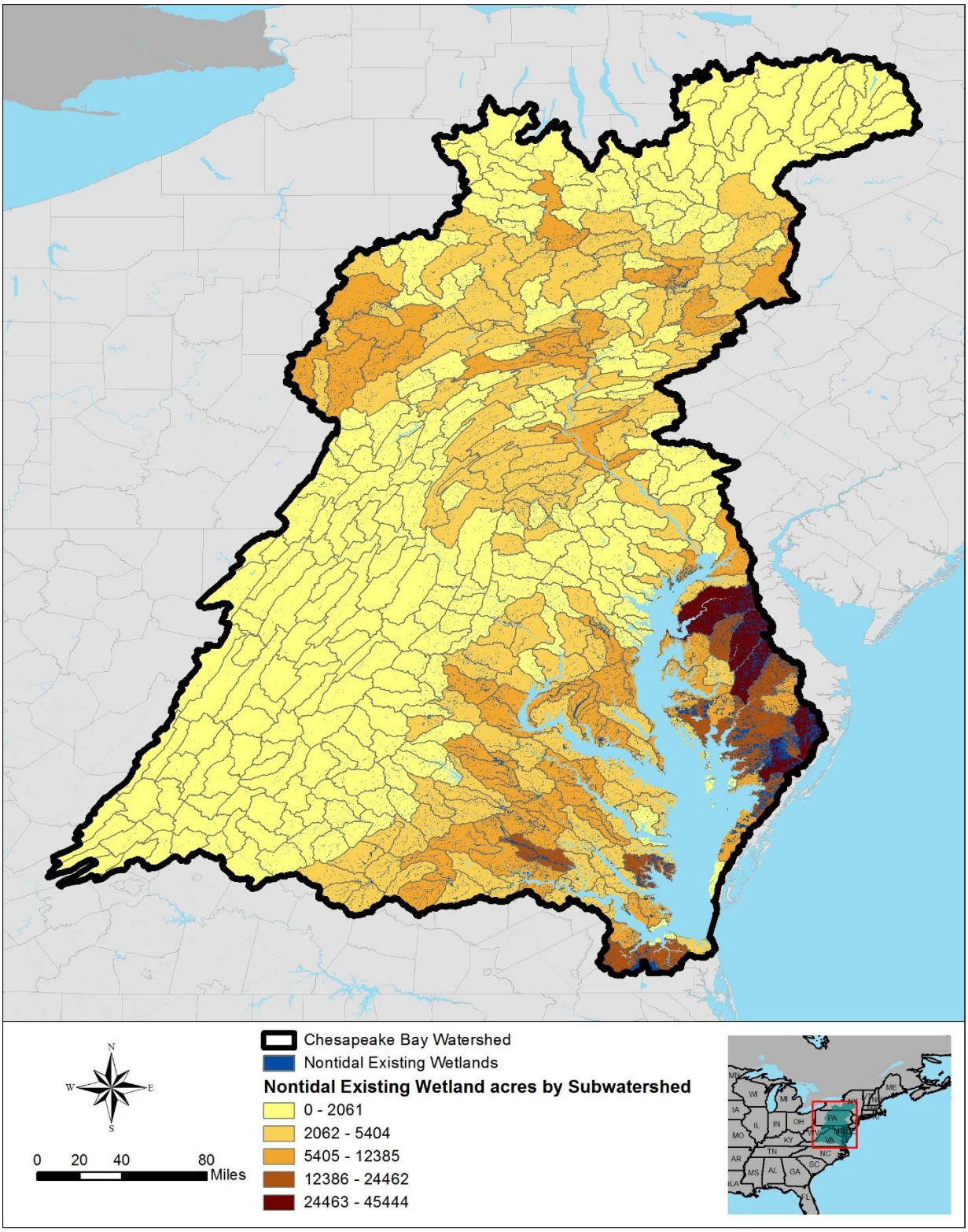

Figure 19.. Nontidal wetland enhancement opportunities

Tidal Wetlands

To identify, potential historic locations of tidal wetlands that have been lost, the USGS digital elevation model was used to establish the potential boundaries from 2 meters above and 2 meters below mean sea level of those areas that are currently not identified as wetlands in the high-resolution land cover dataset.

Restoration

The greatest potential for tidal wetland restoration opportunities are located in subwatersheds in the middle Eastern Shore of Maryland: Blackwater, Transquaking, Little Choptank, and Honga rivers. Other tidal wetland restoration opportunities exist in the Eastern Shore, Maryland in the lower Little Choptank River followed by the Marumsco Creek-Pocomoke Sound. Opportunities exist in other subwatersheds throughout the Delmarva Peninsula and throughout various subwatersheds in Virginia and Pennsylvania. **Figure 20** shows the tidal wetland restoration opportunities by subwatershed. A list of the subwatersheds that provide the highest concentration of tidal wetland restoration opportunities is provided in **Table 24**.

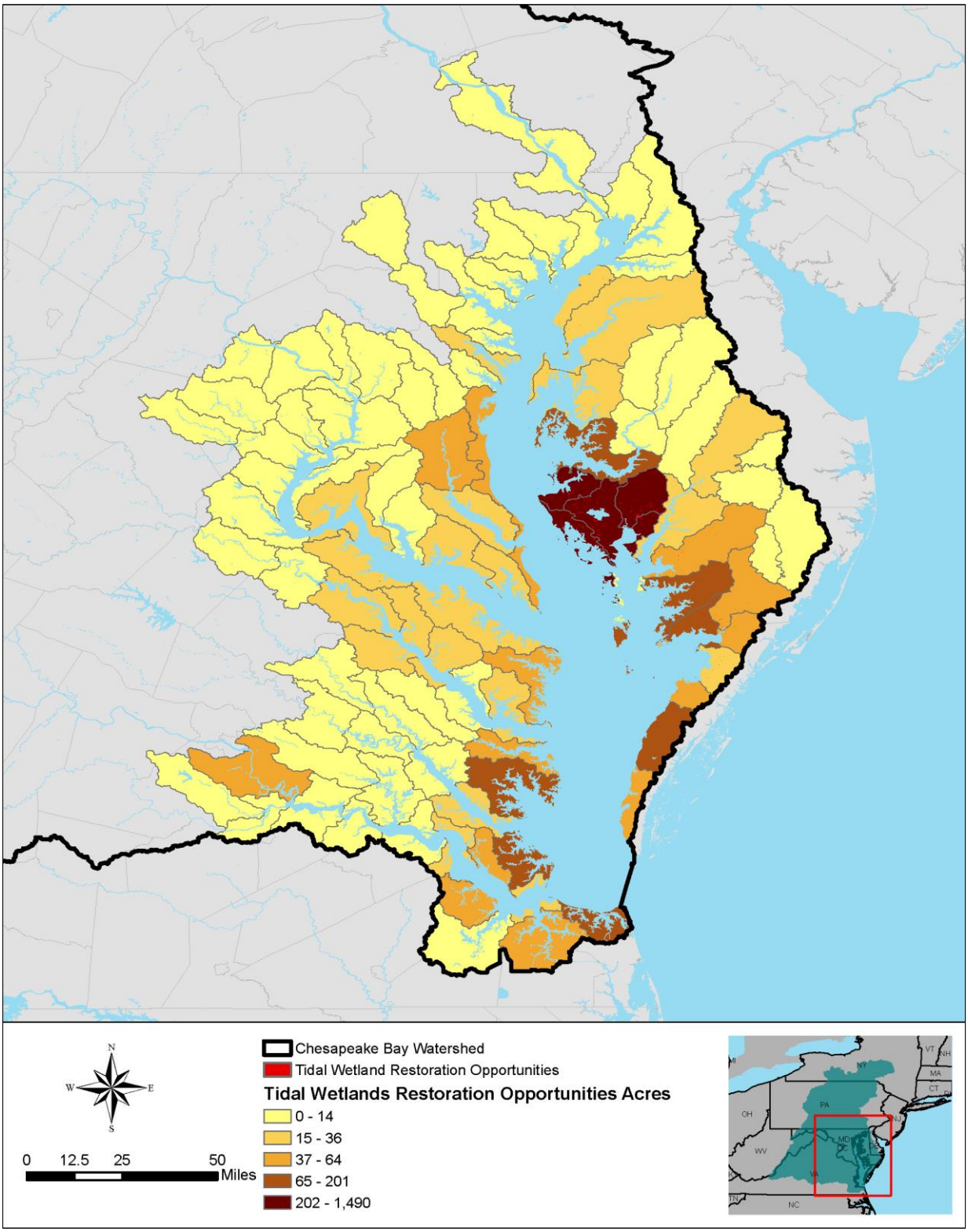

Figure 20. Tidal wetland restoration opportunities

Table 24. Tidal wetland restoration opportunities

Subwatershed Number	Subwatershed Name	STATE	TIDAL RESTORATION OPPORTUNITIES (ACRES)
0208011002	Blackwater River	MD	1,490
0208011001	Transquaking River	MD	896
0206000506	Honga River-Chesapeake Bay	MD	787
0206000504	Little Choptank River	MD	638
0208011105	Marumsco Creek-Pocomoke Sound	MD,VA	201
0208010801	Back River-Lower Chesapeake Bay	VA	175
0208011108	Pungoteague Creek-Lower Chesapeake Bay	VA	173
0208011004	Manokin River	MD	151
0208011006	Lower Tangier Sound	MD,VA	143
0208010802	Lynnhaven River-Lower Chesapeake Bay	VA	138
0208010204	Mobjack Bay-Lower Chesapeake Bay	VA	109
0206000505	Lower Choptank River	MD	106

Enhancement

The greatest opportunity for tidal wetland enhancement is located in the Delmarva Peninsula within the following subwatersheds: Blackwater River, Honga River, Manokin River, Lower Nanticoke River, and the Marumsco Creek-Pocomoke Sound. Other substantive wetland enhancement opportunities are located in the Great Wicomico River Subwatershed in Delaware and Maryland and in the Lower Pamunkey River Subwatershed in Virginia. Other tidal wetland enhancement opportunities also exist in other subwatersheds throughout the Chesapeake Bay in Delaware, Maryland, Virginia, and District of Columbia.

Figure 21 shows tidal wetland enhancement opportunities by subwatershed. **Table 25** shows acreages of potential wetland enhancement opportunities by subwatershed.

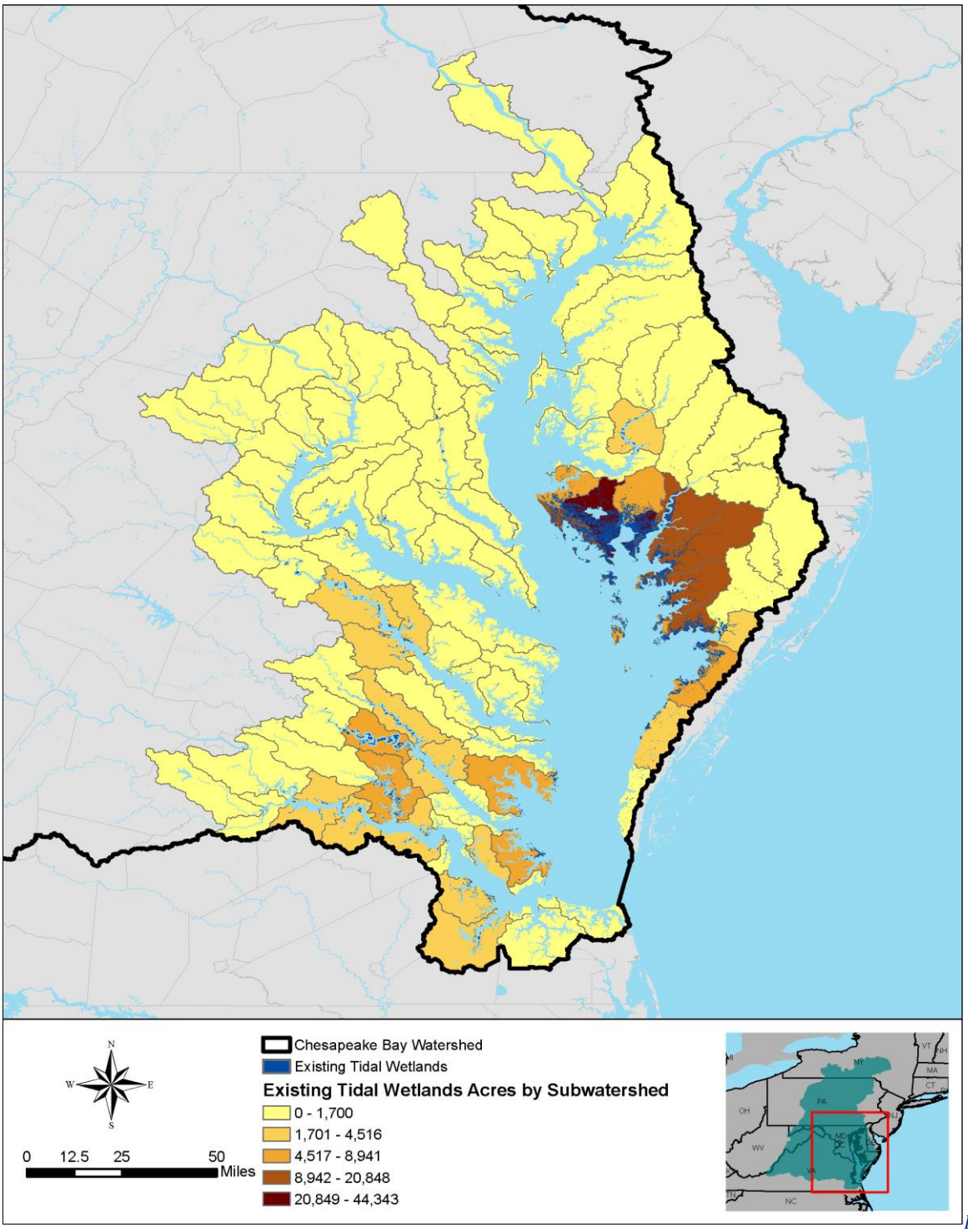

Figure 21. Tidal wetland enhancement opportunities

Table 25. Tidal wetland enhancement opportunities

Subwatershed Number	Subwatershed Name	States	EXISTING TIDAL WETLANDS (ACRES)
0208011002	Blackwater River	MD	44,343
0206000506	Honga River-Chesapeake Bay	MD	20,848
0208011004	Manokin River	MD	13,021
0208010905	Lower Nanticoke River	DE,MD	12,421
0208011105	Marumsco Creek-Pocomoke Sound	MD,VA	10,424
0208011003	Wicomico River	DE,MD	10,246

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Section 5

Sustainable Fisheries Goal

"Protect, restore, and enhance finfish, shellfish and other living resources, their habitats and ecological relationships to sustain all fisheries and provide for a balanced ecosystem in the watershed and Chesapeake Bay."

5.1 Outcome: Fish Habitat

As identified in the 2014 Bay Agreement, the Fish Habitat Outcome is "to continually improve the effectiveness of fish habitat conservation and restoration efforts by identifying and characterizing critical fish and shellfish spawning, nursery and forage areas within the Chesapeake Bay and its tributaries and to use existing and new tools to integrate information and conduct assessments to inform restoration and conservation efforts."

The CBCP did not complete any direct evaluations associated with the fish habitat outcome. However, the analyses completed for brook trout, stream health, riparian buffers, oysters, and SAV all have the potential to contribute to improvements in fish habitat.

5.2 Outcome: Oysters

As identified in the 2014 Bay Agreement, the Oysters Outcome is "to continually increase finfish and shellfish habitat and water quality benefits from restored oyster populations. Restore native oyster populations in 10 tributaries by 2025 and ensure their protection."

Table 26. Evaluation of Oyster Restoration Outcome

Current Status	Eight Chesapeake Bay tributaries have been selected for oyster reef restoration: Harris Creek, the Little Choptank River and the Tred Avon River in Maryland, and the Great Wicomico, Lafayette, Lower York, Lynnhaven and Piankatank in Virginia. Each of these tributaries is at a different level of progress in a process that involves developing a tributary restoration plan, construction and seeding reefs, and monitoring and evaluating restored reefs. The current level of progress for each tributary can be found in the Oyster Reef Restoration Progress Dashboard located at: http://www.chesapeakeprogress.com/abundant-life/oysters
Effort needed to meet goal	The last phase of the oyster restoration process in the eight identified tributaries will determine success in meeting this outcome, but will not be completed until after 2025, as a tributary must be monitored at three- and six-year intervals following reef construction and seeding before it can be deemed restored. The target acreage (350 acres) was reached in Harris Creek, Reef monitoring and evaluation began in Harris Creek in 2015. In Maryland, approximately 564 acres of oyster reefs are considered "complete." In Virginia, 445 acres of oyster reefs are considered "complete." Continued collaboration and communication among stakeholders and the availability of federal, state, and local funding are efforts that need to continue for this goal to be achieved.
Description of CBCP analyses	A watershed stressor score for the eight tributaries was combined with the priority restoration tributaries using GIS data. Strategies were generated within each subwatershed to address existing impairments that will promote healthy habitat conditions in the rivers for oysters.

Findings/Recommendations	• Restore native oyster reef habitats through construction of new habitat in areas that historically supported oyster reefs. • Enhance the function and value of existing, degraded native oyster reef habitats. • Conduct monitoring and adaptive management at oyster reef restoration sites. • Conserve existing reefs and restored reefs by designating them as reef sanctuary sites. • Protect oyster reefs by increasing monitoring and enforcement to deter poaching. • Increase mechanisms to allow for regulatory protection of oyster restoration reefs through designation of sanctuary areas.
Authority/Program	CAP Section 206;CAP Section 1135; WRDA 1996; Section 510; WRDA 1986; Section 704(b)
Funding Requirements	Cost of restoration is largely driven by material used to restore the reef habitat.
Factors Influencing Success	Low population, availability of resources (funding, shell/substrate/hatchery spat supply), water quality, enforcement, spat set variability, oyster resource management (permitting, bottom leasing, and sanctuary designation), shell loss, connectivity, hard bottom availability, public support, climate change/ocean acidification, innovative restoration techniques, and navigation.
Integration with other 2014 Bay Agreement goals and outcomes	There is overlap with water quality, climate change, and engaged communities.

Status of Problems and Needs

The eastern oyster (*Crassostrea virginica*) is a keystone species of Chesapeake Bay, sustaining the region's most valuable commercial fishery for over a century while playing an essential role in the functioning and health of the bay. Oysters clean the waters of the bay, provide a critical role in nutrient cycling and sediment processes, provide unique reef habitat for a variety of aquatic species, and provide food for some waterfowl. Oyster populations throughout Chesapeake Bay are at critically low levels. The decline of the bay's native oyster population can be attributed to several factors, including historic over-harvesting, disease, impaired water quality, and habitat loss. There is public recognition that the oyster decline has threatened a way of life for watermen and the functioning of the bay itself. Some of the issues that make oyster restoration challenging are described by the CBP Oyster Restoration Outcome: Management Strategy (2015–2025) and The Native Oyster Restoration Master Plan (USACE 2012).

Oyster Restoration Analyses

The CBCP Oyster Restoration Analysis identified spatially specific strategies and projects that would help achieve oyster outcomes. As there are extensive multi-agency efforts focused on identifying tributaries in which to undertake oyster restoration in Chesapeake Bay, this analysis is primarily focused only on those subwatersheds that drain directly to previously selected oyster restoration tributaries. This strategy is aimed at providing healthy habitat conditions to promote oyster survival and restoration success. The intent is to understand existing watershed impairments in those watersheds draining into tributaries where oyster restoration is being undertaken. Once impairments are understood, opportunities can be proposed to address to improve conditions.

The CBCP used data layers consisting of Virginia and Maryland oyster restoration sites and the CBCP Watershed Stressor Analysis (**Figure 22**). From the CBCP Watershed Stressor Analysis, subwatersheds that drain to tributaries previously selected for large-scale oyster restoration (Piankatank River, Lynnhaven River, Lafayette River, Great Wicomico River, York River, Harris Creek, Little Choptank River, and Tred Avon River) were isolated. Strategies were generated within each subwatershed to address existing impairments aimed at promoting healthy habitat conditions in the rivers for oysters.

Table 27. Oyster Restoration Opportunities

Subwatershed Number	Subwatershed Name	WATERSHED STRESSOR SCORE	Subwatershed Acres
0208010202	Dragon Swamp	0.61	89,956
0208010611	Lower Pamunkey River	0.50	70,779
0208010100	Lower Chesapeake Bay	0.50	753,512
0208010506	Garnetts Creek-Mattaponi River	0.50	92,096
0208010203	Piankatank River-Lower Chesapeake Bay	0.44	75,926
0208010201	Great Wicomico River-Lower Chesapeake Bay	0.39	108,452
0208010701	Upper York River	0.39	93,332
0206000504	Little Choptank River	0.39	60,775
0206000505	Lower Choptank River	0.33	192,220
0208010702	Lower York River	0.33	93,449
0208010204	Mobjack Bay-Lower Chesapeake Bay	0.28	155,394
0208011109	Cherrystone Inlet-Lower Chesapeake Bay	0.22	54,909
0208020802	Elizabeth River	0.11	128,751
0208010801	Back River-Lower Chesapeake Bay	0.06	85,747
0208010802	Lynnhaven River-Lower Chesapeake Bay	0.00	61,244

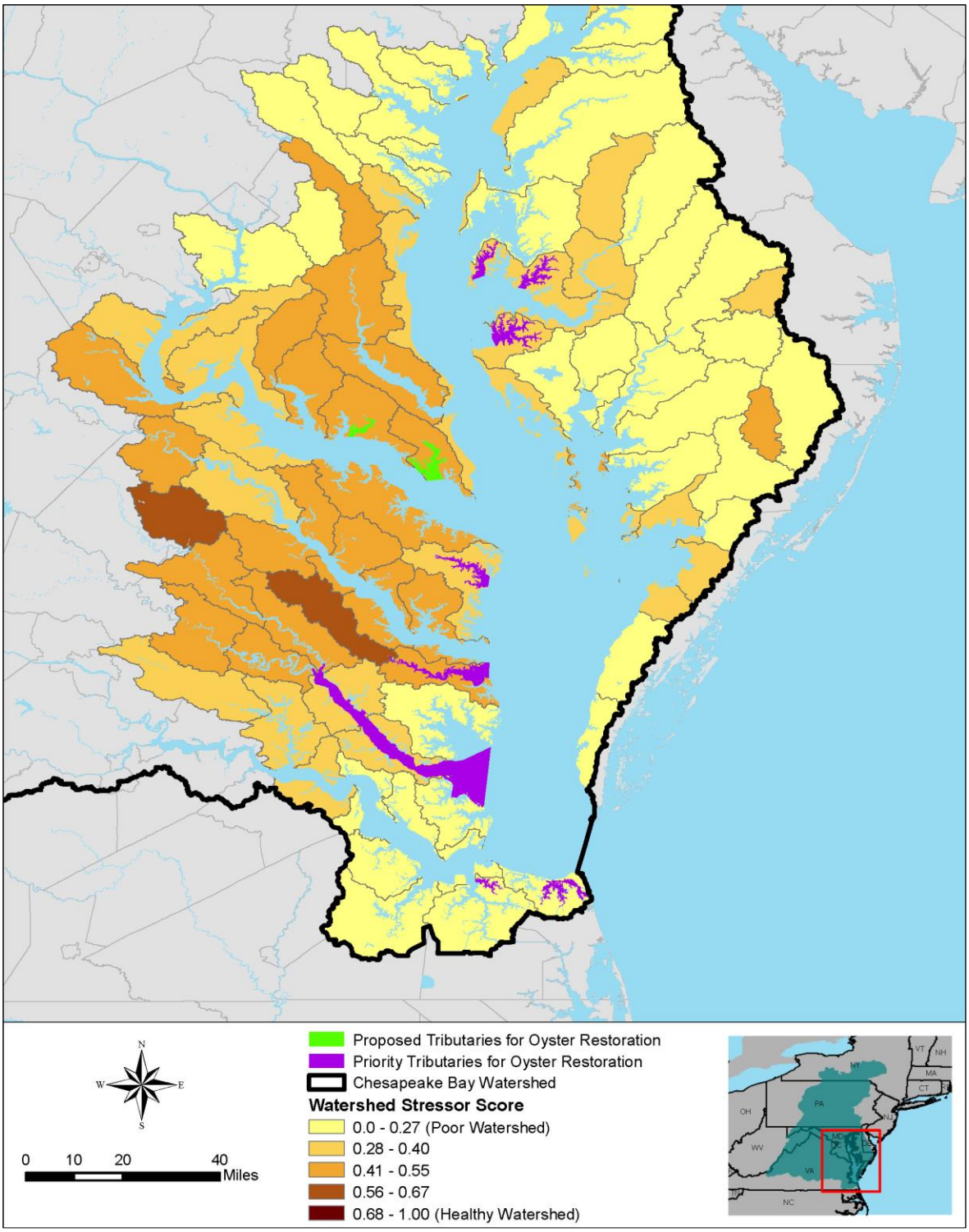

Figure 22. Oyster restoration analysis

Actions and Requirements for Ongoing Work in Areas Not Identified in CBCP Opportunities

Tier 1 and 2 tributaries for oyster restoration within the Chesapeake Bay Watershed were identified in USACE's Chesapeake Bay Oyster Recovery – Native Oyster Restoration Master Plan (USACE 2012). Interagency Working Groups in Maryland and Virginia did not select certain Tier 1 tributaries as one of the 10 for restoration by 2025; however, restoration actions in these tributaries should be encouraged and supported by local, state, and federal agencies. These tributaries were chosen based upon a suitability analysis that evaluated historic habitat, salinity, dissolved oxygen, and water depth. Targets were established for each tributary as restoration goals that would lead to a sustainable oyster population within the tributary.

Table 28. USACE Native Oyster Master Plan tiered list of restoration tributaries

Tier 1	Tier 2
Maryland	
Severn R (S) South (S) Chester R (lower) (S) Eastern Bay (lower, upper) (S) Choptank R (lower, upper) (S) Harris Creek (S) Broad Creek Little Choptank (S) St. Mary's R (S) Tangier Sound Manokin R (S)	Magothy R (S) Rhode R West R Chester R (upper) (S) Corsica R (S) Honga R Potomac R Fishing Bay Nanticoke R (S) Monie Bay Big Annemessex R Little Annemessex R Patuxent R (S) All MD Mainstem Segments (S)
Virginia	
Rappahannock R (lower) Great Wicomico R (S) Piankatank R Mobjack Bay York R (lower) Pocomoke/Tangier Sound James R (lower, upper) Elizabeth R Lynnhaven R	VA Mainstem Little Wicomico R Cockrell Creek Rappahannock R (middle, upper) Corrotoman R Severn R York R (upper) Poquoson R Back R Onancock Creek Nassawaddox Creek Hungars Creek Cherrystone Inlet Old Plantation Creek Nansemond R

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Section 6

Toxic Contaminants Goal

The toxic contaminants goal ensures Chesapeake Bay and its rivers are free of the effects of toxic contaminants on living resources and human health. There are two outcomes under this goal.

6.1 Toxic Contaminants Outcomes

In the 2014 Bay Agreement, the Toxic Contaminants Outcome is "to continually increase our understanding of the impacts and mitigation of toxic contaminants and develop a research agenda and further characterize the occurrence, concentrations, sources and effects of mercury, polychlorinated biphenyls (PCBs) and other contaminants of emerging and widespread concern. In addition, identify which best management practices might provide the multiple benefits of reducing nutrient and sediment pollution as well as toxic contaminants in waterways."

In the 2014 Bay Agreement, the toxic contaminants policy and prevention outcome is "to continually improve practices and controls that prevent or reduce the effects of toxic contaminants on aquatic systems and humans. Build on existing programs to reduce the amount and effects of polychlorinated biphenyls (PCBs) in the Chesapeake Bay Watershed. Use research findings to evaluate the implementation of additional policies, programs and practices for other contaminants that need to be further reduced or eliminated."

Table 29. Evaluation of Toxic Contaminants Outcome

Current Status	Contaminated sites throughout the watershed are in varying states of remediation. The Superfund, or National Priority List (NPL) sites, listed by state and their current cleanup status is provided by EPA at: https://www.epa.gov/superfund/national-priorities-list-npl-sites-state#VA.
Effort Needed to Meet Goal	Cleanup and remediation efforts needed, watershed-wide, to ensure the Chesapeake Bay and its rivers are free of the effects of toxic contaminants, including PCBs; Mercury; PAHs; Pesticides; Petroleum hydrocarbons; Dioxins and Furans; Metals and Metalloids; Pharmaceuticals, Household and Personal Care Products, Flame Retardants, Biogenic Hormones. A detailed description and status of each of the above toxic contaminants is available at: http://executiveorder.chesapeakebay.net/ChesBayToxics_finaldraft_11513b.pdf.
Description of CBCP Analyses	Superfund sites were depicted on the Pennsylvania Department of Environmental Protection (PADEP) Abandoned Mines and Abandoned Mine Land Problem Areas to identify areas with the watershed with known toxic contamination. No compilations were completed to identify any relationships, as this analysis was exclusively used to identify areas of toxic contamination.
Findings/Recommendations	There are contaminated sites located throughout the watershed that require remediation before restoration and conservation efforts can be implemented. There appears to be some correlation between military lands and NPL sites.
Authority/Program	EPA, DOI, USGS, facilities/organizations involved in release of toxic contaminants, Section 510, CAP 206; USACE could provide dredged material for capping and/or dredge toxic areas, but would require funding.
Funding Requirements	Funding requirements are contingent upon the amount and type of toxic contaminant remediation needed.
Implementation Barriers	In general, resource constraints (i.e. funding/staffing), lack of consolidation of existing data into a single information system, no standardization in data collection/format for Bay states. For more detailed description of

	implementation barriers for toxic contaminants, refer to the CBP Management Strategy, Factors Influencing Success.
Integration with other 2014 Bay Agreement goals and outcomes	Restoration and conservation could be incorporated into any toxic contamination remediation/cleanup efforts in the Chesapeake Bay Watershed.

Status of Problems and Needs

Nearly 75 percent of the tidal waters within Chesapeake Bay are considered either fully or partially impaired by toxic contaminants. EPA has identified three regions of concern in the watershed: Baltimore Harbor, Anacostia River, and Elizabeth River. These areas have high concentrations of toxic contaminants that can affect both wildlife and humans. Bay-wide cleanup and remediation is needed to reduce toxic contaminants present in terrestrial and aquatic habitats. Additionally, public involvement and education are necessary to effectively lower and maintain low concentrations of toxic contaminants in the watershed (CBP; https://www.chesapeakebay.net/issues/chemical_contaminants).

Toxic Contaminants Analyses

The purpose of the CBCP Toxic Contaminants Analysis was to identify areas with the Chesapeake Bay Watershed with known toxic contamination. The data layers used in the Toxic Contaminants Analysis include:

- National Priorities List (NPL) (Superfund sites)
- Pennsylvania Department of Environmental Protection (PADEP) Abandoned mines and abandoned mine land problem areas

The NPL location data was depicted on the PADEP abandoned mines and abandoned mine land problem areas, but no computations were completed to identify any relationships, as this exercise was exclusively to identify and call attention to areas with toxic contaminants (**Figure 23**). A second figure was generated that overlaid the extent of military lands with NPL sites (**Figure 24**). The Planning Analyses Appendix provides the full discussion of the toxic contaminants formulation. The CBCP Master Results Database documents the available toxic information per subwatershed.

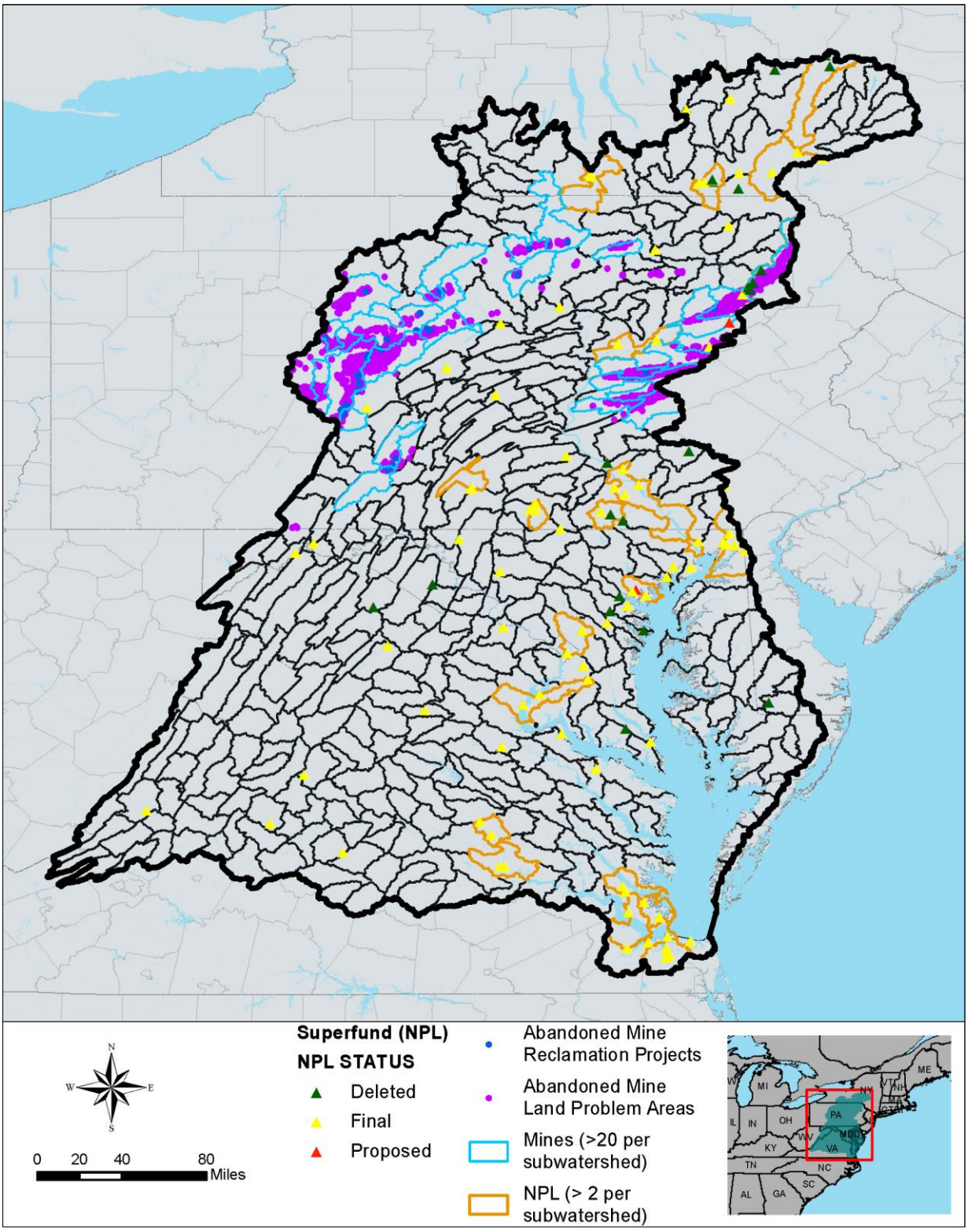

Figure 23. Locations of superfund sites and abandoned mine land problem areas and reclamation projects

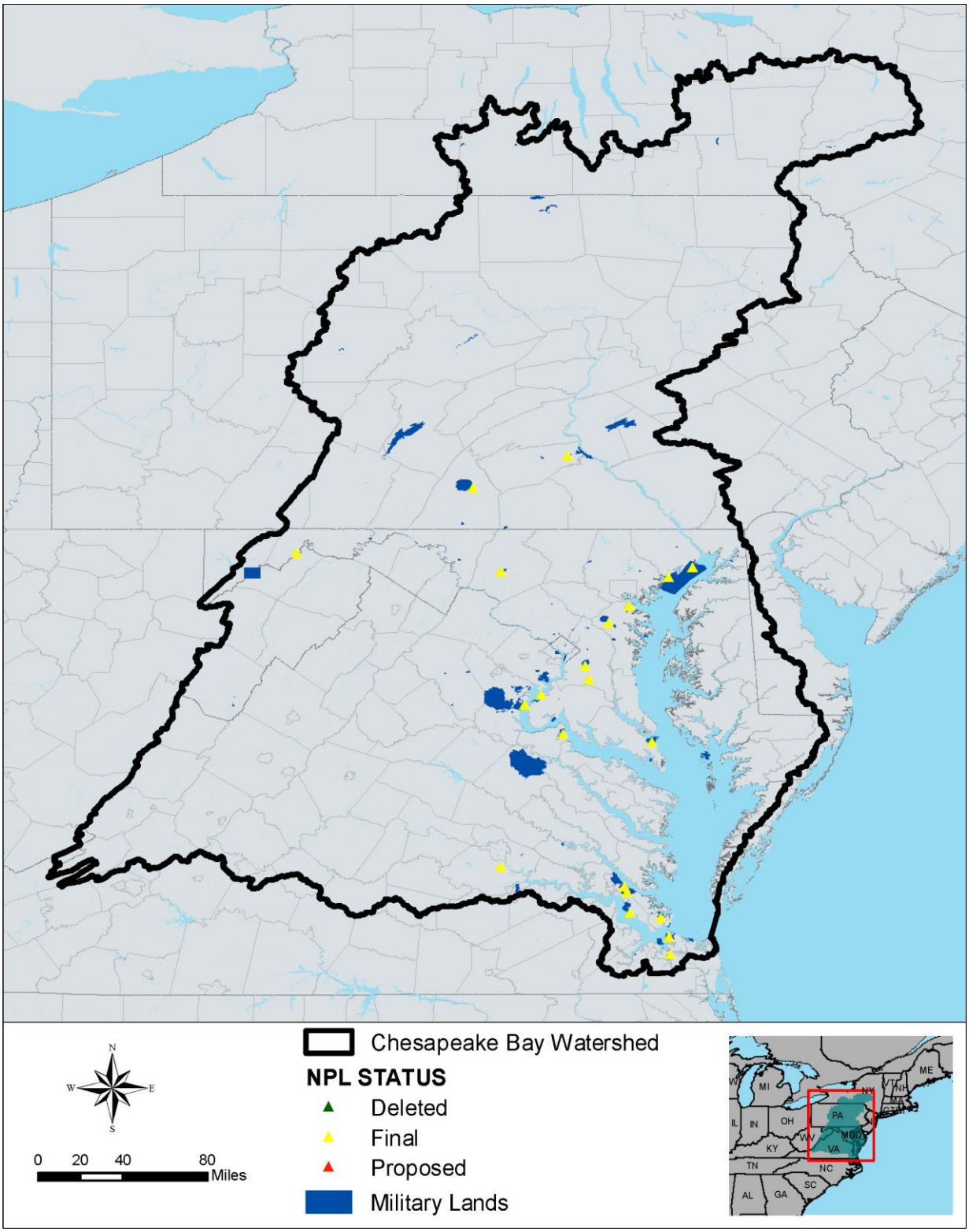

Figure 24. Military lands in conjunction with final listings of NPL sites

Table 30. Subwatersheds with the greatest number of Superfund (National Priority List) Sites

Subwatershed Number	Subwatershed Name	States	NUMBER OF SUPERFUND SITES
0208020802	Elizabeth River	VA	5
0205010302	Coconut Creek-Susquehanna River	NY,PA	4
0205010701	Lackawanna River	PA	4
0206000202	Elk River	DE,MD,PA	4
0205030606	South Branch Codorus Creek	PA	3
0205030617	Susquehanna River	MD,PA	3
0206000307	Back River-Chesapeake Bay	MD	3
0207000901	Rock Creek	MD,PA	3
0207001101	Quantico Creek-Potomac River	MD,VA	3

Table 31. Subwatersheds in Pennsylvania that have the greatest number of abandoned mine land problem areas

Subwatershed Number	Subwatershed Name	States	ABANDONED MINE RECLAMATION PROJECTS (NUMBER OF CLEAN-UP SITES PER SUBWATERSHED)	ABANDONED MINE LAND PROBLEM AREAS (NUMBER OF MINES PER SUBWATERSHED)
0205010702	Upper Susquehanna River	PA	1	533
0205030101	Shamokin Creek	PA	1	482
0205020103	Clearfield Creek	PA	14	434
0205010701	Lackawanna River	PA	0	373
0205030506	Upper Swatara Creek	PA	0	338
0205020105	Moshannon Creek	PA	3	291
0205030105	Mahanoy Creek	PA	0	279
0205020104	Upper West Branch Susquehanna River	PA	1	253
0205020203	Bennett Branch Sinnemahoning Creek	PA	1	228
0205030109	Wiconisco Creek	PA	0	124
0205020107	Lower West Branch Susquehanna River	PA	6	121
0205030107	Deep Creek	PA	0	120
0205020102	Anderson Creek	PA	1	106
0205020402	Beech Creek	PA	3	93
0205020101	Chest Creek	PA	0	80
0205010704	Nescopeck Creek	PA	0	71
0205010703	Middle Susquehanna River	PA	0	58
0205020504	Babb Creek	PA	1	50

Although there are Superfund sites distributed throughout the watershed, the highest concentration of these sites occur in southeastern Virginia. Additional concentrations of NPL sites are generally in Pennsylvania and Maryland, which have areas of NPL concentrations ranging from three to four sites (**Tables 30 and 31**). **Figure 24** displays a potential correlation between military lands and Superfund sites to highlight remediation/restoration that needs to be done on lands occupied or owned by the DOD.

Refer to the Pennsylvania state appendix for more information regarding the abandoned mine areas, as these data are not baywide.

Implementation

There are numerous measures that can be implemented to reach the 2014 Bay Agreement goal of ensuring that the bay is free of the effects of toxic contaminants; however, the principle actions that must occur include monitoring, remediation, and restoration. As restoration efforts are undertaken, it is important to consider the presence of toxics. If toxics are present in a defined restoration area, it is necessary to first identify how the contaminants arrived, then determine whether input into the environment has ceased or is still occurring. Restoration efforts should occur in phases, beginning with removal/remediation of contaminants and ending with environmental restoration. As more knowledge regarding cleanups is gained and reduction of initial toxic inputs to the environment are developed, it will be easier to define distinct implementation actions for the various toxic contaminants in the bay watershed.

Understanding the location of toxic contaminants in correlation to restoration and/or conservation opportunities is important. It allows agencies to effectively and efficiently plan and implement projects that may require sequencing/phasing of actions.

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Section 7

Healthy Watersheds Goal

The healthy watersheds goal is to sustain state-identified healthy waters and watersheds, recognized for their high quality and/or high ecological value.

7.1 Healthy Watersheds Outcome

As identified in the 2014 Bay Agreement, the Healthy Watersheds Outcome is "to ensure 100 percent of state-identified currently healthy waters and watersheds remain healthy."

Table 32. Healthy watersheds

Current Status	Watershed health across the bay region currently ranges from impaired to exceptional/outstanding. Each state has its own definition of healthy waters and watersheds. There is not a common definition for the healthy waters and watersheds addressed in this outcome.
Effort Needed to Meet Goal	All healthy watersheds remain healthy.
Description of CBCP Analyses	In addition to state-identified healthy watersheds, the following data representing healthy habitats were used to develop CBCP Healthy/High Value Habitats Analysis: Subwatersheds identified as brook trout catchments, CBP black duck focus areas, Audubon important bird areas, index of ecological integrity, and nature's network core and connector habitat. Future threats were considered to identify the potential for risks to the healthy status of these habitats.
Findings/Recommendations	The healthiest watersheds are located in the upper West Susquehanna River Watershed in PA and along the western edge of the watershed in the upper Potomac River Watershed in WV and in western VA. USACE resources could assist with habitat restoration/enhancement. Other stakeholder capabilities could be applied to habitat restoration/enhancement and conservation.
Authority/Program	USACE resources could assist with habitat restoration/enhancement - CAP 204; CAP 206; Section 510; Section 1135; GI -
Funding Requirements	Undetermined.
Implementation Barriers	Lack of information for assessing health as opposed to degradation, prioritization within agencies and private sector
Integration with other 2014 Bay Agreement goals and outcomes	There is an overlap with the brook trout, black duck, and stream health outcomes.

Status of Problems and Needs

Each jurisdiction has a different definition of healthy waters and watersheds. There are currently no healthy watersheds in Delaware or the District of Columbia.. In Maryland, a Tier II designation for streams and catchments indicates their quality is significantly better than minimum water quality standards. Healthy water bodies in New York are categorized as "no known impact." In Pennsylvania, waters and watersheds classified as "high quality or exceptional value" are considered healthy. Virginia defines ecologically healthy waters as those with high aquatic integrity. In West Virginia, Tier III is the designation for outstanding national resource waters.

Healthy streams are the foundation for healthy watersheds. It is extremely cost-effective to maintain the quality of healthy/high value habitats compared to the expense in restoring impaired waterways. Additionally, healthy/high value habitats provide clean water for habitats and water supply, contribute resilience to ecosystems, critical habitats, and socioeconomic benefits.

Healthy/High Value Habitats Analysis

The following data were overlaid to identify areas in the watershed that have the healthiest habitats to develop a representation of healthy/high value habitats: State-identified healthy watersheds, subwatersheds identified as brook trout catchments, CBP Black Duck Focus Areas, Audubon Important Bird Areas, Index of Ecological Integrity (North Atlantic Landscape Conservation Cooperative), Nature's Network core and connector habitat. **Figure 25** shows the CBCP Healthy/High Value Habitats Analysis. A detailed description of the formulation is available in the Planning Analyses Appendix. The CBCP Master Results Database provides the data for each layer per subwatershed.

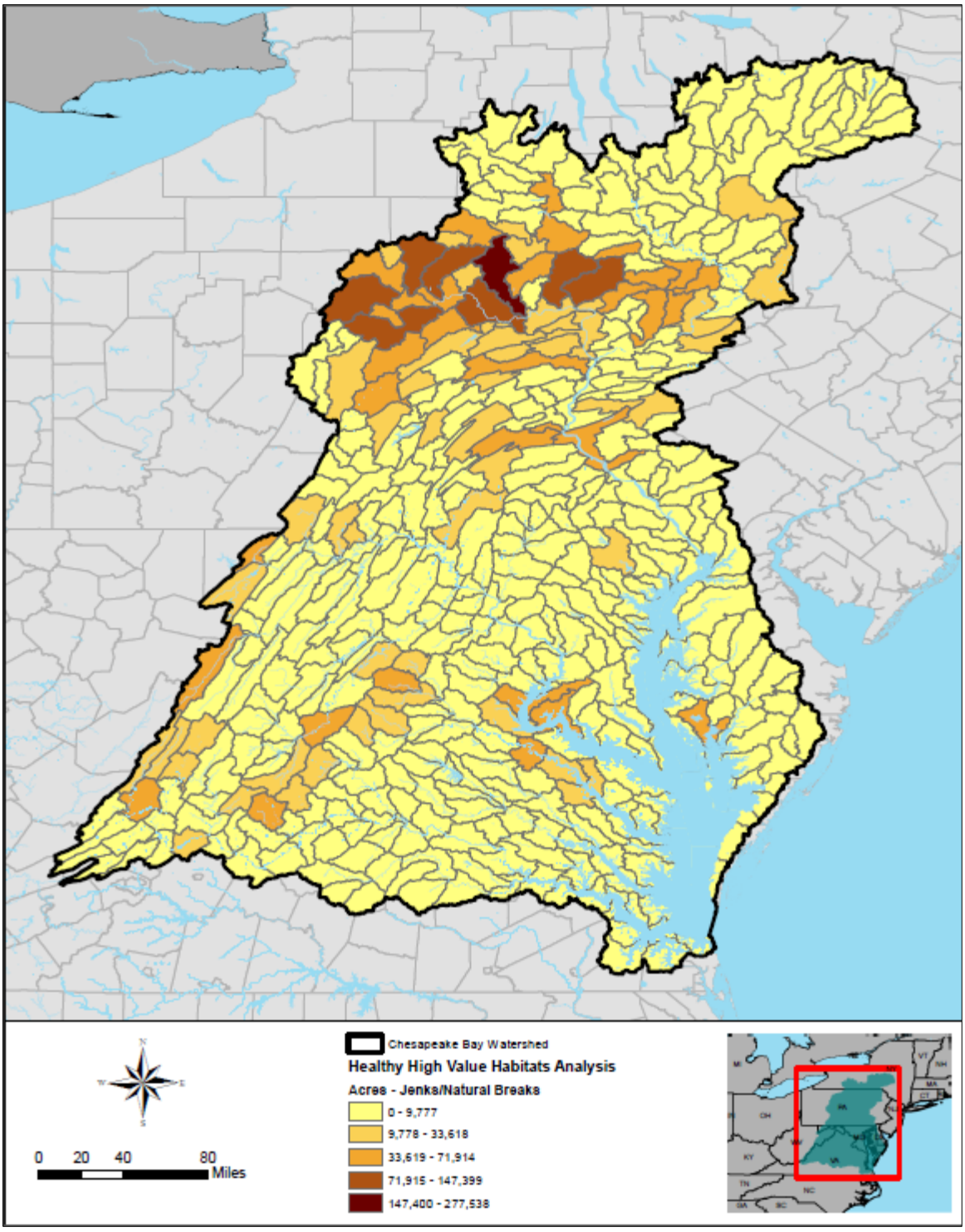

Figure 25. Healthy/High Value Habitats Analysis

The CBCP Healthy/High Value Habitats Analysis was combined with the CBCP Tidal and Nontidal Threats Analyses to identify those habitats at risk to future threats. **Figures 26 and** 27 provide the results of those analyses.

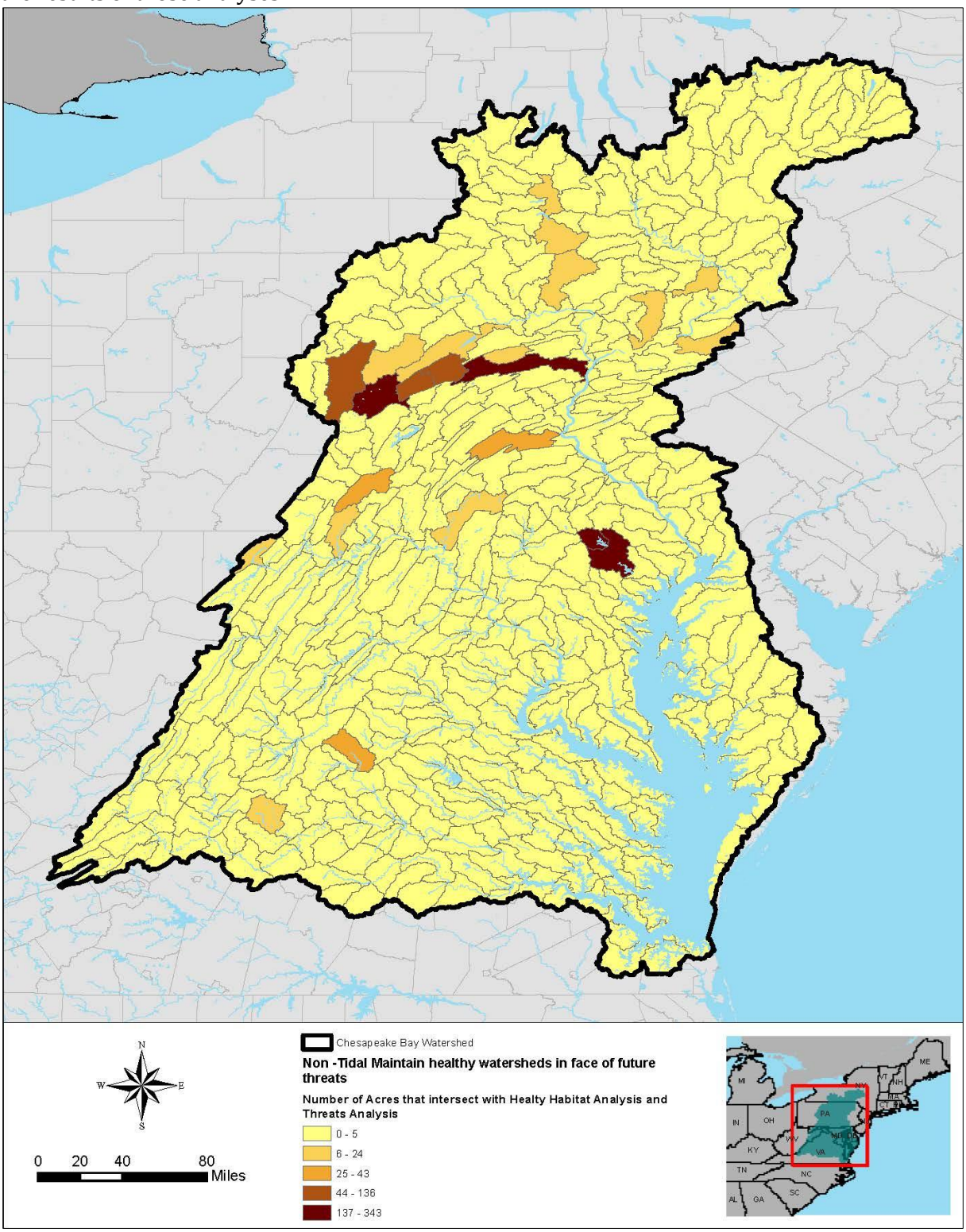

Figure 26. Healthy/High value habitat at risk to nontidal threats

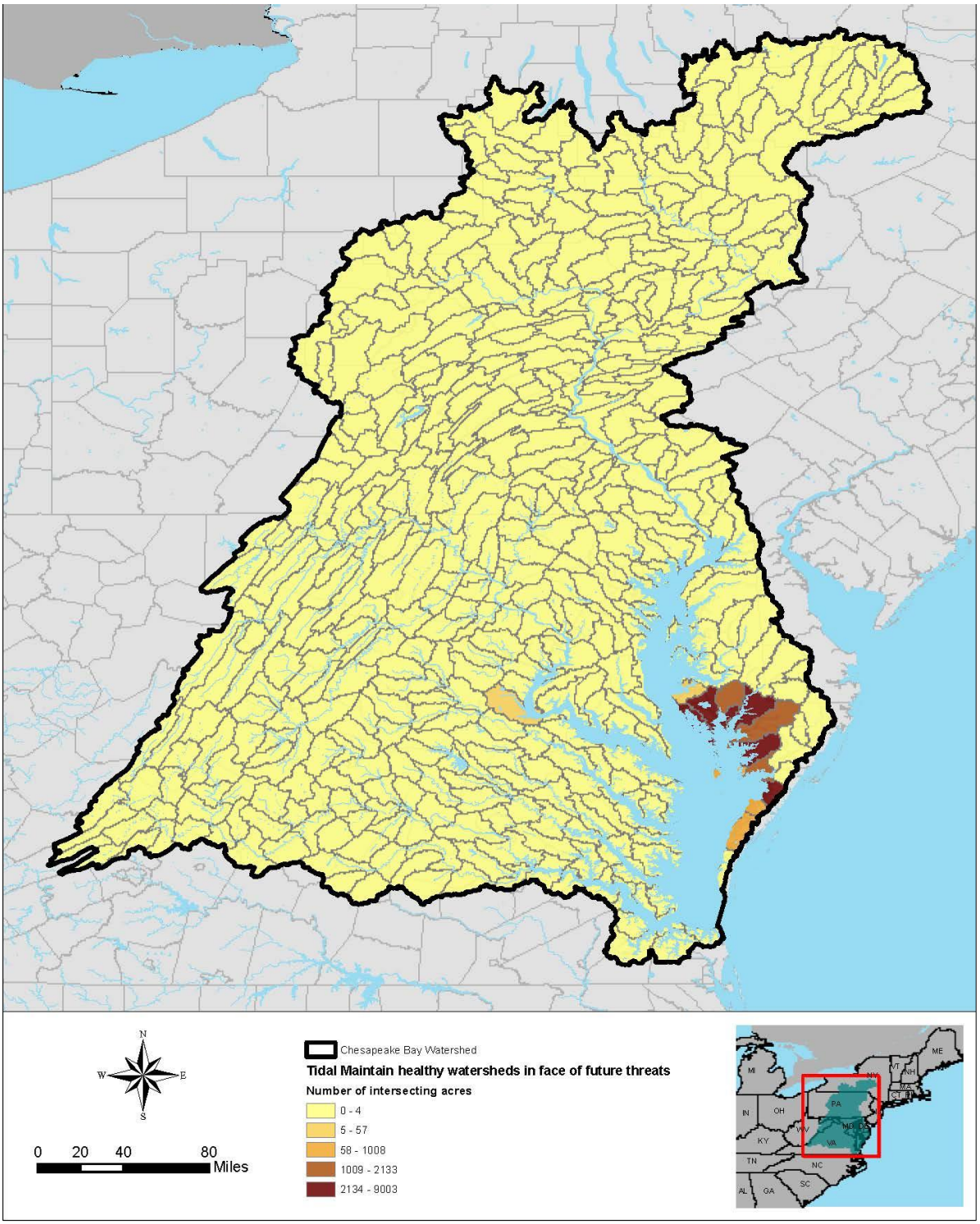

Figure 27. Healthy/High value habitat at risk to tidal threats

Key Points:

- Healthy/high value habitat facing nontidal threats are primarily in Pennsylvania within the northern portion of the Juniata sub-basin—Clearfield Creek, Little Juniata, Spruce Creek, and Spring Creek—and within the northwestern portion of the Lower Susquehanna sub-basin—Spring Creek
- Healthy/high value habitat in Maryland facing nontidal threats include the middle Gunpowder River and upper Gunpowder River (crosses Pennsylvania-Maryland line)
- Healthy/high value habitat facing tidal threats are concentrated in the lower Eastern Shore of Maryland and Virginia

Section 8

Land Conservation Goal

"Conserve landscapes treasured by citizens to maintain water quality and habitat; sustain working forests, farms, and maritime communities; and conserve lands of cultural, indigenous, and community value."

8.1 Outcome: Protected Lands

As identified in the 2014 Bay Agreement, the Protected Lands Outcome is "by 2025, protect an additional 2 million acres of lands throughout the watershed—currently identified as high-conservation priorities at the federal, state, or local level—including 225,000 acres of wetlands and 695,000 acres of forestland of highest value for maintaining water quality."

Table 33. Evaluation of Protected lands Outcome

Current Status	Data collected between 2015 and 2016 shows that since 2010, approximately 1,004,577 acres of land in the Chesapeake Bay Watershed have been permanently protected from development, which is 50% of the land conservation goal. The total amount of protected land in the watershed is 8.8 million acres.
Effort Needed to Meet Goal	To reach the 2 million acre target, approximately 1 million additional acres would need to be permanently protected from development in the Chesapeake Bay Watershed by 2025.
Description of CBCP Analyses	Healthy/High Value Habitats Analysis and the CBP protected lands layer were geospatially analyzed to identify where healthy habitats are not currently protected.
Findings/Recommendations	Opportunities to conserve unprotected healthy/high value habitats are concentrated in the upper Susquehanna River basin and the West Branch Susquehanna basin in PA. Other stakeholder capabilities could be applied to conservation.
Authority/Program	Conservation falls outside USACE's mission area.
Funding Requirements	State and local government open space programs
Implementation Barriers	Changes in land use, public support for conservation, funding, conserving continuous parcels, managing conserved land, climate change.
Integration with other 2014 Bay Agreement goals and outcomes	There is an overlap with the wetlands, oysters, SAV, and stream health outcomes.

Conservation Opportunities Analysis

The purpose of the CBCP Conservation Opportunities Analysis was to identify healthy habitats that are currently not preserved, and to consider how restoration and enhancement opportunities identified by the CBCP analyses could be incorporated into conservation initiatives. The healthy/high value habitats layer was overlaid with the protected lands layer to identify those healthy/high value habitats that are not currently protected (**Figure 28**). The acreage of healthy/high value habitat pixels that were not also protected pixels were summed by subwatershed. The total acreage of unprotected habitat was classified into five groups utilizing

the Jenks method in GIS. The top two groups of subwatersheds based on acreage are identified as opportunities for conservation.

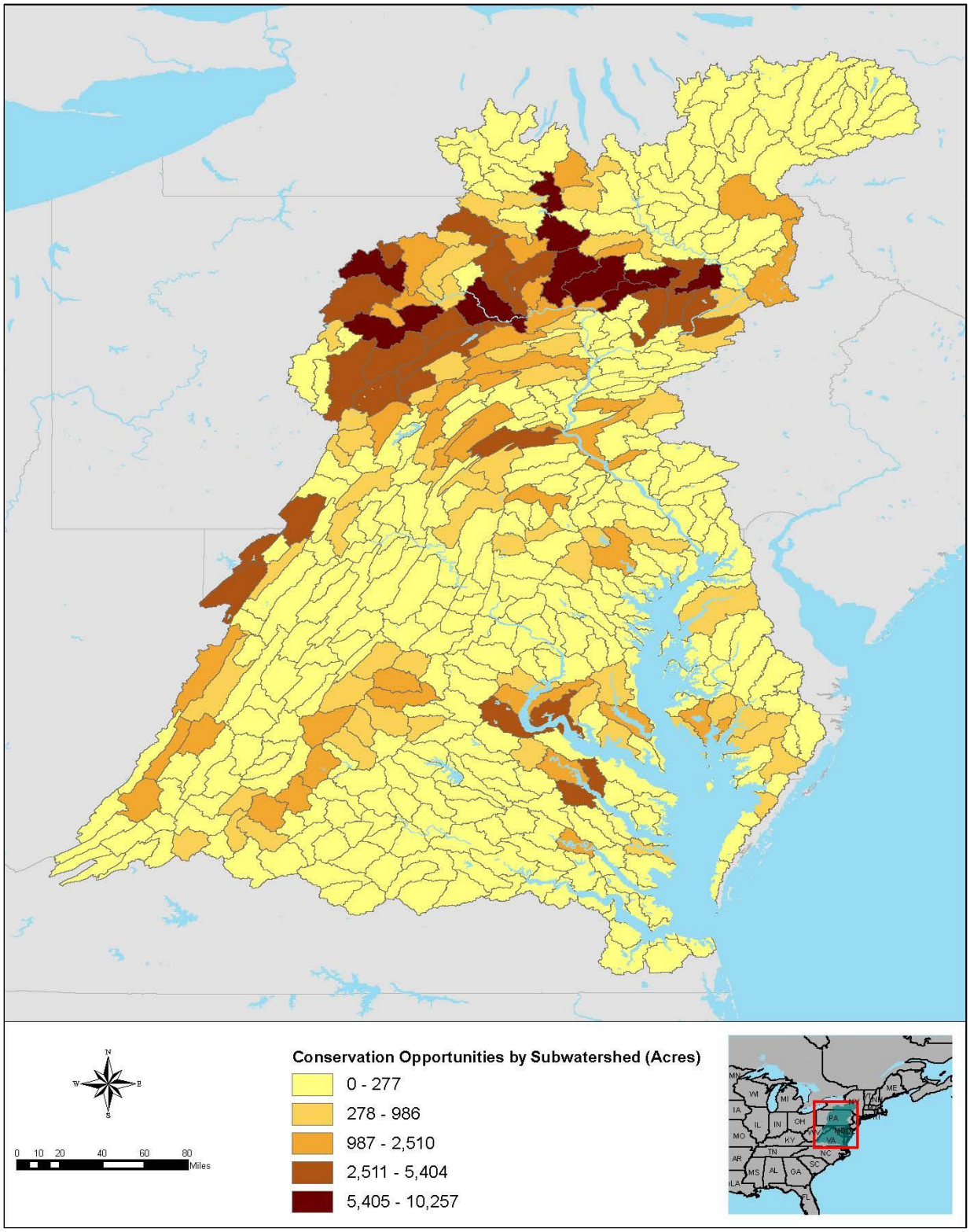

Figure 28. Conservation Opportunities

Opportunities to conserve unprotected healthy/high value habitats are concentrated in the upper Susquehanna River basin and the West Branch Susquehanna basin in PA. Other subwatersheds with high opportunities to conserve unprotected healthy/high value habitats are:

- Sherman Creek in the lower Susquehanna River basin (Pennsylvania)
- Potomac Creek (Virginia and Maryland) and Nanjemoy Creek (Maryland) in the Potomac River Basin
- Cat Point Creek (Virginia) in the Rappahannock River Basin

  Stony River (Maryland and West Virginia), Savage River (Maryland), and Wills Creek (Maryland and Pennsylvania) in the Potomac River Basin

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Section 9

Public Access Goal

"Expand public access to Chesapeake Bay and its tributaries through existing and new local, state, and federal parks, refuges, reserves, trails, and partner sites."

9.1 Outcome: Public Access Site Development

As identified in the 2014 Bay Agreement, the Public Access Site Development Outcome is "by 2025, add 300 new public access sites to the Chesapeake Bay watershed, with a strong emphasis on providing opportunities for boating, swimming and fishing, where feasible."

Table 34. Public access

Current Status	Between 2010 and 2016, 130 public access sites were established in the Chesapeake Bay Watershed.
Effort Needed to Meet Goal	To reach the goal of adding 300 public access sites to the watershed, an additional 170 sites would need to be established by 2025.
Description of CBCP Analyses	The compilation characterizes the locations in the watershed that are important for recreation and public access, and those areas where underserved populations are located.
Findings/Recommendations	There are number of underserved communities that have very little to no public access sites within their HUC10 watersheds. Public access is concentrated along the mainstem and major tributaries of the Chesapeake Bay.
Authority/Program	NPS; USFWS; USACE (reservoirs/dams), state/local government, non-governmental organizations
Funding Requirements	Funding requirements are contingent upon the extent and type of public access area to be constructed.
Implementation Barriers	Public Sector Funding, Land Use and Ownership, Public Lands, Permitting Requirements, Universal Accessibility, Local Government Capacity, Conflicts Among Users, Railroads, Climate Change
Integration with other 2014 Bay Agreement goals and outcomes	The healthy watersheds, protected lands, and climate adaptation outcomes, among others, could be incorporated into projects aimed at public access site development in the watershed.

Status of Problems and Needs

Increasing public access to the waterways within the bay watershed allows for local communities to take pride in and responsibility for the waters that they use for recreational purposes. Currently, there are 1,269 public access sites within the Chesapeake Bay Watershed, with 7 in Delaware, 23 in the District of Columbia, 36 in New York, 46 in West Virginia, 205 in Pennsylvania, 354 in Virginia, and 598 in Maryland (Chesapeake Progress 2017).

In 2013, NPS, in collaboration with the Commonwealths of Pennsylvania and Virginia and the States of Delaware, Maryland, New York, and West Virginia, prepared a public access plan aimed at increasing access to natural resources within the Chesapeake Bay Watershed. This plan is available at: https://federalleadership.chesapeakebay.net/Public_Access_Plan_FINAL.pdf.

Public Access Analyses

The purpose of this analysis is to synthesize information that reflects current societal use of natural resources within the watershed. For the public access analysis, USACE focused primarily on the co-location of underserved communities and public access sites. The data compiled for this analysis characterize areas in the watershed that are important for recreation and public access and those areas where underserved, low income, or minority populations are located (**Figure 29**).

The following data layers were incorporated into the public access analysis:

- Locations of national, state, and local parks
- Public access points – nationally designated trails, existing and proposed public access sites (compiled by the CBP)
- Underserved populations – minority and low-income populations (compiled by CBP utilizing EPA's EJScreen Platform)

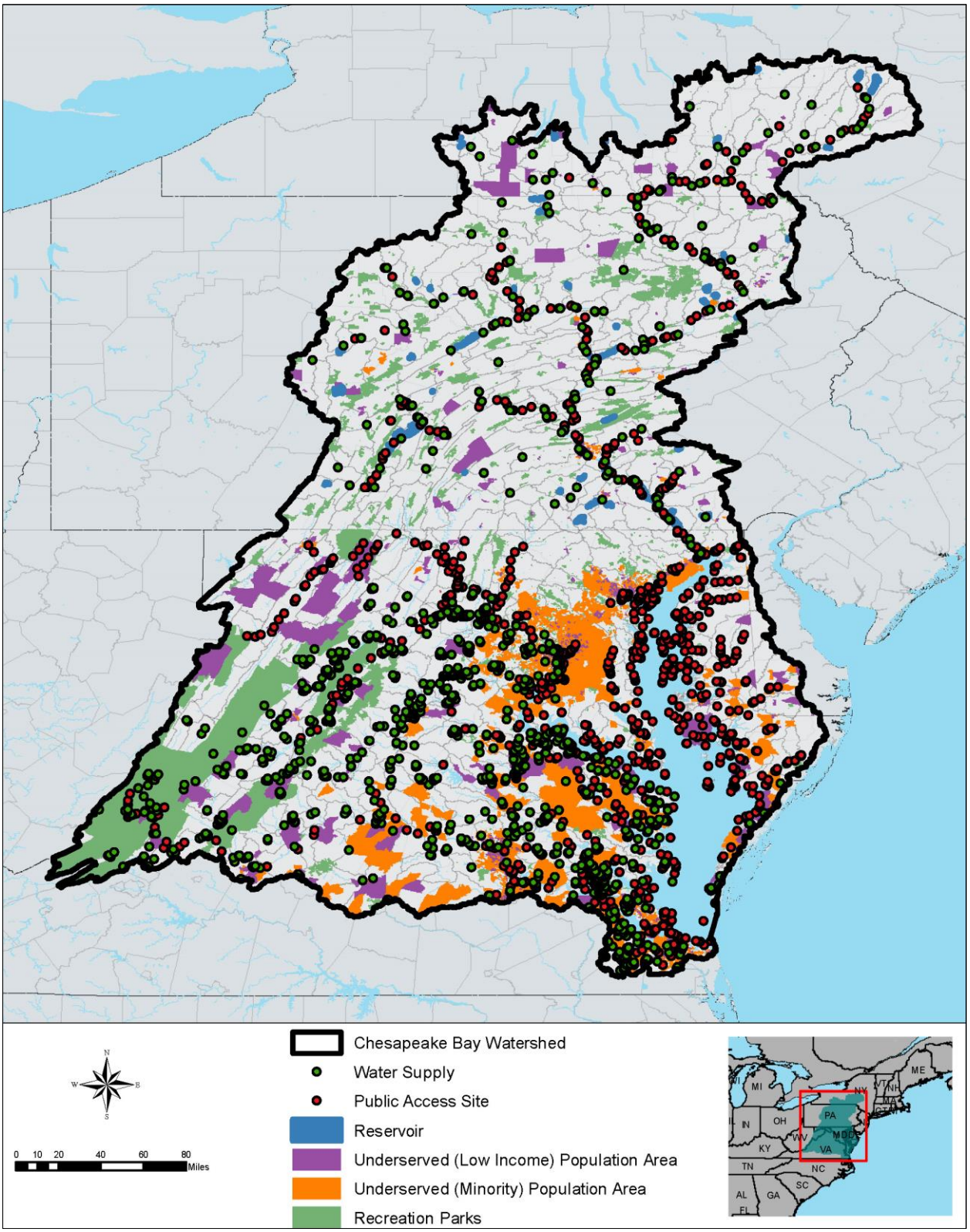

Figure 29. Public access, water supply, and recreation parks in correlation with low-income and minority population areas

Based on the map created from the most up-to-date, readily available data, public access points are well-distributed along major tributaries of Chesapeake Bay. In Pennsylvania and New York, access to waters within the Chesapeake Bay Watershed are predominantly located along the course of the Susquehanna River or its main tributaries. In Maryland, public access sites are concentrated along the extent of the Potomac River and its tributaries and along the mainstem of Chesapeake Bay. Virginia, like Maryland, has public access sites along the Potomac River and Chesapeake Bay mainstem; there is also a concentration of access sites near the mouth of the James and York Rivers. Although there are numerous established public access sites, there are still areas within the bay watershed that have negligible to no public access or recreational areas available to the public. There are minimal to no access points in:

- Central- and western-most subwatersheds in Maryland
- Northern and southern subwatersheds in West Virginia
- South-central subwatersheds in Pennsylvania
- Northern- and western-most subwatersheds in New York

In Virginia, both the Bush and Lower Willis Rivers subwatersheds are priority areas for increased public access, as they both have large areas of minority and low-income populations and no public access sites. However, there are public lands for recreational use located within these two subwatersheds.

Both minority and low-income areas occur throughout the Chesapeake Bay Watershed. The underserved minority populations are predominantly located on the western shore and inland of Maryland and Virginia and the Delmarva Peninsula. The underserved low-income areas are more evenly distributed throughout the watershed though there appears to be a higher concentration of low-income areas within the panhandle of West Virginia.

Recreational park lands are distributed throughout the Chesapeake Bay Watershed, though the greatest concentration of park lands is in the upper Potomac and James Rivers Watersheds.

The CBP Diversity Workgroup has been working simultaneously to identify opportunities to increase access to low-income and minority populations. Due to differences in the analyses, the CBCP was not able to incorporate that work, but, as follow-up, the results of the CBCP analyses should be compared with those of the workgroup.

Implementation

To reach the overall goal of providing 300 public access sites by 2025, there are many actions that must occur from year to year. The management strategy associated with this outcome outlines many watershed-wide actions that have occurred and must continue to occur to successfully reach this outcome. Implementation of access improvements largely falls outside USACE mission areas, but there may be opportunities to increase access on some military lands and at USACE-owned reservoirs with recreation missions.

The CBCP also evaluated existing access sites for the potential to be impacted by future threats by overlaying the tidal and nontidal threat analyses with the socioeconomics compilation. **Figures 30 and 31** show the results of those analyses.

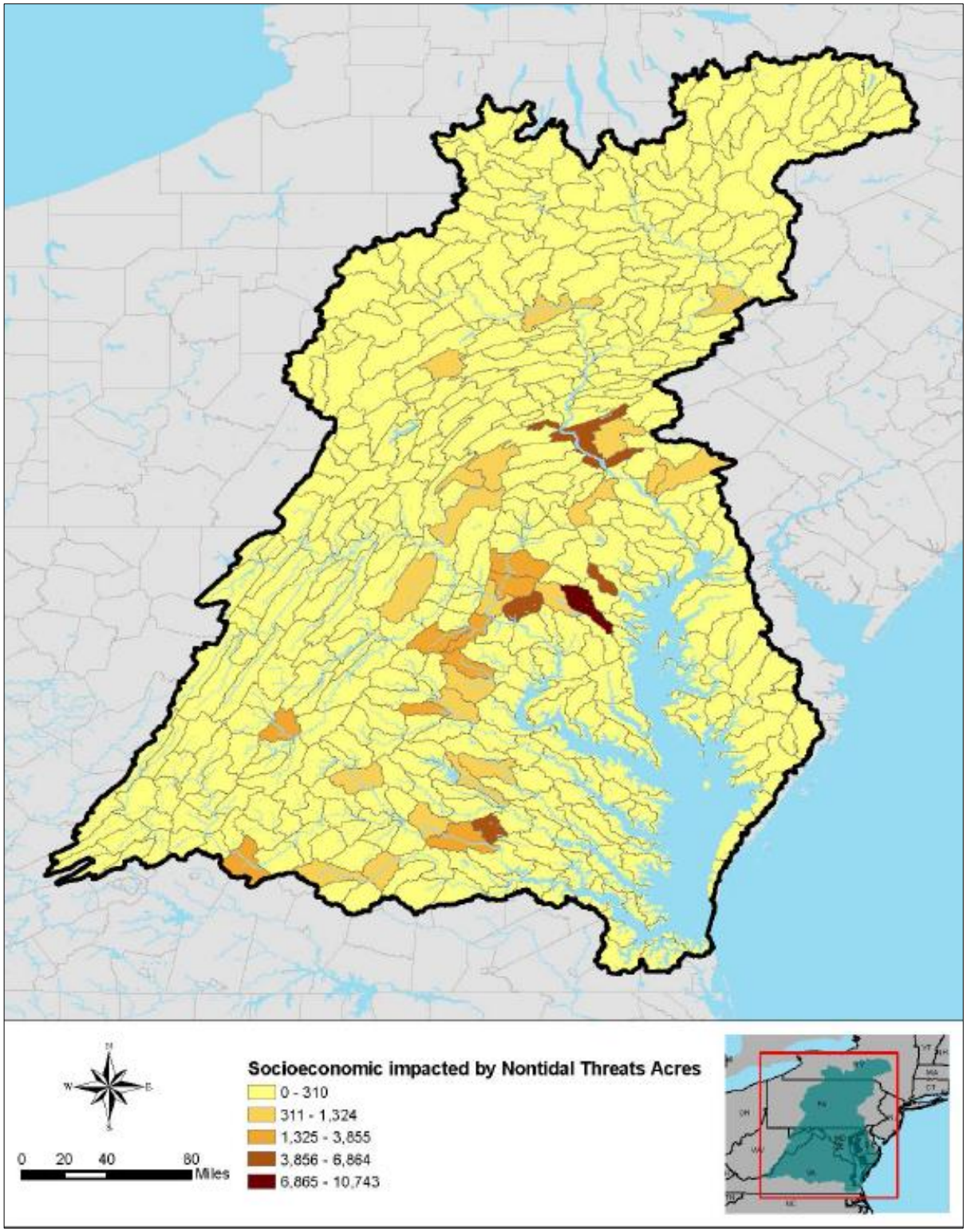

Figure 30. Socioeconomic resources facing nontidal threats

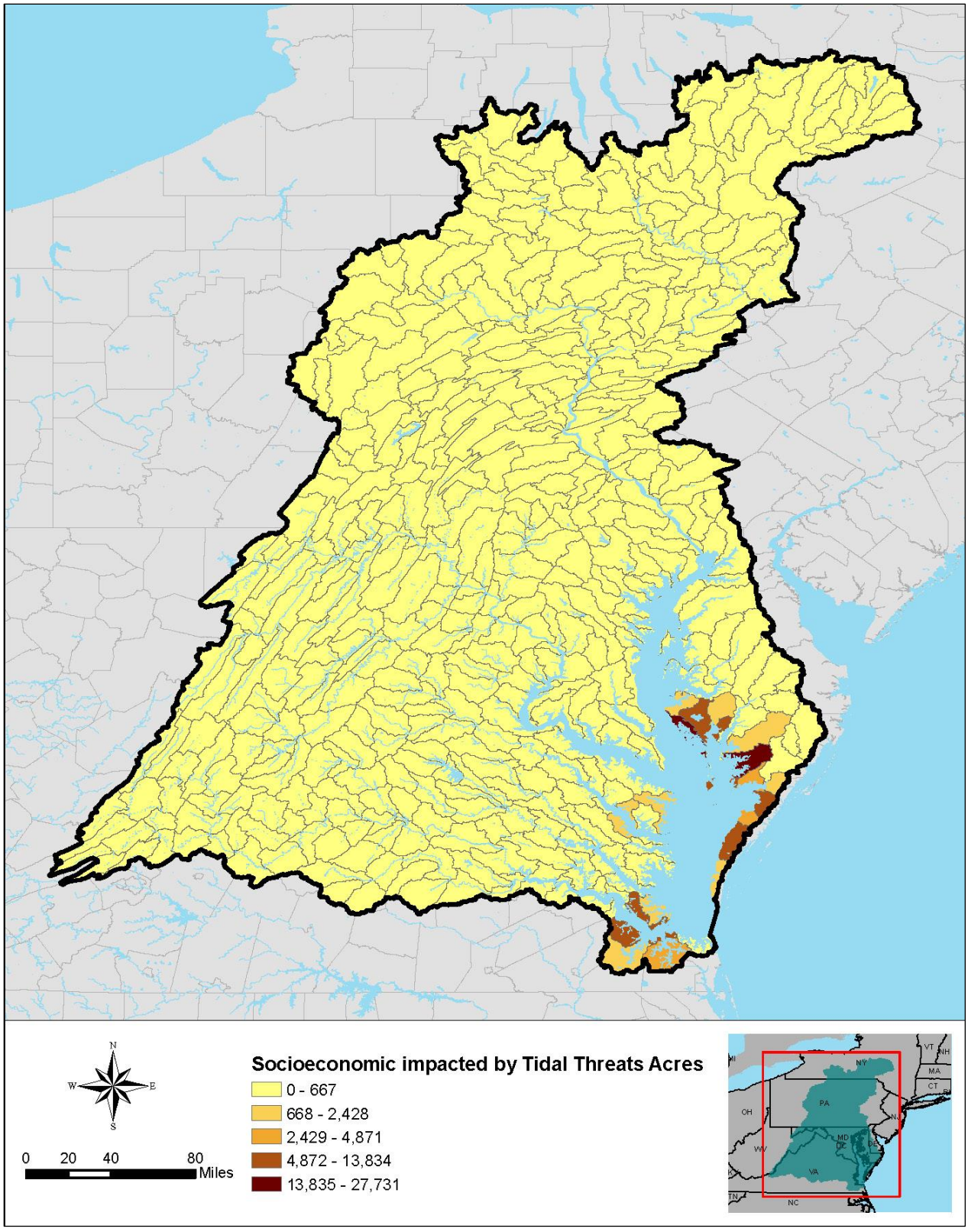

Figure 31. Socioeconomic resources facing tidal threats

The socioeconomic resources at greatest risk to nontidal threats are in:

- Lower Susquehanna River basin
- Subwatershed in Maryland south of Baltimore (Little Patuxent and Gwynns Falls)
- Northwest of Washington, DC (Seneca Creek)
- Upper Chickahominy River in the James River Basin in Virginia

The socioeconomic resources at greatest risk to tidal threats are in the Norfolk, Virginia area and along the bay on the Eastern Shore of Maryland and Virginia.

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Section 10
Climate Resiliency Goal

"Increase the resiliency of the Chesapeake Bay watershed, including its living resources, habitats, public infrastructure, and communities to withstand the adverse impacts from changing environmental and climate conditions."

As identified in the 2014 Bay Agreement, the Climate Resiliency Outcome is to "continually pursue, design and construct restoration and protection projects to enhance the resiliency of the Chesapeake Bay and its aquatic ecosystems against the impacts of coastal storm erosion, coastal flooding, more intense and more frequent storms, and sea level rise."

Table 35. Climate resiliency

Current Status	The baseline for the climate adaption outcome has not been determined, so progress toward this outcome is neutral.
Effort Needed to Meet Goal	Not applicable to this goal
Description of CBCP Analyses	The CBCP analysis aimed to identify conservation and restoration areas that are threatened by urbanization and climate change, as well as areas that are prone to increased/persistent flooding in the future.
Findings/Recommendations	The CBCP Nontidal Threats Analysis identified opportunities closely associated with impervious surfaces, i.e. cities. The CBCP Tidal Threats Analysis identified opportunities with large acreages of wetlands and low lying coastal areas.
Authority/Program	Section 510; CAP 206; GI
Funding Requirements	Undetermined
Implementation Barriers	Undetermined
Integration with other 2014 Bay Agreement goals and outcomes	Tidal and nontidal wetlands, important bird areas, SAV, oysters, riparian buffers, stream restoration, shoreline habitat restoration, and conservation measures could all benefit from efforts to enhance climate resiliency.

Status of Problems and Needs

It is vital for climate adaptation measures to be implemented in the Chesapeake Bay Watershed, as this area is one of the most vulnerable regions in the U.S. for climate change threats and potential impacts.

Climate Resiliency/Threats Analyses

The purpose of the CBCP Threats Analysis was to identify areas within the Chesapeake Bay Watershed that are threatened by urbanization and climate change and areas prone to increased/persistent flooding in the future. By conducting these analyses, opportunities were identified to minimize these threats.

For the CBCP, the climate adaptation outcome has been augmented to include nontidal threats to the Chesapeake Bay Watershed, which will ensure that those nontidal watershed states were considered in the analysis of future threats attributed to climatic changes. Refer to the Planning

Analyses Appendix for information regarding the threats that were incorporated into the analyses for both tidal and nontidal threats and the data used to perform the analyses.

For both the tidal and nontidal threats analyses, there is a broad pattern following development in the watershed; areas with more development and/or urbanization are generally more threatened, especially in those cities along major tributaries that are not tidally influenced. This corresponds with threats to the watershed attributed to future projected land development, as these areas will likely continue to expand in the future, increasing the network of impervious surfaces via urban sprawl.

The nontidal and tidal threats results were applied in various places throughout the CBCP analyses to understand threats to various resources including wetlands, conservation opportunities, and existing healthy/high value habitats.

Nontidal Threats Analysis

The most threatened nontidal areas that are associated with expanses of urban sprawl include those subwatersheds associated with Richmond, Virginia; Philadelphia, Harrisburg, Lancaster, York, and State College, Pennsylvania; and the District of Columbia and Baltimore, Maryland metropolitan areas (**Figure 32**). Opportunities to address nontidal threats (those having the greatest acreage exposed to future threats) are listed in **Table 36**.

These urban expanses, which may continue to develop in the future, are also generally associated with being at high risk for freshwater fish habitat degradation. This may be attributed to factors such as increased nutrient and pollutant runoff due to decreased filter capacity of hardened, impervious surfaces.

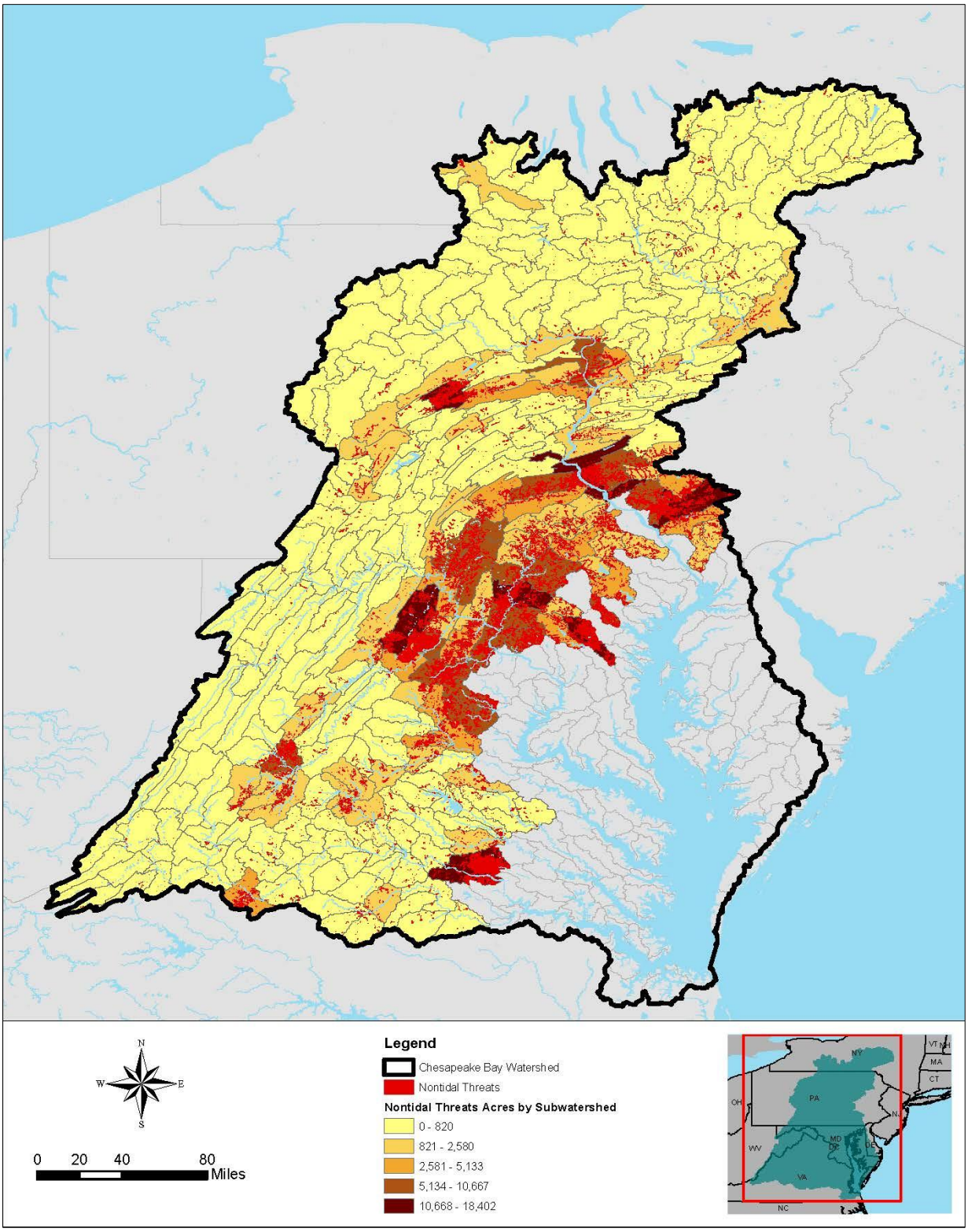

Figure 32. Nontidal threats to the Chesapeake Bay Watershed

Table 36. Opportunities identified by nontidal threats analysis

Subwatershed Number	Subwatershed Name	State	Nontidal Threats (Acres)
0208020604	Upper Chickahominy River	VA	18402
0206000602	Little Patuxent River	MD	18389
0208020506	Tuckahoe Creek-James River	VA	16782
0205020401	Spring Creek	PA	14925
0205030510	Susquehanna River	PA	13589
0207000906	Middle Monocacy River	MD	12716
0207000409	Opequon Creek	VA,WV	11812
0205030611	Conestoga River	PA	11579
0207000805	Upper Goose Creek	VA	10667
0207000807	Lower Goose Creek	VA	9599
0207000907	Lower Monocacy River	MD	8357
0207000808	Seneca Creek	MD	8148
0205030610	Little Conestoga Creek	PA	8049
0205030504	Lower Conodoguinet Creek	PA	7684
0207000506	Lower North River	VA	7484
0205030509	Lower Swatara Creek	PA	7399
0207000408	Conococheague Creek	MD,PA	7238
0207000410	Antietam Creek	MD,PA	7237
0207000904	Double Pipe Creek	MD	6957
0207000702	Long Marsh Run-Shenandoah River	VA	6759
0207001006	Cedar Run	VA	6501
0205030608	Chickies Creek	PA	6345
0207001005	Broad Run	VA	6339
0207000804	Tuscarora Creek-Potomac River	MD	6292
0207000905	Upper Monocacy River	MD	6159
0206000309	Gwynns Falls	MD	6099
0205020612	West Branch Susquehanna River	PA	5696

Tidal Threats Analysis

In contrast to the nontidal threats analysis, tidal threats are associated with areas within the mainstem of the bay that have large expanses of wetlands and low-lying coastlines vulnerable to coastal storms and sea level rise. The most threatened subwatersheds along the coast include lower Choptank River, lower Tangier Sound, Blackwater River, and Manokin River. **Table 37** provides a list of the subwatersheds that are most at-risk to future threats. These areas hold important natural resources such as wetlands and SAV, which in some cases support rare, threatened, and endangered species.

The most threatened tidal area that may be associated with urban sprawl includes the Hampton Roads area, located in southeast Virginia (**Figure 33**). This area is at-risk to increased tidal flooding from increased storms and sea level rise, eroding shorelines, and future development.

Opportunities to address tidal threats (those having the greatest acreage exposed to future threats) are listed in **Table 37**.

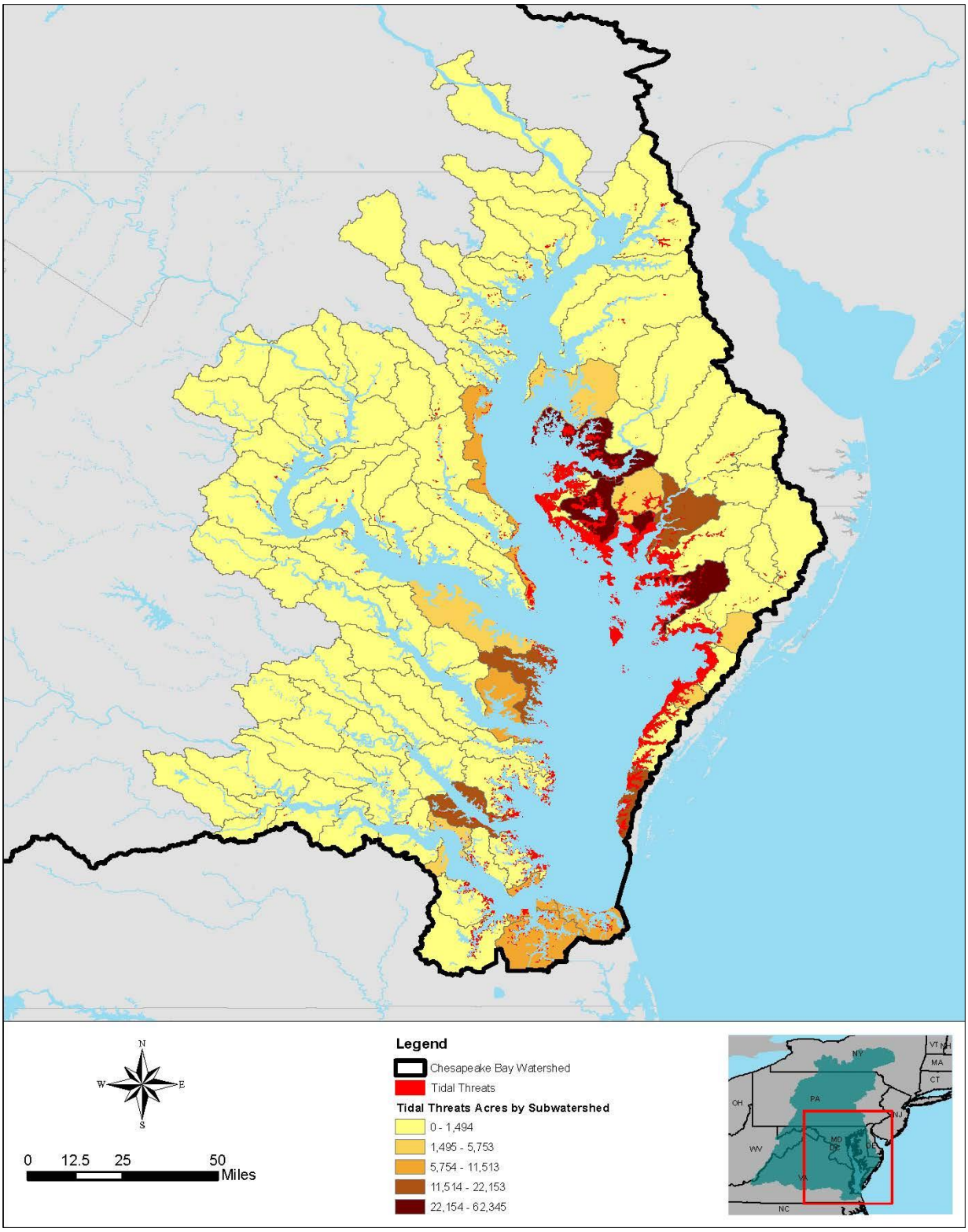

Figure 33. Tidal threats to the Chesapeake Bay Watershed

Table 37. Opportunities identified by tidal threats analysis

Subwatershed Number	Subwatershed Name	States	Tidal Threats (Acres)
0206000505	Lower Choptank River	MD	62345
0208011006	Lower Tangier Sound	MD,VA	46350
0208011002	Blackwater River	MD	40804
0208011004	Manokin River	MD	38814
0208010201	Great Wicomico River-Lower Chesapeake Bay	VA	22153
0208010905	Lower Nanticoke River	DE,MD	20392
0208010702	Lower York River	VA	19281
0208011109	Cherrystone Inlet-Lower Chesapeake Bay	VA	16892

Implementation

Climate resiliency and future risks should be considered for all projects being undertaken to meet Chesapeake Bay Agreement goals. There are also some projects focused solely on resiliency. For example, there is a coastal resiliency project planned for the City of Norfolk, Virginia, which is in the area at moderate risk to future threats in the Chesapeake Bay Watershed. USACE has partnered with the City of Norfolk to work cooperatively to solve issues associated with low-lying urban areas and future threats attributed to increased storms and more-frequent-than-normal coastal storms. The coastal storm resiliency project can serve as an example for other developed areas facing similar threats.

Section 11

Funding and Implementation

11.1 USACE Authorities and Programs

Funding requirements to support the restoration effort across the 64,000-mile Chesapeake Bay Watershed and within the six states and the District of Columbia will require continued support to meet and sustain the 2014 Bay Agreement goals and outcomes. Almost $2 billion was invested in fiscal year 2017, including approximately $569 million from seven of the agencies that comprise the Federal Leadership Committee (FLC) of the Chesapeake Bay and approximately $1.41 billion from the seven watershed jurisdictions (Chesapeake Progress 2018).

USACE activities would complement ongoing conservation and restoration actions being undertaken across the watersheds by the states and the District of Columbia as well as by local governments and non-governmental organizations. USACE actions can be carried out under a variety of authorities and programs, as appropriate and as funding is appropriated by Congress and is made available by nonfederal project sponsors. Actions undertaken by USACE may be pursued under technical services programs (Planning Assistance to States; Floodplain Management Services Program), Interagency and International Support (cost-reimbursable), Section 510, Design-Build Authorities (219, 313, and 567), Continuing Authorities Program, and specifically authorized investigations and construction.

Authorities through which USACE can participate in the study, design, and implementation of ecosystem restoration projects are outlined in **Table 38**.

Table 38. USACE authorities for ecosystem restoration

Authority	Purpose/Location	Feasibility Cost Share Federal/Non-Federal	Implementation Cost Share Federal/Non-Federal	Federal Project Limit
Continuing Authorities Program (CAP)				
CAP Section 204, 1992 Water Resources Development Act (WRDA), as amended	Regional Sediment Management	100% / 0%	65%/35% (1,2)	$10,000,000
CAP Section 206, 1996 WRDA, as amended	Aquatic Ecosystem Restoration	100%/0% for initial $100,000; 50%/ 50% remaining cost	65%/35%	$10,000,000
CAP Section 1135, 1986 WRDA, as amended	Project Modifications for Improvements to the Environment	100%/0% for initial $100,000; 50%/ 50% remaining cost	75%/25%	$10,000,000
CAP Section 14, 1946 Flood Control Act, as amended	Emergency Stream Bank and Shoreline Protection	100% / 0% for initial $100,000; 50% / 50% remaining cost	65%/35%	$5,000,000
Construction Authorizations				
Section 510, WRDA 1996, as amended	Chesapeake Bay Environmental Restoration and Protection Program	--	75%/25%	$40,000,000 appropriation limit; approximately $28,500,000 remaining
Section 704(b), WRDA 1986, as amended	Chesapeake Bay Oyster Recovery, Maryland and Virginia	--	75%/25%	$100,000,000
Section 3086, WRDA 2007, as amended	Restoration of the historic Chesapeake and Ohio Canal; Cumberland, Maryland	--	65% ($16,738,000)/35% ($9,012,000)	$25,750,000
Section 537, WRDA 1996, as amended	Beneficial Use of Dredged Material; Poplar Island, Maryland	--	75% /25%	$195,000,000
Section 1001(26), WRDA 2007	Environmental Restoration; Smith Island, Maryland	--	65% ($10,127,000)/ 35% ($5,453,000)	$15,580,000
Section 501(a), WRDA 1986	Shoreline Protection and Beach Nourishment	--	45%/55%	$58,200,000 (First Cost)
Section 101a(8), WRDA 1996	Environmental Restoration; Anacostia and Tributaries, District of Columbia and Maryland	--	75%/25%	$17,144,000
Section 304, WRDA 1992	Watershed Reclamation and Wetlands Pilot Project; Broad Top Region, Pennsylvania	--	75%/25%	$5,500,000

Authority	Purpose/Location	Feasibility Cost Share Federal/Non-Federal	Implementation Cost Share Federal/Non-Federal	Federal Project Limit
Section 313, WRDA 1992, as amended	Environmental Restoration Infrastructure and Resource Protection Development Program; South Central Pennsylvania	--	75%/25%	$17,000,000
Section 5087, WRDA 2007	Non-structural flood damage reduction and ecosystem restoration; Charlestown, Maryland	--	75%/25%	$2,000,000
Section 204, WRDA 1992, as amended	Dredged Material Disposal (including beneficial use-protection, restoration, and creation of aquatic and ecologically related habitats including wetlands)	--	75%/25%	Not to exceed $15,000,000 annually
Section 5059, WRDA 2007	Delmarva Conservation Corridor Program; Delaware, Maryland, & Virginia	--	50%/50%	--
Section 5147, WRDA 2007	Restoration of Dyke Marsh; Fairfax County, Virginia	--	--	--
Section 5027, WRDA 2007	Rehabilitation and improvement of water and transportation-related infrastructure for the historic property in the Anacostia River watershed located in the District of Columbia	--	--	$1,000,000
Section 401 (a), WRDA 1986, as amended	Carry out flood control and review opportunities for increased public access; Wyoming Valley, Pennsylvania	--	75%/25%	$181,000,000
Study Authorizations				
Section 114(d), WRDA 1992	Watershed Impact Assessment; Anacostia River watershed in District of Columbia and Maryland	--	--	$3,000,000
Section 443, WRDA 1996	A study of flooding, erosion - including an assessment of wetland protection, erosion control, and flood damage reduction needs; Prince William County, Virginia	--	--	--
Section 729, WRDA 1986	Study of Water Resources Needs of River Basins and Regions	--	--	$5,000,000 (for fiscal years beginning after 1986)
Section 567, WRDA 1996, as amended	Study and develop a strategy for wetland restoration, soil and water conservation practices, and non-structural measures to reduce flood damage, improve water quality and create wildlife habitat; Upper Susquehanna River Basin, Pennsylvania and New York	75%25%	--	Juniata River Watershed - $8,000,000; Susquehanna River Watershed - $5,000,000

Authority	Purpose/Location	Feasibility Cost Share Federal/Non-Federal	Implementation Cost Share Federal/Non-Federal	Federal Project Limit
Section 2010, WRDA 2007	Watershed and River Basin Assessments	75%/25%	--	$5,000,000 (for fiscal years beginning after 1986)
Section 5060, WRDA 2007	Comprehensive Action Plan for restoration and protection of ecological integrity of the Anacostia River and its tributaries; District of Columbia and Maryland	--	--	--
Section 5023, WRDA 2007	Potomac River Watershed Assessment and Tributary Strategy Evaluation and Monitoring Program	--	--	--
Section 216, 1970 Flood Control Act	Undertake a reconnaissance study of flood control needs and environmental restoration opportunities; Four Mile Run, Virginia	--	--	$100,000 (provided in Energy and Water Development Appropriations Bill of 2002)
Section 553, WRDA 1999	Upper Susquehanna-Lackawanna, Pennsylvania, Watershed Management and Restoration Study	--	--	--
Study Resolutions				
House Committee on Public Works and Transportation, 30 April 1992	Study regarding flood control, hurricane protection, navigation, erosion, sedimentation, fish and wildlife, water quality, environmental restoration, recreation and other related purposes; Baltimore Metropolitan Water Resources - Gwynn's Falls	--	--	--
House Committee on Public Works and Transportation, 30 April 1992	Study regarding flood control, hurricane protection, navigation, erosion, sedimentation, fish and wildlife, water quality, environmental restoration, recreation and other related purposes; Baltimore Metropolitan Water Resources - Patapsco Urban River Restoration Initiative (PURRI)	--	--	--
Senate Committee on Environment and Public Works, 5 June 1997	Conduct watershed management studies regarding water resource improvements in the interest of navigation, flood control, hurricane protection, erosion control, environmental restoration, wetlands protections and other allied purposes in watersheds of the Eastern Shore, Maryland and Delaware	--	--	--
Senate Committee on	Conduct watershed management studies regarding	--	--	--

Authority	Purpose/Location	Feasibility Cost Share Federal/Non-Federal	Implementation Cost Share Federal/Non-Federal	Federal Project Limit
Environment and Public Works, 5 June 1997	water resources improvements in the interest of navigation, harbor protection, flood damage reduction, floodplain management, environmental restoration, and other allied purposes in watersheds; Susquehanna River and Chesapeake Bay at Havre de Grace, Maryland			
House Committee on Public Works and Transportation, 28 September 1994	Conduct a comprehensive watershed management study for water resources improvements in the interest of navigation, flood control, erosion control, environmental restoration, wetlands protection, and other purposes; Patuxent River, Maryland	--	--	--
Senate Committee on Environment and Public Works, 15 May 1991	Included in this study will be the development of physical, environmental, and engineering data on coastal changes and processes to evaluate water resources improvements to navigation, flood control, hurricane protection, erosion control, wetlands protection, water supply, and other allied purposes to preserve and enhance the water resources infrastructure which is being severely taxed and degraded by growth, development and other factors; Ocean City, Maryland and Vicinity	--	--	--
House Committee on Transportation and Infrastructure, 9 May 1996	Conduct a comprehensive watershed management study for water resources improvements in the interest of navigation, flood control, erosion control, environmental restoration, ecosystem protection and other allied purposes for the Potomac River Estuary from Piscataway Creek to its mouth; Lower Potomac Estuary Watershed, Virginia and Maryland	--	--	--
Senate Committee on Environment and Public Works, 23 May 2001	Conduct a study for improvements in the interest of ecosystem restoration and protection, flood plain management, and other allied purposes for the middle Potomac River watershed; Middle Potomac River Watershed, Maryland, Virginia,	--	--	--

Authority	Purpose/Location	Feasibility Cost Share Federal/Non-Federal	Implementation Cost Share Federal/Non-Federal	Federal Project Limit
	Pennsylvania, West Virginia, and the District of Columbia			
Senate Committee on Environment and Public Works, 23 June 2004	Determine the need for improvements in the interest of ecosystem restoration and protection, abandoned mine drainage abatement, floodplain management, flood control, water supply, navigation and other allied purposes for the Potomac River watershed within the Commonwealth of Pennsylvania; Potomac River Watershed, Pennsylvania	--	--	--
House Committee on Transpiration and Infrastructure, 7 March 1996	Conduct a comprehensive watershed management study for the Chemung River Basin for water resources improvements in the interest of stream bank stabilization, flood damage reduction, floodplain management, environmental restoration, and other allied purposes.	--	--	--
House Committee on Transportation and Infrastructure, 14 September 1995	Conduct a comprehensive watershed management study for the lower basin for water resources improvements in the interest of environmental restoration, flood damage reduction, floodplain management, and other applied purposes; Lower West Branch Susquehanna River Basin Environmental Restoration, Pennsylvania	--	--	--
House Committee on Transportation and Infrastructure, 24 July 2002	Determine whether modification to the recommendations contained therein (Report of the chief of engineers on the Susquehanna River and Tributaries) are advisable at the present time in the interest of environmental restoration and protection, water supply, floodplain management and related purposes; Lower Susquehanna River Basin, Pennsylvania	--	--	--
House Committee on Transportation and Infrastructure, 23 May 2007	Develop a comprehensive systems-based solution for water resources improvements in the interest of flood damage reduction, floodplain management, environmental restoration, water quality improvements, sediment	--	--	--

Authority	Purpose/Location	Feasibility Cost Share Federal/Non-Federal	Implementation Cost Share Federal/Non-Federal	Federal Project Limit
	control, watershed management, and other allied purposes in the Middle and West Branch sub-basins of the Susquehanna River Basin, Pennsylvania			
House Committee on Transportation and Infrastructure, 26 October 2005	Determine whether modifications of the recommendations contained therein (House Document 702, 77th Congress Session) are advisable in the present time in the interest of environmental restoration and protection, water supply, floodplain management, and related purposes, with special emphasis on abandoned mine drainage abatement and reestablishment of stream and river channels; North Central, Pennsylvania	--	--	--
House Committee on Transportation and Infrastructure, 14 September 1995	Conduct a comprehensive watershed management for the basin for water resources improvements in the interest of stream bank stabilization, flood damage reduction, floodplain management, environmental restoration, and other allied purposes; Tioga River Watershed, Pennsylvania	--	--	--
House Committee on Transportation and Infrastructure, 7 March 1996	Conduct a comprehensive watershed management study for the basin for water resources improvements in the interest of stream bank stabilization, flood damage reduction, floodplain management, environmental restoration, and other allied purposes; Upper Susquehanna River Basin Environmental Restoration, New York and Pennsylvania	--	--	--
House Committee on Transportation and Infrastructure, 2 December 2010	Review the report on the Chesapeake Bay Study, dated September 1984, to determine whether any modifications of the recommendations contained therein are advisable at the present time in the interest of watershed planning, environmental restoration, coastal erosion control, and improvement of water quality; Chesapeake Bay and Maryland Coastal Bays, Delaware, Maryland, and Virginia	--	--	--

Authority	Purpose/Location	Feasibility Cost Share Federal/Non-Federal	Implementation Cost Share Federal/Non-Federal	Federal Project Limit
Senate Committee on Environment and Public Works, 26 September 2002	Develop a coordinated, comprehensive master plan within Corps mission areas for restoring, preserving and protecting the Chesapeake Bay Ecosystem	--	--	--
House Committee on Transportation and Infrastructure, 2 December 2010	Determine the feasibility of carrying out projects on federally owned property for shoreline protection, environmental restoration, and improvement of water quality; Chesapeake Bay, Maryland, Pennsylvania, and Virginia	--	--	--
Senate Committee on Environment and Public Works, 23 May 2001	Conduct a study that shall evaluate structural and non-structural environmental enhancement opportunities and other innovative protection measures in the interest of ecosystem restoration and protection, and other allied purposes for the Chesapeake Bay; Chesapeake Bay (shoreline erosion), Maryland, Virginia and Delaware	--	--	--
House Committee on Public Works and Transportation, 28 September 1994	Review the report published as House Documents 176, eighty-eighth Congress, First Session, to determine whether modifications of the recommendations are advisable at the present time, with particular emphasis on providing improvements on Smith Island MD and VA, in the interest of navigation, flood control, erosion control, environmental restoration, wetlands protection and other purposes; Smith Island, Maryland and Virginia	--	--	--
House Committee on Public Works and Transportation, 13 May 1993	Review report published as House Document 622, Seventy-Ninth Congress, Second Session, to determine whether the modification of recommendations contained therein are advisable at the present time in the interest of mitigation of the loss of fish and wildlife habitat, water quality, recreation, flood damage reduction, and related purposes; North Branch Potomac River	--	--	--

Authority	Purpose/Location	Feasibility Cost Share Federal/Non-Federal	Implementation Cost Share Federal/Non-Federal	Federal Project Limit
	Basin, West Virginia, Maryland and Pennsylvania			
House Committee on Transpiration and Infrastructure, August 5 1999	Determine the feasibility of measures conducted in cooperation with local, State, and other Federal agencies and in the interest of flood damage reduction, environmental restoration and protection, economic development, and other allied purposes for Paxton Creek and Paxton Commons area in Harrisburg, Pennsylvania	--	--	--
House Committee on Transportation and Infrastructure, 24 September 2008	Repost House Document 336, 76th Congress, First session, to determine whether any modifications of the recommendations contained therein are advisable at the present time in the interest of watershed management, flood damage reduction, stream bank stabilization, environmental restoration, recreation, and other related purposes; Susquehanna River, and Sunbury, Pennsylvania			
Planning Assistance to States				
PAS program - Section 22 WRDA 1974, as amended	Flood damage reduction; water supply; water conservation; environmental restoration; water quality; hydropower; erosion; navigation; fish and wildlife; cultural resources; and environmental resources	50%/50%	--	$500,000

For structural flood damage reduction purpose, non-federal share is 35% up to 50% (based on cost of LERRDs), plus 5% must be in cash.
For non-structural flood damage reduction purpose, non-federal share limited to 35% with no 5% cash requirement.

11.2 Other Agency Authorities and Programs

The Federal Leadership Committee for the Chesapeake Bay, including EPA and the Departments of Agriculture, Commerce, Defense and the Interior – invested more than $536 million in watershed restoration in fiscal 2016. Funding is directed to state and local governments, educational institutions, non-profit organizations and territorial and tribal agencies. These groups often provide addition funding, cash or in-kind, to further facilitate restoration efforts.

The next section summarizes programs and organizations (federal, state, and non-governmental) that could be pursued for assistance in implementation efforts.

11.3 Federal Agency Programs and Funding

The following Catalog of Federal Funding Sources for Watershed Protection is a searchable online database of financial assistance sources (grants, loans, and cost-sharing) available to fund a variety of projects (available at: https://www.epa.gov/waterdata/catalog-federal-funding). The database can be searched by:

- Keyword (wetlands, infrastructure, education, forestry, etc.)
- Type of organization (non-profit groups, state, tribal, educational institution, etc.)
- Match requirement (yes or no)
- Federal agency

A search of all criteria provided the following programs by agency (**Table 39**) that may be useful for many different needs and opportunities that have been identified in the CBCP. Each program is linked to a separate web page that details current information regarding the funding source, including a program overview, current and past funding levels, lowest/median/highest awards, match requirements, contact information, and eligible organizations.

Table 39. Catalog of federal funding source for watershed protection for 2017

Program Name	Overview	FY 2017 Funding Level
Public Works and Development Facilities Program	EDA's Public Works program helps distressed communities revitalize, expand, and upgrade their physical infrastructure. This program enables communities to attract new industry; encourage business expansion; diversify local economies; and generate or retain long-term, private-sector jobs and investment through the acquisition or development of land and infrastructure improvements needed for the successful establishment or expansion of industrial or commercial enterprises. EDA Public Works program investments help facilitate the transition of communities from being distressed to becoming competitive by developing key public infrastructure, such as technology-based facilities that utilize distance learning networks, smart rooms, and smart buildings; multitenant manufacturing and other facilities; business and industrial parks with fiber optic cable; and telecommunications and development facilities. In addition, EDA invests in traditional public works projects, including water and sewer systems improvements, industrial parks, business incubator facilities, expansion of port and harbor facilities, skill-training facilities, and brownfields redevelopment.	$100 million
Program Name	Overview	FY 2017 Funding Level
Pre-Disaster Mitigation Program	The Pre-Disaster Mitigation (PDM) Program is authorized by Section 203 of the Stafford Act, 42 U.S.C. 5133. The PDM Program is designed to assist States, Territories, Indian Tribal governments, and local communities to implement a sustained pre-disaster natural hazard mitigation program to reduce overall risk to the population and structures from future hazard events, while also reducing reliance on Federal funding in future disasters.	$50 million (est.)
Flood Mitigation Assistance Program	The Flood Mitigation Assistance (FMA) program is authorized by Section 1366 of the National Flood Insurance Act of 1968, as amended (NFIA), 42 U.S.C. 4104c, with the goal of reducing or eliminating claims under the National Flood Insurance Program (NFIP).	$60 million (est.)
Hazard Mitigation Grant Program	HMGP is authorized by Section 404 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act, as amended (the Stafford Act), Title 42, U.S. Code (U.S.C.) 5170c. The key purpose of HMGP is to ensure that the opportunity to take critical mitigation measures to reduce the risk of loss of life and property from future disasters is not lost during the reconstruction process following a disaster. HMGP is available, when authorized under a Presidential major disaster declaration, in the areas of the State requested by the Governor. Indian Tribal governments may also submit a request for a major disaster declaration within their impacted area.	$600 million (est.)
Program Name	Overview	FY 2017 Funding Level
Chesapeake Bay Stewardship Fund: Chesapeake Bay	The Chesapeake Bay Small Watershed Grants Program provides grants to organizations and local governments working on a local level to protect and improve watersheds in the Chesapeake Bay basin, while building citizen-based resource stewardship. The	$6 million

Small Watersheds Grant Program	purpose of the grants program is to support protection and restoration actions that contribute to restoring healthy waters, habitat and living resources of the Chesapeake Bay ecosystem. The Small Watershed Grants Program has been designed to encourage the development and sharing of innovative ideas among the many organizations wishing to be involved in watershed protection activities. The Small Watershed Grants Program is administered by the National Fish and Wildlife Foundation (Foundation), in cooperation with the U.S. Environmental Protection Agency, Chesapeake Bay Program. The Chesapeake Bay Program is a partnership among Virginia, Maryland, Pennsylvania, the District of Columbia, the Chesapeake Bay Commission, and the federal government.	
Chesapeake Bay Stewardship Fund: Innovative Nutrient and Sediment Reduction Program	The overall goal for the Chesapeake Bay Innovative Nutrient and Sediment Reduction Grant Program is to expand the collective knowledge on the most innovative, sustainable and cost-effective strategies - including market-based approaches - for reducing excess nutrient loads within specific tributaries to the Chesapeake Bay. To achieve this goal, the National Fish and Wildlife Foundation, in partnership with EPA and the Chesapeake Bay Program, will award Chesapeake Bay Stewardship grants on a competitive basis of between $200,000 and $1 million each to projects that target and reflect the diverse conditions (e.g., urban, rural, suburban) and sources of nutrients (e.g., agricultural, stormwater, other non-point sources) that exist throughout the Chesapeake watershed.	$6 million
Pulling Together Initiative	The National Fish and Wildlife Foundation's Pulling Together Initiative (PTI) promotes the conservation of natural habitats by preventing, managing, or eradicating invasive and noxious plant species. The program helps support the creation of local cooperative weed management area or cooperative invasive species management area partnerships. Such partnerships bring together local landowners, citizens groups and weed experts to develop and implement strategies for managing weed infestations on public lands, natural areas, and private working lands.	$850,000
Bring Back the Natives Grant Program	The Bring Back the Natives initiative (BBN) funds on-the-ground efforts to restore native aquatic species to their historic range. Projects should involve partnerships between communities, agencies, private landowners, and organizations that seek to rehabilitate streamside and watershed habitats. Projects should focus on habitat needs of species such as fish, invertebrates, and amphibians that originally inhabited the waterways across the country. Funding for the BBN program is administered through NFWF from federal agencies cooperating to support this program. Cooperating agencies and organizations include the US Fish and Wildlife Service (FWS), Bureau of Land Management (BLM), USDA Forest Service (FS), and Trout Unlimited (TU).	TBD
Conservation Partners	Conservation Partners is a partnership between the U.S. Department of Agriculture's Natural Resources Conservation Service (NRCS) (www.nrcs.usda.gov), the National Fish and Wildlife Foundation (NFWF) (www.nfwf.org) and other regional/initiative specific partners. The purpose of this program is to provide grants on a competitive basis to support field biologists and other habitat conservation professionals (ecologists, foresters, range cons, etc.) working with NRCS field offices in providing technical assistance to farmers, ranchers,	TBD

	foresters and other private landowners to optimize wildlife habitat conservation on private lands. Conservation Partners aims to better focus and increase the effectiveness of Farm Bill assistance funded through programs such as Wildlife Habitat Incentives Program (WHIP), Environmental Quality Incentives Program (EQIP), Conservation Reserve Program (CRP) and others. In addition, Conservation Partners will consider funding capacity and outreach for organizations whose mission matches the goals of this program.	
Environmental Solutions for Communities	In 2012, Wells Fargo and the National Fish and Wildlife Foundation launched the Environmental Solutions for Communities initiative, designed to support projects that link economic development and community well-being to the stewardship and health of the environment. This 5-year initiative is supported through a $15 million contribution from Wells Fargo that will be used to leverage other public and private investments with an expected total impact of over $37.5 million. Funding priorities for this program include: (1) supporting sustainable agricultural practices and private lands stewardship; (2) conserving critical land and water resources and improving local water quality; (3) restoring and managing natural habitat, species and ecosystems that are important to community livelihoods; (4) facilitating investments in green infrastructure, renewable energy and energy efficiency; and (5) encouraging broad-based citizen participation in project implementation.	TBD
National Wildlife Refuge Friends Group Grant Program	The National Fish and Wildlife Foundation provides grants for projects that help organizations to be effective co-stewards of our Nation's important natural resources within the National Wildlife Refuge System. This program provides competitive seed grants to help increase the number and effectiveness of organizations interested in assisting the refuge system nationwide. The program will fund: (1) Start-up Grants to assist starting refuge support groups with formative and/or initial operational support (membership drives, training, postage, etc.); (2) Capacity Building Grants to strengthen existing refuge support groups' capacity to be more effective (outreach efforts, strategic planning, membership development); and (3) Project Specific Grants to support a specific project (conservation education programs for local schools, outreach programs for private landowners, habitat restoration projects, etc.)	TBD
Program Name	Overview	FY 2017 Funding Level
Office for Coastal Management Grants and Cooperative Agreements	The National Oceanic and Atmospheric Administration (NOAA) guides the conservation and management of coastal resources through a variety of mechanisms, including collaboration with the coastal resource management programs of the nation's states and territories. The mission of the Office for Coastal Management is to support the environmental, social, and economic well-being of the coast by linking people, information, and technology. The Office's vision is coastal communities becoming more resilient through informed decision-making.	$7.8 million (est.)
National Sea Grant College Program	The National Sea Grant College Program's mission is to enhance the practical use and conservation of coastal, marine and Great Lakes resources in order to create a sustainable economy and environment. Sea Grant accomplishes this mission through	$72.5 million

	research, education, outreach and technology transfer and works as a partnership between the nation's universities and the National Oceanic and Atmospheric Administration. There are 33 Sea Grant Programs in every coastal and Great Lakes state, Puerto Rico, Lake Champlain and Guam. Sea Grant serves as a bridge between government, academia, industry, scientists, and private citizens to promote the sustainable use of Great Lakes and ocean waters for long-term economic growth. Funding opportunities are available through national- and state-level competitions. (Click on the program name and refer to the link listed under "primary Internet" for information on national-level competitions and links to all state Sea Grant Program offices).	
Coastal Zone Management Administration Awards	The National Oceanic and Atmospheric Administration (NOAA) guides the conservation and management of coastal resources through a variety of mechanisms, including collaboration with the coastal resource management programs of the nation's states and territories. The mission of the Office for Coastal Management is to support the environmental, social, and economic well-being of the coast by linking people, information, and technology. The Office's vision is coastal communities becoming more resilient through informed decision-making.	$77.5 million (est.)
Coastal and Marine Habitat Restoration Grants	The principal objective of the National Marine Fisheries Service's (NMFS) Coastal and Marine Habitat Restoration Project solicitation is to identify and support proactive restoration project(s), which use a habitat-based approach to foster species recovery and increase fish production. Proposals submitted under this solicitation will be selected based on their ability to demonstrate how the proposed habitat restoration actions will help recover T&E species listed under the Endangered Species Act, sustain or help rebuild fish stocks managed under the Magnuson-Stevens Fishery Conservation and Management Act, or benefit other coastal and marine species with a nexus to NMFS management. Successful proposals will 1) identify a habitat-based issue/concern limiting the recovery or sustainability of one or more target species (e.g. fish marine mammals, sea turtles); 2) identify the project(s)' goal(s) and describe in detail the actions and on-the-ground habitat restoration project(s) to be undertaken to resolve the issue/concern and; 3) describe the measurable impact on the target species, including evaluation techniques.	$9.29 million
Community-based Marine Debris Prevention and Removal Grants	The NOAA Marine Debris Program (MDP), provides funding to catalyze the implementation of locally driven, community-based marine debris prevention, assessment, and removal projects that benefit coastal habitat, waterways, and NOAA trust resources. The primary priorities for removal are large-scale debris, derelict fishing gear, derelict vessels, tsunami debris clean-ups and targeted shoreline and watershed projects. Projects funded through the MDP have strong on-the-ground habitat components and provide long-term ecological habitat improvements for NOAA trust resources, and provide educational and social benefits for people and their communities.	TBD
Program Name	Overview	FY 2017 Funding Level
Healthy Forests Reserve Program	The Healthy Forests Reserve Program (HFRP) is a voluntary program established for the purpose of restoring and enhancing forest ecosystems to: 1) promote the recovery of T&E species, 2)	$0 (est.)

	improve biodiversity; and, 3) enhance carbon sequestration. Program implementation has been delegated by the Secretary of Agriculture to the Natural Resources Conservation Service.	
Environmental Quality Incentives Program	The USDA Natural Resources Conservation Service's Environmental Quality Incentives Program (EQIP) was established to provide a voluntary conservation program for agricultural producers to address significant natural resource needs and objectives. Through a competitive process, EQIP offers financial assistance contracts with a maximum term of ten years, to help implement eligible conservation practices. Persons or legal entities, who are owners of land under agricultural production or who are engaged in livestock or agricultural production on eligible land, including private non-industrial forest land, or Indian Tribes may participate in EQIP. Conservation practices implemented through EQIP are subject to NRCS technical standards adapted for local conditions. NRCS or Technical Service Providers (TSPs) help applications develop a plan of operations which identifies practices needed to address natural resource concerns and support the EQIP contract. EQIP-related programs include Conservation Innovation Grants (CIG), Resource Conservation Partnership Program (RCPP), and the National Water Quality Initiative (NWQI).	$1.274 million (est.)
Emergency Watershed Protection	The USDA Natural Resources Conservation Service's Emergency Watershed Protection (EWP) program helps protect lives and property threatened by natural disasters such as floods, hurricanes, tornadoes, droughts, and wildfires. EWP provides funding for such work as clearing debris from clogged waterways, restoring vegetation, and stabilizing river banks. The measures that are taken must be environmentally and economically sound and generally benefit more than one property owner. EWP also provides funds to purchase floodplain easements as an alternative (in lieu of recovery) to the normal emergency recovery measure. Floodplain easements restore, protect, maintain, and enhance the functions of the floodplain; conserve natural values including fish and wildlife habitat, water quality, flood water retention, ground water recharge, and open space; reduce long-term federal disaster assistance; and safeguard lives and property from floods, drought, and the products of erosion. EWP cost-share rate is paid at a 75/25 percent ratio, but can provide up to 90 percent cost share if an area qualifies as a limited resource areas, as determined by the federal, state, and local census data.	$15 million (est.)
Watershed Rehabilitation Program	This program provides a 65 percent Federal cost-share to rehabilitate aging dams that were originally constructed either through Public Law-566, Public Law-534, Pilot Watershed Program authorized under the Department of Agriculture Appropriation Act of 1954, or through the Resource Conservation & Development program. The purpose for rehabilitation is to extend the service life of dams and bring them into compliance with current and applicable safety and performance standards or to decommission the dams so they no longer pose a threat to life and property.	$15.643 million (est.)
Conservation Reserve Program	The Conservation Reserve Program (CRP) is a voluntary program for agricultural landowners. Through CRP, you can receive annual rental payments and cost-share assistance to establish long-term, resource conserving covers on eligible farmland.	$2 billion (est.)

Community Forest and Open Space Conservation Program	The Community Forest Program (CFP) provides financial assistance grants to local governments, Indian Tribes, and qualified non-profits to establish community forests through fee simple acquisition that provide public benefits. The CFP: 1) Provides public access and recreational opportunities, protects vital water supplies and wildlife habitat, addresses the effects of a changing climate, provides demo sites for private forest landowners, and derives financial and community benefits from sustainable management. 2) Promotes protection and enjoyment of the Nation's outdoor heritage by empowering people and communities to protect and restore places they cherish. 3) Targets private lands that are threatened by conversion to non-forest uses, are not held in trust by the United States, and can provide defined community benefits and allow public access.	$2 million
Agricultural Management Assistance	Agricultural Management Assistance (AMA) provides cost share assistance to agricultural producers to voluntarily address issues such as water management, water quality, and erosion control by incorporating conservation into their farming operations. Producers may construct or improve water management structures or irrigation structures; plant trees for windbreaks or to improve water quality; and mitigate risk through production diversification or resource conservation practices, including soil erosion control, integrated pest management, or transition to organic farming.	$2.5 million
Regional Conservation Partnership Program (RCPP)	The Regional Conservation Partnership Program (RCPP) is a new farm bill program that gives NRCS the authority to enhance regional cooperation to implement and maintain conservation activities, thereby promoting the restoration and sustainable use of soil, water, wildlife, and related natural resources on regional or watershed scales. NRCS will co-invest in mobilizing creative and workable solutions to agricultural production and resource management challenges with eligible partners. NRCS provides assistance to producers through partnership agreements and through program contracts or easement agreements. RCPP combines the authorities of four former conservation programs – the Agricultural Water Enhancement Program, the Chesapeake Bay Watershed Program, the Cooperative Conservation Partnership Initiative and the Great Lakes Basin Program. Assistance is delivered in accordance with the rules of EQIP, CSP, ACEP and HFRP; and in designated Critical Conservation Areas the Watershed Operations and Flood Prevention Program.	$230 million
USDA's Small Business Innovation Research	To stimulate technological innovation in the private sector, strengthen the role of small businesses in meeting Federal research and development needs, increase private sector commercialization of innovations derived from USDA-supported research and development efforts, and foster and encourage participation, by women-owned and socially disadvantaged small business firms in technological innovation. The selected areas for research are Forests and Related Resources; Plant Production and Protection-Biology; Plant Production and Protection - Engineering; Animal Production and Protection; Air, Water and Soils; Food Science and Nutrition; Rural and Community Development; Aquaculture; Bio-fuels and Bio-based Products; and Small and Mid-size Farms.	$25.2 million (est.)
Wildlife Habitat Incentives Program	The Wildlife Habitat Incentives Program (WHIP) is a voluntary program for people who want to develop and improve wildlife	$5 million

	habitat on private lands. It provides both technical assistance and cost sharing to help establish and improve fish and wildlife habitat. Participants work with USDA's Natural Resources Conservation Service to prepare a wildlife habitat development plan in consultation with a local conservation district. The plan describes the landowner's goals for improving wildlife habitat, includes a list of practices and a schedule for installing them, and details the steps necessary to maintain the habitat for the life of the agreement.	
Forest Legacy Program	The USDA Forest Service supports state efforts to protect environmentally important forest lands from the conversion to non-forest uses through the use of conservation easements and fee-simple purchase. Designed to encourage the protection of privately owned forest lands, FLP is an entirely voluntary program. Since inception the program has conserved 2.6 million acres of forest land through support of conservation easements (84% of acres) and fee acquisition (16% of acres). Conservation easements enable landowners to retain ownership of their land and continue to earn income from it while keeping drinking water safe and clean, conserving valuable open space as well as protecting critical wildlife habitats and outdoor recreation opportunities. The program promotes professional forest management and requires forest management plans to guide management of the conserved properties. The program emphasizes strategic conservation - working in partnership with States, local communities and non-governmental organizations to make a difference on the land and for communities by conserving areas of unbroken forest, watershed or river corridor forests or by complementing existing land conservation efforts.	$62.347 million
National Urban and Community Forestry Challenge Cost-Share Program	The U.S. Forest Service's Urban and Community Forestry Challenge Cost-Share Grant Program seeks to establish sustainable urban and community forests by encouraging communities to manage and protect their natural resources. The program works to achieve a number of goals, including (1) effectively communicating information about the social, economic, and ecological values of urban and community forests; (2) involving diverse resource professionals in urban and community forestry issues; and (3) supporting a holistic view of urban and community forestry. In particular, the program supports an ecosystem approach to managing urban forests for their benefits to air quality, stormwater runoff, wildlife and fish habitat, and other related ecosystem concerns. The Forest Service awards these grants based on recommendations made by The National Urban and Community Forestry Advisory Council, a 15-member advisory council created by the 1990 Farm Bill to provide advice to the Secretary of Agriculture on urban and community forestry. These grants are intended to address national issues or opportunities related to urban and community forestry. Local proposals are asked to contact their state forestry agency.	$900,000
Water and Waste Disposal Systems for Rural Communities	This USDA Rural Utilities Service program provides monies to provide basic human amenities, alleviate health hazards, and promote the orderly growth of the rural areas of the nation by meeting the need for new and improved rural water and waste disposal facilities. Funds may be used for the installation, repair, improvement, or expansion of a rural water facility including costs of distribution lines and well pumping facilities. Funds also support the installation, repair, improvement, or expansion of a	Grants: $348 million (est.); Loans: 1.1 billion (est.); Guaranteed Loans: 10 million (est.)

	rural waste disposal facility, including the collection and treatment of sanitary waste stream, stormwater, and solid wastes.	
Agricultural Easement Conservation Program (ACEP)	USDA Natural Resources Conservation Service (NRCS) developed one new consolidated easement program (repealing the individual WRP, GRP, and FRPP programs). Two components were developed under the ACEP that are similar to the predecessor repealed programs, including Wetland Reserve Easement (ACEP-WRE) component and the Agricultural Land Easement (ACEP-ALE) component. The purposes of FRPP and GRP have been consolidated under the ACEP-ALE component, the purposes of WRP are contained in the ACEP-WRE component.	TBD
Sustainable Agriculture Research and Education	The Sustainable Agriculture Research and Education (SARE) program of the U.S. Department of Agriculture National Institute of Food and Agriculture (NIFA) works to advance farming systems that are productive, profitable, environmentally sound and good for communities through a regional grants program. SARE funds research and extension activities to reduce the use of chemical pesticides, fertilizers, and toxic materials in agricultural production; to improve management of on-farm resources to enhance productivity, profitability, and competitiveness; to promote crop, livestock, and enterprise diversification and to facilitate the research of agricultural production systems in areas that possess various soil, climatic, and physical characteristics; to study farms that are managed using farm practices that optimize on-farm resources and conservation practices; and to promote partnerships among farmers, non-profit organizations, agribusiness, and public and private research and extension institutions. Click on program name and check the link in the Primary Internet box for more information about grant opportunities and program results.	TBD
National Integrated Water Quality Program (NIWQP)	The National Integrated Water Quality Program (NIWQP) provides funding for research, education, and extension projects aimed at improving water quality in agricultural and rural watersheds. The NIWQP has identified eight "themes" that are being promoted in research, education and extension. The eight themes are (1) Animal manure and waste management (2) Drinking water and human health (3) Environmental restoration (4) Nutrient and pesticide management (5) Pollution assessment and prevention (6) Watershed management (7) Water conservation and agricultural water management (8) Water policy and economics. Awards are made in four program areas - National Projects, Regional Coordination Projects, Extension Education Projects, and Integrated Research, Education and Extension Projects. Please note that funding is only available to universities.	none
Program Name	Overview	FY 2017 Funding Level
Tribal Environmental Regulatory Enhancement Program	The purpose of the Environmental Regulatory Enhancement (ERE) program is to provide funding for the costs of planning, developing, and implementing programs designed to improve the capability of tribal governing bodies to regulate environmental quality pursuant to federal and tribal environmental laws. The ERE program supports the principle that projects must follow tribal cultural preservation and natural resource management priorities in order to achieve environmentally healthy, sustainable Native	TBD

	American and Alaska Native communities. The Administration for Native Americans (ANA) is therefore interested in supporting locally designed projects that strengthen tribal environmental regulatory programs in a manner consistent with the goals of native communities. Program areas of interest include, but are not limited to, the following: 1) providing training and education to employees responsible for enforcing, or monitoring compliance with, environmental quality laws; 2) developing laws, regulations, and ordinances to protect the environment; 3) enforcing and monitoring environmental quality laws, regulations and ordinances; 4) establishing baseline condition for regulatory purposes; 5) building the technical and program capability of the tribe or organization to perform essential environmental program functions to meet tribal and federal regulatory requirements; 6) informing the community about regulations and environmental stewardship; 7) establishing demonstration projects to exhibit technologies, which can lead to compliance with environmental regulations.	
Program Name	Overview	FY 2017 Funding Level
Community Development Block Grants/Entitlement Grants	The objective of this program is to develop viable urban communities, by providing decent housing and a suitable living environment, and by expanding economic opportunities, principally for persons of low and moderate income. Recipients may undertake a wide range of activities directed toward neighborhood revitalization, economic development and provision of improved community facilities and services.	$3 billion
Indian Community Development Block Grant Program	This Department of Housing and Urban Development program is intended to help Indian tribes and Alaska Native villages develop viable Indian communities. Grant money may be used to improve housing stock, provide community facilities, make infrastructure improvements, and expand job opportunities by supporting the economic development of the communities. Eligible activities include housing rehabilitation, construction of tribal and other facilities, streets and other public facilities, and economic development and environmental improvement projects (including drinking water, wastewater, and solid waste projects).	$80 million (est.)
Program Name	Overview	FY 2017 Funding Level
Not-for-Profit Acid Mine Drainage Reclamation	The U.S. Department of Interior's Acid Mine Drainage (AMD) Reclamation Program is designed to support the efforts of local not-for-profit organizations, especially watershed groups, to complete construction projects designed to clean streams impacted by AMD.	$1.5 million
Cooperative Watershed Management Program	Through the Cooperative Watershed Management Program (CWMP), Reclamation provides financial assistance to locally led watershed groups to encourage diverse stakeholders to form local solutions to water management needs. By providing this funding, Reclamation aims to promote the sustainable use of water resources and improve the condition of rivers and streams through water conservation, improved water quality and ecological resilience, and reduced conflicts over water through collaborative conservation efforts.	$1.75 million (est.)

Rivers, Trails, and Conservation Assistance (National Park Service)	The Department of Interior, through its Rivers, Trails and Conservation Assistance Program (Rivers & Trails) promotes sustainable community-based environmental conservation and brownfields redevelopment. The National Park Service (NPS) does not provide financial assistance, but does provide staff time for efforts such as conservation and community revitalization.	$10 million
WaterSMART Grants	WaterSMART Grants is administered by the Bureau of Reclamation and is designed to contribute to this goal by providing 50% cost shared funding for water and energy improvement projects that make more efficient use of existing water supplies. WaterSMART Grants provide cost-shared assistance on a competitive basis. Funding is used primarily to carry out water and energy efficiency improvements, including projects that save water; increase energy efficiency and the use of renewable energy in water management; support environmental benefits; facilitate and support water markets; mitigate the risk of future water conflict in areas of high risk; and accomplish other benefits that contribute to water supply sustainability in the western United States.	$24 million
Drought Response Program	Reclamation's Drought Response Program supports a proactive approach to drought. Through the Drought Response Program, Reclamation provides assistance to water users for drought contingency planning, and to take actions that will build long-term resiliency to drought.	$7.5 million
Land and Water Conservation Fund (Outdoor Recreation, Acquisition, Development and Planning Grants)	To provide financial assistance to the States and their political subdivisions for the preparation of Statewide Comprehensive Outdoor Recreation Plans (SCORPs) and acquisition and development of outdoor recreation areas and facilities for the general public, to meet current and future needs.	$94 million
Forestry on Indian Lands	This U.S. Department of the Interior, Bureau of Indian Affairs program is intended to maintain, protect, enhance, and develop Indian forest resources through the execution of forest management activities, including reforestation and commercial forest stand improvement, timber sales management, forest inventories and plans, forest program management and administration, and forest protection activities. Previously funded projects include tree planting, weeding and fertilization, development or revision of long-term sustained-yield forest management plans, timber preparation, timber sale administration, and forest restoration.	TBD
Water Resources on Indian Lands	This program assists Indian tribes with the management, planning, protection, and development of their water resources and related land resources. Tribes use funds for specific water resource projects, as well as to collect and analyze baseline data and to facilitate litigation and negotiation activities. Previously funded projects have included geographic and hydrologic quantitative and qualitative analysis of water, ground water and surface water quality and quantity monitoring, aquifer classification, stream gaging, ecosystem development and management, and planning for compliance with the Endangered Species Act.	TBD
Program Name	Overview	FY 2017 Funding Level

Urban Waters Small Grants	The mission of EPA's Urban Waters Program is to help local residents and their organizations, particularly those in underserved communities, restore their urban waters in ways that also benefit community and economic revitalization. EPA's funding priority is to achieve the goals and commitments established in the Agency's Urban Waters Strategic Framework (www2.epa.gov/urbanwaters/urban-waters-strategic-framework). One of the ways the Urban Waters Program is accomplishing this mission is through the Urban Waters Small Grants Program. This program recognizes that healthy and accessible urban waters can help grow local businesses and enhance educational, recreational, social, and employment opportunities in nearby communities.	$0
Drinking Water State Revolving Fund	EPA awards grants to states to capitalize their Drinking Water State Revolving Fund (DWSRF) programs. States use a portion of their capitalization grants to set up a revolving fund from which loans are provided to eligible public water utilities (publicly and privately owned) to finance the costs of infrastructure projects. States rank projects and offer loans to utilities based on a priority ranking system. Priority is given to eligible projects that: (1) address the most serious risk to human health; (2) are necessary to ensure compliance with the requirements of the Safe Drinking Water Act; and, (3) assist systems most in need, on a per household basis, according to state-determined affordability criteria. States may also use up to 31 percent of their capitalization grants to fund set-aside activities that help to prevent contamination problems of surface and ground water drinking water supplies, as well as enhance water system management through source water protection, capacity development, and operator certification programs.	$1 billion (est.)
Clean Water State Revolving Fund	The EPA's Clean Water State Revolving Fund (CWSRF) program provides a permanent source of low-cost financing for a wide range of water quality infrastructure projects. These projects include municipal wastewater treatment and collection, non-point source pollution controls, decentralized wastewater treatment systems, green infrastructure, water efficiency, and estuary management. Funds to capitalize the program are provided annually through federal grants and state matching funds (equal to 20% of federal grants). Monies are loaned to assistance recipients at below-market rates. In addition, states also have the ability to customize loan terms to benefit small and disadvantaged communities. Loan repayments are recycled back into the programs to fund additional projects. Since its inception, the CWSRF has provided over $118 billion in assistance to eligible borrowers, including communities of all sizes, farmers, small businesses, and non-profit organizations. More information on the CWSRF program can be obtained at http://www.epa.gov/cwsrf	$1,393,887,000
Source Reduction Assistance Grant Program	During Fiscal Years 2016 and 2017, the Source Reduction Assistance Grant Program will fund two-year grants and/or cooperative agreements that carry out project activities using at least one of the following methods – surveys, studies, research, investigation, experimentation, education, training and/or demonstrations. Projects will also need to address one or more of the Pollution Prevention Program's National Emphasis Areas: Climate Change Mitigation/Prevention of Greenhouse Gas Emissions, Food Manufacturing and Processing and State or Community Approaches to Hazardous Materials Source Reduction	$1.294 million

	in order to be considered for funding. Additionally, applicants are required to address environmental outcomes of: reducing pollution, conserving energy and water, and saving dollars through P2 efforts; as identified in EPA's Strategic Plan under Goal 4: Ensuring Safety of Chemicals and Preventing Pollution, Objective 4.2: Promote Pollution Prevention. Eligible entities include: state agencies, colleges or universities (that are instrumentalities of a state), federally-recognized tribes, intertribal consortia, local governments, city or township governments, independent school district governments, state controlled institutions of higher education, non-profit organizations (other than institutions of higher education), private institutions of higher education and community-based grassroots organizations.	
Wetlands Program Development Grants	The EPA's Wetland Program Development Grants are intended to encourage comprehensive wetlands program development by promoting the coordination and acceleration of research, investigations, experiments, training, demonstrations, surveys, and studies relating to the causes, effects, extent, prevention, reduction, and elimination of water pollution. Projects build the capacity of states, tribes, and local governments to effectively protect wetland and riparian resources. Projects funded under this program support building or refining a wetlands program through four core elements of a wetlands program: regulation, monitoring/assessment, voluntary restoration/protection, and water quality standards for wetlands.	$14.15 million (est.)
Non-point Source Implementation Grants (319 Program)	Through its 319 program, EPA provides formula grants to the states, territories and tribes to implement non-point source programs and projects and programs in accordance with section 319 of the Clean Water Act (CWA). Non-point source pollution projects can be used for a wide range of activities including agriculture, forestry, construction, and urban challenges. When set as priorities within a state's Non-point source management program, projects may also be used to protect source water areas and high quality waters. Examples of previously funded projects include installation of best management practices (BMPs) for animal waste; design and implementation of BMP systems for stream, lake, and estuary watersheds; and basin-wide landowner education programs. Most states provide opportunities for 3rd parties to apply for funds under a state request for proposal.	$168 million
Environmental Workforce Development and Job Training Cooperative Agreements (formerly Brownfields Job Training Program)	Environmental Workforce Development and Job Training Grants are designed to provide funding to eligible entities, including non-profit organizations, to recruit, train, and place predominantly low-income and minority, unemployed and under-employed residents of solid and hazardous waste-impacted communities with the skills needed to secure full-time, sustainable employment in the environmental field and in the assessment and cleanup work taking place in their communities.	$2.7 million (est.)
Five-Star Restoration Program	The EPA supports the Five-Star Restoration Program by providing funds to the National Fish and Wildlife Foundation and its partners, the National Association of Counties, NOAA's Community-based Restoration Program and the Wildlife Habitat Council. These groups then make sub-grants to support community-based wetland and riparian restoration projects. Competitive projects will have a strong on-the-ground habitat	$250,000

	restoration component that provides long-term ecological, educational, and/or socioeconomic benefits to the people and their community. Preference will be given to projects that are part of a larger watershed or community stewardship effort and include a description of long-term management activities. Projects must involve contributions from multiple and diverse partners, including citizen volunteer organizations, corporations, private landowners, local conservation organizations, youth groups, charitable foundations, and other federal, state, and tribal agencies and local governments. Each project would ideally involve at least five partners who are expected to contribute funding, land, technical assistance, workforce support, or other in-kind services that are equivalent to the federal contribution.	
Environmental Education Grants	Under the EE Grant Program, EPA funds grant proposals from eligible applicants to support environmental education projects that promote environmental stewardship and help develop knowledgeable and responsible students, teachers, and citizens. Further, this grant program provides financial support for projects that design, demonstrate, and/or disseminate environmental education practices, methods, or techniques as described in each solicitation notice. In FY17 EPA expects to award one or two rounds of environmental education grants from the ten EPA Regional offices, selecting from the pool of applications received late in FY16.	$3.3 million
Pollution Prevention Grant Program	During Fiscal Years 2016 and 2017, the Pollution Prevention Grant Program will fund two-year grants and/or cooperative agreements that provide pollution prevention technical assistance or training to businesses. Projects must address one or more of the Pollution Prevention Program's National Emphasis Areas: Climate Change Mitigation/Prevention of Greenhouse Gas Emissions, Food Manufacturing and Processing and State or Community Approaches to Hazardous Materials Source Reduction in order to be considered for funding. Applicants are also required to address environmental outcomes of: reducing pollution, conserving energy and water, and saving dollars through P2 efforts; as identified in EPA's Strategic Plan under Goal 4: Ensuring Safety of Chemicals and Preventing Pollution, Objective 4.2: Promote Pollution Prevention. Eligible entities include: state agencies, colleges or universities (that are instrumentalities of a state), federally-recognized tribes and intertribal consortia.	$3.969 million
Clean Water Act Indian Set-Aside Grant Program	The EPA's Clean Water Act Indian Set-Aside Grant Program provides assistance to Indian tribes and Alaska Native Villages for the planning, design, and construction of wastewater treatment systems. This program uses the Indian Health Service's (IHS) Sanitation Deficiency System (SDS) to identify priority wastewater projects for EPA grant funding. Eligible projects include, but are not limited to, interceptor sewers, wastewater treatment facilities, infiltration/inflow correction, collector sewers, major sewer system rehabilitation, and correction of combined sewer overflows.	$30 million
Science to Achieve Results	The Science to Achieve Results (STAR) program is designed to improve the quality of science used in EPA's decision-making process. STAR funds are provided for research in the following the following priority areas: (1) Air, Climate and Energy: Anthropogenic Influences on Organic Aerosol Formation and Regional Climate Implications; Measurements and Modeling for	$47 million (est.)

	Quantifying Air Quality and Climatic Impacts of Residential Biomass or Coal Combustion for Cooking, Heating, and Lighting. (2) Chemical Safety and Sustainability: Center for Sustainable Molecular Design; Center for Material Life Cycle Safety; Human Exposure to Chemicals in Consumer Products and Indoor Environments; Development and Use of Adverse Outcome Pathways that Predict Adverse Developmental Neurotoxicity. (3) Safe and Sustainable Water Resources: Sustainable Chesapeake: A Community-Based Approach to Stormwater Management Using Green Infrastructure; Performance and Effectiveness of Green Infrastructure Stormwater Management Approaches in the Urban Context: A Philadelphia Case Study; High Priority Water Quality and Availability Research. (4) Safe and Healthy Communities: Research with Children's Health; Children's Environmental Health and Disease Prevention Research Centers (with NIEHS); Science for Sustainable and Healthy Tribes; Healthy and Sustainable Schools: Environmental Factors, Children's Health and Performance, and Sustainable Building Practices. In addition to the solicitations identified above, other solicitations may be announced in the coming year. Please check the NCER website for an updated listing of all solicitations.	
Chesapeake Bay Program Grants	The EPA's Chesapeake Bay Program (CBP) awards grants to reduce and prevent pollution and to improve the living resources in the Chesapeake Bay. Grants are awarded for implementation projects, as well as for research, monitoring, and other related activities.	$54.1 million
Brownfields Assessment and Cleanup Cooperative Agreements	Brownfield sites are real property, the expansion, redevelopment, or reuse of which may be complicated by the presence or potential presence of a hazardous substance, pollutant, or contaminant. The objectives of the brownfield assessment, revolving loan fund and cleanup cooperative agreements (project grants) are to provide funding: (1) to inventory, characterize, assess, and conduct planning and community involvement related to brownfield sites; (2) to capitalize a revolving loan fund (RLF) and provide sub-grants to carry out cleanup activities at brownfield sites; and (3) to carry out cleanup activities at brownfield sites that are owned by the grant recipient.	$56 million (est.)
Indian Environmental General Assistance Program	The Indian Environmental General Assistance Program provides financial assistance to Indian tribal governments and intertribal consortia to cover the costs of planning, developing, and establishing the capacity to implement, on Indian lands, programs administered by the Environmental Protection Agency. The program also provides financial assistance for implementation of tribal government solid and hazardous waste programs that are carried out in accordance with federal laws, including the Solid Waste Disposal Act. These grants support tribal governments' efforts to develop and maintain core environmental program capacities (e.g., financial management, codes and ordinances, technical/analytical, intergovernmental agreements and public education) and develop baseline capacities for media-specific programs (e.g., ambient air quality, water quality and managing waste). Determined by regional offices.	$64.3 million
Beaches Environmental Assessment and Coastal Health (BEACH) Act Grants	The EPA's Beaches Environmental Assessment and Coastal Health (BEACH) Act Grant Program provides formula grants to eligible states, territories, and tribes to support microbiological testing and monitoring of coastal recreation waters, including the Great Lakes, that are adjacent to beaches or similar points of access	$9.4 million

	used by the public. BEACH Act grants also provide support for development and implementation of programs to notify the public of the potential exposure to disease-causing microorganisms in coastal recreation waters.	
Great Lakes Program	USEPA leads a consortium of programs, agencies, and public and private institutions in attaining specific objectives and actions that will address the most significant Great Lakes ecosystem problems and efforts in five major focus areas: Toxic Substances and Areas of Concern; Invasive Species; Non-point Source Pollution Impacts on Nearshore Health; Habitats and Species; and Foundations for Future Restoration Actions. Funded activities will advance protection and restoration of the Great Lakes ecosystem in support of (i) the Great Lakes Restoration Initiative as described in the Great Lakes Restoration Initiative Action Plan II (available from: http://www.greatlakesrestoration.us/actionplan/index.html), (ii) the Great Lakes portion of Objective 2.02 (Protect and Restore Watersheds and Aquatic Ecosystems) of EPA's 2014-2018 Strategic Plan, and/or (iii) the Great Lakes Regional Collaboration Strategy to Protect and Restore the Great Lakes (http://www.glrc.us/strategy.html).	GLRI total: $300 million. Grants: $65 million (est.). GLLA: $40 million (est.)
Drinking Water SRF Tribal Set-Aside Program	EPA sets aside a portion of the total Drinking Water State Revolving Fund (DWSRF) allocation for infrastructure improvements to public drinking water systems that serve tribes. Funds are allotted to EPA regions which award projects through regionally developed priority setting processes. Eligible projects include installation and upgrade of treatment, storage, or distribution systems, as well as projects to develop sources or replace contaminated sources. Projects not eligible include reservoirs, dams, dam rehabilitation and water rights. Projects must address an existing drinking water quality problem and identify how the proposed project will improve the quality of drinking water to comply with Safe Drinking Water Act (SDWA) primary or secondary standards.	TBD
Superfund Technical Assistance Grants for Citizen Groups at Priority Sites	The EPA awards funds to qualified groups of individuals to procure independent technical advisors to help in interpreting and commenting on Superfund site-related information and decisions. Examples of how a technical advisor can help a group include, but are not limited to: reviewing preliminary site assessment/site investigation data; participating in public meetings to help interpret information about site conditions, proposed remedies, and the implementation of a remedy; visiting the site vicinity periodically during cleanup, if possible, to observe progress and provide technical updates to the group; and evaluating future land use options based on land use assumptions in the "remedial investigation/feasibility study." Funds can be used at sites that are listed on the National Priorities List (NPL) or proposed for the NPL where a "response" action has begun.	TBD
Program Name	Overview	FY 2017 Funding Level
Coastal Program	The U.S. Fish and Wildlife Service (FWS) Coastal Program partners with communities to provide technical and financial assistance to assess, protect, and restore or enhance priority coastal habitats for the benefit of fish and wildlife. The program is delivered through a network of 24 field offices in priority coastal habitats	$14 million (est.)

	along the Atlantic, Pacific, Gulf of Mexico coasts and in the Great Lakes. Program biologists provide restoration expertise and financial assistance to federal and state agencies, local and tribal governments, businesses, private landowners, and conservation organizations such as local land trusts and watershed councils.	
Clean Vessel Act Pumpout Program	The Clean Vessel Act Grant Program is intended to prevent recreational boat sewage from entering U.S. waters. The program provides grants to coastal states for surveying and planning pumpout/dump stations for wastewater. The program also provides funds to all states for construction and renovation of pumpout/dump stations, as well for educational programs about disposing of human waste in an environmentally safe manner.	$15.4 million
National Coastal Wetlands Conservation Grant Program	The U.S. Fish and Wildlife Service's National Coastal Wetlands Conservation Grant Program provides matching grants to states and territories for coastal wetland conservation projects. Funds may be used for acquiring land or conservation easements, restoration, enhancement, or management of coastal wetland ecosystems. Projects must provide for long-term conservation of coastal wetlands.	$17 million (est.)
State Wildlife Grant Program (Non-Tribal and Non-Competitive)	The U.S. Fish and Wildlife Service's (USFWS) State Wildlife Grant (SWG) program provides grants to states, territories, and the District of Columbia for wildlife conservation. The SWG program provides funds to help develop and implement programs that benefit wildlife and their habitat, including species that are not hunted or fished. Although not directly eligible for these grants, third parties such as non-profit organizations may benefit from these funds by working directly with their states to see if either grants or partnering opportunities are available.	$48,379,586
Partners for Fish and Wildlife Program	The Partners for Fish and Wildlife Program provides technical and financial assistance to private landowners to restore fish and wildlife habitats on their lands via cooperative agreements. Since 1987, the program has partnered with more than 37,700 landowners to restore 765,400 acres of wetlands; over 1.9 million acres of grasslands and other upland habitats; and 6,560 miles of in-stream and streamside habitat. In addition, the program restores stream habitat for fish and other aquatic species by removing barriers to passage.	$52 million (est.)
Cooperative Endangered Species Conservation Fund	The U.S. Fish and Wildlife Service's (USFWS) Cooperative Endangered Species Conservation Fund provides financial assistance to states and territories that have entered into cooperative agreements with the USFWS to assist in the development of programs for the conservation of endangered and threatened species. The assistance provided to the state or territorial wildlife agency can include animal, plant, and habitat surveys; research; planning; monitoring; habitat protection, restoration, management, and acquisition; and public education. The Fund is dispersed to the states and territories through four programs: Conservation Grants, Habitat Conservation Planning Assistance Grants, Habitat Conservation Plan Land Acquisition Grants, and Recovery Land Acquisition Grants. Although not directly eligible for these grants, third parties such as non-profit organizations and local governments may work with their state or territorial wildlife agency to apply for these funds.	$53.495 million

North American Wetlands Conservation Act Grants Program	The U.S. Fish and Wildlife Service's Division of Bird Habitat Conservation administers this matching grants program to carry out wetlands and associated uplands conservation projects in the United States, Canada, and Mexico. Grant requests must be matched by a partnership with non-federal funds at a minimum 1:1 ratio. Conservation activities supported by the Act in the United States and Canada include habitat protection, restoration, and enhancement. Mexican partnerships may also develop training, educational, and management programs and conduct sustainable-use studies. Project proposals must meet certain biological criteria established under the Act. Visit the program web site for more information. (Click on the hyperlinked program name to see the listing for "Primary Internet".)	$78 million (est.)
U.S. Small Grants	The U.S. Small Grants Program is a competitive, matching grant program that supports public-private partnerships carrying out projects in the U.S. that further the goals of the North American Westalnd Conservation Act. These projects must involved long-term protection, restoration, enhancement and or establishment of wetlands and associated uplands habitats for the benefit of all wetlands associated migratory birds. A 1:1 match is required.	$3 million
Program Name	Overview	FY 2017 Funding Level
Water Resources Research National Competitive Grants Program	This program supports research on the topic of improving and enhancing the nation's water supply, including (but not limited to) enhancement of water supply infrastructure, development of drought impact indicators, evaluation of the dynamics of extreme hydrological events and associated costs, development of methods for better estimation of the physical and economic supply of water, integrated management of ground and surface waters, the resilience of public water supplies, and the evaluation of conservation practices. Proposals are sought in not only the physical dimensions of supply, but also the role of economics and institutions in water supply and in coping with extreme hydrologic conditions. A copy of the Announcement is available at https://niwr.net/competitive_grants/RFP	$6.5 million
Program Name	Overview	FY 2017 Funding Level
Five-Star & Urban Waters Restoration Grants	The Five Star and Urban Waters Restoration Program seeks to develop nation-wide-community stewardship of local natural resources, preserving these resources for future generations and enhancing habitat for local wildlife. Projects seek to address water quality issues in priority watersheds, such as erosion due to unstable stream banks, pollution from stormwater runoff, and degraded shorelines caused by development.	$2.5 million
Environmental Justice Small Grants Program	The Environmental Justice Small Grants Program supports and empowers communities working on solutions to local environmental and public health issues. The program is designed to help communities understand and address exposure to multiple environmental harms and risks. Environmental Justice Small Grants fund projects up to $30,000, depending on the availability of funds in a given year.	--
Environmental Justice	The EJCPS Program provides up to $120,000 in financial assistance over a two-year period to enable community-based organizations	TBD

Collaborative Problem Solving (EJCPS) Grants Program	to partner with stakeholders from across industry, government, academia to develop and implement solutions that will significantly address environmental and/or public health issues at the local level. Projects must use the CPS Model, comprised of seven elements of a successful collaborative partnership, to address local environmental and/or public health issues. Because EPA requires substantial involvement and interaction between the applicant, EPA regions and OEJ, these awards will be made in the form of cooperative agreements.	
Surface Transportation Program	The Surface Transportation Program is one of the main sources of flexible funding available for transit or highway purposes. STP provides the greatest flexibility in the use of funds. The funds may be used (as capital funding) for public transportation capital improvements, car and vanpool projects, fringe and corridor parking facilities, bicycle and pedestrian facilities, and intercity or intracity bus terminals and bus facilities. As funding for planning, these funds can be used for surface transportation planning activities, wetland mitigation, transit research and development and environmental analysis.	TBD
Transportation Investment Generating Economic Recovery (TIGER) Discretionary Grant Program	The U.S. Department of Transportation provides assistance for capital projects related to highways, bridges, public transportation, rail, ports, and intermodal projects. A primary selection criterion specifically mentions addressing environmental sustainability including avoiding adverse environmental impacts to water quality, providing environmental benefits such as ground water recharge in areas of water scarcity, and stormwater mitigation, including green infrastructure. Applicants are encouraged to provide quantitative information, including baseline information that demonstrates how the project will reduce stormwater runoff.	TBD

12.3 State and District of Columbia Programs

States rely heavily on federal funding to maintain capacity to facilitate programs and projects that support ecosystem health. The following is a list of state programs that participate in Chesapeake Bay Watershed-related endeavors as reported to Congress in 2016 (**Table 40**).

Table 40. List of state programs that participate in Chesapeake Bay Watershed-related endeavors as reported to Congress in 2016

JURISDICTION	DEPARTMENT
Delaware	Natural Resources and Environmental Control Conservation Cost Share Non-point Source Program Local Government Funding Chesapeake Bay Regulatory & Accountability Grant Program
District of Columbia	Energy and the Environment State Revolving Fund Clean Water Construction Non-point Source Program Chesapeake Bay Program Water Pollution Control Program Stream Restoration and Demonstration Floodplain Management Program Fisheries Management and Aquatic Education

JURISDICTION	DEPARTMENT
	Fishing License Program MS4 Stormwater Program Stormwater and Erosion/Sediment Control Anacostia Fund Anacostia Sediment Study Transportation Green Infrastructure in Roadway and Bridge Capital Projects Urban Forestry Administration DC Water Blue Plain Operations and Maintenance
Maryland	Natural Resources Program Open Space Rural Legacy Oyster Restoration Artificial Reef Initiative Agriculture Maryland Agricultural Land Preservation Foundation Agricultural BMPs Planning Environment Septic Systems Stormwater Wastewater Treatment Plants Education Transportation Transit and Sustainable Transportation Alternatives
New York	Agriculture and Markets Non-point Source Abatement and Control Grant Program Agricultural Environmental Management Environmental Conservation Water Quality Improvement Projects Grant Program Engineering Planning Grant Chesapeake Bay Watershed Program Environmental Facilities Corporation Green Infrastructure Program
Pennsylvania	Environmental Protection Growing Greener Water Pollution Control Chesapeake Bay Implementation Program Management, Project Construction and Regulatory & Accountability Flood Protection Program Non-point Source Program Water Pollution Control and Monitoring Monitoring, Assessment and Planning Soil, Water, and Air Technologies Program State Conservation Commission Conservation District Fund Allocation Program Dirt, Gravel and Low Volume Road Program Nutrient Management Program Resource Enhancement and Protection Program

JURISDICTION	DEPARTMENT
	Infrastructure Investment Authority Project Construction and Implementation Natural Resources Land Conservation Rivers Conservation Riparian Buffers
Virginia	Conservation and Recreation Soil and Water Conservation Assistance to Conservation Districts Agricultural BMPs Cost Share Assistance Dam Inventory, Evaluation and Classification Flood Plain Management Natural Heritage Preservation and Management Preservation of Open Space Lands Design and Construction of Outdoor Recreation Facilities State Park Management and Operations Chesapeake Bay Program Activities Virginia Green Program Environmental Quality Water Quality Improvement Fund – point source and non-point source grants Clean Water State Revolving Fund Stormwater Local Assistance Grants Superfund Petroleum Remediation Litter Control and Recycling Combined Sewer Overflow Grants (Lynchburg & Richmond only) Game and Inland Fisheries Fisheries and Aquatic Habitat Species of Conservation Need and Habitat Wildlife and Terrestrial Habitat Land Acquisition Transportation MS4/Chesapeake Bay TMDL Special Condition Pollinator Habitat Program Marine Resources Commission Oyster Restoration Health Onsite Septic Program

11.5 Non-Governmental Resources

Outreach and public engagement, advocacy, volunteer and community support, monitoring and research, are examples of activities that many non-governmental and non-profit groups do as part of their mission. These groups often are more nimble that larger governmental agencies. They are on the ground and aware of opportunities and constraints at the parcel scale. Networking with community groups can bring much needed resources to the aid to communities who have the capacity to facilitate restoration efforts. Below is a short list (**Table 41**) of groups that support habitat conservation, management, and restoration efforts that compliment Chesapeake Bay goals.

Table 41. Non-governmental resources for habitat conservation, management and restoration

RESOURCES FOR GRANT SEEKERS	
Chesapeake Bay Funders Network	Strategies for protecting/restoring the lands and waters of the Chesapeake Bay
Global Restoration Network	Compendium of restoration projects and practices
The Grantsmanship Center	Community foundations by state
Environmental Finance Center	Financing advice for agriculture, stormwater, climate & energy, green infrastructure
GuideStar – non-profit profiles	Subscription service for non-profit organizations
Grants.gov	Free searchable data base of federal grants, cooperative agreements, etc.
GRANT-MAKING ORGANIZATIONS	**WHAT THEY FUND**
Chesapeake Bay Foundation	Education, tree plantings, oyster restoration, agricultural conservation
CBF Small Watershed Grants Program	Community based projects, environmental improvement, stewardship
NOAA Chesapeake Bay Watershed Education	Environmental education, teacher professional development
Restore America's Estuaries	Protection and restoration of bays and estuaries as essential resources
Fish America Foundation	Conservation and research fisheries resources, partnering to enhance fish habitat
Keith Campbell Foundation	Comprehensive planning & zoning, consensus-based problem solving
Chesapeake Bay Trust - Maryland	County restoration programs, education, community engagement
Anne Arundel County MD & CB Trust	Watershed restoration, land protection, tree planting
Charles County MD & CB Trust	Forestry, community watershed assistance
Montgomery County MD & CB Trust	Water quality improvements, outreach, stewardship

City of Gaithersburg MD & CB Trust	Stormwater best management practices (BMPs)
Prince George's County MD & CBT	Stormwater BMPs & rebates
Chesapeake Bay Restoration Fund	Funds MD state programs for sewage, septic system conversions, and cover crops
National Fish and Wildlife Foundation	Sustain, restore, & enhance the nations fish, wildlife, plants and their habitats
Town Creek Foundation	Ecological sustainability
Isaak Walton League of America	Environmental stewardship & recreation
Open Space Institute - Northeast Resilient Landscapes Fund	Plant and animal protection through land conservation
Virginia Community Foundation	Community enrichment
Appalachian Regional Commission	Research, economic development, tourism, infrastructure, energy, health
Virginia Environmental Endowment	Improvement of local rivers, Chesapeake Bay, land conservation, literacy
PARTNERING, NON-GRANT MAKING INSTITUTIONS	**FOCUS AREAS OF INTEREST**
National Wildlife Foundation	Wildlife conservation and advocacy
Chesapeake Conservancy	Land conservation, public access, advocacy
Pinchot Institute	Conservation challenges and opportunities
Ducks Unlimited	Wetland conservation & hunting
Trout Unlimited	Fisheries restoration & conservation
Wild Turkey Federation	Terrestrial habitat conservation & hunting
Nature Conservancy, Chesapeake Bay Habitat Restoration	Land and water conservation
National Parks Conservation Association	Advocacy for national parks
Audubon Society	Bird research, education, land conservation, education
Virginia Outdoors Foundation	Land conservation by easements
Izaak Walton League of America	Environmental stewardship & recreation
Elizabeth River Project	River restoration, community involvement
National Arbor Foundation	Conservation and education for trees
Accokeek Foundation	Natural and cultural heritage, stewardship & sustainability
American Farmland Trust	Agricultural land conservation and producer support
Appalachian Trail Conservancy	Recreation, land conservation, advocacy

Harry Hughes Center for Agro-Ecology	Retention of working landscapes while protecting the Chesapeake Bay
Canaan Valley Institute	Stream restoration, wastewater, education
Alliance for the Chesapeake Bay	Conservation of rivers, streams, forests in all 6 states of the Chesapeake Bay
Interstate Commission on the Potomac River Basin	Research, planning, regional cooperation, education
Susquehanna River Basin Commission	Research, planning, regional cooperation, education
Chesapeake Climate Action Network	Global warming concerns
Environment Virginia	Environmental advocacy
Old Dominion Land Conservancy	Land conservation by easements
Keep America Beautiful - state chapters	Promotes recycling, litter education and community clean ups
Pennsylvania Environmental Council	Environmental advocacy
Chemung River Friends	Quality of life, economy and natural environmental along the river
Delaware Native Plant Society	Use, propagation and conservation of native plants
DC Environmental Network	Protecting and restoring the Capital City's urban environment
Patuxent River Commission	To protect, enhance and restore the Patuxent River and watershed
Friends of the Rappahannock River	Advocacy for a healthy and scenic Rappahannock River, restoration, education
Chesapeake Bay Savers	Legislative efforts, community outreach, environmental education
James River Association	Watershed restoration, education, outreach, and advocacy
York River & Small Coastal Basins Roundtable	Education, collaboration, conservation, and restoration along the York River

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Section 12

State and Agency Coordination and Collaboration

Stakeholder and agency coordination along with the opportunity to share information with the public occurred throughout the development of the CBCP. NFWF staff along with USACE staff participating in the CBP partnership activities assisted with the identification of interagency points of contact and subject matter experts with whom to collaborate. An extensive stakeholder distribution list was prepared for email distributions of the watershed assessment status, data or information requests, and invitations to participate in planned, periodic webinars to solicit input and feedback on specific topics of interest. Stakeholders included representatives from: the CBP partnership; other federal, state, and local agencies; non-governmental organizations; contractors; academia; and other affiliated organizations, such as watershed committees and the Silver Jackets teams.

State agency representatives provided specific input into the formulation of the study, including local knowledge of existing conditions for the subwatersheds of interest identified for further analyses as part of the CBCP. The State-Selected Watershed Action Plans, attached to the corresponding state chapters in this appendix, present additional details of the coordination actions with respective state agency representatives.

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