Bigger Bang for Your Buck: Using Natural Buffers in the Maryland Watershed Implementation Plan and Chesapeake Bay Restoration

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Abstract

The Chesapeake Bay is one of the world's most productive and biologically diverse estuaries; however, it is suffering from a confluence of environmental abuses from agriculture, sprawling development, nutrient and sediment pollution, and a drastic loss of natural filters. The Chesapeake is not only a national, but also a global test case for environmental rule making and the decisions we make about how to restore it will have broad and profound implications. As of 2009, the U.S. EPA has required Bay states to develop Watershed Implementation Plans (WIPs) that address how they plan on meeting the Total Maximum Daily Loads (TMDLs) for nitrogen, phosphorus, and sediment as calculated by the EPA. Although the EPA found Maryland's WIP to be the most substantial of the Bay states, the MD WIP neglects the non-point source pollution problem and directs most of its attention to point source pollution in the form of wastewater treatment plants. The MD WIP's neglect of natural buffers, such as forests and wetlands, is a predictable failure, partially attributable to a larger cultural fixation on technology and measurability that is representative of pollution abatement policy across the nation. This fixation not only contributes to the breakdown of rural culture, but it also masks the consequences of growth and delays and dismisses the importance of controlling non-point source pollution. Natural buffers have an inherent ability to control non-point source pollution and should no longer be reserved solely for agriculturalists. Through appropriate policy reformations and innovations, natural buffers can become a key resource in Chesapeake Bay restoration.

There's No Place Like Home

Maryland's Chesapeake

The drive down route 50. To the watermelon haulers, the seafood truckers, the chicken-feed deliverers, and me, it's a bit like home. It's the connection between two parts of my life, where I grew up, near Annapolis, and where I actually grew, on Maryland's Eastern Shore. Both places have had their impacts.

I grew up in suburban Prince George's County, wedged in between Washington, D.C. and Baltimore, and only fifteen minutes from one of the few National Parks I've ever even visited, Greenbelt Park – managed by the National Park Service, but essentially just an oversized backyard for D.C. suburbanites. I didn't grow up in the stereotypical environmentalist family; my mom toted our Girl Scout troop around in a Chevy Suburban and my dad was a hot-rodder. Growing up, I remember thinking I had been born into the wrong era, that maybe the fifties or sixties would have suited me better. Now, I think maybe I was instead born in the wrong location.

Although I grew up in Prince George's, I fell in love with the Eastern Shore during my four years of college at Salisbury University. It was on the Eastern Shore that I really began to explore the Bay, both physically and academically. I became concerned about preserving and protecting what I had come to love and appreciate about the Chesapeake Bay and the Eastern Shore. I came to realize that these two sides of my life, the Western Shore and the Eastern Shore, the suburban life and the rural character, were not disparate. They were not only both part of my life, but they are both part of the Bay as well. During my junior year of college, the Environmental Protection Agency required Watershed Implementation Plans (WIPs) from all the states in the Chesapeake Bay watershed. I knew then that if I were to investigate this new and groundbreaking piece of environmental policy, I would have to approach it from both parts of my life, the part west of the Bay bridge and the part east of it.

Behind our suburban home in Prince George's County flowed a small, tame, and probably quite dirty creek. Now I dread thinking of all the Chem-Lawn fertilizers and Pennzoil engine oil that probably flowed from our lawn and drive into that little creek. Back then I didn't know any better. What I did know though was that that measly little creek would eventually flow into a slightly bigger creek and then that creek into a stream and that stream into a river and that river into the Chesapeake Bay, which would eventually meet with the ocean. My father taught me that, not knowing that his lesson would one day lead to a passion for the areas where land and water meet.

This little creek brought all kinds of exciting critters to my backyard – frogs, toads, black rat snakes, foxes, woodpeckers, orioles, opossums, chipmunks, and even whitetail deer once in awhile. Treefrogs, something I held in reserve for Amazonian rainforests, were found on trees, in the gutters, and in flowerpots on our porch. As a child, I kept them as pets, along with the occasional box turtle found crossing the road, luna moth caterpillars, and a junebug named Clyde. So much life on just a quarter acre lot. That's what happens where land and water meet.

Maryland and the Chesapeake Bay are the epitome of where land and water meet so as you may expect, life is both diverse and plentiful. The union between Maryland and the Bay runs so deep that it is not only present ecologically, but culturally and economically as well. But as the Bay withers, this connection seems to as well. Most people are not in tune with the natural systems around them anymore. Most do not hunt or fish for their own food, nor do they grow

their own vegetables or raise their own chickens. Instead, they buy them cut, cleaned, and packaged at the nearby supermarket. What makes this disconnect even worse is that the nearby supermarkets aren't really that nearby. Suburban sprawl has made it so that people must drive to the supermarket or anywhere else they need to go.

Sprawl on the Western Shore has gotten so bad that the land has become an indistinguishable mass of roads, houses, apartment buildings, schools, and shopping centers. It's hard to say where the city ends and the sprawl begins when suburbs have their own suburbs and brand new housing developments pop up overnight in some of the most unlikely places. As the sprawl expands across the landscape, replacing forests, wetlands, and agricultural land with impervious surfaces such as roads, parking lots, and rooftops, people seem to lose their connection with the very Bay they're increasingly polluting. "Drains to the Chesapeake Bay" spray-painted in blue across storm drains is just a faint reminder of where the untreated stormwater will end up.

The drive down route 50 from Annapolis to Salisbury crosses at least 10 bodies of water and passes by numerous others. It first crosses the Severn River, where tall red clay banks burn in the morning sun, then passes by the U.S. Naval Academy. Next is the Chesapeake Bay Bridge, a feat of human engineering that extends 4.3 miles across the Bay, connecting Maryland's rural Eastern Shore with the more urban Western Shore.[i]

The first taste of the Eastern Shore resembles the Western Shore more than anywhere else we'll see along our trip. Kent Island, home of Maryland's earliest English settlement, shows the wear of long-term human inhabitance. Its shorelines armored by seawalls, its marshes paved over with macadam, its coves filled with yachts and sailboats, and its route 50 lined with fast-food chains.

As population increases, sprawl creeps like an invasive vine across the Bay Bridge to the Eastern Shore, bringing with it retirees and commuters alike. The problem of sprawl reverberates from city council meetings to college classrooms and newspapers to finger-pickin' bluegrass songs. Many Eastern Shore natives dread this creeping sprawl, and their concerns are embodied in the words of Chester River Runoff, "an original bluegrass band from Maryland's rural Eastern Shore."[ii]

> *"They're building plastic houses by the thousands in the county. They're building plastic houses on the farms of our fathers…Soon the day will come when all the farms have sold. Gone are the days when we went fishing and we ate what we had grown. We'll be in suburbs for all the strangers who drive from the Western Shore…When it's over and there's no room for farms and trees and fields, we'd all live in a faceless landscape with no identity. We'll live in sprawl in plastic houses and no one will ever be home."*[iii]

But don't be fooled, sprawl is not the only land-use on the Eastern Shore that's having a considerable impact on the Bay. Industrial agriculture has overwhelmingly replaced the Mom and Pop farms that once dotted the landscape and has resulted in a shift in agricultural practices, replacing diversified vegetable farming with monocrop corn, soybean, and chicken production.

From Kent Island we cross Cox Creek and then the Kent Narrows and arrive on the mainland of the Eastern Shore. Now route 50 doesn't actually directly cross every river we're going to pass on the way to Salisbury, but a short venture off the highway would lead you to the Wye River, the Miles River, the Tred Avon River, or any one of their numerous tributaries. These all lie within the 20 miles between Queenstown and Easton. Aside from the outlet mall

and Chesapeake College, these 25 miles of route 50 are primarily lined with agricultural fields, the dominant land-use on Maryland's Eastern Shore.

Upon entering Easton, we pass the Easton Municipal Airport and a couple of car dealerships, some of which were forced to close their doors and empty their lots when the recession was at its worst. Next comes a small solar field beside the Easton Community Center, which houses the only ice rink on the Eastern Shore. Like Kent Island, the town of Easton is also lined with fast food chains and gas stations, all ready and eager to serve the summer tourists. What's not unusual is that Route 50 bypasses what is perhaps the most interesting part of Easton – the historic district, where antique shops and art galleries abound. Perhaps most unusual though is that we cross no rivers in Easton, even though "you are five minutes from the water in any direction."[iv]

After Easton, it's only fifteen minutes before we cross the Choptank River entering Cambridge. The old Choptank River Bridge now stands as a fishing pier for both residents and cormorants alike. On the right sits Dayton's, one of the few restaurants remaining that serves muskrat. Dayton's location is no big surprise, for Cambridge sits at the heart of Dorchester County, the home of the World Championship Muskrat Skinning Contest and Miss Outdoors Pageant. What's a common talent of Miss Outdoors contestants? You guessed it, muskrat skinning. These events are part of the overall Annual National Outdoor Show, a 67-year tradition that celebrates the cultural heritage of south Dorchester, where people have been fishing, crabbing, and oystering on the Bay, and hunting and trapping in its marshes and forests for centuries.[v]

Remnants of this heritage are still present in Cambridge – a new outdoors store just opened and late Friday nights, pick-up trucks towing ATVs and field dog kennels pile into the small town. It's not unusual to walk into the Wawa gas station or a restaurant and see at least one person in full waders and camouflage. Much of the private land surrounding Cambridge is leased to hunt clubs, and many of these hunters are out-of-towners that drive down from the Western Shore for the weekend. Still though, they must be coming for something. That's because outside of Cambridge, there's something special.

Along the way, there are subdivisions and local businesses, but soon those give way to houses and produce stands scattered amongst the fields of soybeans, corn, millet, and milo. In the wintertime, it's not unusual to see clouds of voracious, migratory snow geese falling from the sky to gorge on whatever cover crops or leftovers they can find in a farmer's field. The farmer-turned-hunter anxiously sits in his blind waiting for the gluttons or their Canadian cousins to toll in. During deer season, the same hunter's bright orange vest is visible from the road as he waits for a whitetail or a non-native miniature elk known as a sika deer.

But even past all of this sits what's special to the area; what supports tens of thousands migratory ducks, geese, swans and other waterfowl each winter; what feeds resident waterfowl, deer, osprey, bald eagles, and the endangered Delmarva fox squirrel year round – Blackwater National Wildlife Refuge. No, it's not at all visible from route 50 and only one small brown sign will point you in its direction, but it is well worth the detour. Blackwater National Wildlife Refuge encompasses over 27,000 acres of tidal salt marsh, freshwater ponds and swamps, mixed evergreen and deciduous forests, and croplands and impoundments managed solely for wildlife. In conjunction with the adjacent Fishing Bay Wildlife Management Area, the two areas cover almost 60,000 acres.[vi, vii]

A day in Blackwater is like a day nowhere else. Dark blue-black water snakes through the land, permeating and pervading it, changing its shape and pattern with the tides (Figure 1).

The road winds perilously through vast expanses of marsh and then stretches out into long straightaways like a snake racing after its prey and then launching itself forward for the kill. Drainage ditches lining the road always have at least a few inches of water in them and are a perfect breeding ground for mosquitoes and habitat for the little fish that eat them. Great blue herons hang out at these ditches like animals of the African savannah flocking to the watering hole, like gossipy co-workers gathering around the water cooler. Every few yards, one of these prehistoric dinosaur-like beasts pokes around in the murky water of the ditch looking for a bite to eat. As the car approaches, they flail their six-foot wingspan and rise out of the ditch with great force, just in time to pass over the hood of the car.

In the winter, Canadian geese pile into fields by the tens of thousands (Figure 2). At first glance they look nothing like geese, but just a blurred mass of brown and black. They become indistinguishable from each other and instead look like a formation of the land, like giant ruts in the mud left by a tractor.

Figure 1. Water permeates forest and salt marsh in Blackwater National Wildlife Refuge (Photo by Elizabeth Young).

Figure 2. A flock of migratory Canadian Geese at Blackwater National Wildlife Refuge in winter (Photo by Emily Thorpe).

The gradual and elegant transition from lush, golden fields of *Spartina* and *Distichlis* marsh, interspersed with dark rolling masses of *Juncus* and robust fiery-red patches of *Salicornia* to scrubby wetlands of *Iva fructescens* and groundsel-bush to loblolly pines and finally to white oak, red oak, and maple is enough to make an ecologist's skin tingle. Trees grow only in the areas of highest elevation – though it's not by much. Where there are trees you can expect to find squirrels the size of housecats, the endangered Delmarva fox squirrel, as well as the occasional bald eagle nest. In fact, I'm not sure it's possible to go to Blackwater and not see at least one of our national birds, after all, Blackwater is home "to the largest breeding population of bald eagles on the East Coast, north of Florida."[viii]

Blackwater is truly a thing of beauty, not only because of the diversity of plants and animals it supports, but also because it is a federally protected representation of what once was. Forests and wetlands once carpeted the state of Maryland and the rest of the Chesapeake Bay

watershed as well. These ecosystems are just two examples of natural filters, which also include grasslands, bay grasses, and oyster reefs. To me, these natural filters differ from their natural buffer counterparts. Buffers can be seen from route 50. In today's environment, 35 to 100 foot strips of trees count as forested buffers and stormwater management ponds count as constructed wetlands. Natural buffers often line agricultural ditches, creeks, streams, and rivers and represent an attempt to undo the water quality damage that has arisen from changing land-use practices. Sure they filter, and sure they're a start, but one must thoughtfully consider the difference between this strain of forests and wetlands and the class of forests and wetlands that piece together the mosaic of ecosystems found in Blackwater. These ecosystems once "lent the Bay a tremendous resilience," but have largely been lost to agriculture and development, both of which dramatically alter the delicate balance that has existed between land and water for thousands of years.[ix] Nevertheless, we cannot kick out the 16 million people that live in the watershed and allow trees and wetlands and grasslands to grow up in their place. Living in this watershed is about finding a balance, and natural buffers are a way of achieving that balance.

Much like the roads weaving through Blackwater's marshes, that was quite a detour from our drive down route 50. Once we say goodbye to Cambridge, we head east, crossing the Chicamacomico River, then the Nanticoke River in Vienna, where the power plant emits a tower of smoke during peak hours on the coldest winter days. The marsh on either side of the Nanticoke has been overrun by the invasive *Phragmites*, but during periods of drought, the marsh still emits a rich odorous stench of rotten eggs as sulfur-reducing bacteria release hydrogen sulfide gas. From the Nanticoke, we cross Barren Creek and then Rewastico Creek before crossing the drawbridge over the Wicomico River in Salisbury, where it's not all that uncommon to see a tugboat pulling a barge or rather large ship down the narrow channel cut below the road.

The land between Cambridge and Salisbury is overwhelmingly farmland sprinkled with housing developments or single houses that line route 50 or the rivers. Even though many of the houses are on septic systems, a more polluting form of sewage treatment, and not city sewers, they look harmless enough from the road; however, from the air, the true story becomes more visible.

Sprawling housing developments weave roads and sidewalks through the land, some ironically ending in curvy river-like cul-de-sacs, while others cut neat, straight lines. Each house has a driveway and from above, it's strikingly obvious just who does and does not fertilize their expansive lawn. Some neighborhoods have stormwater retention ponds, a compensation measure that is becoming more and more common. The age of many developments is also

apparent; those with no trees were farms not that long ago and quite a few still share a border with their former land-use (Figure 3).

Figure 3. **Sprawl Development on Maryland's Eastern Shore (Photo by Elizabeth Young).** Sprawl development has been replacing agricultural land in Maryland and is quickly becoming a major contributor of nutrient and sediment pollution. This development shows the use of stormwater management ponds as well as the often too close proximity of neighborhoods to farmland.

Waterfront property owners often bar their yards from the water with seawalls and riprap to protect their land from erosion (Figure 4 and 5). Many of these waterfront homes, some of them huge mansions with private drives, lush green lawns, and personal docks, are built on what were once wetlands, but have since been filled. Wetlands don't make for a good place to live, too much flooding, too many bugs, too unpredictable. But when your home sits not even 30 feet

above sea level and only a hundred yards off the water, you can expect flooding, bugs, and unpredictability no matter what.

Figure 4. A large waterfront home with private dock and riprap jetties (Photo by Elizabeth Young).
Figure 5. The contrast between riprapped shoreline and lawn and a more natural scrubby wetland shoreline (Photo by Elizabeth Young).

Chicken houses, often invisible from the road, can be seen surrounded by a border of trees. This small border of trees serves primarily to block the houses from view and to trap the pungent odor emitted from chicken litter, but do little to prevent the runoff of litter into nearby waterways. Since you're never far from water on the Eastern Shore, many chicken houses sit within close proximity of rivers, streams, and creeks.

Even if these homes and chicken houses aren't in close proximity to the water, the land here is shockingly flat, rising barely 35 feet above sea level even in areas of higher ground. While some may argue that flatness is better than steepness in terms of nutrient and sediment pollution, the almost severe uniformity of the land has created its own problems on the Eastern Shore. In order to be productive, farmers must build up the centers of their fields and dig ditches around them to ensure proper drainage. These drainage ditches typically lead to nearby natural streams, funneling nutrient and sediment pollution into waterways with each rain.

Flatness also creates a problem when considering the impact of ground water pollution on the Chesapeake. A U.S. Geological Survey study found that "an average of 48 percent of the nitrogen load in streams in the Bay watershed was transported through ground water, with a range of 17 to 80 percent in different streams." The flatness of the land makes it easier for nitrogen to sink in to the soil and escape via ground water. Agricultural land uses have been found to have "the greatest impact on nitrogen concentrations in groundwater;" however, septic tanks are also a contributor. The other issue with ground water is that once in the system, "nitrogen may take less than a year to decades to be transported to a stream." This creates a "'lag time' between implementation of management practices in a watershed and the decrease of nitrogen concentrations in a stream."[x]

You can easily experience the flatness in a drive down route 50, but *how* flat, *how* thin is even more visible from the air. The land is so low and level that it's easy to imagine sheets of rainwater washing over it and through it at the same time. In some places, the land seems to float on the water like a leaf in a puddle. More than 50% of Dorchester County's "land area lies

below elevation 4.9 feet above sea level" and in the salt marshes it is often hard to tell whether you're standing on land or in water.[xi]

With the wetlands and forests of Maryland's Coastal Plain removed by agriculture, suburban sprawl, or wealthy McMansion owners, there is little left to hold back the tide of non-point source pollution that washes over the land with each rainfall event. There is little left to protect the Bay and its tributaries from nutrient-induced eutrophication, a process in which increased levels of nutrients cause excess algal growth and subsequent oxygen depletion. There is little left to protect the waters of the Chesapeake from environmental troubles beyond the realm of current restoration policies, problems such as climate change, endocrine disrupters, and heavy metal pollution. But the watershed still has people, 16 million of them to be exact, and people can make choices to protect the Bay.

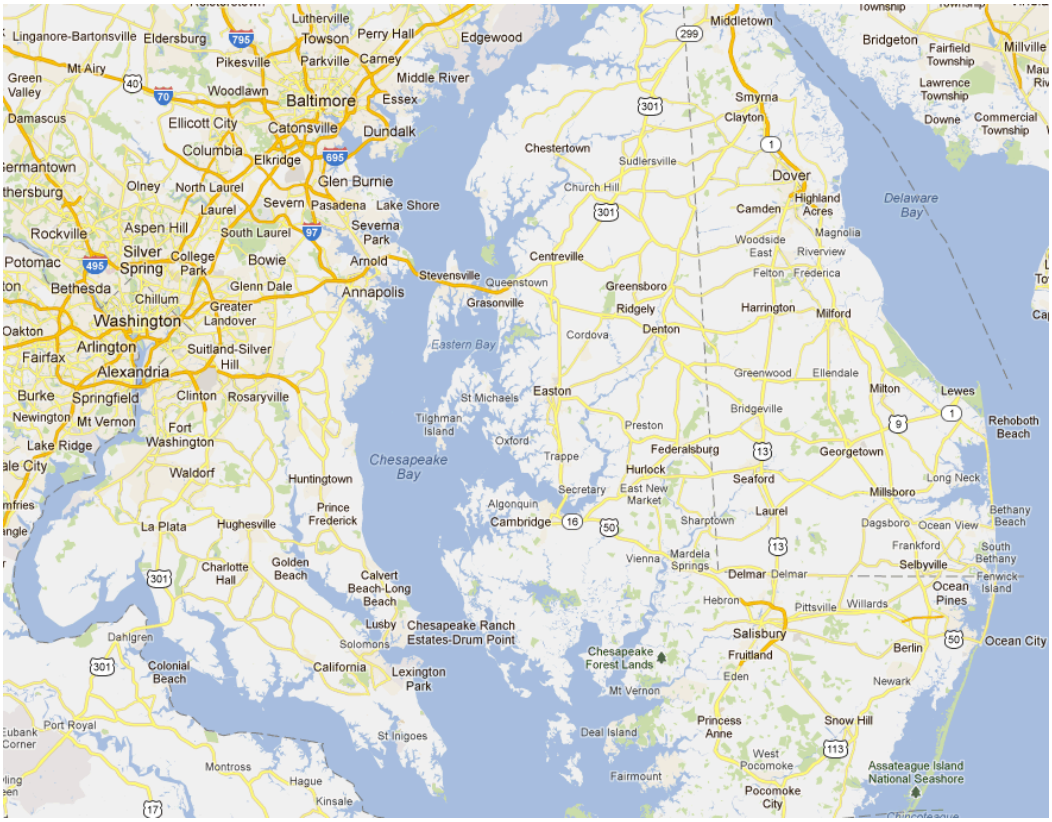


Figure 6. Map of the area relevant to a drive down route 50 from Annapolis to Salisbury.

A Marylander's Concern

Today's Chesapeake Bay is one of distortion, imbalance, disequilibrium. It still retains quite a bit of its former beauty and biodiversity, but the system has been seriously altered. Farmers have drained precious wetlands and replaced them with agricultural fields. Developers have cut down forests or bought up family farms and replaced them with suburban communities to foster the ever-growing human population. Large, heavily mechanized commercial farms are now strewn across the landscape, coating the already over-fertilized agricultural land in ungodly amounts of nutrient-rich chicken litter. The poultry industry has deemed the litter a resource for

farmers, but when the Delmarva Peninsula alone produces 570,000 to 700,000 tons of it per year, there is considerably more than enough to go around.[xii]

On the other hand, suburban sprawl has literally paved the way to an unhealthy Bay by replacing soft, porous forest floor with impervious surfaces. Nearly 5%, or 400,000 acres, of Maryland's total land area is covered with impervious surfaces, representing an area large enough for 42 million cars. "The entire Chesapeake Bay watershed consists of about 1.1 million acres…[meaning] there are about 3,267 square feet of impervious surface for each resident of the Bay watershed…To put it another way, the total area of developed land in the Bay's watershed now exceeds the total area of the tidal Bay by a factor of two."[xiii] When rain falls, no longer does it brew through leaf litter like water through a tea bag, distilling any impurities and concocting a tonic rich with tannins and nutrients. No longer do vast forests suck up this sweet potion, infusing its nutrients in their bark, branches, and leaves and thus preventing future eutrophication of the Bay. No, now rains scour the landscape, washing over farm fields, roads, cities, and suburban neighborhoods, carrying pollutants and debris into rivers and streams. Neither agriculture nor development is solely to blame, but rather in combination, they've exacerbated the problem.

Intense agricultural pressures, sprawling development, loss of natural buffers, and an extraordinarily flat Coastal Plain are just a couple of the factors contributing to the declining health of the Chesapeake. Other factors stem from the very nature of the Bay itself. Stretching approximately 200 miles, the Chesapeake Bay is the largest estuary in the United States and was once the most productive. The Bay's "intricate shoreline…snakes over 5,000 miles in length – more than the shoreline of the entire Pacific Coast of the United States."[xiv] It is "fed by 48 major rivers, 100 smaller rivers, and thousands of tiny streams and creeks."[xv] The Bay ecosystem "supports more than 3,600 species of plants and animals."[xvi]

What's most important to point out is the interaction between the land in the watershed and the water itself. The Bay's watershed covers over 64,000 square miles, includes six states and Washington D.C., and is home to more than 16 million people (Figure 7). The watershed is 16 times as large as the Bay itself, giving it a considerably larger land to water volume ratio than any other water body on Earth (Figure 8). On average, the Bay is extremely shallow, averaging a depth of only 21 feet.[xvii] This characteristic contributes to both its productivity and vulnerability. A growing human population and changes in land-use, such as agriculture and development, have contributed greatly to the degradation of the Bay's water quality. The estuary is listed on the EPA's "impaired waters" list and received a D+ from the Chesapeake Bay Foundation's most recent *State of the Bay* report.[xviii] Among the most serious threats to the health of the Bay are

nutrient and sediment pollution, which can cause eutrophication, hypoxia, and reduced light levels for bay grasses as well as smother already overharvested or disease-afflicted oyster beds.

Figure 7. Satellite image of the Chesapeake Bay watershed. The Chesapeake Bay watershed covers 64,000 square miles and includes portions of Maryland, Virginia, Delaware, Pennsylvania, West Virginia, New York, and Washington, D.C.[xix]

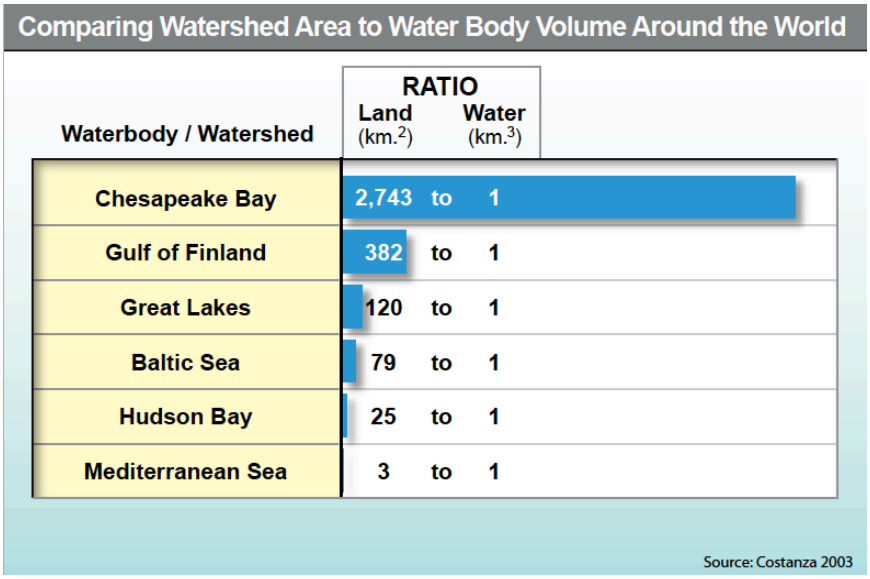


Figure 8. The Chesapeake Bay has the largest land to water volume ratio of any body of water in the world.[xx] Because the Bay is such a shallow system fed by such vast expanse of land, it is both extremely productive and extremely vulnerable to pollution.

When it comes to Chesapeake Bay pollution and cleanup, Maryland is in a particularly important location. When discussing Bay cleanup, it is important to recognize that some areas of land matter more than others. Although Maryland comprises only 14% of the Chesapeake Bay

watershed, with approximately 6,945 miles of Bay shoreline compared to Virginia's 3,315 miles, Maryland has more land in direct contact with the Bay than any other state in the watershed.[xxi, xxii] While only 9% of the Bay watershed is developed land, at 18% Maryland has the highest percentage of developed lands of any of the Bay states, excluding D.C., and one of the lowest percentages of forested lands (45%).[xxiii] Although Maryland has been a leader in Bay cleanup, it may face increased challenges due to the fact that it has more developed land and more shoreline than any other state. Maryland policymakers need to seriously consider the state's important role as a model for Chesapeake Bay cleanup. If Maryland, with nearly a third of the population of the entire watershed, can devise policies and programs to overcome the problems associated with impervious surfaces and forest loss and to reduce the amount of pollution flowing from its lands to the Bay, then other Bay states should be able to follow suit.[xxiv]

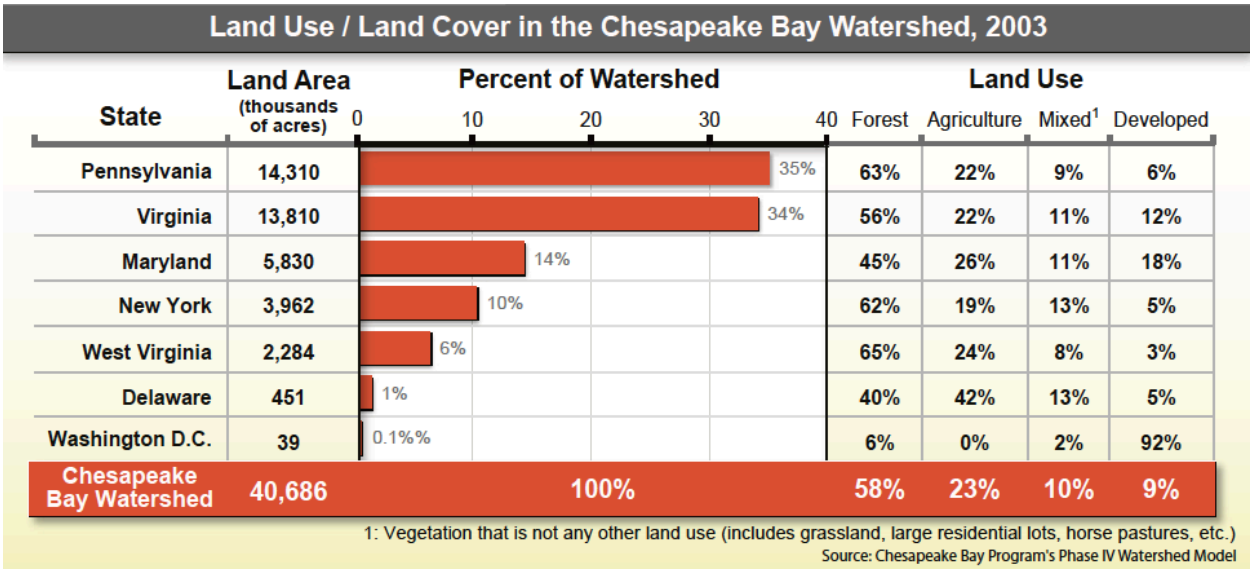


Figure 9. Land use and land cover in the Chesapeake Bay watershed.[xxv] Maryland represents only 14% of the watershed, but is composed of the highest percentage of developed land, 18%, and one of the lowest percentages of forested land, 45%; a composition that could jeopardize its abilities to restore the Chesapeake Bay.

Perhaps the most important question is why does all of this matter? What difference does it make if the Bay is healthy or not? Let's think back to the description of Blackwater's beauty and Dorchester County's unique cultural heritage. The beauty and culture of the Bay once extended well beyond its current rural confines. The Bay ecosystem "shaped the commerce and culture of the region for 400 years."[xxvi] Maryland's state symbols provide proof of that. The Maryland state boat – the skipjack. Skipjacks were the last sailboats used for work in the United States. Winter fleets were used for oyster dredging for over 100 years. The Maryland state dog – the Chesapeake Bay Retriever, a breed that originated in the Bay region as a working dog for waterfowl hunters.[xxvii]

Let's look at those symbols that come directly from the Bay itself. The Maryland state fish – the rockfish, or as the rest of the world calls it, the "striped bass." In designating the rockfish as the state fish, the General Assembly named it one of "the good reasons for living in Maryland." When populations declined due to overfishing and pollution, the state was forced to place a moratorium on rockfish harvest for four years. If that isn't a treasured species, I don't know what is. Or maybe I do, the Maryland state reptile – the Diamondback Terrapin, most

famously known as Testudo the Terp, the official mascot of University of Maryland College Park. After centuries of harvest, it is now illegal to take or possess terrapins for commercial purposes.[xxviii]

Yet another example is found in the Maryland state crustacean – the Maryland Blue Crab. The blue crab's scientific name, *Callinectes sapidus*, means "savory beautiful swimmer." The blue crab fishery is the most valuable commercial fishery in Maryland and is vital to the state's economy.[xxix] In the Eastern Shore town of Crisfield, the annual National Hard Crab Derby and Fair is held on Labor Day weekend and consists of crab races, crab picking contests, crab cooking contests, and a crab feast.[xxx] Blue crabs are about as ornery as the men who catch them, but so prized that they've earned their own nicknames: Jimmy for males, Sally for immature females, and Sook for mature females. Not only is the state known for its crabs, but also for its Maryland crab cakes, which I've seen advertised as far away as Arizona. "Crab cakes and football, baby! That's what Maryland does!" became a popular quote for Marylanders after the 2005 release of the movie *Wedding Crashers*.[xxxi]

While we're on the subject of cakes, the Maryland state dessert – the Smith Island Cake, named after Maryland's last inhabited island reachable only by boat. Smith Island was settled in the 1600s and has been home to watermen ever since.[xxxii] If ever there were a Maryland state man or state job or state lifestyle, it would have to be the waterman, the quintessential man of the Chesapeake. He does everything from oystering and crabbing to hunting and trapping to fishing and turtle catching. If there's ever going to be a place for watermen, there has to be a cleaner Chesapeake.

Maybe those seem like silly reasons, but to a lot of Marylanders, those things are exactly what make the Chesapeake our home – summer crab feasts and oyster shucking contests with family, sailing and rockfishing on the Chesapeake, hunting with our bird dogs, chicken-necking for blue crabs, rooting for the Terps, and buying a Smith Island Cake at the grocery store since few of us ever learned to make the delicious dessert due to the isolation of Smith Island and its delightful bakers. The point is, "we bay dwellers move in a far richer and more extensive matrix of subtle relations and ancient connections with nature than we can yet explain or admit."[xxxiii] But if that's not enough and you're looking for more practical reasons, the economic value of the Chesapeake Bay was estimated at "over $1 trillion annually" by the Chesapeake Bay Watershed Blue Ribbon Finance Panel. The panel also "noted that the experiential and deep historical and cultural values of the Bay are beyond calculation."[xxxiv] We Marylanders have got hold of a good thing, but it's time our appreciation for all that the Bay has to offer translates into our restoration policy and results in an ethic of responsibility and respect amongst Bay dwellers.

It's Bigger Than Us

National Precedence and Federal Involvement

The health of the Chesapeake Bay isn't just an issue for the small state of Maryland. It isn't just an issue for the six state watershed. The Chesapeake Bay is a national, and even global, test case for environmental rule making; however, this experiment's side effects will not be confined to a laboratory. The decisions we make about how we are going to cleanup the Chesapeake Bay reach far beyond the actual Bay health. These decisions will answer questions about environmental policy making, implementing, and enforcing; questions about scientifically managing estuaries, fisheries, and watersheds; questions about facing opposition from powerful lobbies; questions about the social and cultural implications of environmental negligence. These decisions will influence the political-economic structures in the Bay region and cause changes in resource distribution, power structures, and cultural possibilities as well. What ultimately becomes of the Bay's health will then flow back into these other sectors, closing a large and complex feedback loop.

The health of the Chesapeake Bay is an issue with national precedence that dates back to the Clean Water Act of 1972. The Clean Water Act established "the goals of making all U.S. waterways fishable and swimmable by 1983 and eliminating the discharge of pollutants into the nation's waterways by 1985."[xxxv] It's 2012 and that goal still hasn't been accomplished in the Chesapeake Bay or in many other parts of the United States. Rivers are frequently closed to swimming and fishing because of toxic algal blooms, heavy metal contamination, or other forms of pollution. The Clean Water Act is a hefty piece of legislation, but it provides no clear definition of what constitutes a clean system and no direction of how to implement clean up.

Early Bay cleanup efforts promised to "cap" nutrient pollution entering the Bay at 40 percent of the 1985 pollution levels by the year 2000. "In 1987, when the bay cleanup began in earnest, there were fond hopes that helping the bay would be largely a win-win solution for farmers, a matter of education and modest financial help from government." Cleanup would simply be a matter of improving wastewater treatment plants in urban areas and reducing the use of fertilizer and manure in addition to implementing voluntary best management practices (BMPs) in agricultural areas.

BMPs are focused on reducing non-point source nutrient and sediment pollution from agricultural fields and include actions such as nutrient management plans, conservation tillage, forest buffers, fenced streams, and cover crops. "Across the watershed, tens of thousands of BMPs have been implemented;" however, they have yielded little in the way of results. In 2002, the EPA's Chesapeake Bay Program estimated "that all these BMPs and others, applied for more than a decade, had reduced agriculture's nitrogen pollution by about 23 million pounds, or 15 percent, and reduced phosphorus by about 2 million pounds, or 18 percent. Those numbers are far short of the sought-after 40 percent reduction" and to make things even worse, this goal is nowhere near the necessary reduction that scientists are calling for today. [xxxvi]

There are a number of reasons why BMPs have not been wholly successful and in many ways, these reasons work together to further prevent success. BMPS are voluntary practices for farmers, but lack a sufficient reporting mechanism to ensure that they are being properly maintained to effectively control nutrient and sediment pollution. A lack of adequate funding

and staff to ensure proper implementation further hinders the usefulness of BMPs in recording and calculating total load reductions in pollution models.

For example, in 2002 it was estimated that "85 percent of the cropland in Maryland, 45 percent of the cropland in Pennsylvania and 40 percent of the cropland in Virginia" were under nutrient management plans; however, "most experts agree that…no more than 60 percent of the plans are being fully implemented."[xxxvii] A type of BMP, "nutrient management plans are science-based documents that help farmers manage crop nutrients and animal waste more efficiently in order to protect water quality in streams, rivers, and the Chesapeake Bay." The Maryland Department of Agriculture reported that as of 2009, more than 99 percent of Maryland's farms had submitted nutrient management plans; however, a randomly selected survey of farms found that only "69 percent of those inspected were fully in compliance" (Figure 10 and 11).[xxxviii] This example illustrates that in order for BMPs to be successful, education and support programs for farmers, as well as increased funding and monitoring will be necessary to ensure that BMPs are being properly implemented and maintained.

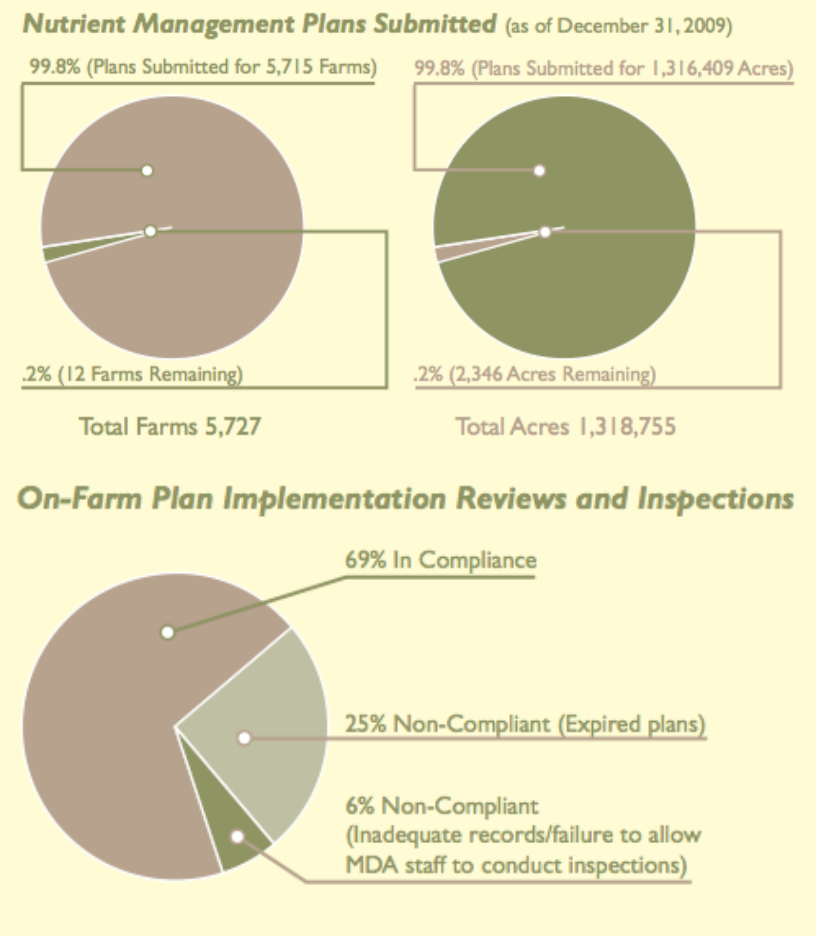


Figure 10. Nutrient Management Plans in Maryland and On-Farm Implementation of Nutrient Management Plans. As of December 2009, more than 99 percent of Maryland's farms had submitted nutrient management plans to Maryland Department of Agriculture. Only 69 percent of randomly selected farms were found to be in compliance with their submitted nutrient management plans. [xxxix]

More modern BMPs have focused on reducing stormwater runoff in urban and suburban areas and include practices such as stormwater retention ponds, temporary soil stabilization on construction sites, porous pavement, low-impact development practices or environmental site design, and urban forests. Despite the enthusiasm and motivation of county officials and planners, these stormwater BMPs have suffered from some of the same problems as those associated with agricultural BMPs: lack of staff and funding, improper maintenance, and infrequent monitoring.

A report by Community and Environmental Defense Services states that stormwater BMPs in the Severn River watershed of Anne Arundel County "could be keeping up to 1.4 million pounds of pollution out of the Severn every year. However, CEDS evaluations of a small number of these BMPs indicates that a third to nearly all (depending on BMP type) are no longer functioning properly. As a result, pollution retention is well below 1.4 million pounds per year." Anne Arundel County also exhibits a staffing issue. "In the 1990s the County had a Stormwater Inspection Section with a supervisor and six inspectors," but today, there is only one inspector. "Current law requires that each stormwater facility be inspected once every three years," while new strategies will require "annual inspections to credit existing BMPs with pollutant removal;" however, if the inspector cannot currently evaluate all the existing stormwater BMPs every three

years, it is impractical to think that he/she will be able to every year and especially not if the number of BMPs continues to increase as we would expect. Increased community involvement in the establishment and maintenance of stormwater BMPs, as well as "modest budget increases" to county inspection agencies could help to strengthen this pollution control strategy and give county governments greater ability to achieve pollution reduction goals.[xl]

The restoration work of two decades produced insufficient results, and in 2000, Maryland, Virginia, Pennsylvania, the District of Columbia, the Chesapeake Bay Commission, and the U.S. Environmental Protection Agency, as a representative for the federal government, signed the Chesapeake 2000 Agreement, establishing a continued commitment to the Chesapeake Bay Watershed Partnership. *Chesapeake 2000* shared goals similar to those of its predecessors, the Chesapeake Bay Agreement of 1983, which established the Chesapeake Bay Program, and the 1987 Chesapeake Bay Agreement which "set the first numeric goals to reduce pollution and restore the Bay ecosystem." Unlike these two agreements however, *Chesapeake 2000* was "a comprehensive agreement that set a clear vision and strategy to guide restoration efforts through 2010" by establishing "102 goals to reduce pollution, restore habitats, protect living resources, promote sound land use practices and engage the public in Bay restoration. It was also the first Bay agreement to emphasize ecosystem-based fisheries management." *Chesapeake 2000* eventually came to be signed by Delaware, New York, and West Virginia as well.[xli]

With the election of Maryland Governor Martin O'Malley in 2007 came the creation of BayStat, a program designed to "assess, coordinate and target Maryland's Chesapeake Bay restoration programs and to provide citizens with a way to track [government] progress."[xlii] The goal of BayStat was to allow for transparency, accountability, and coordination amongst some of Maryland's state agencies and the public; however, it is more of just a data collection system aimed at documenting progress and lacks real-world implementation.

In 2010, the Chesapeake Bay Program assessed its progress on each of its commitments, knowing full well that the Chesapeake Bay was still in a state of disarray. Their results are not surprising; many of their goals to develop, identify, or assess were completed, but many goals of implementing, restoring, and conserving were not (Appendix I). In other words, the planning was there, but the implementation was not. When the Bay watershed partners signed *Chesapeake 2000*, it was with "the understanding that if the voluntary actions taken were not successful in reaching the water quality goals" by the end of 2010, then the U.S. Environmental Protection Agency would have to complete a Total Maximum Daily Load (TMDL), or a "'pollution diet' that sets limits on the amount of nutrients and sediment that can enter the Bay and its tidal rivers to meet water quality goals."[xliii]

As expected, voluntary efforts were not enough. In a precedent setting move in May of 2009, President Barack Obama named the Chesapeake Bay "a national treasure," issuing an Executive Order "to protect and restore the health, heritage, natural resources, and social and economic value" of the Chesapeake Bay. He announced that the "Federal Government should lead this effort" and work in collaboration with State and local governments, the private sector, and the people living in the Bay watershed.[xliv] As a response, the EPA established the Chesapeake Bay TMDL and required Watershed Implementation Plans (WIPs) from all 6 Bay states and Washington D.C. in 2010. Each state's WIP should detail a specific plan of action to meet the TMDLs by 2025; however, I would argue that Maryland's WIP neglects non-point source pollution by focusing the majority of its attention and money on upgrades to wastewater treatment facilities and by underutilizing natural buffers as a form of pollution control. In doing

so, the WIP delays the implementation of more challenging regulations, such as those on agriculture or private property owners.

The Maryland Watershed Implementation Plan

The Maryland WIP is the newest piece of Chesapeake Bay restoration policy in the State. The goal of the Maryland WIP is to provide "reasonable assurance of implementation" for Maryland's portion of the Bay's TMDLs. TMDLs are essentially a "pollution diet" established by the EPA in collaboration with the Bay states. The TMDLs for the Chesapeake Bay are the largest and most complex ever developed by the EPA and "a multi-jurisdictional TMDL on the scale of the Chesapeake Bay watershed has never been completed before. There will actually be 294 TMDLs, one for each of the three pollutants (nitrogen, phosphorus, and sediment) for 98 impaired Bay segments…Maryland drains to 58 of the segments and will be subject to 174 TMDLs…In general, TMDLs set pollutant limits for all sources by dividing, or "allocating," the maximum allowable pollutant loads among those sources." As broad as this sounds, the WIP actually retains a very narrow focus by placing all of its concern on nitrogen, phosphorus, and sediment when in fact there is much more to quality of life in the Chesapeake Bay. It ignores heavy metals, endocrine disruptors, and other polluters, as well as climate change and fishery collapse and seems to assume that all will be well with the Bay if nitrogen, phosphorus, and sediment are properly controlled.

The TMDLs for the Chesapeake Bay require a 21% reduction in nitrogen and an 18% reduction in phosphorus from the 2009 baseline load.[xlv] One relevant issue to consider is the use of 2009 as a baseline. Even if we are to achieve the necessary reductions from the 2009 baseline, where will that leave us? Chesapeake Bay clean up is a moving target: what constitutes clean?

The WIP also conveys "allocation information" from Bay states to the EPA. An important feature of the Plan is the identification of "target loads to be achieved by various pollution source sectors and in different geographic areas. The final target loads will be used by EPA in setting TMDL allocations."[xlvi] The WIP is also part of EPA's "accountability framework," designed to ensure that clean up commitments are met. This accountability framework includes 2-year milestones regulated by the EPA, "a tracking and accountability system for jurisdiction activities, and federal contingency actions that can be employed if necessary to spur progress."[xlvii] It is presumed that these federal contingency actions will include fines and increased federal regulatory power; however, specific details about these actions are not outlined anywhere in the WIP or the Chesapeake Bay's TMDL.

In Phase 2 of the WIP, states refine the goals of Phase 1 via "more geographic specificity regarding target loads" and "greater detail about pollution controls that the State and partners will implement by the end of 2017."[xlviii] Phase 2 is also designed to engage local governments, watershed organizations, conservation districts, citizens and other key stakeholders in reducing water pollution."[xlix]

The third and final Phase is to be developed in 2017 to address further reductions necessary to achieve Maryland's portion of the TMDLs. The state of Maryland originally chose to challenge its potential clean up abilities by accelerating its timeframe. While the rest of the Bay states were aiming for total reduction by 2025, Maryland had its eye set on the year 2020; however after further consideration, the state decided to return to the 2025 final deadline. The final version of the WIP submitted on December 3, 2010 used the 2020 date; therefore, this is the

date that the proceeding paragraphs will refer to. Regardless, Maryland will have to achieve its Interim Target of 70% reduction by the year 2017.[l]

Unfortunately, these WIPs contain their fair share of shortfalls and do not appear to provide the kind of revolutionary legislation necessary to regaining Chesapeake Bay health. Although Maryland's WIP was "the most aggressive WIP of any Bay State" and was the first to be approved by the EPA, the WIP still leaves some stones unturned.[li] The Maryland WIP's fixation on technology and urban solutions indicates a gradual demise of the rural cultural character that we idealize and love about the Chesapeake region. As more and more funds are poured into urban point source solutions, rural areas become increasingly neglected, making them vulnerable to sprawl or destructive environmental practices. The WIP's general neglect of the value of natural buffers in pollution control, as well as other added environmental benefits, suggests that the policymakers really don't understand the bigger picture and that once again, they missed the mark completely.

The Problem with Point Source Solutions

Despite the challenges facing agricultural BMPs, the Maryland WIP still employs them, but maintains most as voluntary actions funded by preexisting programs that the WIP does little, if anything, to strengthen. Instead, the WIP focuses most of its attention on upgrading 69 major Wastewater Treatment Plants (WWTPs), including Maryland's portion of Blue Plains Advanced Wastewater Treatment Plant, "the largest advanced wastewater treatment plant in the world."[lii] Twenty-four of the plants were scheduled to be upgraded to meet Maryland's Enhanced Nutrient Removal (ENR) standards between 2010 and 2011, and 44 of the plants between 2012 and 2017, of which, only 8 have had funding committed to them. The total cost is estimated at $2.461 billion, with $1.186 billion for the 36 facilities still in need of funding commitments. Blue Plains is scheduled for upgrade to ENR by 2015 at a cost of $402 million. The total combined cost for all the upgrades, Blue Plains and the 68 other plants, is estimated at $2.86 billion.

The Bay Restoration Fund (BRF) supplies funding for upgrades to the 67 public plants. The fund is derived from the "flush tax," a monthly fee applied to the water and sewer bills of Marylanders on public sewage systems, as well as the property taxes of septic system users.[liii] The "flush tax" not only funds WWTP upgrades, but also the replacement of failing septic systems, efforts to control stormwater runoff, and the planting of cover crops.[liv] The fee is calculated based on water consumption and a proposal suggesting a doubling of the tax was recently passed in order to cover the costs of the necessary upgrades.[lv,lvi]

Maryland's 2009 baseline nitrogen load was 49.421 million pounds. The final target load is 39.086 million pounds, or a 21% reduction representing 10.335 million pounds. The interim target load, expected to be achieved by 2017, is 41.319 million pounds, a 16% reduction representing 8.102 million pounds. Although the interim target load is supposed to represent 70% of the total necessary reductions, Maryland's interim target is actually about 79% of the total reductions goal (8.102/10.3 x 100 = 78.7%). Maryland's accelerated clean up date and heightened interim target may be a means of providing some insulation from federal action if the clean up is not achieved as expected.

The 69 major WWTPs, including Maryland's portion of Blue Plains, are estimated to reduce nitrogen pollution by 5.6 to 5.7 million pounds by 2017. It is important to note that the WIP shows some discrepancies in numbers, indicating on page 5-22 that these WWTP upgrades

will reduce the nitrogen load by 5,724,366 pounds per year and indicating in a table on page ES-6 that reduction will amount to 5.561 million pounds per year (Table 1). This table also indicates that the WIP is expected to achieve a reduction of 8.102 million pounds of nitrogen by the interim target in 2017. The reductions from WWTP upgrades comprise about 69% of this reduction. This means that 69% of all reductions by 2017 are expected to come from improved wastewater treatment.

The same table also indicates that by the final target load in 2020, WWTPs will account for only about 36% of the total nitrogen reduction. This is because the amount of nitrogen released by WWTPs is expected to increase before the 2020 deadline. Between 2017 and 2020, growth is expected to erode some of the gains made by WWTPs, and without any controls on growth, it is likely to bring us back to where we started in terms of WWTP emissions.

As the WIP states, "Because the point source sector is on track to achieve most of the reduction needed by 2017, the remainder of the gap to achieve the final 2020 Target must be addressed by nonpoint sources," primarily agriculture according to Table 1.[lvii] Between 2017 and 2020, reductions will come largely from agriculture, accounting for about 39% of the total reduction in 2020 versus only 13.7% in 2017. Not only will agriculture have to address its own share of the reductions, but also part of the gap due to the increase in nitrogen from growth in the WWTP sector. The plan for achieving this scale of reduction in the agricultural sector does not look promising, focusing increasingly on enhanced nutrient management and decision/precision agriculture (Figure 28).

As previously stated, a 79% total reduction is expected to be achieved between 2009 and the interim target. It appears as if the end will be in sight in 2017, needing to reduce by only 2.233 million pounds by 2020 (41.319 – 39.086 = 2.233), but in reality, a 4.108 million pound reduction will have to be achieved in order to make up for the 1.875 million pound increase from WWTPs (10.462 – 8.587 = 1.875 and 1.875 + 2.233 = 4.108). If the interim target achieved the 79% reduction, we would expect to see only a 21% reduction necessary between 2017 and 2020. Even if the interim target achieved only the 70% reduction that the EPA required, we would still expect to see only a 30% reduction necessary. However, because the discharges from WWTPs are expected to increase between 2017 and 2020, a 40% reduction in nitrogen loading will be necessary in these three years (4.108/10.335 x 100 = 39.7%). In addition to three years being an uncomfortably short amount of time to achieve reductions of this magnitude, the WIP further

neglects non-point sources of pollution by underemphasizing just how much they will actually have to reduce in order to achieve the final target load.

Total Nitrogen Interim and Final Target Loads by Source Sector

Total Nitrogen - By Sector (Million lbs/yr)					
Sector	**2009 Progress**	**Final Target Load**	**% Reduction from 2009 Progress**	**Interim Target Load**	**% Reduction from 2009 Progress**
UrbanReg	5.098	4.184	18%	4.650	9%
UrbanNonReg	0.551	0.444	19%	0.591	-7%
Agriculture	17.713	13.653	23%	16.606	6%
CAFO	0.080	0.070	12%	0.064	20%
Septic	4.007	2.454	39%	2.975	26%
Forest	7.133	7.133	0%	7.149	0%
Air	0.691	0.686	1%	0.698	-1%
WWTP & CSO	14.148	10.462	26%	8.587	39%
Total	**49.421**	**39.086**	**21%**	**41.319**	**16%**

Table 1. Total Nitrogen Interim and Final Target Loads by Source Sector According to the Maryland Watershed Implementation Plan.[lviii] The first column indicates the sectors responsible for nitrogen pollution. The second column shows the amount of nitrogen pollution reaching the Bay in 2009. The third column represents the final target load and the fourth column is the percent reduction from 2009 that each sector is responsible for achieving. The fifth and sixth column represent the interim target load (70% of the final target load expected to be achieved by 2017) and the percent reduction from 2009.

Three major problems exist with the WWTP focus of the Maryland WIP. First, it is an extraordinarily expensive solution. It may have the greatest potential to drastically reduce nutrient loads quickly, but these upgrades may cost between $15.80 and $47.40 per-pound of

nitrogen reduced, not to mention additional millions of dollars in increased operating and maintenance costs associated with more complicated treatment systems (Figure 12).

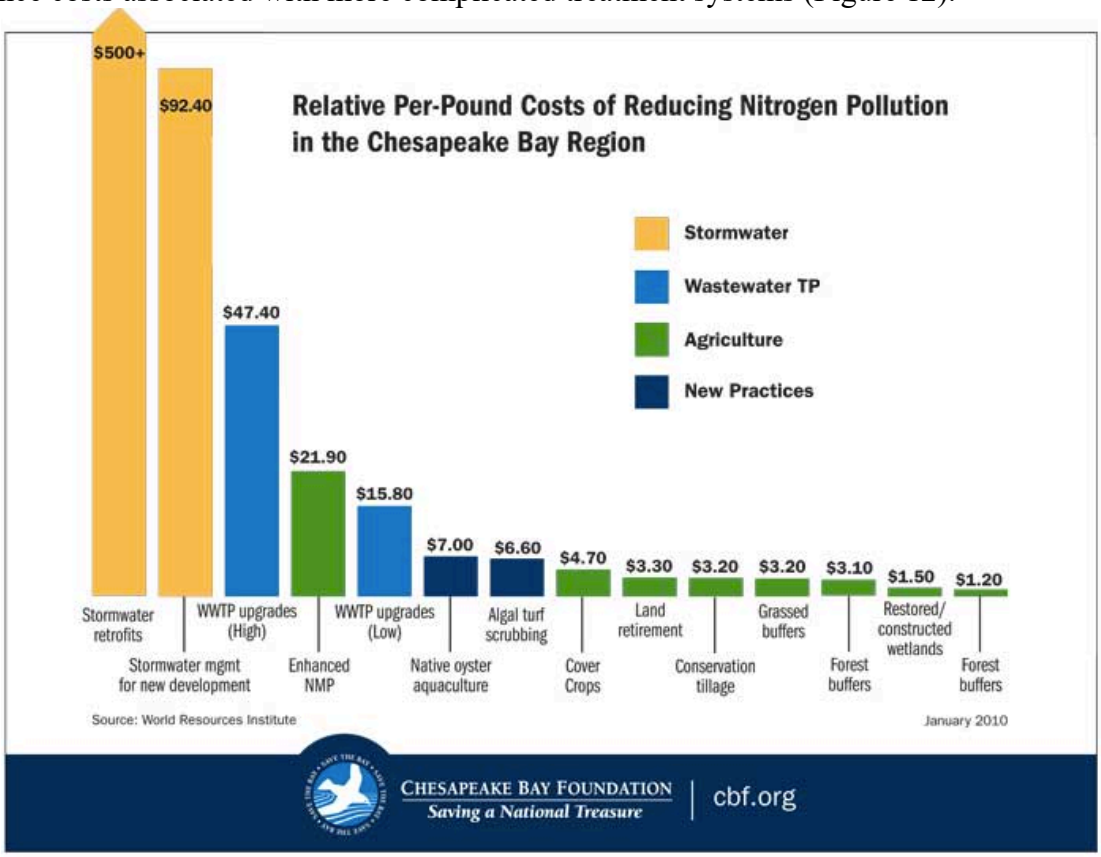


Figure 12. Relative per-pound costs of reducing nitrogen pollution in the Chesapeake Bay region. Per-pound costs of reducing nitrogen pollution range for just $1.20 for forest buffers all the way up to $500 or more for stormwater retrofits.[lix]

Secondly, growth. Bay-wide, population growth may not offset the nitrogen and phosphorus reductions gained by upgrading WWTPs, but for certain plants, it certainly will. For example, the City of Bowie Wastewater Treatment Plant showed a decrease from 30,453 pounds of nitrogen per year before the upgrade to 23,308 pounds after the upgrade. However, it is estimated to release 40, 201 pounds of nitrogen per year when it reaches its full capacity. That's an increase of about 10,000 pounds of nitrogen. A similar pattern exists for phosphorus. Upon reaching full capacity, the plant is estimated to release 3,015 pounds of nitrogen per year, 1,700 pounds more than it was releasing before the upgrade. However, plants such as the one in Salisbury for example, will see a decrease in nitrogen and phosphorus loads even with growth. The Salisbury plant initially released 320,092 pounds of nitrogen per year, but after the upgrade, should only release 62,708 pounds. Once it reaches full capacity, it will still only release 103,549 pounds per year. Again, a similar pattern exists for phosphorus.[lx]

To put it simply, the greatest reductions will come from those who are worse off to begin with and growth will significantly erode some gains for some river systems and individual plants, likely leaving us better off than we are now, but worse off than we may be expecting. No doubt these upgrades are better than allowing both growth and nutrient loads to increase, "but there is a lot more to [the water quality problem] than meeting the list of legal requirements on pollutant discharges in the federal permits for a sewage plant. It is a lesson that we are still

learning, that there is a vast difference between keeping Maryland pollution-free and keeping it lovely and unique; between keeping it environmentally legal and keeping it eminently livable."[lxi] These concerns will become increasingly important as growth forces us to ask how it is we expect more and more people to live on, and more importantly enjoy, the Bay and its dwindling resources.

The third problem with the Maryland WIP's reliance on WWTP upgrades is that it uses urban point source solutions to address what is dominantly and increasingly a suburban and rural non-point source problem. In Maryland, municipal and industrial wastewater accounts for only 25 percent of the nitrogen load to the Bay. Septic systems, somewhat in between point and non-point sources, account for another 7 percent. Urban and suburban runoff represents 14 percent and atmospheric deposition from mobile sources, utilities, and industries account for another 14 percent. Finally, agriculture accounts for approximately 39 percent of the nitrogen load when you include chemical fertilizer, manure, and atmospheric deposition from livestock and fertilized soil emissions. The final 1 percent comes from natural atmospheric deposition. Basically, if we include septic as a point source, we're looking at approximately one-third of Maryland's nitrogen load coming from point sources. That means that two-thirds of the nitrogen pollution comes from non-point sources with agriculture alone contributing nearly 40 percent. Wastewater treatment plants do not address non-point source pollution and therefore, cannot address two-thirds of the nitrogen problem (Figure 13).[lxii]

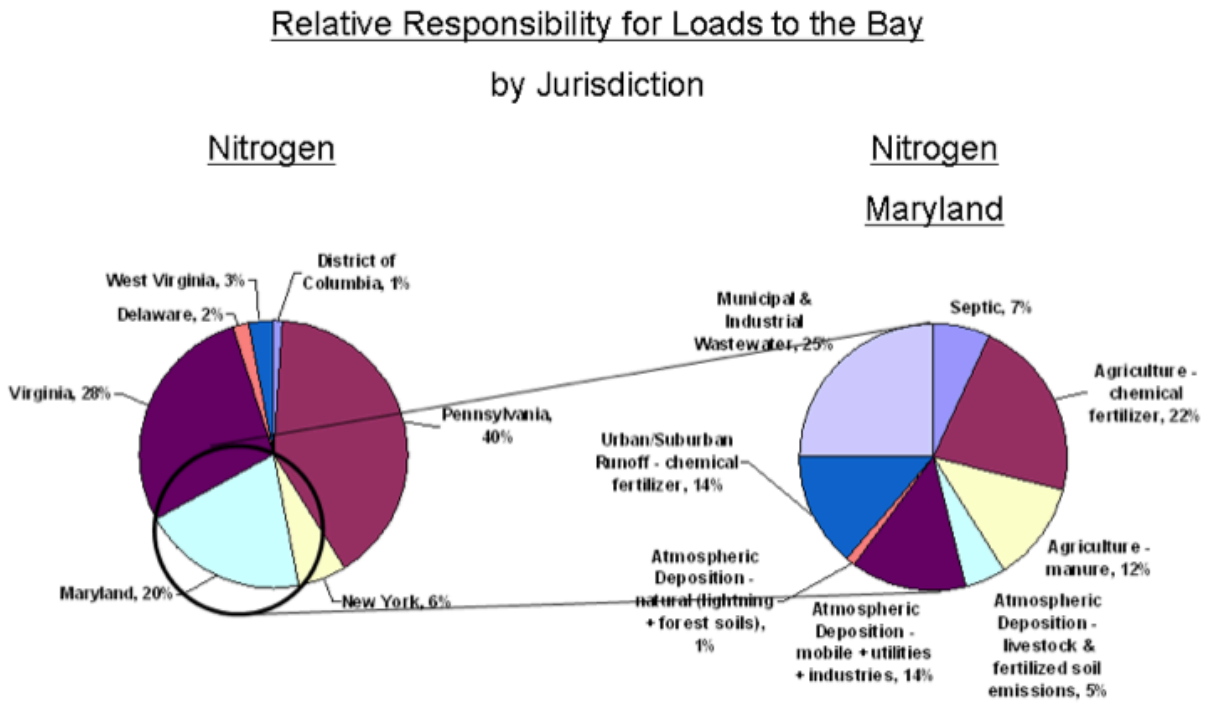


Figure 13. Nitrogen contributions to the Chesapeake Bay by State and also by sectors in Maryland.[lxiii] Non-point source pollution accounts for two-thirds of the nitrogen pollution in Maryland, with agriculture contributing 39 percent.

As the limiting nutrient in most freshwater ecosystems, many wastewater treatment plants are already aware of the damaging effects of phosphorus. WWTPs account for only about 19 percent of Maryland's phosphorus load to the Bay. Stormwater runoff and agriculture, both non-

point source polluters, account for 38 percent and 41 percent respectively. The remaining 2 percent can be attributed to Maryland's forests (Figure 14).

Estimates regarding the percentage of nitrogen and phosphorus from different sectors vary slightly from source to source because they are based on the information generated by models and new information is becoming available every day. It is important to remember that these are estimates and therefore exhibit some degree of variation.

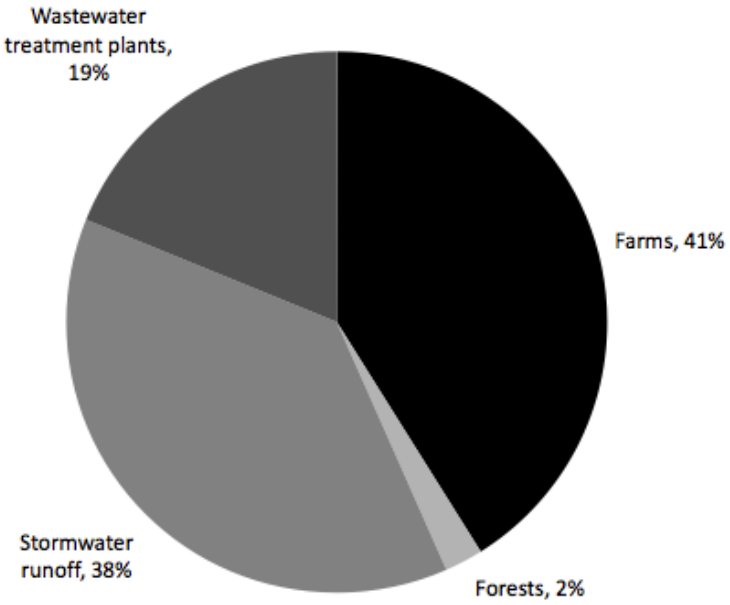


Figure 14. Maryland Sources of Phosphorus Pollution in the Chesapeake Bay.[lxiv]

In terms of agriculture, the main phosphorus culprit is animal manure, specifically chicken litter in terms of Maryland's agricultural practices. On Maryland's Eastern Shore, chickens outnumber people about 1,000 to 1, with over 296 million broiler chickens and 550,000 tons of chicken litter produced in 2007 alone.[lxv, lxvi] The ratio of nitrogen to phosphorus in chicken litter is about 1.5 to 1; however, the amount of phosphorus taken up by grasses and crops is only one tenth of the amount of nitrogen, a ratio of 10 to 1.[lxvii] This means that phosphorus is consistently over-applied in order for crops to meet their nitrogen needs.

Unlike nitrogen, at low levels phosphorus binds with the soil and therefore does not run off with water unless sediment is being transported as well. This is both a blessing and a curse. It is a blessing because it means proper erosion control practices can help reduce phosphorus loads to the Bay. Unfortunately, scientists are finding that phosphorus no longer binds with soils once they have reached a phosphorus saturation of 20 percent or more. When soils become over-saturated, not all the phosphorus is bound to the soil and some is carried away by rain.

Also unfortunate is that "phosphorus build-up in soil is an increasing problem in Maryland, particularly on agricultural land close to the bay" like Maryland's Eastern Shore. "Soil test data from 2002 show that more than 60 percent of soil samples from four Maryland counties," all located on the Eastern Shore – "where tens of millions of chickens are raised annually – were saturated with phosphorus."[lxviii] The soils are literally poisoned with phosphorus and may result in negative impacts on plants. Over-fertilization of phosphorus may result in leaf

chlorosis due to the nutrient's ability "to compete with iron and manganese uptake by roots…deficiencies of these two metal micronutrients causes interveinal yellowing." Elevated phosphorus levels can also have detrimental effects on the health of mycorrhizal fungi. The "mutually beneficial relationship between [this] fungus and the plant roots allows the plant to more effectively explore the soil environment and extract needed nutrients. In the absence of mycorrhizae, the plant must expend more energy growing additional roots and root hairs to accomplish the same task."[lxix] In an agriculturally focused area, the over-application of phosphorus could mean reduced crop yields, but due to the nature of the soil system, any phosphorus control efforts may take decades to show results. This is a problem in need of serious consideration; a massive non-point problem that can't be solved with point source solutions like wastewater treatment plants.

My point in this was to make it clear that the largest sources of nitrogen and phosphorous loads to the Bay come from non-point sources like stormwater runoff and agriculture. Why then is so much focus placed on urban point source solutions like wastewater treatment plants? In terms of dealing with non-point source pollution, why does the WIP continue to kick the can even further down the road? There are many reasons why politicians, policymakers, and citizens alike more readily approve of point source pollution controls. Like much environmental policy, the Maryland WIP's prioritization of point source pollution is not surprising or uncommon.

Point source pollution control efforts supply jobs to engineers, construction workers, technicians, regulatory officers, and many others. "Each $1 billion invested in water and sewage projects can generate 20,000 jobs in construction, engineering, and suppliers."[lxx] In addition to being easier and more popular politically, the construction of a new wastewater treatment plant is also a tangible accomplishment of a politician's time in office. It's more than that though. Compared to non-point source pollution, point source is more discrete and can be more easily regulated and reduced; it is part of a larger cultural fixation on technology and measurability, as opposed to planting trees and controlling stormwater runoff. It is something we feel safe investing our time, money, and energy in; however, it ignores at least two-thirds of the pollution problem and further disconnects us from the issues facing the Chesapeake Bay as a whole.

A Changed Landscape

Natural Buffers

> *"We must learn to see the bay whole, as water and watershed and airshed inseparably linked; to see it as a system whose forests and oysters and underwater grasses and marshes are every bit as much components of pollution control and environmental health as sewage treatment plants, automotive emissions controls, and sediment fences. We easily accept spending $50 million or more on sewage treatment, but the filtering, cleansing forest may not be allowed to stand because it is "uneconomic" not to develop it."*[lxxi]
>
> - Tom Horton, *Turning the Tide*

The lands of the Chesapeake Bay watershed were once a mosaic of forests and wetlands while the waters of the Bay brimmed with grasses and oyster reefs. Famous explorers like John Smith described sparkling clear waters, oyster banks so large they could ground ships, flocks of waterfowl that could blacken the sky, and a plethora of fish and wild game. Sometimes it's hard to imagine that their descriptions were once reality.

When we ask ourselves what's changed since then, there are plenty of answers, but one of the most resounding is the landscape. During the last 300 years, wetlands have been drained, forests have been cut, and the landscape has been "converted to agricultural fields and urban and suburban development."[lxxii] For the most part, this development of wetlands and forests is an irreversible process. It is not so difficult to see that the loss of forests and wetlands is a large part of the pollution problem and should therefore play a significant role in the solution.

Forests, wetlands, grasslands, bay grasses, and oyster reefs are what we call natural buffers or filters. Together, they "once constituted a marvelous system of buffers and filters, stabilizers, and regulators. They lent the Bay a tremendous resilience, a capacity to absorb environmental insult and recover."[lxxiii] These systems have the natural ability to filter out nutrients and other pollutants, to trap and retain sediment, and to normalize the flow of water, keeping it slow and steady, rather than forceful and sporadic. They are also all a place of enormous habitat value for other species in and around the Bay, including us as human beings. They are ecologically important, economically efficient, and generally neglected by the Maryland WIP.

Forests

> *"Forests – so vital for wildlife, clean water, and clean air – must be also seen as essential to restoring the Bay and to maintaining our quality of life. We must regain the Bay's natural resilience through the natural systems like forests that help the Bay help itself!"*[lxxiv]
>
> - Tom Horton, *The State of Chesapeake Forests*

The health of a watershed is dependent on the health of the lands that feed it, and healthy forests are essential to watershed function. "No other land use – pasture, cornfield, lawn, or urban street – consistently delivers the clear, pure water received from the forest."[lxxv] When early European settlers encountered the Chesapeake Bay region in the early 1600s, forests dominated approximately 95 percent of the watershed. These expansive and seemingly inexhaustible forests would prove to be an invaluable resource to colonists. The invention of the plow in the 1700s contributed to forest loss as agriculture took hold over the landscape. "The amount of farmed land increased from 20% to 40-50%...From 1880 to 1930, growing human populations along with the use of imported fertilizers and animal waste resulted in cultivation of 60% to 80% of the watershed." Unfortunately for the Chesapeake Bay, the conversion of forest to agriculture reduced the ability of the land to retain nutrients at a time when the fairly new practice of crop rotation allowed for a greater return of nutrients to the soil and was later supplemented by chemical fertilizers.[lxxvi] More recently in the Chesapeake Bay region, the loss of forestland has occurred at a rate of 60 acres per day since 1973 and 100 acres per day since the mid 1980s.[lxxvii]

Forests currently cover approximately "58% of the Bay watershed, a larger proportion than any other single land cover."[lxxviii] However, in the relationship between land cover and water quality, location is everything. Percent forest cover increases as you travel farther away from the Chesapeake Bay, placing the most heavily forested areas in the outer reaches of the watershed and not in the heavily populated and heavily farmed Coastal Plain area where it is most needed (Figure 15). As of 2005, "percent forest cover in the Chesapeake watershed [ranged] from roughly 40% to 60% with the lower amount of forest cover in Maryland."[lxxix] Between 1986 and 1999, Maryland lost 6%, or 141,000 acres, of its forestland. This was the greatest percentage loss of any of the Bay states. Virginia lost more than 5%, or 461,000 acres of its forestland between 1984 and 2002 (Figure 16).

The distance of forests from streams and nutrient sources directly influences how well they are able to keep nutrients and sediments out of rivers, streams, and the Bay itself. Forested riparian, or streamside, vegetated buffer strips have been found to reduce nitrogen in groundwater by 68–100% and in surface runoff by 78–98%. They have also been found to reduce phosphorus in surface runoff by 50–85%. Studies have found that the amount of nutrient reduction was dependent on initial nutrient concentrations before flowing through the buffer, the width of the buffer, and the soil type.[lxxx] Because riparian forests lie in the areas where land and

water meet, connecting aquatic habitats with their terrestrial counterparts, they are incredibly productive ecosystems and are fundamental for achieving healthy water quality.[lxxxi]

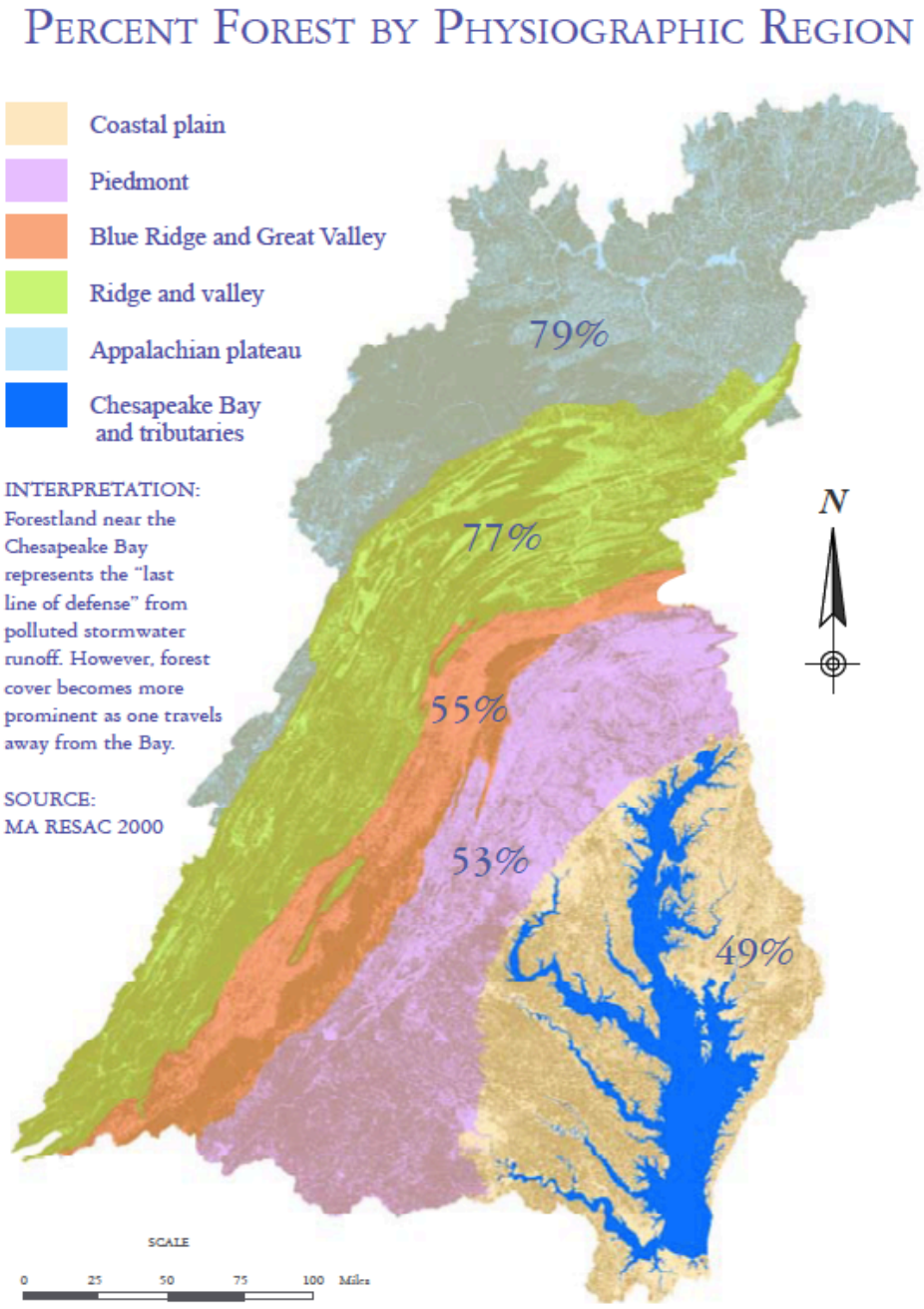


Figure 15. Percent Forest Cover by Physiographic Region.[lxxxii] Percent forest cover increases as you travel farther away from the Chesapeake Bay, meaning there is less protection in the areas where it is needed most.

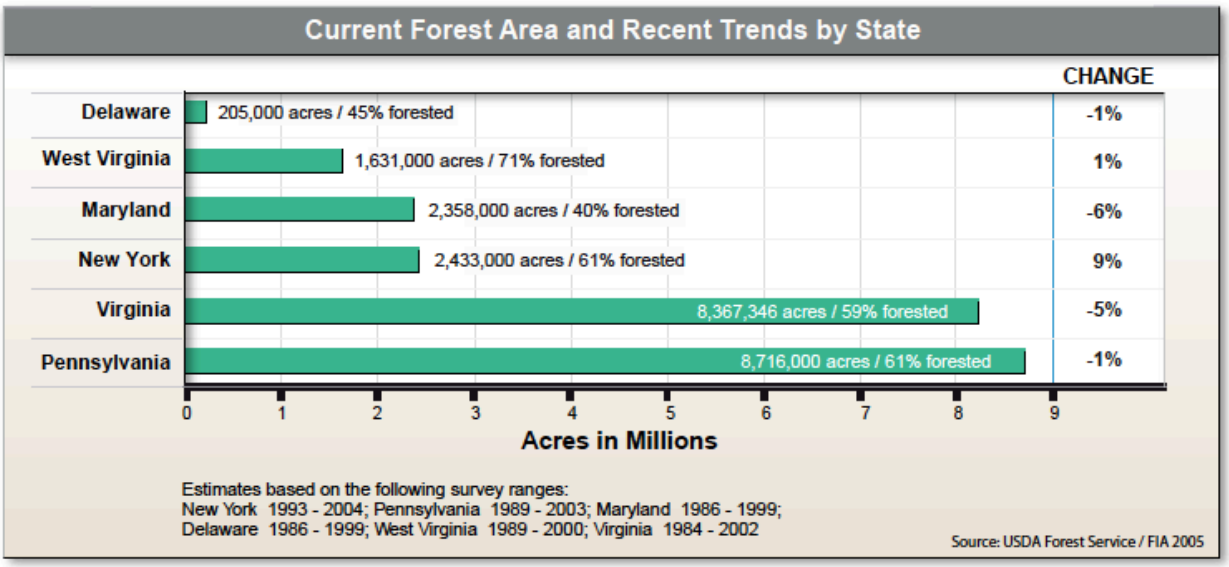


Figure 16. Current Forest Area and Recent Trends by State.[lxxxiii] Percent forest area has declined by 6% in Maryland and 5% in Virginia, the two states in closest contact with the Bay and thus in need of the greatest forest protection. It is important to note that not the entire area of some Bay states is within the watershed; and therefore, not all of their forestland may be contained within the watershed.

Comprising only 5% of the total land area in the Bay watershed, riparian forests "currently buffer 60% of the streams and rivers in the Bay watershed. To achieve water quality, habitat, and watershed function goals in the Bay watershed, at least 30,000 miles of additional riparian forest buffers will be needed."[lxxxiv] Buffers are generally between 35 and 100 feet, meaning an additional 198 to 570 square miles, or about 127,000 to 365,000 acres of riparian buffers are needed in the Chesapeake Bay watershed; however, no estimate was available for how many acres of riparian buffers are needed in Maryland alone. The Maryland WIP estimates 3,645 acres of specifically streamside forested buffers will be planted (Appendix II). If every other forest project described by the WIP was to only plant streamside buffers that would still only allow the planting of 13,645 acres. If every Bay state, excluding D.C., were to plant that many acres of streamside buffers, we would still only have 81,870 acres of forested streamside buffers. In this sense, the WIP is not being aggressive enough in its expansion of riparian forestland.

The loss of forestland also "disproportionately increases nutrient pollution to the Bay. Reducing forest area in a watershed by 10% leads to as much as a 40% increase in nitrogen loads to the water."[lxxxv] Although the Bay watershed currently stands at 58% forest cover, studies have shown that "watershed health begins to decline as forest cover drops below 65 – 75 %."[lxxxvi] For the Bay, this figure may be even higher due to its shallowness and the increased fragility that this attribute creates. Figure 17 presents a more detailed view of percent forest cover, exposing that

closer sub-watersheds have less forest cover, and thus offer less protection from nutrient pollution.

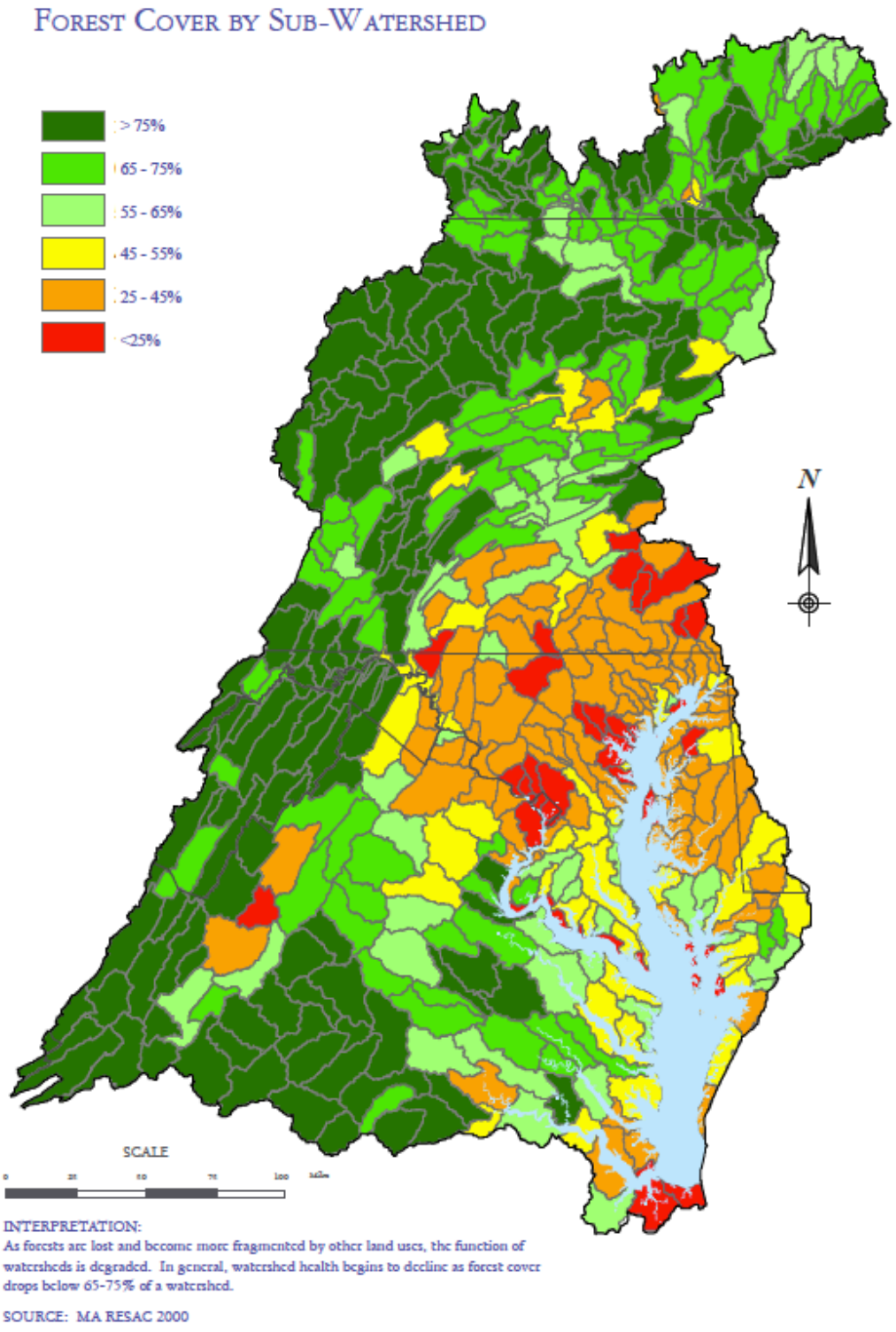


Figure 17. Forest Cover by Sub-Watershed.[lxxxvii]

Although forestlands are imperative to Bay health, they are limited in their ability to reduce pollution on their own. The main problem with forest loss is that it is a compound problem – not only do you lose the filtering and retaining abilities of the forest, but you often gain the increased runoff and pollution caused by the agriculture or impervious surfaces that replace them (Figure 18). The Smithsonian Environmental Research Center found that increases in agricultural land and impervious area are stronger determinants for water quality than percentage forestland alone (Figure 19). "Total impervious surfaces in the watershed increased from over 240,000 hectares [approximately 593,000 acres] in 1990 to 350,000 hectares [approximately 865,000 acres] in 2000."[lxxxviii]

In spite of this, forested areas and maintained buffer zones can help to dilute the impacts of these other land uses. For example, urban forests, defined as 100 trees per acre, and rural forests can help to reduce stormwater runoff from small storms by "storing and filtering up to six times more rainfall than grass and 20 times more than a parking lot."[lxxxix] In addition to being efficient, they're also exceptionally cheap. One could say they're incredibly stingy systems, offering the biggest bang for your buck. The Chesapeake Bay Foundation estimates that the cost of reducing nitrogen pollution using forest buffers is between only $1.20 and $3.20 per pound of nitrogen, compared with $15.80 to $47.40 per-pound of nitrogen reduced using WWTP upgrades (Figure 12).[xc] The price range for forest buffers is due to on-site differences in soil type, slope,

hydrology, and nutrient load, as well as the use of different tree species or different design schemes within the buffer.

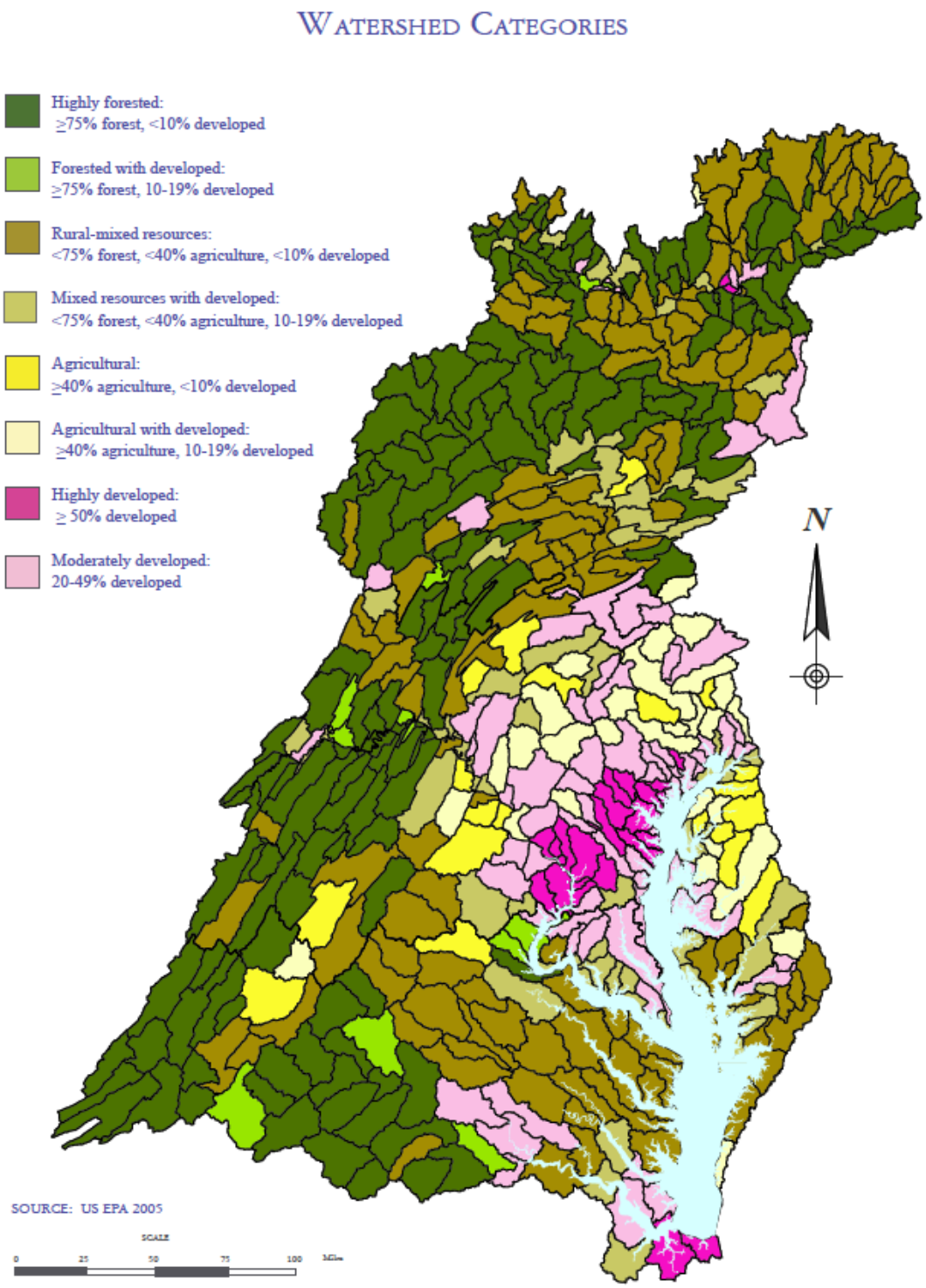


Figure 18. Watershed Categories.[xci] As forest cover declines in a sub-watershed, it is typically replaced with agriculture and development.

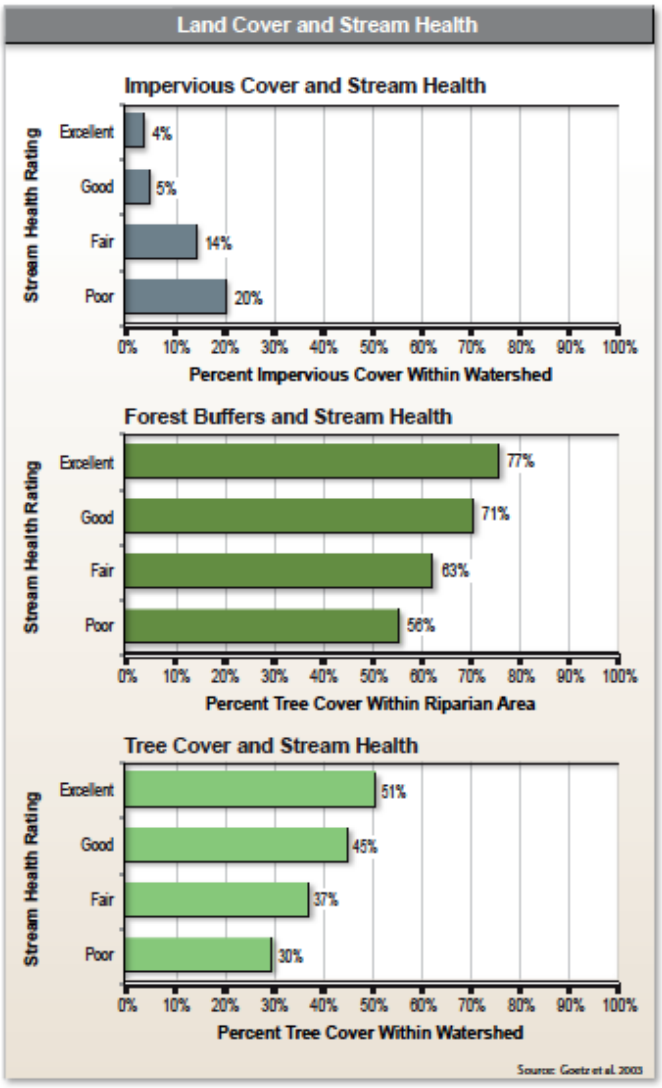


Figure 19. Land Cover and Stream Health.[xcii] Stream health declines rapidly with small increases in impervious surfaces; however, it increases with increases in riparian forest buffers and tree cover within the watershed.

In addition to improved water quality and increased habitat, forested buffers generate other benefits as well. In urban environments, buffer plantings "can provide visual privacy, attenuate noise, diminish air pollution, reduce and retard stormwater runoff, help maintain water quality, increase property values, provide habitat for wildlife, moderate microclimates, and reduce the energy required to heat and cool nearby buildings." They can also be used to separate "incompatible land uses," such as residential and industrial areas.[xciii] A 1998 study by Kuo, et al. demonstrated that, contrary to popular belief, increased tree density and grass maintenance actually increased both preference and sense of safety for residents of inner-city neighborhoods.[xciv]

Forested buffers can also prove useful in the rural-urban fringe, where "massive urban developments abut equally massive agricultural enterprises" and all too frequently create "not only an abrupt and sometimes harsh visual and physical interface, but also one that is highly charged politically." Forested buffers along this interface have the ability to transform "this zone of conflict into one of shared ownership and use…in which both groups see the area as one of

positive social, economic, and ecologic interaction (Figure 20)."[xcv] Researchers have termed these areas as "ecobelts." Other studies have found approval for buffers among farmers, academics, and residents, suggesting that these buffers may provide more than just environmental benefits in the agricultural and "rural-urban fringe" landscape; however, it is important to take into account the different wants and needs of socio-economic groups when designing buffer policy.[xcvi]

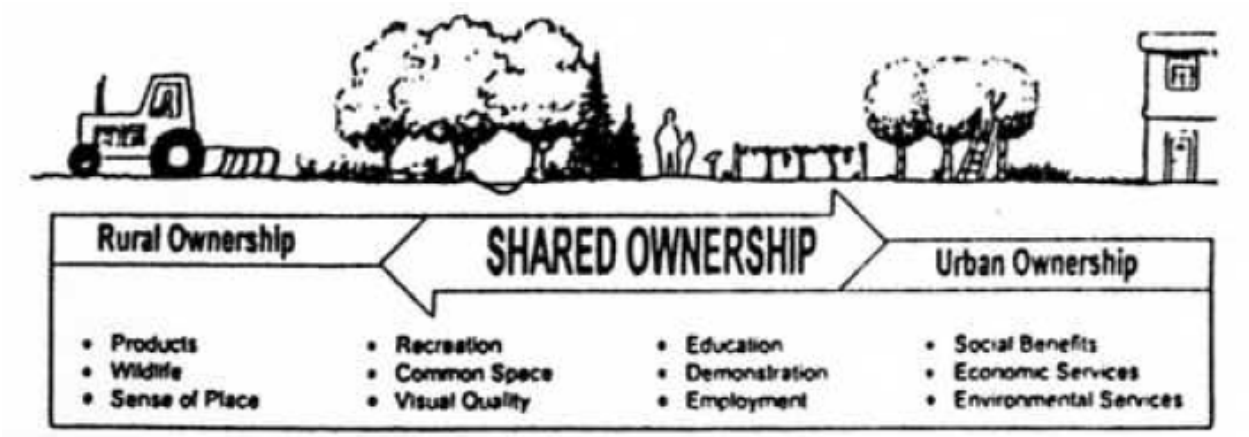


Figure 20. The Rural-Urban Interface: A Zone of Shared Ownership.[xcvii] Buffers between rural and urban areas can create zones of shared ownership that can contribute to products, wildlife, sense of place recreation, common space, visual quality, education, demonstration, employment, social benefits, economic services, and environmental services.

Aesthetic considerations are also important when we consider areas like Maryland's Eastern Shore and our desire to preserve its rural character even as more and more people flock to it. Buffers on farmland not only increase land values, but they also enhance the scenic quality of the area and can help to encourage agrotourism.[xcviii] Agrotourism may prove to be a useful additional source of income for farmers on the shore as Westerner's visit to tour organic farms, pumpkin patches, and vineyards. A Michigan study found that farmers, planners, and citizens all "preferred settings including both farm and forests. Participants also preferred housing developments with mature trees over developments with few trees." An issue arose when participants were required to give their preferences concerning rural residential development however. Participants preferred large-lot type of developments, a kind of wasteful sprawl that consumes forests and agricultural land, instead of "clustered housing that preserves farm and woodland surrounding the development."[xcix] This is an issue that Maryland planning and zoning commissioners as well as policymakers need to address in order to prevent sprawl from consuming our remaining forests and farmlands.

Forest conservation in the Chesapeake Bay region may also face increased challenges in the future due to the continued fragmentation of forests by housing subdivisions, farms, and other land uses, as well as increasing parcelization of forests (Figure 21). "More people own forests than ever before, but they own increasingly smaller parcels with nearly 70% of all family forest owners holding less than 10 acres. This trend, known as "parcelization," threatens forest

sustainability."[c] Parcelization often creates a self-reinforcing cycle and typically ends in forest destruction due to sprawling development (Figure 22).

In Baltimore County, Maryland, dozens of ownerships (blue) dissect the riparian forest corridor (red) increasing the difficulty of managing and conserving the forest.

Figure 21 and 22. Fragmentation and parcelization both threaten forest stability by making it difficult to manage forests.[ci]

Families or businesses privately own 78% of the forests in the Chesapeake Bay's watershed (Figure 23). More than 900,000 families hold 64% of all forestland in the watershed. "Fewer than 20% of owners (2,500 acres) have written forest management plans and only a third (5,000 acres) have sought professional advice… Financial incentives for forest conservation and stewardship are insignificant. As a result, forests are primarily managed for short-term economic gains, not managed at all, or sold for development."[cii] It is clear that "forestland conservation,

restoration, and management on private lands will determine the future breadth and condition of Chesapeake forests."[ciii]

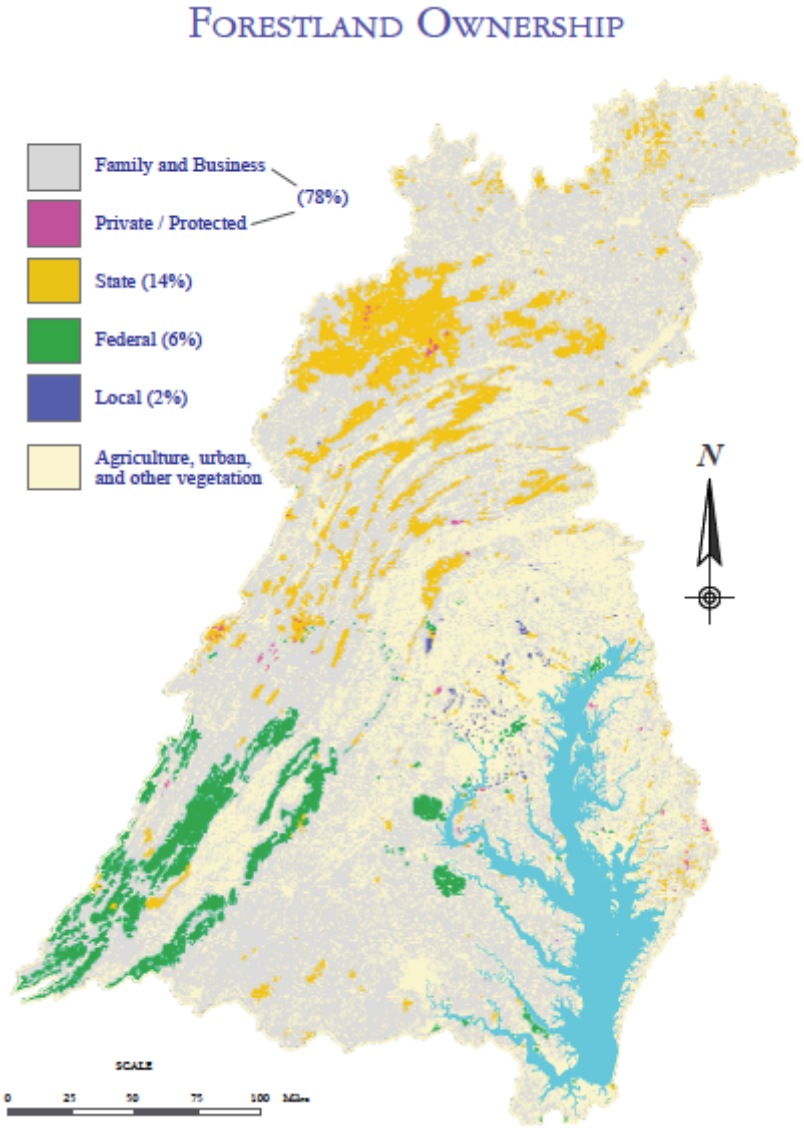


Figure 23. Forestland Ownership. Families and businesses privately own the vast majority of Chesapeake Bay forests, while most of the federal and state forests are in the outer reaches of the watershed.

Overall, there is strong public support for land conservation amongst the Chesapeake Bay states. Between November 1996 and May 2005, 88% of 166 measures supporting the conservation of natural and scenic landscapes were approved; however, it is possible that some of these were outside of the Chesapeake Bay watershed, especially in states like New York and West Virginia that comprise only a small portion of the watershed. Although Maryland passed 100% of its measures, these amounted to only 9 actions amounting to approximately $31 million.

Maryland's approved funding was over $250 million less than the next highest state, Virginia, and represented significantly less than funding in Pennsylvania and New York (Figure 24).

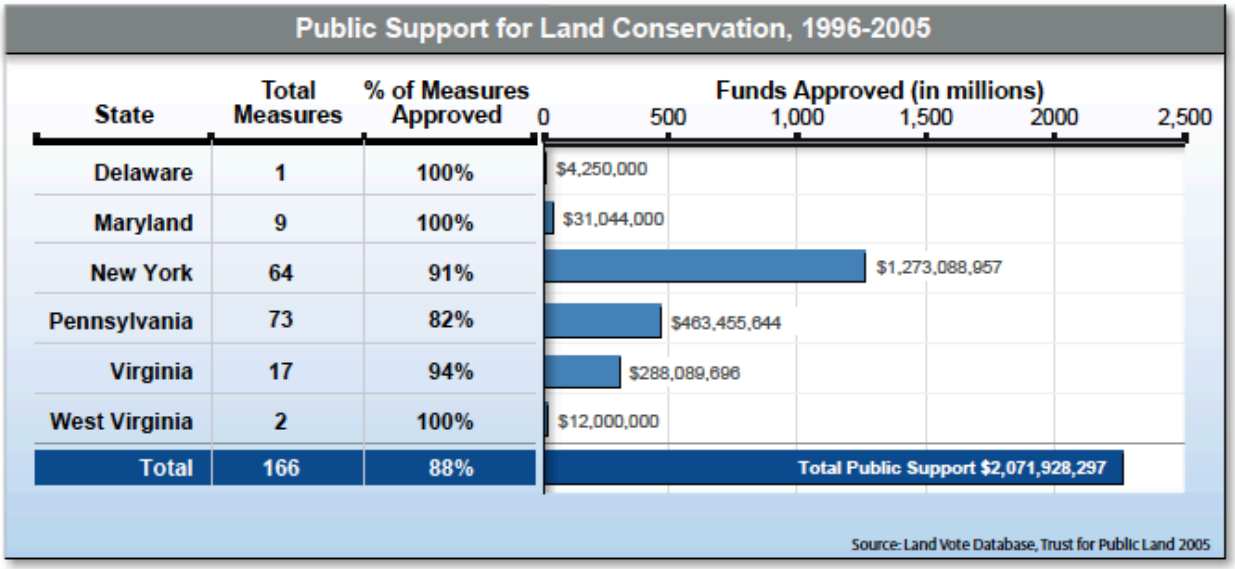


Figure 24. Public Support for Land Conservation in Chesapeake Bay States, 1996-2005.[civ]

If we ever expect to see improvements in Chesapeake Bay water quality, it is imperative that Maryland put more emphasis on forestland conservation. Maryland is situated in a location vital to Chesapeake Bay restoration or degradation. It has the most land in direct contact with the Bay and can therefore have the greatest impact on Bay health. Maryland's important location means that it needs to be a leader in all aspects of pollution reduction and not just advancements in WWTP technology.

Wetlands

"The edges of the Chesapeake Bay reflect the wider fight to reconcile the region's natural resources with a growing human impact on them. In the marshes and the shallows of the edges lies the bay's greatest productivity, while along the waterfront is where most of us are drawn to live and to site power plants, marinas, and sewage treatment discharges."[cv]

- Tom Horton, *Turning the Tide*

Wetlands are another form of natural filter that are fundamental to the health of the Chesapeake Bay. Wetlands perform priceless ecosystem services very similar to forests, including removing, retaining, and transforming nutrients; minimizing sediment loads; absorbing chemical and organic pollutants; filtering out trace metals, trace organics, and pathogens; stabilizing streamflow; controlling flooding; and reducing erosion. "These processes are driven by diverse treatment mechanisms: sedimentation, filtration, chemical precipitation and adsorption, microbial interactions, and uptake by vegetation."[cvi] The Chesapeake Bay Foundation asserts that the loss of wetlands surrounding the Chesapeake Bay has "stripped the watershed of these buffers, and today pollution flows undiluted into waterways."[cvii]

Unfortunately, these highly productive and economically important ecosystems have taken quite a beating historically, losing acreage to agriculture, development, and more recently, sea-level rise. Traditionally, "private owners converted wetlands to other uses to increase their productive value. For most of U.S. history, public incentives were offered to private owners to encourage wetland conversion to more productive uses in order to promote economic growth and westward expansion."[cviii] In the Bay region, overall wetland coverage has declined by almost 60 percent, or more than four million acres, since 1780. "New York and Maryland account for nearly two-thirds of the total decline in wetlands in this region." In Maryland alone, there has been a 75% loss of wetlands since the 1700s.[cix]

Maryland currently retains about 591,000 acres of wetlands, split evenly between tidal and non-tidal.[cx] Detrimental effects can be seen in the state of Maryland due to its tolerance of "a greater impact on wetlands." While "most states allow bulkheads where they are necessary to protect property," unlike Maryland, "they have not formally granted a right to hold back the sea."[cxi] In an attempt to prevent erosion along its 7,719 miles of shoreline, Maryland has armored fifteen to twenty-five miles of coast annually over the past twenty years.[cxii, cxiii] Armored shorelines compounded with rising sea levels threaten the Bay's health even more as they overtake existing wetlands essential to creating a healthier aquatic ecosystem.

Blackwater National Wildlife Refuge has lost "over 8,000 acres – or 12 square miles – of marsh…at a rate of 150 acres per year" since the 1930s. "Causes of this marsh loss include sea level rise, erosion, subsidence, salt water intrusion, and invasive species."[cxiv] Current projections suggest that "tens of thousands of acres around the Chesapeake will drown in the next century" due to rising sea levels, with Dorchester County estimated to lose about 85,000 acres of marsh and forest by 2100. "While many Bay scientists think a three-foot rise [in sea level] by 2100 is reasonable, they don't rule out a rise up to six feet."[cxv]

The primary issue with wetland preservation is "that the public benefits – providing fish and wildlife habitat, preserving water quality, storing flood waters, and so forth – extend well beyond the bounds of wetlands themselves…many of these public goods benefits accrue to society at large or to individuals other than the wetland owners…As a result, many private wetland owners may find it more profitable to convert wetlands to alternative uses, such as

agriculture or urban development, even when such conversion is costly to society."[cxvi] There are however several protected wetland areas around the Bay, including areas in Blackwater National Wildlife Refuge and Fishing Bay Wildlife Management Area on the Eastern Shore and Jug Bay Wetlands Sanctuary on the Western Shore.

Generally, wetlands have proven themselves worthy in terms of water quality benefits in agricultural areas. "Restored wetlands receiving crop field drainage water are shown to lower concentrations of both nitrogen and phosphorus." A study of several wetlands restored for wildlife habitat "on former agricultural lands of the Atlantic coastal plain near the Chesapeake Bay" revealed added water quality benefits. On average, the Maryland wetlands could "remove up to 68% of nitrate-nitrogen and 43% of phosphorus from drainage water." Results also indicated "that performance is highly sensitive to retention time, with greatest nutrient removal during flow conditions that facilitate retention times of at least one to two weeks. Where wetlands are incorporated into forested riparian buffer strips, additional water quality benefits are shown."[cxvii]

Other studies have indicated "that nitrate-nitrogen removal efficiencies of greater than 95% are realistic," as are nitrite-nitrogen removals of up to 96 percent and ammonium nitrogen removals of 14 – 98 percent. When designing wetlands for agricultural runoff, it is important to consider retention time, wetland size and location, and maintenance as agricultural runoff can "carry a heavy sediment load and high nutrient and pesticide concentrations, which can degrade wetland treatment systems."[cxviii] Nevertheless, restored or constructed wetlands are still a cost-effective option for reducing nitrogen pollution, estimated at only $1.50 per pound of nitrogen compared with $1.20 to $3.10 for forest buffers and $15.80 to $47.40 for WWTP upgrades (Figure 12).[cxix]

The United States has pursued a "no net loss" wetlands policy since the late 1980s. "The 'no net loss' goal can be pursued by conserving existing wetlands, restoring former wetlands that were converted, or by some combination." The policy implication "is that conservation alone will not be enough…In many areas, wetland conversion has destroyed so much of the original wetland base that restoration is required for functioning wetland ecosystems." Wetland conservation programs were in place before the mid-1980's; however, at that time, wetland restoration programs were still in their early phases.[cxx]

There is still some controversy over conservation and restoration of wetlands. While "conservation avoids adding the cost of restoration to the original costs of converting wetlands that ultimately prove marginal in their converted use," it is also likely that conservation on its own will not be enough. Maryland, as well as much of the rest of the United States, has already experienced drastic wetland losses and it is likely that "future wetland conversion where public and private benefits exceed costs is unavoidable. Wetland restoration is the only way to make up for truly unavoidable losses."[cxxi] Both conservation and restoration will be essential in the future; however, it is important in the Chesapeake Bay region to target those areas that will produce the greatest nutrient reduction benefits.

Between 1998 and 2008, 13,000 acres of wetlands were established or restored in the Bay area; however, ecologists often question the quality of man-made or restored wetland areas compared to natural ones.[cxxii] Constructed wetland acreage does not necessarily translate into the same wetland functions and ecosystem services that a natural system provides. "Critics of wetland restoration argue that the functions and values of wetlands lost are never totally recovered in restorations."[cxxiii] For example, "Maryland lost 740 acres of wetlands to permitted construction from 1991 to 2009…but because developers built 1,417 acres of wetlands

mitigation projects, the state claims it actually gained 677 acres of wetlands during this time period." Unfortunately many of these artificial wetlands die in droughts because they do not have proper wetland soils or hydrology. A Maryland Department of the Environment study in 2007 "found that only half of 641 wetlands restoration projects in the state were successful. Despite this relatively low rate of success, Maryland approves 99.8 percent of applications by builders and developers for permits and authorizations to build in wetlands."[cxxiv] Further studies are needed to determine if these constructed wetlands really provide the same environmental benefits in addition to improved water quality. These benefits include "fish and wildlife enhancement, flood and erosion control, educational benefits, and others. Studies have shown that the economic value associated with these benefits can be substantial."[cxxv]

The Maryland WIP addresses the restoration of between 2,155 acres and 3,367 acres of wetlands, representing only a fraction of what used to exist in Maryland and just a drop in the bucket for the overall watershed (Appendix II). The WIP does nothing to further conserve or incentivize the preservation of existing wetlands. By placing more emphasis on the importance of restoring wetlands than preserving natural ones, the WIP creates a social predicament that rewards farmers, developers, and landowners for destructive behaviors towards wetlands so long as they compensate for it with an artificial system.

Grass Buffers

Grass buffers are also discussed by the Maryland WIP; however, their presence in the literature is much less prevalent than forest or wetland buffers. "The limited information on grass [vegetated buffer strips] reveals [nitrogen] reductions of 10 – 60%...while grass buffers 4.6 – 27 m in width reduced nitrate concentration by 54 – 84%...[and phosphorus] concentrations by 61 – 83%." An Illinois study even found that grass buffers show greater efficiency at retaining phosphorus than the forested buffers; however, they were not as efficient in nitrogen removal.[cxxvi]

Russ Brinsfield is a research associate and the executive director of the Harry R. Hughes Center for Agro-Ecology, a foundation associated with the University of Maryland, College Park. The mission of the Harry R. Hughes Center for Agro-Ecology is to bring "together diverse interests from the agricultural, forestry, and environmental communities for the purpose of retaining Maryland's working landscapes and the industries they support while protecting and improving the health of the Chesapeake Bay and its tributaries."[cxxvii] The Center also hosted a series of WIP Phase II workshops across the state of Maryland in which information and planning advice were presented to local planners, agriculturalists, environmental organizations, and other interested citizens. This is not Brinsfield's only affiliation however; he also serves as the mayor of Vienna, is a long-time farmer, has his PhD and has co-authored more than 100 publications. Needless to say, he knows the Chesapeake and the issues that face it.

In an interview with Brinsfield, he described recent scientific studies showing that grass buffers in Maryland need to be composed of deep-rooted warm season grasses, such as switchgrass or gamma grass, rather than cool season grasses that are currently being grown. These warm season grasses are slightly more difficult to get established and require some specialized equipment, but for the most part, they aren't being grown because farmers are not familiar with them. In terms of forest, wetland, or grass buffers, the latter are the most popular amongst farmers because they are less expensive to plant and maintain and because unlike trees,

grass buffers are easily removed if farmers no longer want to grow them. Although they are less expensive to plant, they also give less return in terms of nutrient reduction.[cxxviii] The average cost of reducing nitrogen pollution using grassed buffers is $3.20 per pound of nitrogen, the most expensive per-pound cost of the three buffers discussed (Figure 12).[cxxix]

In terms of strictly agricultural buffers, the Maryland WIP seems to follow suit with farmer's preferences, even though these are not the most effective buffer for improving water quality. The WIP proposes the planting of 7,000 acres of streamside grass buffers on agricultural lands, the largest land allocation amongst forest, wetland, and grass buffers. When it comes to activities on public lands, where there is little to no public backlash, grass buffers receive fewer acres, amounting to only 69 acres of streamside grass buffers and 45 acres of grassland (Appendix II). This uneven distribution of acreage that favors grass buffers on agricultural lands calls into question just how much influence the farm lobby has over environmental policy and planning.

Same Problem, Same Solutions, Same Results

In terms of the effectiveness of agricultural best management practices, Russ Brinsfield ranks buffers as second to only cover crops. He believes that, for pounds of reduction per unit costs, buffers are a cost-effective solution as well. Not only are natural buffers ecologically effective and cost-effective for reducing nutrient pollution, but there's also money out there for the taking from numerous incentive programs, most of which are agriculturally focused.

The problem with natural buffers arises from two things – making them cost-effective for landowners and common practice without being required.[cxxx] The Maryland WIP addresses neither of these problems, but instead relies on existing natural buffer policies and programs. These programs have failed to reach their goals in the past and without any expansion or strengthening from the WIP, will likely fail to meet their goals in the future.

Agriculture

The Maryland WIP identifies a variety of agricultural programs to fund its pollution control strategies. Two of these programs are the Maryland Agricultural Water Quality Cost-Share (MACS) program and the USDA's Conservation Reserve Enhancement Program (CREP). The MACS program provides farmers with grants to cover up to 87.5 percent of the costs to install BMPs on their farms. More than 30 BMPs are currently eligible for MACS grants.[cxxxi] Maintenance is incredibly important to keeping BMPs functioning effectively, but currently there is not enough funding to support the costs of monitoring BMPs.

Culturally there is also still some resistance to BMPs. Generally speaking, farmers are independent, hardworking people with a bit of a cowboy-like defiance. They work for themselves and don't like to be told what to do. To them, BMPs may seem like a precursor to top-down, hardnosed environmental regulations. The Maryland WIP only increases the already growing pressure on the farming community to think of natural buffers as a requirement. To this day, buffers are not a requirement and if they were, Maryland farmers would cease to receive cost-share dollars and would be unable to compete with farmers in other states. While some farmers see BMPs as a means of government interference, other farmers think that they are doing enough for the environment and are just being picked on as immoral polluters because they are

cost-effective easy targets. Truthfully speaking, science really is pointing to agriculture as one of the biggest polluters of the Chesapeake Bay; however, it is essential that policymakers be sympathetic to the financial investment side of farmers' arguments.[cxxxii]

Similar to MACS, CREP promotes the voluntary retirement of marginal crop and pastureland and the application of conservation practices, such as forest buffers, filter strips, and wetland restoration, by providing financial backing for these activities.[cxxxiii] Maryland was the first state to develop CREP and has had an active program since 1997.[cxxxiv] The Maryland CREP originally evolved from the federal level Conservation Reserve Program (CRP) that was aimed at reducing "soil loss on highly erodible agricultural land." CRP and CREP have done more than that though. They've also produced benefits such as "the reversal of landscape fragmentation, maintenance of regional biodiversity, creation of wildlife habitat, and favorable changes in regional carbon flux."[cxxxv]

CREP land eligibility depends on a variety of factors. In order to be eligible, the land must be physically and legally capable of being cropped, there must be the identification of an agriculture-related environmental issue, and the landowner must complete a project proposal. Enrollment in CREP is limited to specific geographic areas and agricultural practices as well. Once land is covered under the policy, it is the landowner's responsibility to commit to 10-15 years of keeping the land out of agricultural production.[cxxxvi] Landowners receive payments based on the type of practices they install and are eligible for five types of payments – a signing bonus, an annual rental payment, cost-share assistance, a practice incentive payment, and maintenance payments. CREP also offers permanent easement options in which landowners receive payments "based on the fair market value of foregone development and agricultural productivity" in exchange for permanently protecting their land.[cxxxvii]

To date, CREP has been the most successful program involving natural buffers in Maryland, but so far, it appears to have been limited by enrollment rather than funding. As of March 2011, the USDA has allotted approximately $165 million to the Maryland CREP "for rental payments to be made over 15 years, and about $33 million for cost-share payments during the same period, for a total of $198 million. Maryland will spend an estimated $1 million in cost-share payments in addition to other state direct and in-kind contributions of approximately $89 million."[cxxxviii] "The Maryland Board of Public Works appropriated $7.5 million for CREP costs, and approved $5.7 million for permanent easements" between 2001 and 2003. Maryland landowners have also "received about $37.5 million in Federal rental payments for establishing vegetative buffers on their property."[cxxxix] In addition to state and federal funding, "Ducks Unlimited and the Chesapeake Bay Foundation…furnished 40% of non-federal contributions to the Maryland CREP."[cxl]

Between 1997 and 2004, "a total of 5,191 CREP contracts, comprising 71,208.5 acres, [had] been issued, leaving a balance of 28,791.5 acres available for future enrollment. More than 4,398 acres have been permanently protected through CREP conservation easements."[cxli] A 2005 study by the U.S. Geological Survey reported that in that same year Maryland had 69,035 acres enrolled in CREP, split between 4,986 contracts on 3,005 farms.[cxlii] This either shows a reduction in CREP acreage of more than 2,000 acres between 2004 and 2005, or vagueness in reporting. When fully implemented, Maryland plans to have 100,000 acres enrolled in CREP, "reducing an estimated 11.5 million pounds of nitrogen and 1.1 million pounds of phosphorus from entering Maryland waterways each year" and also "reducing the amount of sediment entering the Bay…by approximately 200,000 tons annually." These 100,000 acres would

establish and enhance "77,000 acres of riparian buffers, 5,000 acres of wetland habitat and 2,000 acres of habitat for declining, threatened, or endangered species."[cxliii]

The unfortunate matter is that the Maryland CREP has not been able to achieve these goals yet, and with no strengthening from the WIP, does not appear likely to in the future. Deflated by simple economics, CREP has lost popularity over the years and is not seeing the expected increases in enrollment. It was most popular when grain prices were low because the money you could receive for planting a buffer or restoring a wetland was more than you would get for grain harvested from the same area. As the price of corn, a dominant cash crop in Maryland began to rise due to its use in the production of ethanol, the expansion of CREP slowed. The increase in corn planting due to ethanol actually more than offset the reductions in nitrogen achieved in the previous recent years. This illustrates a larger disconnect in the EPA's strategy to not only push ethanol, but to also push water pollution clean up.[cxliv] It is now possible for farmers to make money on their marginal lands, leaving CREP unviable and unsellable economically. Although it still offers financial incentive, today's CREP relies more heavily than ever on farmers' ecological and environmental consciousness and while most farmers are conservationists, they can't always afford the "greener" option.

Another problem with CREP is that it provides no real reporting or monitoring mechanism. It is too young of a program to really know what the long-term benefits or environmental effects are. Because it originally started as a land retirement and protection program, monitoring and evaluation of CREP performance in terms of water quality has been dismal. No government agency, state or federal, was given the authority to monitor buffer maintenance and therefore, neighbors sometimes took it upon themselves to report poorly maintained or illegal CREP land use. Similarly, no government agency was given the authority to monitor water quality on CREP lands; however, it is likely that some individualized special studies have been privately conducted. Even without these studies we can infer that CREP has been beneficial to individual streams and rivers; however, further studies are needed to determine how it has affected the overall Chesapeake Bay.[cxlv]

Lastly, the WIP identifies the 2010 Chesapeake Bay Trust Fund as a viable source of funding for agricultural streamside grass and forest buffers, wetland restoration, highly erodible land retirement, and cover crops; however, there seems to be some confusion in the press and even in the state government over this fund. The agriculture section of the WIP refers to the 2010 Chesapeake Bay Trust Fund as a source of funding, but the public lands section refers to the Chesapeake and Atlantic Costal Bays Trust Fund. This inconsistency is also present in newspaper articles and state websites offer no clear explanation.

A 2010 Baltimore Sun article cites that the Chesapeake and Atlantic Coastal Bays Trust Fund was created in 2007 and was supposed to fund $50 million a year; however, "it has never come to that level, as lawmakers whittled away at it and revenues lagged. In 2009, O'Malley asked for $25 million," but received only $9.6 million, then only $8.81 million in 2010 (Figure 25).[cxlvi] The Trust Fund received some rejuvenation in 2011, receiving $20 million, but still falling quite short of the proposed $50 million.[cxlvii] Similarly, a review of the 2011 Maryland

fiscal budget reveals that "the 2010 Chesapeake Bay Trust Fund [received] $20 million – less than the statutory requirement but more than either fiscal 2009 or 2010."[cxlviii]

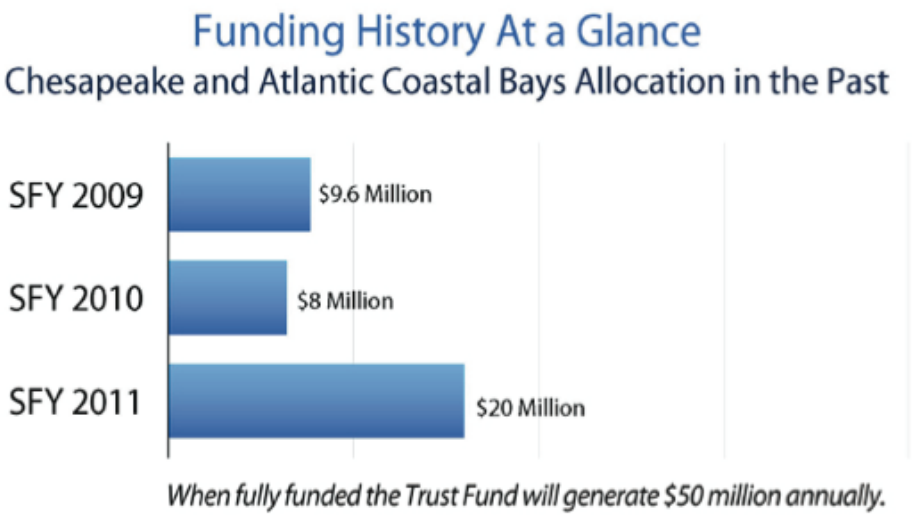


Figure 25. Chesapeake and Atlantic Coastal Bays Funding History, 2009 – 2011.[cxlix]

A March 2012 article in The Dispatch, an Ocean City newspaper, reports that the Maryland General Assembly approved "a plan to spend $50 million per year to clean up the Chesapeake Bay," but not the coastal bays in and around the Ocean City area. This plan is referred to as the Chesapeake Bay 2010 Trust Fund and "will be funded in large part by a portion of the gasoline tax, car rental taxes and the newly increased vehicle titling tax," the same sources of revenue identified for the funding of the Chesapeake and Atlantic Coastal Bays Trust Fund; however, it "does not include any provisions for funding for the coastal bays and focuses strictly on the state's largest estuary."[cl] The article goes on to say that "last year's Chesapeake Bay and Atlantic Coastal Bays Green Fund bill would have created a rather onerous fee on new construction based on the amount of impervious surface created," but would have included the coastal bays. Last year's bill was not passed, but in the approved 2012 Green Fund bill there was no reference to the coastal bays. Delegate Jim Mathias (D-38B) "pointed out the Chesapeake Bay 2010 Trust Fund is a completely different piece of legislation than the Green Fund bill" and was quoted saying "for one thing, the identified funding source is different. Funding comes from a portion of the gasoline tax and the rental car tax. It doesn't have anything to do with fees on new construction."[cli]

The discrepancies surrounding these plans seem to be confusing to concerned citizens and legislators alike and the similarities in names do nothing to help those involved. Given the similarities between most of the reports on the 2010 Chesapeake Bay Trust Fund and the Chesapeake and Atlantic Coastal Bays Trust Fund, in addition to the fact that no state website exists for the former plan, yet one does for the latter, it seems relatively safe to assume that they are one and the same. However, the multiple names do nothing to clarify the issue and only create more confusion about just how much money is being spent on Bay restoration.

Regardless of the name of the program, the Chesapeake and Atlantic Coastal Bays Trust Fund is still allocating money for Bay restoration; however, it seems that most is going to

agricultural BMPs, specifically cover crops, and not natural buffers. Maryland's Chesapeake and Coastal Program identified that $13.61 million would fund agricultural BMPs assuming a state fiscal year 2012 allocation of $25 million, while only $2.76 million would go toward planting forests and wetlands (Figure 26).

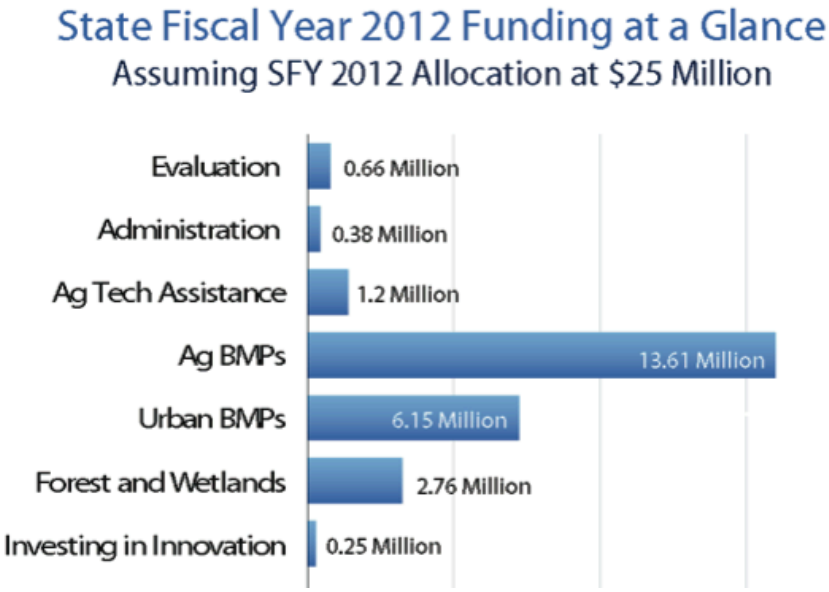


Figure 26. Chesapeake and Atlantic Coastal Bays Trust Fund Spending Assuming State Fiscal Year 2012 Allocation of $25 Million.[cliii]

A 2008 article reports on Maryland Governor Martin O'Malley's 2008 passage of $18 million in funding as a means to plant cover crops. "Cover crops are one of the most cost-effective and environmentally sustainable ways to protect the Bay and its tributaries from nutrient runoff…The record $18 million in funding will help farmers offset higher planting and fuel costs associated with planting cover crops," said Governor O'Malley. Maryland Agriculture Secretary Roger L. Richardson was quoted saying, "Available funding this year will allow farmers to plant nearly 500,000 acres in protective cover crops this fall, including in some targeted watersheds." The funding for the cover crops not only came from the 2010 Chesapeake Bay Trust Fund, but also the MACS Program and the Chesapeake Bay Restoration Fund.[cliii]

Despite their efforts, a 2012 article from Maryland Department of Agriculture reported, "record cover crop acreage planted by Maryland farmers" in 2011, a total of 429,818 acres. Three years later and still not the 500,000 acres expected in 2008; however, "the 2011 cover crop planting is the largest in Maryland history and exceeds Maryland's 2013 Chesapeake Bay milestone goal by 21 percent." O'Malley is quoted saying, "Cover crops are the workhorse of our Bay restoration efforts."[cliv] What is not acknowledged however is the sliding scale of cover cropping. Not all cover crops are equal and much of their nutrient reducing ability depends on if they are planted in early or late season; so while over 400,000 acres of cover crops were planted, it is possible that they were not functioning at their greatest capacity.[clv]

In no way do I attempt to discredit cover crops, they have certainly proven themselves as efficient means of controlling nutrient and sediment pollution; however, it appears that the majority of the money in the Chesapeake and Atlantic Coastal Bays Program is going to fund them and not natural buffers. Perhaps this trend is changing slightly. The most recent report from the re-named Maryland's Chesapeake and Coastal Service, responsible for the Chesapeake

and Atlantic Coastal Bays Trust Fund, indicates that agricultural BMPs will receive $12.8 million in fiscal year 2013 and natural filters will receive $8.97 million, assuming a $25 million budget (Figure 27). This "increases funding for the restoration of streamside forests and wetland restoration (natural filters). As these projects are more permanent in nature, they will provide nutrient reductions well into the future." In addition, the "capital budget also includes $27.8 million in General Obligation Bonds for local structural stormwater projects [urban BMPs] that were identified by BayStat."

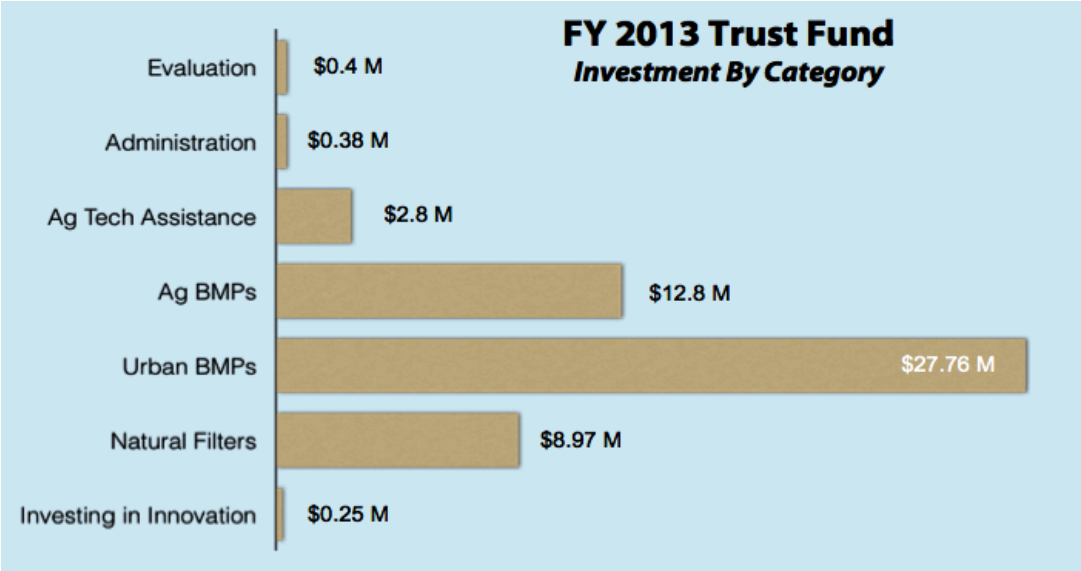


Figure 27. Chesapeake and Atlantic Coastal Bays Trust Fund Spending for the Fiscal Year 2013.[clvi]

Public Lands

The WIP's funding opportunities for natural filters on public lands are a little more numerous and include the Chesapeake and Atlantic Coastal Bays Trust Fund, Maryland's Tributary and Wetland Restoration Fund, Maryland's Ecosystem Enhancement Program, Program Open Space, as well as two competitive funding programs such as the Transportation Enhancement Program and Corporate Wetlands Restoration Partnership.

The Chesapeake and Atlantic Coastal Bays Trust Fund, discussed in the previous section as well, generates money through motor fuel tax and rental car tax in Maryland and allows the State "to accelerate Bay restoration by focusing limited financial resources on the most effective non-point source pollution control projects...Now in its third year, the Trust Fund has targeted over $38M resulting in a total of 1.5 million lbs of nitrogen, 117,000 lbs of phosphorus, and 111 tons of sediment reduced from the Bay watershed."[clvii] Martin O'Malley's 2011 proposal to increase the fund by 25 percent was approved, bringing funding for state fiscal year 2012 to $25 million. Just like O'Malley proposed a year ago, the Trust Fund will use "90 percent of the overall budget for practices and infrastructure that will employ installers, designers, engineers and construction services."[clviii]

While this sounds like the funds are being used to build new wastewater treatment plants or some other technological pricey counterpart, the Trust Fund is actually being used for increased monitoring and data collection, hiring staff for Soil Conservation Districts, constructing stormwater retention ponds and other stormwater retrofits, restoring wetland

floodplains and streams, offering workshops on Low Impact Development, contributing to Maryland's CREP and cover crop program, constructing animal waste storage BMPs, assisting local communities with implementing their local watershed implementation plans, and working on other non-point source pollution control activities. The Trust Fund is truly focused on directing programs that not only reduce non-point source pollution, but also increase citizen education and engagement in restoration projects. According to the Trust Fund, the projects identified for state fiscal year 2012 will reduce 2.1 million pounds of nitrogen, 30 percent of the State's annual nitrogen goal, and 105,000 pounds of phosphorus, 25 percent of the State's annual phosphorus goal.[clix]

The WIP identifies the Maryland Ecosystem Enhancement Program as funding source for wetland restoration, streamside forest buffers, tree planting, streamside grass buffers, and grasslands on public lands. Maryland's Ecosystem Enhancement Program was established in 2008 as a partnership between the Maryland Department of the Environment, the Department of Natural Resources, and the Department of Transportation in an effort to "use a BayStat targeting approach to employ a better model for the State's mitigation funds to accelerate Bay restoration and improve cost effectiveness."[clx] Like most of the other programs identified in the WIP, the memorandum of understanding signed by these three parties indicates that the program is focused more on the "mitigation of transportation projects" than it is on conservation.[clxi]

Program Open Space (POS) was started in 1969 and is "one of the oldest land protection programs in the country."[clxii] Showcasing "Maryland's long-term commitment to conserving natural resources while providing exceptional outdoor recreation opportunities, [Program Open Space] acquires parklands, forests, wildlife habitat, natural, scenic and cultural resources for public use." A "targeting system" has recently been implemented in conjunction with POS to identify areas for land conservation based on its ecological priorities.[clxiii] By 2003, POS "had purchased about 250,000 acres of state parks, wildlife habitat, and natural areas, and 36,000 acres of local parks."[clxiv]

A related Department of Natural Resources program that is not included in the WIP is the Rural Legacy Program which "provides the focus and funding necessary to protect large, contiguous tracts of land and other strategic areas from sprawl development and to enhance natural resource, agricultural, forestry and environmental protection through cooperative efforts among state and local governments and land trusts."[clxv] It seems as though this program, that went unmentioned in the WIP, could be essential to preserving rural culture and seeing the watershed as a whole.

Despite the untold popularity of both the Rural Legacy Program and Program Open Space, both conservation programs have recently experienced hardships in the Maryland Senate, losing "money set aside for land conservation" to instead "pay for storm water projects." The Senate "took $26 million of the Program Open Space money, took money that was supposed to be paid back to Program Open Space and the Maryland Agricultural Land Protection Foundation, and completely defunded the Rural Legacy program." Both of these programs are funded by "a half a percent real estate transfer tax specifically to protect land from future development." What's really unique about the programs is that they support the conservation of farmlands and working landscapes, which certainly contribute to the beauty and charm of the Chesapeake

region.[clxvi] This loss of funding does more than hurt individual landowners that participate in the programs, it hurts the environment and the ecotourism sector of Maryland's economy.

Obstacles to Implementation

Although the WIP's plans for addressing agricultural runoff seem slightly better thought out than its hodge-podge of programs aimed at improving natural filters on public lands, both sectors could be greatly improved upon. When trying to understand this assortment of programs, one comes to the obvious conclusion that hardly any of the programs directly impact the majority of the people living in Maryland. Although farmers may account for a hefty portion of the total nutrient load, they are a minority in the population. The WIP almost blatantly ignores non-point source pollution coming from residential homeowners, waterfront property owners, and sprawl dwellers. At the same time, it does nothing to reward private owners that are preserving forests and wetlands on their own property. In doing this, the WIP not only perpetuates pollution, but it also further distances citizens from the Chesapeake Bay and the lands that feed it. Without enacting policy that will impact the very citizens both positively and negatively affecting the Chesapeake Bay, we will never see a larger social and cultural shift to increased respect for natural systems.

Like any policy strategy, there are always obstacles to implementation. The environmental benefits of natural buffers are well documented in various scientific studies; however, there are some gaps in our knowledge. Most of these benefits have been deduced from "site-specific studies. We know little, however, about how this research relates to other spatial scales. In fact, our understanding of the impact of buffers on overall water quality in the US is extremely limited."[clxvii] This is partially due to the complexity of the system, but also due to the fact that land-use policies, like CREP, do not have a water quality-monitoring component.

This lack of monitoring causes natural buffers to be a harder sell politically. They do not offer the kind of quantifiable results that can be obtained from any wastewater treatment plant, and without this, they are often not seen as worthwhile pollution control efforts. With two-thirds of the pollution entering the Chesapeake Bay coming from non-point sources, we cannot expect easy technological fixes that offer hard measurable numbers. Taking care of wastewater treatment is the easy part and it's what we're good at, but now we have to face the issues that we've put on the backburner for decades – agricultural and stormwater runoff.

The Phase II WIP appears to rely heavily on technology and planning to fix the agricultural runoff problem (Figure 28). This figure comes from a Maryland Department of Agriculture presentation on "Maryland's TMDL Process and the Role for Agriculture – WIP Phase II Summary," and illustrates the changes in agriculture's plan for meeting its share of nitrogen reductions between the WIP II first meeting and WIP II second meeting. Two of the most outstanding changes are the 13% increase in decision/precision agriculture and the 15% addition of enhanced nutrient management. "Enhanced nutrient management calls for a further 15 percent reduction in nutrient application beyond those recommended under traditional plans." Traditional plans seek "to maximize production under ideal conditions" that are typically not present and thus leave unused nutrients on the ground to runoff when it rains.[clxviii] Essentially, enhanced nutrient management plans suggest that farmers weren't managing nutrients well enough, so now they're going to put on paper that they will manage their nutrients better. Just

like with traditional nutrient management, these plans are not always followed, allowing more nutrients to flow into the Bay.

Significant decreases were seen in soil conservation and water quality plans (16% to only 3%), animal waste management (12% to only 2%), and cover crops (28% to 22%). Perhaps most unfortunate were the meager percentages designated to stream protection and wetlands (5%) and buffers (4%). These two practices had the lowest percentages of all, excluding loss of agricultural land – if you can even count that as a means of reducing the nitrogen load, and given sprawl development's consumption of agricultural land, I'm not so sure you can. Even more appalling, stream protection and wetlands and buffers were both reduced in percentage as of the second meeting to only 3% and 1% respectively.

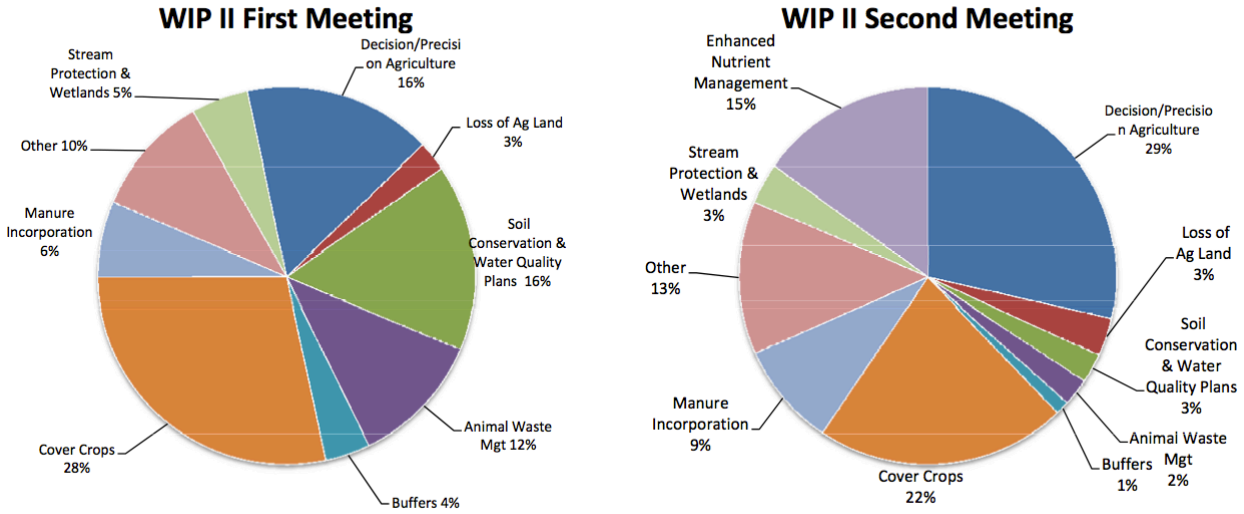


Figure 28. Estimated 2025 N Reduction by BMP from the Maryland Department of Agriculture.[clxix]

Agriculture's neglect of natural buffers is surprising giving their relatively low costs compared to other agricultural practices. Once again, we rely on more expensive but also more technological and measurable fixes for our nutrient problem. For example, the per-pound cost of reducing nitrogen pollution using enhanced nutrient management plans is estimated at $21.90, versus $1.20 - $3.20 for buffers or wetlands (Figure 12).[clxx]

There may still be some controversy over just how much buffers reduce and how much they cost. For example, there are concerns about the time period over which natural buffers are able to reduce nutrient loads – how long does it take after planting to see reductions, how long will the buffer be able to reduce pollution, will the reductions decrease as the buffer matures, etc. There are other concerns about the costs and types of buffers being planted. Living shorelines, for example, are constructed to protect land from erosion "by providing long-term protection, restoration or enhancement of vegetated shoreline habitats through strategic placement of plants, stone, sand fill and other structural or organic materials."[clxxi] However, because they are a highly involved and engineered method of erosion control, living shorelines can be relatively expensive compared to other forms of natural buffers, costing an average of $50-$100 per foot for non-structural methods or $150-$500 per foot for methods using sand fill or stone structures. Like

other buffers though, "the value of ecosystem services provided by living shorelines help offset these costs indirectly over time."[clxxii]

Typical buffers are not nearly as expensive as these engineered living shorelines. "Maryland's Tributary Strategies show that, to reach a 40 percent reduction of nutrients by the year 2000, forest buffers and non- structural controls are significantly more cost effective than engineered approaches. Where forest buffers are estimated to cost $671,000, and nonstructural shore erosion prevention/control $1.6 million per year, comparable structural techniques could cost $3.7 million to $4.3 million per year."[clxxiii]

Or, perhaps it is an entirely different issue, something other than costs and effectiveness that seems to so impede the implementation of natural buffers. A 2004 report entitled "Cost-Effective Strategies for the Bay" from the Chesapeake Bay Commission identifies WWTP upgrades, diet and feed adjustments for poultry and livestock, traditional nutrient management, enhanced nutrient management, conservation tillage, and cover crops as the most cost-effective ways for reducing nutrient and sediment pollution in the Chesapeake Bay. The only time buffers are mentioned is in a subsection of the report regarding the impacts of development on the Bay; however, it may reference the biggest obstacle to buffer implementation. "Urban and suburban areas can benefit as much as rural from forest buffers, but often there are practical limits to the width and extent of buffers. Measures must be taken to protect existing buffers from development as well as to restore them where practical."[clxxiv]

Where practical – this may be the ultimate reason why buffers are so neglected by the Maryland WIP, by the Maryland Department of Agriculture, by the Chesapeake Bay Commission, by environmental policy in general. Obviously we cannot restore all the original acres of forests and wetlands and grasslands that once covered the Chesapeake's watershed. There are people living here now and they have homes, businesses, universities, shopping centers, gas stations, and all kinds of other things that have replaced the Bay's natural filters. But, does this mean that natural buffers are impractical? They're cheap, cost-effective, fairly easy to install and maintain, and they offer a whole assortment of other benefits on top of improved water quality.

So what is so impractical? Natural buffers are thought of as impractical because we can't imagine planting every acre of every river, stream, creek, and agricultural ditch; because we can't imagine them as a requirement of streamside farmers, homeowners, businesses; because we can't imagine how on earth we would pay for it, especially since taxes are increasing to pay for wastewater treatment plant upgrades and a whole host of other initiatives. They're impractical because non-farmer private property owners don't feel obligated to plant or preserve them. The pressure that exists in the agricultural sector isn't there, and neither are the incentives. But if programs existed to reward any and all watershed citizens for planting or preserving buffers, then more people would be inclined to maintain them. And eventually, watershed citizens would get

used to seeing buffers lining rivers, streams, and agricultural ditches and would frown upon it when they weren't – then we would have buffers and then we would have a cleaner Bay.

Same Problem, New Solutions, Better Results

Improvements and Solutions

There are improvements to policies and changes in people's perceptions of natural buffers that can be made to improve their implementation. With these changes, perhaps we could see greater application of natural buffers in the Chesapeake region. Some of these changes include simple adjustments that individuals can make, while others require policy reform and increased scientific research.

The societal benefits of natural buffers are fairly obvious – cleaner drinking water, reduced sedimentation of bodies of water, decreased flooding, increased recreational opportunities – but the benefits to landowners are less frequently noted. In addition to the financial benefits from incentive programs, "buffers often improve crop yields by minimizing soil loss and reducing wind velocity over crops…increase land values because they improve the aesthetic quality of the farm…and increase nearby wildlife. Landowners can profit from the products of buffer vegetation including hay from grasses and legumes, saw timber from hardwood trees, and nuts or berries from various fruiting species...In fact, some farmers even profit from the recreational opportunities buffers provide – charging a fee for hunting, fishing, or other activities that are available in buffer areas."[clxxv]

Russ Brinsfield, executive director of the Harry R. Hughes Center for Agro-Ecology, suggests that allowing farmers to annually harvest biomass from their buffers would greatly strengthen buffer programs in Maryland. Switchgrass from buffers could be harvested and used as a biofuel so that farmers could receive even more benefits from buffers.[clxxvi] Studies show that harvesting may even increase the nutrient-reducing capabilities of natural buffers. "During the dormant season, both grass and forested buffer strips released dissolved and total P to the groundwater. The [vegetated buffer strip] apparently acted as a nutrient sink for much of the year, but also released accumulated nutrients during the remaining portion of the year. Periodic harvesting of plant biomass may reduce the amount of P released during the dormant season."[clxxvii]

Despite the benefits that natural buffers have to offer, "the decision to set land aside, plant buffers, and continue to maintain buffers lies primarily in the hands of individual landowners or farmers." Establishment and maintenance costs of buffers are important determinants of a landowner's willingness to place land in natural buffers. Maintenance, including mowing, weed and invasive species control, and the removal of accumulated sediment, is especially important because it keeps the buffer functioning properly and prevents a sink for nutrient and sediment pollution from turning into a source. Other concerns include "the lost profit when land is taken out of production" or the possibility of reduced crop yields due to pests or shade.[clxxviii]

"The lack of widespread use of buffers on farms and the heavy reliance on incentive programs suggest the costs still outweigh the benefits for many landowners." Increased coordination between government agencies with similar goals concerning natural buffers may help to further buffer enrollment. In addition, perhaps it is time to reconsider how we incentivize

natural buffer programs. For example, "to what extent might farmers support redirecting crop subsidies to support land being taken out of production and planted as buffers?"[clxxix] Other possible options include tax abatement or tax forgiveness programs based off of how much natural buffer is planted or preserved.[clxxx] A problem with incentive programs is that they "place greater emphasis on the development of new buffer areas…rather than preserving existing natural riparian buffers or wetlands that often provide greater environmental benefits and plant diversity."[clxxxi] It is important that farmers that have preserved these important ecosystems on their lands are rewarded for preserving these areas similarly to how they are rewarded for planting new ones.

Approaching the issue from a watershed-scale, rather than the scale of an individual farm or county, may give us new insight into buffer design, placement, and management. Geographic Information Systems (GIS) can also help to determine optimal buffer placement based on slope, soil type, nutrient loads, and erosion rates. By combining GIS and a watershed approach, we can surely get the most bang for our buck by creating larger contiguous areas of buffers and by targeting areas in greatest need of buffers – like wastewater treatment plants, the greatest reductions will come from those areas that are worse off to begin with.[clxxxii]

Policy reform may be necessary in order to achieve the most cost-effective use of buffers. Current incentive policies, like CREP, "pay a fixed rate per acre for installing [buffers]." Per acre pricing encourages lands with low reduction capabilities to be just as likely to enroll as lands with high reduction capabilities, whereas offering greater financial incentives for high reducing acres encourages these lands to be more readily enrolled.[clxxxiii]

There are two policy options for achieving buffers on the most cost-effective acres: performance incentive policies or direct targeting without monetary incentive policies. Performance incentive policies offer payment for buffers based on the number of pounds of nitrogen, phosphorus, or sediment reduced by the practice. "An underlying requirement for performance-based payment to generate greater cost efficiency is that loads and land uses do not change in response to the performance incentive. When this incentive is not met, it is possible that participants will shift to higher loading land uses, to thereby increase the total value of their [buffer]." Direct targeting without monetary incentives involves pursuing those acres that offer greater reductions. "Targeting in this instance is effected by giving preference to desired enrollment applications, marketing and outreach." This method involves increased enrollment recruiting and an increased reliance on technology in order to weed out less effective locations.[clxxxiv]

GIS and modeling may provide the kind of technological approach needed to make buffers a more viable pollution control option politically. Although some may consider the simplicity and naturalness of buffers part of their appeal, it seems that even buffers can benefit from our technological fixation. More long-term research is also needed "since long-term management approaches may be critical to the ultimate success of buffers." Finally, more research is needed to determine what kinds of buffers and what species of plants should be used in different geographic and agricultural regions.[clxxxv]

Unlike the numerous programs encouraging agricultural conservation practices, "no comprehensive program exists to adequately reward small tract family forest [or wetland] owners who sustainably manage their land, despite the multiple economic, societal, and ecological benefits" of these ecosystems. In 2004, more than $130 million went to providing financial assistance to regional farmers for using conservation practices. That amount is more than 11 times the funding that the USDA Forest Service provided for forestry. Little of the funding that

was received by the Forest Service was for direct financial incentives for landowners. In the WIP's rural residential tree planting strategy for example, the plan identified no funding program and only "consider[s] mandatory stream and waterway buffers."[clxxxvi] These rural residential areas are places of sprawling development in need of forested buffers to reduce stormwater runoff, but the WIP seems to have little in the way of plans for them. In order to maintain and expand these precious ecosystems, increased funding for education and financial assistance needs to be made available to forest and wetland landowners, as well as nonagricultural property owners interested in planting buffers.

Riparian forests and wetland ecosystems need to be given highest priority for protection and restoration given their ecological importance and proximity to waterways. Unless proper management by private landowners can be guaranteed, government purchasing of these areas may become important to their future protection. Waterfront property owners especially have an added responsibility. Although they are facing new regulations concerning the application of lawn fertilizers adjacent to waterways, waterfront living is environmentally risky and should be treated as such by requiring the planting of buffers, the upgrading of septic systems, and severe restrictions on nutrient applications.[clxxxvii] Buffer implementation should no longer be reserved only for agriculturalists. In order to restore Chesapeake Bay health, it is essential that natural buffers be implemented on public and private lands alike whether they are agricultural or residential in nature.

Conclusions

In 1864, George Perkins Marsh wrote of the far-reaching impacts of forest loss, yet we still have not acted accordingly in the Chesapeake Bay region. "Just by growing, forests in the Bay's watershed today are sopping up an estimated 184 million pounds of nitrogen from polluted air each year that would wash into watershed if it fell on paved streets. The forests are thus accomplishing about three times the annual reduction of nitrogen achieved by all the technological pollution control efforts of the last two decades combined. And the trees do it for free, while other solutions cost billions."[clxxxviii] We cannot economically afford to disregard and degrade these natural systems that are working so hard and so inexpensively to protect us.

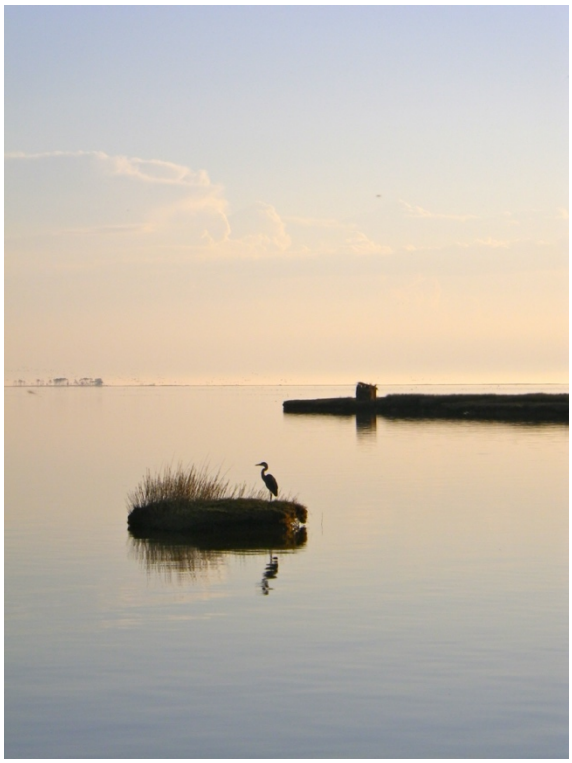
Like much environmental policy in the U.S., the WIP promotes a technological, human-engineered remedy. This fixation on technology and measurability blinds us to how our every day choices impact the Bay. By focusing on wastewater treatment plant upgrades, the WIP takes the easy way out and further postpones handling the tough stuff – non-point source pollution from agriculture and stormwater runoff – while at the same time, piling an even greater load on these sources by neglecting the impact growth will have on future wastewater discharges. This only further exacerbates the non-point source pollution problem and leaves rural areas without sufficient funding for land conservation and water quality restoration programs.

The WIP offers a glimmer of hope of what could be a new Chesapeake Bay; however, without making any radical changes in the ways policy, buffers, and people interact, it seems doubtful that water quality will improve greatly due to reductions from the non-point sector. The ecological and economic values of the ecosystems services provided by natural buffers, including their ability to retain and transform non-point source pollution, have been well documented; however, environmental policy such as the Maryland WIP continues to neglect their usefulness in environmental restoration. Given adequate attention, proper support, and

sufficient funding, natural buffers have the ability to play a key role in restoring Chesapeake Bay water quality.

The WIP needs to mandate increased regulation, monitoring, and funding for natural buffers, as well as expand its range to further include non-agricultural forest and wetland owners, waterfront property residents, and residential home dwellers. Given the financial difficulties already affecting farmers, it is not practical to impose stricter requirements on them without sufficient monetary support; however, agriculture and sprawling development are both major contributors to Chesapeake Bay pollution and need to be addressed. No longer can the two sides point fingers at one another. Like the two parts of my life, they are both connected by route 50 and they are both connected by the Chesapeake Bay. Ultimately that means both sides are at fault, but more importantly, it means that cooperation will be key to achieving restoration goals. It means that our restoration strategies must be diversified; they cannot solely focus on urban areas or point sources or rural areas or non-point sources. The focus must be on all of these, utilizing the methods best fit for nutrient and sediment reduction given the circumstances.

The degradation of the Chesapeake Bay is something that we've all contributed to, there's no denying that. Now, we must all contribute to the restoration of it, especially if we expect to continue to enjoy the waters and lands of the Chesapeake as our own personal playground – a place for crab feasts, sailing, duck hunting, progging, oyster shucking, rockfishing, and so much more.



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