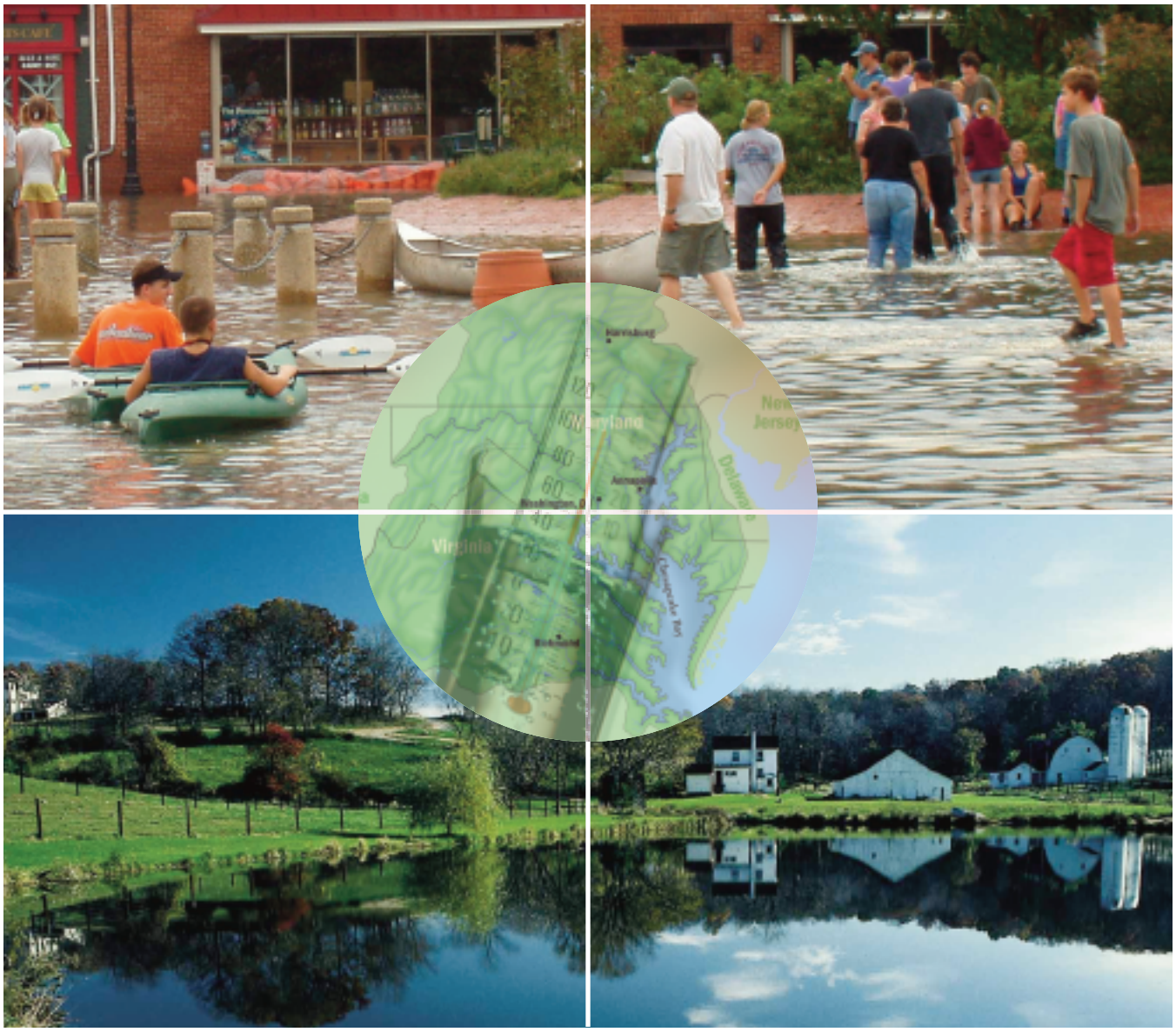
CHESAPEAKE BAY FOUNDATION
Saving a National Treasure

REPORTS



Climate Change and the Chesapeake Bay: Challenges, Impacts, and the Multiple Benefits of Agricultural Conservation Work

EXECUTIVE SUMMARY

Scientists agree: Climate change is here, and across the region, we are seeing the effects. Rising temperatures are inhospitable to vital underwater grasses and stress fish populations from striped bass in the main Bay to brook trout in Pennsylvania's coldwater streams. Sea level rise inundates many of the Bay's iconic islands—islands that until recently supported thriving communities.

Climate change adds new challenges to an ecosystem already stressed by pollutants, population growth, and increasing development.

Fortunately, the situation is not without hope. The fight to reduce the greenhouse gases that cause climate change is not unlike the challenge we face in cleaning up and restoring the Chesapeake Bay and its rivers and streams. And many of the solutions are the same.

The Bay's watershed states have identified a list of cost-effective agricultural conservation practices that must be implemented to achieve the pollution reductions necessary to remove the Chesapeake Bay and its tributaries from the nation's "dirty waters" list. And, as a recent Yale study demonstrates, many of these agricultural practices will also sequester substantial amounts of carbon from the atmosphere.

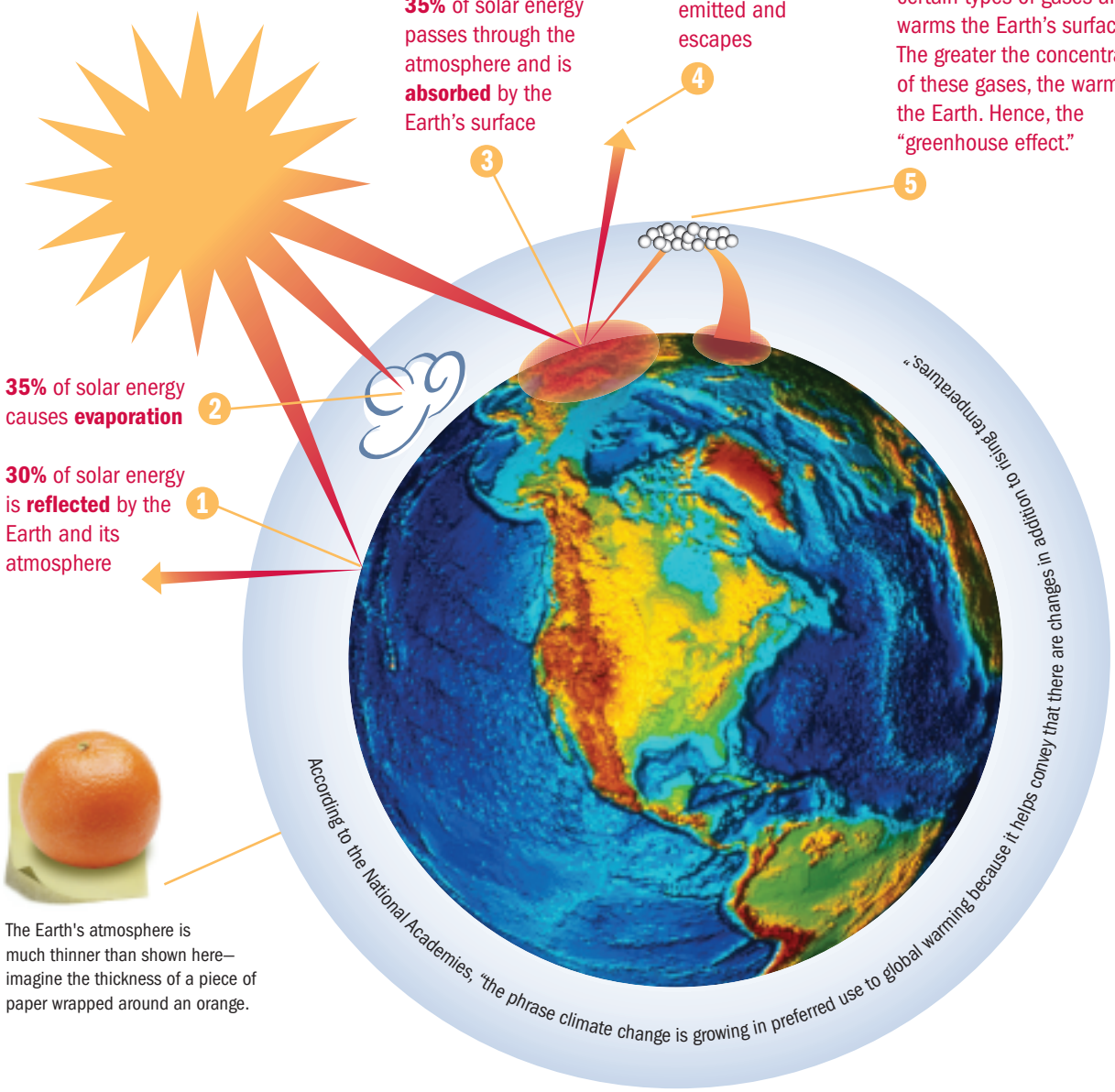
Using information on the number of acres of land, watershed-wide, expected to be placed under several agricultural best management practices, including cover crops, riparian buffers, rotational grazing and no-till farming, the Yale study estimated the amount of carbon dioxide that would be removed from the atmosphere over a 15 year period.

The result? Approximately 4.8 million metric tons of carbon dioxide would be sequestered annually—the equivalent of mitigating the carbon dioxide emissions from residential electricity use across Delaware. The conclusion is clear: Protecting the Bay also helps fight climate change. Accordingly, CBF is working with partners across the watershed to secure state and federal funding for agricultural conservation practices and technologies to reap the multiple benefits of these practices.

Clearly, however, these actions alone will not turn the tide.

To avoid the more catastrophic effects associated with climate change, scientists have estimated we need to reduce greenhouse gas emissions worldwide by 50 to 80 percent over the next 50 years. Transportation, commercial building operations, and residential energy use account for almost two-thirds of greenhouse gas emissions, so a comprehensive plan must also address these sources, all of which will also benefit water quality. The technology is there, as is the knowledge. With careful planning, sustained commitment, aggressive action, and political will, the Bay—and the planet—can be saved.

CLIMATE CHANGE 101



The Earth's atmosphere is much thinner than shown here—imagine the thickness of a piece of paper wrapped around an orange.

U.S. Greenhouse Gas Emissions by Gas, 2005

(Percentages reflect amounts of gases adjusted for their relative potency.)

Carbon Dioxide (CO_2) — 84%
CO_2 is the least potent greenhouse gas, but it is by far the most abundant, and so remains of primary concern.

Methane (CH_4) — 7%
Methane is more potent than CO_2, trapping **20-25 times** more solar energy.

Nitrous Oxide (N_2O) — 7%
Nitrous Oxide traps **300 times** more solar energy than CO_2.

Other (like chlorofluorocarbons) — 2%

Major Sources of Greenhouse Gases: motor vehicles, energy generation, deforestation, livestock, agriculture

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CLIMATE CHANGE AND THE CHESAPEAKE BAY: CHALLENGES, IMPACTS, AND THE MULTIPLE BENEFITS OF AGRICULTURAL CONSERVATION WORK

Scientists agree: Climate change is here, and it is affecting local rivers, streams, and the Chesapeake Bay.

According to the Intergovernmental Panel on Climate Change (IPCC), there is near-universal consensus about the scientific reality and probable impacts of climate change. Further, these scientists confirm what has long been debated: Human activity is to blame. In fact, human actions are accelerating numerous phenomena, from higher air and water temperatures and rising sea levels to the unpredictable weather patterns and increased storm intensity expected as the result of increasing emissions of greenhouse gases.

In the Mid-Atlantic Region, scientists predict a wide range of climate change-associated effects—from changes in agricultural and forest production to degraded coldwater fisheries and the influx of more invasive plants. One likely outcome: the loss of underwater grasses, like eelgrass, that support species as diverse as the iconic blue crab and the human communities that depend on them.

Some experts, like Dr. Donald Boesch, President of the University of Maryland Center for Environmental Science, theorize that due to the relatively fragile nature of the Chesapeake Bay's current condition and the region's sinking shorelines, the Bay will be particularly vulnerable to the temperature increase and sea level rise associated with global climate change.

Temperature Increase

According to the National Climatic Data Center, global annual temperatures are now about one degree Fahrenheit (F) warmer than at the start of the 20th century. This warming has accelerated over the past 30 years, increasing approximately three times faster than previous century-average trends. The IPCC estimates a further increase in average temperatures of 2.5 to 10.4 degrees F before 2100.

Among other impacts, higher air temperatures in the Chesapeake Bay region mean a rise in water temperatures, with potentially devastating ecological consequences. Warmer water has less capacity to hold dissolved oxygen, and dissolved oxygen is critical for most life in the Bay, its rivers, and its streams. Thus, higher temperatures may exacerbate the Bay's dead zone, potentially expanding both the size and the duration of oxygen-deprived areas in the Bay.

Changes in water temperature can also affect the distribution and health of aquatic species in the Chesapeake. For instance, adult striped bass, also known as rockfish (a $6.6 billion fishery), try to avoid water warmer than about 76 degrees F by finding refuge in the cooler temperatures of deeper water. During the summer, however, rockfish face what scientists call "temperature-dissolved oxygen squeeze," when dissolved oxygen concentrations in these waters drop past the point where adult rockfish can survive.

With predictions of higher water temperatures and expanded dead zones, rockfish will be increasingly squeezed, forced to live in uncomfortably warm water in order to "breathe."

Such stress can affect the health of the fish by changing their feeding habits or making them more susceptible to disease.

Sea Level Rise

Worldwide, the IPCC predicts that sea level will rise between 8 inches and 2 feet by the end of this century. Many scientists consider those estimates to be conservative; evidence is mounting that ice caps and glaciers are melting at accelerated rates. If that continues, says Dr. Boesch, apparent sea level rise could be as high as three to four feet in the Bay region by the end of the century.

The Chesapeake Bay and its tributaries share 11,000 miles of shoreline and coastline, including some of the most valuable areas in the country. Although sea level rise will affect many parts of the world, the Bay region may suffer even more. Why? Because, even as waters rise, much of the area is actually sinking due to geological processes that began during the last ice age. This combination of processes has resulted in approximately one foot of net sea level rise in the Chesapeake Bay over the past 100 years—a rate nearly twice that of the global historic average. As a result we are losing Tangier Island, Smith Island, and many other low-lying lands around the Bay.

Thousands of acres of environmentally-critical tidal wetlands are now unable to trap sediments fast enough to keep pace with rising water levels. In the future, the combination of sea level rise, relatively flat topography, and subsiding land mass could make the Mid-Atlantic region—and the people who live here—particularly vulnerable. (Rygel, Yarnal, Fisher. 2005).

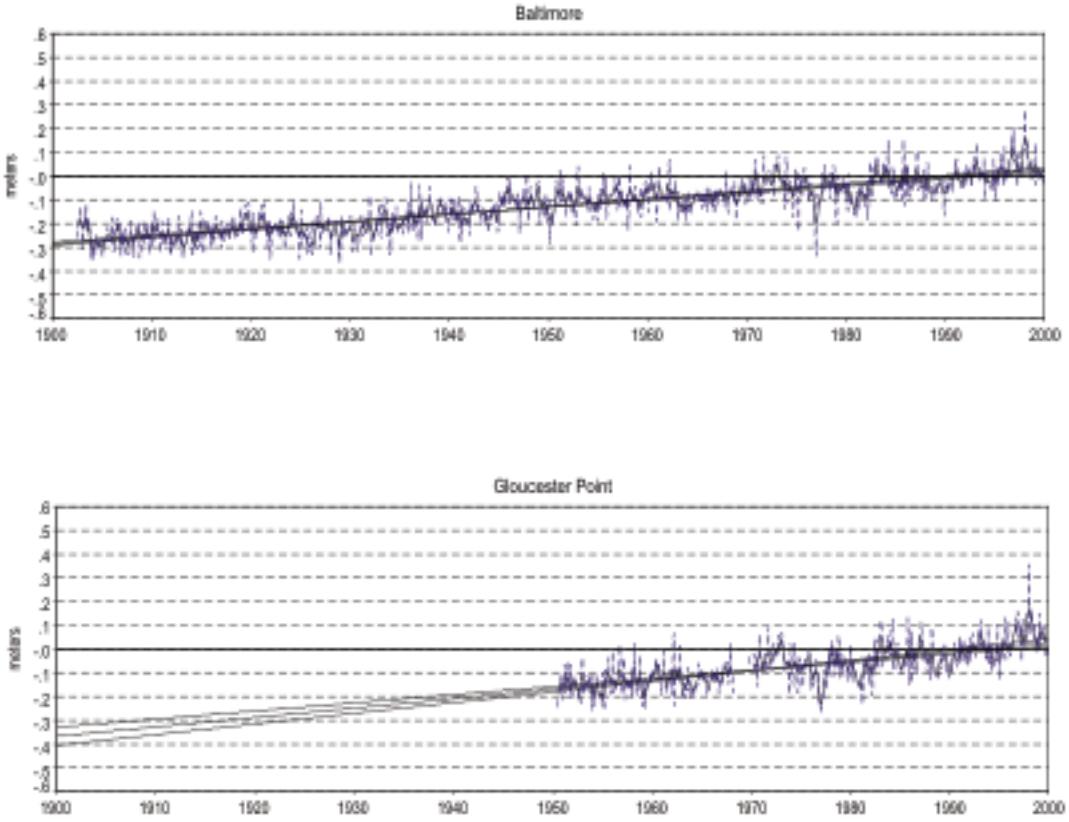
Such scenarios have clear and sobering implications for restoration efforts across the watershed.

The impacts of climate change may well impede progress toward meeting Bay restoration and water quality goals, and make it more of a challenge to restore its health. The prospects appear grim.

But the situation is not without hope: personal and public commitment, existing knowledge, and new technologies can change the tide. In fact, the fight to reduce greenhouse gas emissions is not unlike the challenge we face in cleaning up and restoring the Chesapeake Bay and its rivers and streams. And many of the solutions are the same.

Mean Sea Level Trends for Selected Locations in the Chesapeake Bay Watershed

(Source: NOAA)



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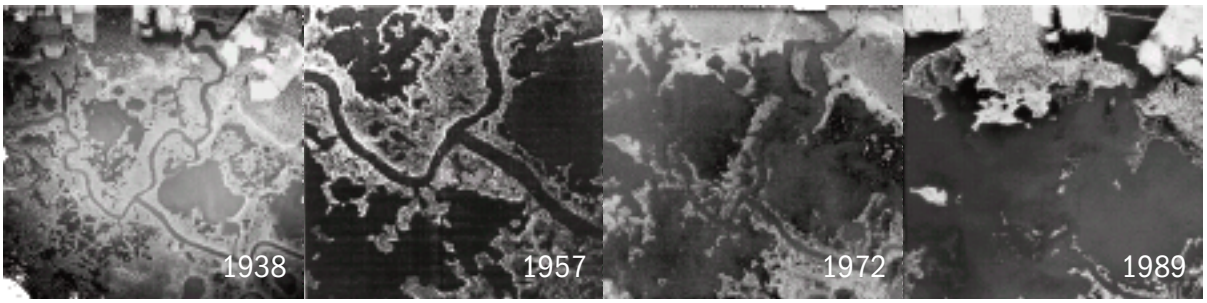
The Bay's Disappearing Lands

Island	Previous Acreage		Recent Acreage		% Lost	Notes
Sharps	890	(1660)	0	(1962)	100	Drowned in 1962
Poplar	1,400	(1670)	125	(1990)	91	Abandonment in 1930
St. Clements	400	(1634)	40	(1990)	90	Abandonment in 1920s
Barren	700	(1664)	250	(1990)	64	Abandonment in 1916
Holland	217	(1668)	140	(1990)	35	Abandonment in 1992
Smith	11,033	(1849)	7,825	(1987)	29	Submerging
Hoopers	3,928	(1848)	3,085	(1942)	21	Submerging
Bloodsworth	5,683	(1849)	4,700	(1973)	21	Submerging

(Source: Johnson, Z., 2000)

Taken in the late nineteenth century, the photo at left shows Holland Island, in southern Dorchester County, Maryland. Once spanning over five miles, this island supported a post office, a church, a schoolhouse, and several stores. As the devastation of erosion became apparent in the early 1900s, many residents of Holland Island moved their homes to Cambridge and other towns. Today, most of the remaining 100 acres are marshland. Only one structure remains.



Seven thousand acres of marsh land have been lost since the establishment of the Blackwater National Wildlife Refuge in Maryland—due to a combination of sea level rise, land subsidence, and the invasive, marsh-grass eating rodent known as nutria. These losses are continuing (at a rate of approximately 150 acres per year) and in the future, widespread inundation of marsh lands is expected across the watershed. Besides serving as important fish and wildlife habitat, wetlands serve a critical role in protecting shorelines and nearby lands from the effects of flooding and erosion. Strategies to address climate change must include actions that minimize the loss of these critical buffers.

July 2007

THE ROLE OF AGRICULTURE IN MITIGATING GREENHOUSE GASES

Many of the steps needed to reduce water pollution will also lead directly to reductions in greenhouse gases and help minimize the effects of rising sea level and higher temperatures.

Dual Benefits of Reducing Nitrogen Pollution in the Chesapeake Region

Nitrogen pollution contributes to the formation of frequent oxygen-deprived "dead zones" in the Chesapeake Bay and its tributaries, a condition which—in addition to killing aquatic life —can actually contribute to greenhouse gas generation by the Bay itself.

Globally, estuaries emit approximately one third of the world's oceans' net emissions of nitrous oxide. In the few places where it has been studied, nitrogen pollutant loads to estuaries have been shown to contribute to increased nitrous oxide emissions (Matson and Ortiz-Monasteno. 2003). Similarly, estuarine production of methane also increases under low-oxygen conditions due to bacterial activity, so the Bay, in its overloaded and degraded state, is actually contributing to climate change.

Watershed-wide, about one-third of the nitrogen pollution in the Chesapeake comes from the air, much of it in the form of nitrogen oxides formed from the combustion of fossil fuels. Thus, personal choices to conserve electricity or drive more fuel-efficient vehicles, along with state and national efforts to increase the use of renewable energy sources also reduce emissions of nitrogen oxides. Each of these actions has the added benefit of reducing carbon dioxide as well.

Environmental strategies focused on reducing one pollutant (nitrogen) have the potential to address multiple problems. The conclusion is clear: Protecting the Bay also helps fight climate change.

Agricultural Conservation and the Fight to Slow Climate Change

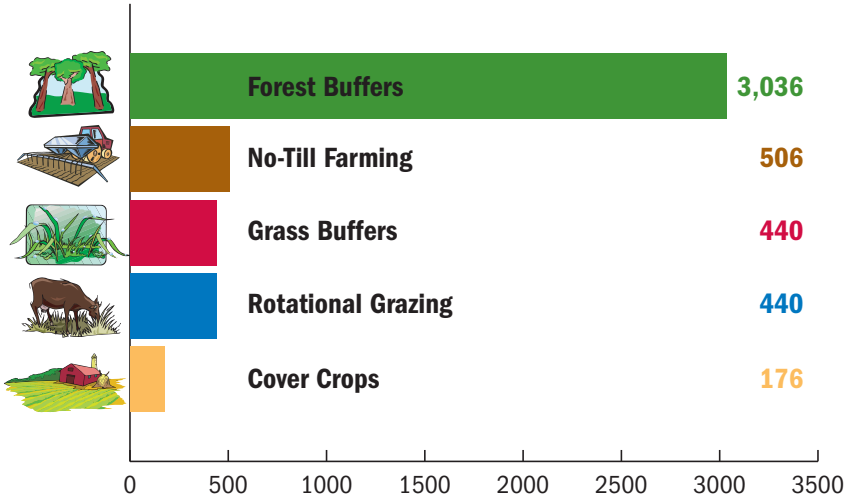
Implementation of agricultural conservation practices, while often overlooked in policy discussions about reducing greenhouse gases, promises to be doubly beneficial for climate change and water quality in the Bay region and beyond.

The Chesapeake Bay watershed states have already defined agricultural conservation as a key tool to achieve the pollution reductions necessary to remove the Chesapeake Bay and its tributaries from the Clean Water Act's "dirty waters" list. As part of the Chesapeake 2000 Agreement—a pledge to cut the amount of nitrogen, phosphorus, and sediment pollution discharged into the Bay and its rivers—those watershed states (Pennsylvania, Maryland, Virginia, Delaware, West Virginia, and New York) and the District of Columbia have each developed river-specific "Tributary Strategies" to achieve targeted pollution reduction goals.

Region-wide implementation of these plans' agricultural components would reduce the excess nitrogen entering the Bay by nearly 65 million pounds annually—approximately 60 percent of the reduction needed to restore the Bay and its tributaries. As a recent study conducted by graduate students at the Yale School of Forestry and Environmental Studies (Devooght, Caldwell, and Jewell 2007) demonstrates, many of these practices will also sequester substantial amounts of carbon from the atmosphere.

Carbon Sequestration Rates of Selected Agricultural Conservation Practices

(Pounds of Carbon per Acre per Year)

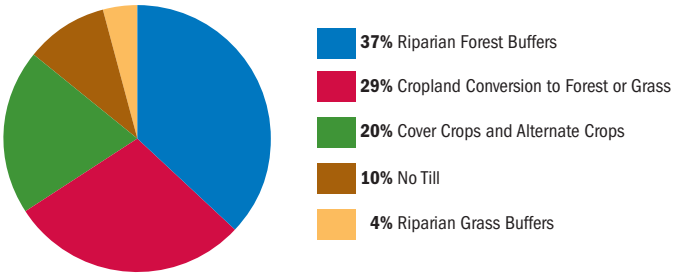


Carbon sequestration refers to the net removal of CO_2 from the atmosphere into long-term or permanent terrestrial 'pools': living (trees or grasses; roots and microbes in the soil), stored in products with long lives such as lumber, or contained as soil carbon. An enormous amount of carbon is stored in the soil and detritus on the soil—the remnants of plants and trees. **Agricultural practices can help increase these carbon pools.** For example, planting riparian buffers results in carbon sequestered in trees or grasses. And although traditional farming techniques, such as plowing, reduce soil carbon levels by allowing CO_2 to be released into the air, many farmers in the Bay region practice conservation tillage, where plowing and hoeing are replaced with either no, or shallow, tillage that exposes less soil to erosion—and less carbon to the atmosphere.

Using data from the Chesapeake Bay Program on the number of acres of land, watershed-wide, expected to be placed under selected agricultural best management practices, or BMPs, the Yale study estimated the total amount of carbon dioxide that would be removed from the atmosphere over a 15-year period. The study included only those conservation measures for which there was sufficient scientific evidence for reliably estimating carbon sequestration rates: conservation tillage, use of winter cover crops, grassed and forested riparian buffers, rotational grazing, and conversion of cropland to forests or open space.

The Yale analysis found that watershed-wide implementation of selected agricultural BMPs on Bay region farms would sequester approximately 4.8 million metric tons of carbon dioxide annually, over a 15-year period (for details see www.cbf.org/yalestudy). One metric ton equals 2,205 pounds.

Relative Contribution of each Agricultural BMP to the Total Amount of Carbon Dioxide Sequestered

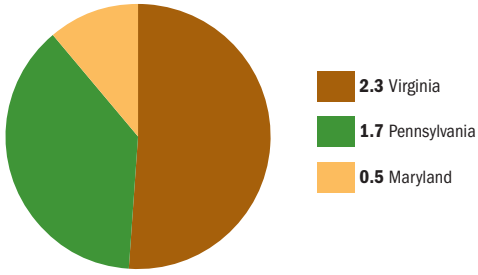


Rotational Grazing was not included because the contribution was less than 1%.

It is worth noting that with the exception of winter cover crops, these practices are included in the suite of eligible "offset projects" by the Chicago Climate Exchange, North America's only active voluntary, legally-binding, integrated greenhouse gas trading system (http://www.chicagoclimatex.com/)

Put this number into perspective: Implementing these practices could mitigate, or balance out, the carbon dioxide emissions of nearly three quarters of a million SUVs (approximately 786,438 Hummers traveling an average of 12,000 miles annually), or the entire statewide residential electricity use of either New Hampshire or Delaware (electricity use estimated using state emission factors for greenhouse gases and residential electricity sales. Energy Information Administration). Essentially, helping Bay region farmers adopt these measures could mitigate the residential electricity use of an entire state.

Metric Tons of Carbon Dioxide Sequestered by Implementing Select Tributary Strategy Agricultural Practices by State



On a state-by-state basis, the greatest carbon sequestration benefits would be accrued in Virginia—approximately 2.3 of the 4.8 million metric tons. This large share is due to the prevalence of forest buffers and restoration programs in the Commonwealth's Tributary Strategies. In Pennsylvania and Maryland, carbon benefits would come from a broader combination of conservation practices. All of these activities also improve water quality, aquatic life, and healthy habitats across the local rivers and streams of the Chesapeake.

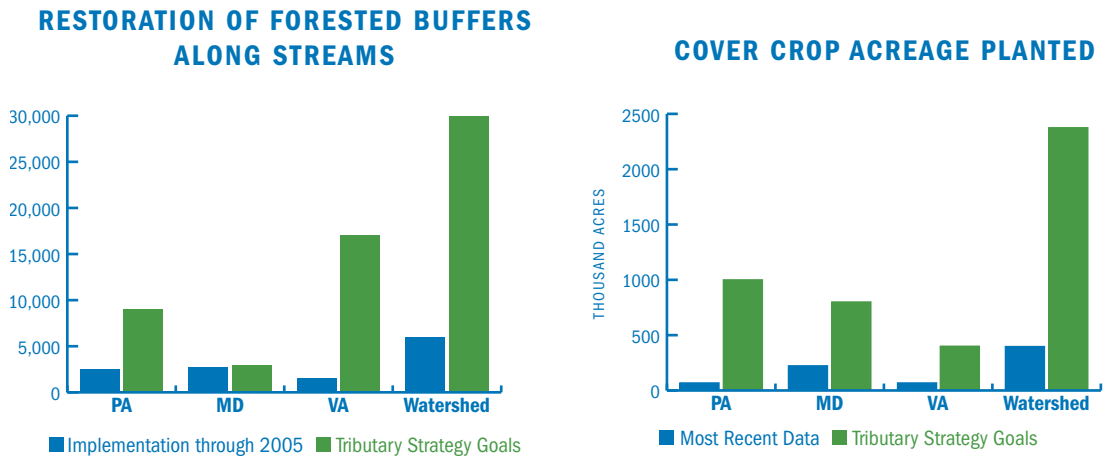
Additional Climate Change Benefits of Saving the Bay

CBF believes the Yale study's estimate to be conservative because it calculated only the carbon sequestration benefits of a portion of the agricultural practices in the Tributary Strategies. Other programs that benefit water quality and mitigate greenhouse gases were not included because of insufficient quantitative information on their benefits. These include:

- Adoption of enhanced nutrient management practices that will result in less fertilizer use. This will lead to reduced emissions of nitrous oxide, a potent greenhouse gas, by as much as 30 to 40 percent (Council for Agricultural Science and Technology, 2004).
- Improved manure management: Manure-to energy projects such as anaerobic digesters will capture methane and use it as an energy source that displaces fossil fuels.
- Precision feeding: Enhanced animal feed quality and metabolic efficiency in meat and milk production can reduce methane production by livestock.
- Minimizing the use of farm machinery: Practices such as conservation tillage and no-till farming can reduce fossil fuel consumption and its associated carbon dioxide emissions by up to 70 percent (West and Marland 2002).

In addition, agriculture can help reduce energy dependence on fossil fuels by providing new sources of energy (for example: ethanol made from corn or switchgrass, or biodiesel made from soybeans). (For more detail, see cbf.org/ethanol).

Implementing the agricultural practices called for in the Tributary Strategies will create multiple environmental benefits—on the local level by cleaning up the Bay, its rivers, and its streams, and globally by mitigating greenhouse gases. Across the watershed, CBF is working with other stakeholders to secure the funds needed to achieve this goal.



Although the Bay state governments have taken some important steps toward funding agricultural conservation practices, we are far from reaching the levels necessary to achieve Chesapeake Bay water quality goals. The charts above compare state-by-state implementation rates to Tributary Strategy goals for two key agricultural programs.
(Source: Chesapeake Bay Program)

Progress around the Watershed

Agriculture has much to offer in helping to reduce greenhouse gas emissions to the atmosphere, while at the same time improving water quality and the sustainability of the agricultural sector. Of course, much more needs to be done in this region if we are to achieve the reductions that scientists say are necessary to avoid catastrophic climate change. Thankfully, some smart steps are already taking place.

PENNSYLVANIA

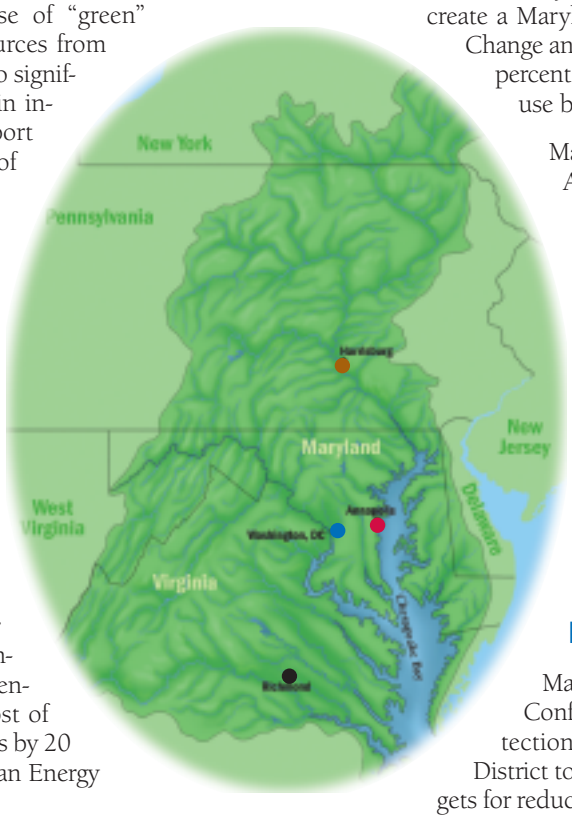
Governor Rendell recently doubled the Commonwealth's government purchase of "green" electricity from renewable sources from 10 to 20 percent, in addition to significantly increasing investment in infrastructure upgrades to support production and distribution of alternative fuels.

Pennsylvania implemented the "Clean Vehicles Program" which requires new cars or light-duty trucks to meet stringent California emissions standards for carbon dioxide and other pollutants.

VIRGINIA

Governor Kaine issued an Executive Order that established "green building standards" for new and renovated state government buildings, ordered all agencies to reduce their annual cost of nonrenewable energy purchases by 20 percent by 2010, and created an Energy Policy Advisory Council.

Virginia passed legislation that requires the development of a comprehensive 10-year Energy Plan by July 2007, joins Maryland in establishing a solar energy grant program, and allows Virginia consumers to receive a tax credit valued at 20% of the cost of certain energy efficient products.



MARYLAND

Governor O'Malley issued an Executive Order to create a Maryland Commission on Climate Change and committed to achieving a 15 percent reduction in residential energy use by 2015.

Maryland passed a "Clean Cars Act" which requires new cars or light-duty trucks to meet stringent California emissions standards for carbon dioxide and other pollutants, and approved the "Healthy Air Act" which commits Maryland to joining the Regional Greenhouse Gas Initiative, a multi-state partnership that requires reductions in green- house gas emissions from power plants.

D.C.

Mayor Fenty signed onto the U.S. Conference of Mayors Climate Protection Agreement, committing the District to meet the Kyoto Protocol's targets for reducing greenhouse gas emissions.

The District's newly formed Department of the Environment includes a "Sustainable Solutions Division" whose self-stated vision is to "power the District of Columbia with Green," and the Reliable Energy Trust Fund supports a variety of energy efficiency and renewable energy programs.

CHESAPEAKE 2000

The Chesapeake 2000 Agreement, if fully implemented, would remove approximately 110 million pounds of nitrogen pollution from the Bay annually and help mitigate the Bay region's output of CO2.

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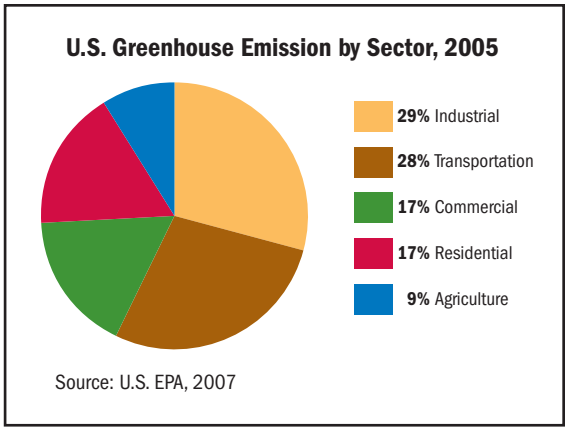
NEXT STEPS

To avoid the more catastrophic effects associated with climate change, scientists believe we need to stabilize greenhouse gas concentrations in the atmosphere. Doing so means reducing emissions of these gases worldwide by 50 to 80 percent over the next 50 years. Recent reports issued in Maryland and Pennsylvania have identified state specific greenhouse gas reduction targets consistent with this goal, and outlined policy recommendations for achieving them (Environment Maryland, 2007; Pennsylvania Environmental Council, 2007).

Environment Maryland's "Blueprint for Action" recommends several policy options to reduce carbon dioxide emissions by approximately 30 million metric tons, representing a 23% decrease from 2006 emissions in Maryland. Similarly, the Pennsylvania Environmental Council's "Climate Change Road Map" describes a comprehensive set of policy options that could be implemented to reduce carbon dioxide emissions in Pennsylvania by 25% from 2000 levels, a reduction of approximately 75 million metric tons.

Given the need for such drastic cuts and the multitude of greenhouse gas sources, a comprehensive response to climate change will require a portfolio of solutions: Agriculture is only one. Transportation, commercial building operations, and residential energy use account for almost two-thirds of greenhouse gas emissions, so a comprehensive greenhouse gas mitigation plan must also address these sources, all of which will also benefit water quality.



As highlighted in the reports by Environment Maryland and Pennsylvania Environmental Council, policy options should include:

Transportation:

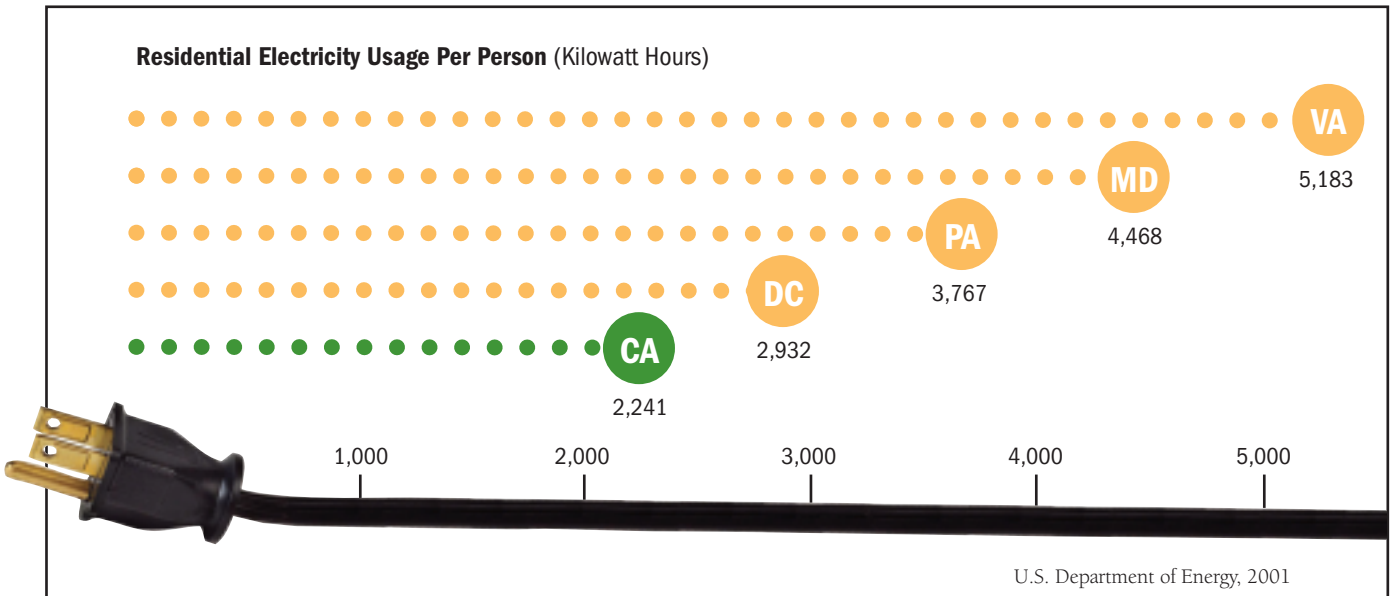
- REDUCE reliance on automobile travel through "commuter choice" programs like mass transit, carpooling, and telecommuting that expand the options available to commuters;
- PROMOTE smart growth and CURB sprawling development by building more compactly, in already urbanized areas; and
- CONSTRUCT modern and efficient transit systems.

Buildings:

- PROVIDE incentives to build energy-efficient "green" office buildings and improve energy efficiency in older ones; and
- PLAN and ZONE to promote commercial development inside existing communities and close-in locations, instead of sprawling across the Bay region's remaining rural, undeveloped, "greenfields."

Residential Energy Use:

- IMPLEMENT aggressive energy efficiency programs, including insulation, window replacement, the use of compact fluorescent lighting, and energy conservation; and
- INCREASE the amount of electricity that comes from renewable sources.



U.S. Department of Energy, 2001

Aggressive energy programs and increased renewable energy sources could significantly reduce our carbon dioxide emissions. Per person, Virginia and Maryland use more than two times as much electricity as residents of California.

The long-term campaign to reduce greenhouse gas emissions and avoid the more devastating effects of climate change will be fought on many fronts. Fortunately, as highlighted by the Yale report, efforts to support clean water, including agricultural conservation programs, are vital tools in slowing climate change. CBF calls on our local, state, and federal governments to aggressively pursue funding for, and implementation of, existing and new agricultural conservation practices and technologies. Clearly, however, these actions alone will not turn the tide.

CBF also calls on cities, states, the federal government, and individuals to rethink our national energy policy, increase partnerships between farmers and businesses, take advantage of opportunities presented by transportation and land use planning, adopt more efficient technologies, and undertake fundamental shifts in the choices each one of us makes, every day, in our businesses and homes. With careful planning, sustained commitment, aggressive action, and political will, the Bay—and the planet—can be saved.

Regional Impacts of Climate Change

Higher Air Temperatures in Baltimore, Maryland

It is a hard reality to accept: While climate change will impact everyone, the region's elderly and disadvantaged will likely face the most devastation.

According to the World Health Organization, recent heat waves in Europe have been linked to significant numbers of human deaths. A preliminary analysis of the 2003 heat wave in Europe estimated that it caused higher than average mortality rates in Great Britain (2,045), Portugal (2,099), and France (14,802).

Although quantified predictions are difficult, it is clear that rising atmospheric temperatures in this region may have devastating effects, particularly in urban areas like the city of Baltimore. An EPA report states that a warming of three degrees F could increase heat-related deaths by 50 percent—from the current average of 85 to 130—mostly affecting the elderly. In addition, Baltimore has some of the worst air quality in the country, regularly violating air quality standards for ozone (smog) and fine particulate matter (soot). High temperatures exacerbate this problem and the human health effects associated with air pollution. The possible result: increased incidence of asthma, reduced lung function, and premature death.

Fish Kills on the Shenandoah River, Virginia

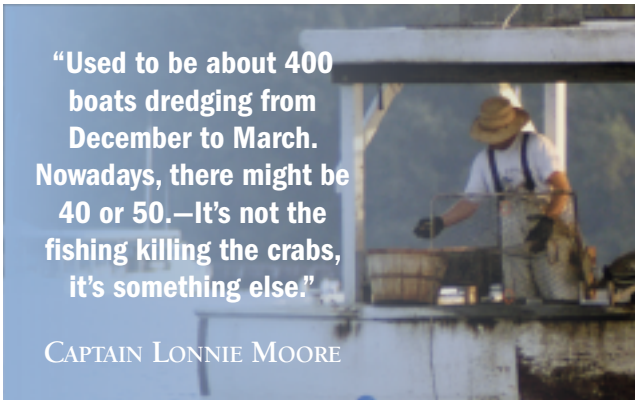
In 2005 alone, nearly 80% of adult smallmouth bass died in more than 100 miles of the South Fork Shenandoah River in Virginia. A preliminary study estimated a loss of $686,000 in retail sales and revenues (Papadakis 2006).

Large numbers of smallmouth bass and redbreast sunfish in Virginia's Shenandoah River watershed have died in the last four years. The causes of the Shenandoah fish kills remain unknown, but scientists have speculated that increased water temperatures may be playing a role—either by causing stress to the fish, making them more susceptible to infection, or providing a more favorable environment for the pathogens that attack them. Bacterial skin and gill lesions are particularly prevalent on many dying fish.

Researchers at James Madison University have documented a water temperature increase of as much as five-degrees Fahrenheit over the past few decades in the Shenandoah basin (Brown, Downey and Benzing. 2007). The cause of the temperature increase is not necessarily linked to global warming, but as the region's scientists continue to search for the causes of these mysterious fish kills, we are left to wonder whether the Bay region will be seeing more of these events as the climate continues to change.

Eelgrass, Crabs, and the Economy and Culture of the Chesapeake Bay

Eelgrass—an underwater grass found in the mid-to-lower parts of the Bay and a vital link in the ecological web of the estuary—experienced a major die-off in 2005. Dr. Robert Orth at the Virginia Institute of Marine Science (VIMS) and other underwater grass researchers concur: The die-off was due to higher water temperatures. Negative impacts of dramatic grass loss may include degradation of critical habitat for blue crabs and other aquatic species, and economic consequences for the people and industries that depend on them.



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Underwater grasses provide blue crabs refuge from predation and—particularly critical for young crabs—cover during molts. Large numbers of juvenile crabs depend on the shelter of the eelgrass beds in Tangier Sound as they move from offshore waters to the upper Bay. (VIMS scientists have found that young crabs are 30 times more prevalent in grass beds than on barren bottom.) In 2006, eelgrass beds remained few and sparse in the Bay, and the 2007 winter crab survey indicated that the number of young-of-the-year crabs—those less than two inches across—was among the lowest observed since the survey began in 1990.

Rising Water Temperatures and Pennsylvania Brook Trout

According to the Pennsylvania Fish and Boat Commission, nearly two million people go fishing in Pennsylvania each year, contributing over $1.6 billion to Pennsylvania's economy. The Susquehanna River basin contains some of the best fishing in the world. Coldwater species, especially brook trout, once thrived in all of the Susquehanna basin's rivers, streams and brooks. Brook trout—sensitive to stream temperatures for survival and reproduction—thrive in water temperatures cooler than 65 degrees. Although the fish can tolerate brief periods of warmer water (up to 72 degrees F), exposure to temperatures warmer than 75 degrees is usually lethal, even if for only a few hours.

Even a small increase in stream temperatures could cause the disappearance of brook trout from Pennsylvania waters.

Today, healthy brook trout habitat and populations exist in only a fraction of the fish's historical range. Despite significant public and private efforts to restore them and their habitat, these remaining populations are seriously threatened by climate change. If the brook trout disappear, what will replace them and the economic engine they drive?

Sea Level Rise Around Hampton Roads, Virginia

A 2005 report by the Center for Integrated Regional Assessment evaluated the relative impacts of sea level rise on Hampton Roads' communities of varying economic health. Compounding the challenges faced by low-lying areas in Hampton Roads is the loss of living, or natural shorelines, and threats to remaining wetlands. While healthy shorelines and wetlands can not stop storms from occurring, they can play a role in protecting communities from the worst storm surges and floods.

A combination of current demographic modeling and projected sea level rise suggests that hundreds of thousands of people in the Chesapeake region could fall victim to serious floods, and these storms are likely to cause the most damage to socially vulnerable populations within the region. The report defines areas within Hampton Roads and with high "numbers of children and elderly, and with a high number of mobile homes" as vulnerable. By a wide margin, these at-risk communities are the most likely to face severe flood and storm damage. Additionally, these storms—which are also predicted to increase in intensity—will not only increase demands on emergency services and rescue facilities in these areas, but literally flood those facilities as well. Essentially, those with the fewest resources to recover from a catastrophic storm will be the hardest hit.

Save the Bay. Save the Planet.

How Can I Make a Difference?

Many of the things we do to help save the Bay and its rivers and streams will also help reduce the greenhouse gases that cause climate change. Simple, everyday choices can have a powerful cumulative effect. Most of us leave the biggest carbon footprint with our cars. Every gallon of gasoline we burn spews about 20 pounds of carbon dioxide into the atmosphere. Car exhaust is also one of the fastest growing sources of nitrogen pollution to the Bay. And, since power plants are huge producers of both CO_2 and nitrogen pollution, anything we do to use less electricity at home will also have a positive effect.

Begin at Home	Good for the Bay	Good for the Planet
❑ Purchase fluorescent light bulbs for your home.	✔	✔
❑ Install motion sensors to turn off lights when you don't need them.	✔	✔
❑ Use energy-efficient appliances. (Look for the Energy Star label.)	✔	✔
❑ Insulate your hot water heater with an insulated blanket.	✔	✔
❑ Ask your energy company to switch your home to "green energy."	✔	✔
❑ Turn down your heat or air conditioning and hot water heater.	✔	✔
❑ Save trees, fuel, and postage by paying your bills online.	✔	✔
❑ Clean or replace your air conditioning filter as recommended.	✔	✔
❑ Install low-flow shower heads to reduce water usage.	✔	✔
❑ Plant trees near your home to provide shade in summer.	✔	✔
❑ Only run your dishwasher when there is a full load.	✔	✔
❑ Insulate walls and ceilings, and caulk around doors and windows.	✔	✔
Economize Your Car		
❑ If you need a new car, choose one with excellent fuel economy.	✔	✔
❑ Carpool, bike, or take mass transit when you can.	✔	✔
❑ In city traffic, roll down your windows to keep cool in warm weather.	✔	✔
❑ Improve your gas mileage by keeping your tires properly inflated.	✔	✔

CHESAPEAKE BAY FOUNDATION
Saving a National Treasure

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Annapolis, MD 21403
410/268-8816
410/269-0481 (from Baltimore metro)
301/261-2350 (from D.C. metro)

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804/780-1392

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E-mail: chesapeake@cbf.org
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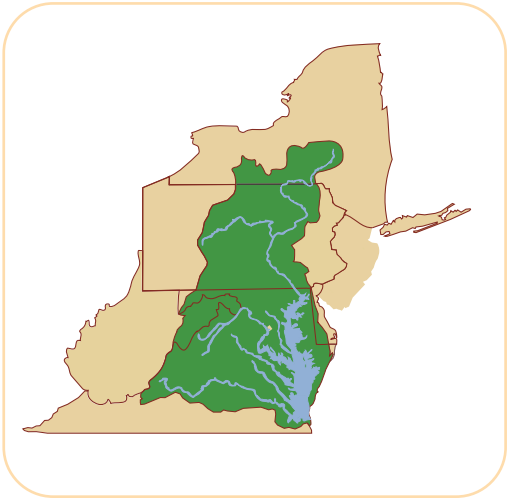
CHESAPEAKE BAY WATERSHED



The Chesapeake Bay's 64,000 square mile watershed covers parts of six states and is home to more than 17 million people.

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REFERENCES:
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