CHESAPEAKE BAY FOUNDATION
Saving a National Treasure

Statement of William C. Baker
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Prepared for a field hearing entitled
"Climate Change at the Water's Edge: Annapolis, MD"

United States House of Representatives Committee on Energy and Commerce
July 17th, 2015

Summary of Major Points

The Chesapeake, America's largest estuary, is a national treasure under severe stress from nitrogen, phosphorus and sediment pollution. Six states, the District, and federal agencies are working to implement the Chesapeake Clean Water Blueprint, an innovative pollution reduction protocol. Unfortunately, global climate change will add more stress to a system already dangerously out of balance.

Warmer waters have a decreased capacity to hold dissolved oxygen, exacerbating the Bay's dead zones. Temperature sensitive Bay species, like eel grass, are also at risk..

The Bay region is particularly vulnerable to **sea level rise, exacerbated by land subsidence**. Approximately one foot of net sea level rise in the Chesapeake Bay over the past 100 years is nearly twice the world average. Thousands of acres of environmentally-critical tidal wetlands and shorelines are now threatened with inundation.

Increased intensity and frequency of storms creates more erosion and runoff, increasing nitrogen, phosphorus, and sediment pollution to streams, rivers and the Bay.

Mitigating climate change and implementing the Clean Water Blueprint are more than just two sides of a coin. We not only need both to save the Bay, but each reinforces and adds value to the other. One plus one can equal three.

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Full Written Statement

Chairman Whitfield, Ranking Member Rush, Congressman Sarbanes, and other distinguished members of the Energy and Commerce Committee, I am William C. Baker, President of the Chesapeake Bay Foundation. On behalf of CBF's board, staff, and more than 200,000 members, thank you for inviting me to participate in today's hearing.

I want to acknowledge the tremendous work that Congressman Sarbanes and other Members of the Maryland Congressional Delegation are doing in Congress on behalf of the Bay. Maryland Congressional Members have a profound love and appreciation for the Bay, and have been doing all that they can to restore its health, and I know they will continue to do so for many years to come.

For more than 40 years, the Chesapeake Bay Foundation has been working to protect and restore the Chesapeake Bay. The Chesapeake Bay is a national treasure, and America's largest estuary. Its 64,000 square mile watershed spans from Cooperstown, New York to Cape Henry, Virginia and westward to the Allegheny Mountains. More than 17 million people live in the Chesapeake Bay watershed, a number that is increasing by roughly 150,000 each year.

As you know, the Chesapeake Bay is a national treasure but has been suffering for decades from the effects of excess nitrogen, phosphorus and sediment pollution. Every summer, the mainstem of the Bay and several of its tributaries are plagued by dead zones, where not enough dissolved oxygen exists to sustain many forms of aquatic life. In CBF's 2014 State of the Bay report, the numeric score that our scientists calculated to represent the overall health of the Chesapeake Bay was a 32 on a scale of 100, meaning that the Bay is ecologically functioning at

only about one-third of its historic capacity.

The good news is that today, the states of Maryland, Virginia, Pennsylvania, Delaware, West Virginia, and New York, the District of Columbia, and the federal government are working together to reduce these pollutants to a healthy level, in what is called the Chesapeake Bay Clean Water Blueprint. And a recent ruling in the Third Circuit Court of Appeals' upheld the legal underpinnings of the Blueprint and made clear that the Environmental Protection Agency's oversight of the Chesapeake Bay Clean Water Blueprint under the Clean Water Act was valid. Furthermore, clean-up efforts are making a difference. There is evidence that the Bay's dead zone is shrinking, that the large underwater grass bed known as the Susquehanna Flats is growing, and many tributaries are returning to health. In turn, these improved conditions will lead to more fish and crabs and to an economic boost to our communities.

CBF recently released a report that shows that residents throughout the watershed will benefit from reducing pollution to the Bay. The report estimates that in 2009 the economic value of nature's benefits in the region was $107.2 billion and implementing the Chesapeake Clean Water Blueprint will increase that value by $22 billion. If we stop implementing the Blueprint, the value of natural services would decline by $5.6 billion annually.[1]

For Maryland, implementing the Blueprint will increase natural benefits by $4.6 billion annually, from $15.8 to $20.4 billion. These benefits will result from such things as more recreational opportunities, increased property values and reduced costs associated with waste treatment.

[1] McGee, B., & Phillips, S. (2014). The Economic Benefits of Cleaning Up the Chesapeake. Retrieved July 6, 2015, from http://www.cbf.org/document.doc?id=2258

However, today the ecological web in the Chesapeake Bay is a pale reflection of what it was not so very long ago. Chesapeake Bay oysters, the great natural filter of the Bay's water, are currently at less than 4% of their historic levels. The Bay's flagship species – the blue crab – is in such jeopardy that watermen's communities are disappearing, and the great crab processing companies now process imported crab. The underwater grasses so essential to life in the Bay are subject to massive die-offs related to increased water temperature, and the Bay's wetlands, critical to thousands of species in its web of life, are being destroyed yard by inexorable yard. And the effects of a changing climate are adding more stress to a system already out of balance. So today, I will briefly touch on some of those changes – specifically warmer waters, sea level rise and flooding, increased storm intensity and rainfall, and their current and predicted future impacts.

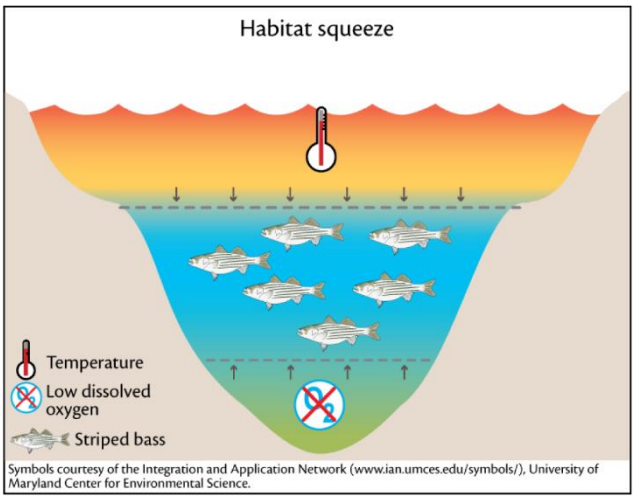
Warmer waters

Climate change is not just something in the Chesapeake Bay's future. Scientists have been collecting data on water temperatures in the Bay over the last several decades. Based on long-term records from the piers at the Chesapeake's two historic marine laboratories—extending back to 1938 at the Chesapeake Biological Laboratory on Solomon's Island, Maryland, and to 1948 at the Virginia Institute of Marine Science at Gloucester Point—it is clear that the Bay has been warming. Taking into account variations in temperatures due to large-scale climate cycles scientists have documented a warming trend of about 1°C or nearly 2°F since the 1960s, and the United Nation's Intergovernmental Panel on Climate Change (IPCC) has used models to predict

that this warming trend will continue over time.[2] Scientists have used these models to predict the range of warming waters to be between 2ºC and 5ºC by 2070 to 2099.[3] This warming trend is due to the slow absorption of the extra heat from the warming atmosphere, caused by climate change.[4]

Warmer waters impact the ecosystem in many ways. They have 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 zones, potentially expanding both the size and the duration of oxygen-deprived areas in the Bay.

Increases in water temperature can also affect the distribution and health of aquatic species in the Chesapeake. For instance, species that are already stressed by high summer temperatures, such as the eelgrass that provides important fish and crab habitats in the lower Bay, may be greatly reduced or eliminated. Adult striped bass, also known as rockfish, try to avoid water that is any warmer than about 76 degrees Fahrenheit. When the water temperatures rise, they seek refuge in the cooler temperatures of deeper water. During the summer, however, rockfish face what scientists call "temperature-dissolved oxygen squeeze," when



Conceptual diagram illustrating how change in a water source's oxygen and tempature can restrict the habitat of species.
Diagram courtesy of the Integration and Application Network (ian.umces.edu), University of Maryland Center for Environmental Science. Source: Ecocheck

[2] Pyke, C. R., R. G. Najjar, M. B. Adams, D. Breitburg, M. Kemp, C. Hershner, R. Howarth, M. Mulholland, M. Paolisso, D. Secor, K. Sellner, D. Wardrop, and R. Wood. 2008. Climate Change and the Chesapeake Bay: State-of-the-Science Review and Recommendations. A Report from the Chesapeake Bay Program Science and Technical Advisory Committee (STAC), Annapolis, MD. 59 pp.
[3] Ibid.
[4] U.S. Environmental Protection Agency. 2014. Climate change indicators in the United States, 2014. Third edition. EPA 430-R-14-004. www.epa.gov/climatechange/indicators.

dissolved oxygen concentrations in these deeper waters drop past the point where adult rockfish can survive. With predictions of higher water temperatures from the IPCC models,[5] 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 fish by changing their feeding habits or making them more susceptible to disease.[6,7]

Warming waters caused by climate change[8] also impact species distribution and range along the Mid-Atlantic coast. Species at the southern end of their range, like soft shelled clams and eelgrass, are already retreating northward up the Atlantic Coast toward more temperate waters. Atlantic menhaden, a critical forage fish within the overall food web, haven't produced strong year classes in the Bay in twenty years; which is possibly due to climate-related shifts in ocean currents interrupting their life cycles.[9] This lack of strong production is affecting the rockfish population as they shift towards eating blue crabs as a primary food source, which has negative nutritional consequences for the rockfish and obvious negative consequences for the crabs. Similarly, blue crabs may be facing new predators such as red drum which have expanded their range northward into the Chesapeake Bay.[10]

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[5] Pyke, C. R., R. G. Najjar, M. B. Adams, D. Breitburg, M. Kemp, C. Hershner, R. Howarth, M. Mulholland, M. Paolisso, D. Secor, K. Sellner, D. Wardrop, and R. Wood. 2008. Climate Change and the Chesapeake Bay: State-of-the-Science Review and Recommendations. A Report from the Chesapeake Bay Program Science and Technical Advisory Committee (STAC), Annapolis, MD. 59 pp.

[6] Blankenship, K. (2004, November 1). Low oxygen, high temperatures made rockfish feel like fish out of water. *Bay Journal*. Retrieved July 6, 2015, from http://www.bayjournal.com/article/low_oxygen_high_temperatures_made_rockfish_feel_like_fish_out_of_water

[7] Wood, R.J., D.F. Boesch, and V.S. Kennedy. 2002. Future consequences of climate change for the Chesapeake Bay ecosystem and its fisheries. *American Fisheries Society Symposium* 32:171-184.

[8] U.S. Environmental Protection Agency. 2014. Climate change indicators in the United States, 2014. Third edition. EPA 430-R-14-004. www.epa.gov/climatechange/indicators.

[9] Atlantic Ocean overturning found to slow down already today. (2015, March 24). Retrieved July 10, 2015.

[10] Goldsborough, B. (2015, April). Conservation in the Face of Change. *Save the Bay*, 15-15.

Scientists still have much to learn about the effects of warmer water temperatures on the various types of algae found in the Bay. It seems clear, however, that some species, like the harmful blue green algae , may prosper under the various climate change scenarios predicted by the IPCC, and other scientists' models.

Sea level rise and flooding

With more than 11,000 miles of coastline, much of the Chesapeake Bay area, including some large population centers, lies very close to water level. Many scientists believe that the IPCC prediction – that sea level will rise between 8 inches and 2 feet[11] by the end of this century – is conservative;[12] and, recent research indicates that previous assessments of the impacts of sea-level rise may underestimate future rates.[13] Evidence is mounting that ice caps and glaciers are melting at accelerated rates, and this melting is contributing more to sea-level rise than previously anticipated.[14, 15] If the current trend continues, apparent sea level rise could be as high as several feet in the region by the end of the century which would cause much of the Bay's Blackwater National Wildlife Refuge to become open water.[16]

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[11] Solomon, S., D. Qin, and M. Manning. 2007. *Contribution of Working Group I to the Fourth Assessment Report*. Intergovernmental Panel on Climate Change, Geneva.

[12] Horton, B., Rahmstorf, S., Engelhart, S., & Kemp, A. (2014). Expert assessment of sea-level rise by AD 2100 and AD 2300. *Quaternary Science Reviews*, *84*, 1-6. doi:10.1016/j.quascirev.2013.11.002

[13] Potsdam Institute for Climate Research (2012) Projected sea-level rise may be underestimated [Press Release] Retrieved from: https://www.pik-potsdam.de/news/press-releases/archive/2012/projektionen-zum-meeresspiegelanstieg-koennten-unterschaetzt-worden-sein

[14] Khan, S., Kjær, K., Bevis, M., Bamber, J., Wahr, J., Kjeldsen, K., . . . Muresan, I. (2014). Sustained mass loss of the northeast Greenland ice sheet triggered by regional warming. *Nature Climate Change Nature Climate Change*, *4*, 292-299. doi:10.1038/nclimate2161

[15] Boesch, D.F., L.P. Atkinson, W.C. Boicourt, J.D. Boon, D.R. Cahoon, R.A. Dalrymple, T. Ezer, B.P. Horton, Z.P. Johnson, R.E. Kopp, M. Li, R.H. Moss, A. Parris, C.K. Sommerfield. 2013. Updating Maryland's Sea-level Rise Projections. Special Report of the Scientific and Technical Working Group to the Maryland Climate Change Commission, 22 pp. University of Maryland Center for Environmental Science, Cambridge, MD.

[16] Larson, C., I. Clark, G. Gunterspergen, D. Cahoon, V. Caruso, C. Hupp, and T. Yanosky. 2004. *The Blackwater NWR Inundation Model. Rising Sea Level on a Low-lying Coast: Land Use Planning for Wetlands.* U.S. Geological Survey Open File Report 04-1302 http://pubs.usgs.gov/of/2004/1302/index.html

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.[17] 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.[18]

Increased Storm Intensity and Frequency

Increasingly intense storms, due to the increased and accelerated hydrological cycle caused by warming atmospheric and water temperatures, produce storm surges that build on top of the inexorably slowly rising Bay. For example, in 2003 Hurricane Isabel resulted in storm surges up to 9 feet. This exceeded the maximum recorded levels of a 1933 hurricane, which had a very similar trajectory and intensity, by about one foot.[19] This measurement – one foot-- correlates with the approximate increase in relative sea level over that 70 year interlude. Add to this the potential for increased frequency and intensity of storms as result of warmer ocean waters, and there emerges the considerable likelihood that we will see a significant increase of storm impacts on the Chesapeake Bay's coastal communities and environments in the future. This fate is not

[17] Cronin, T. 2013. U.S. Geological Survey Science Summary – Sea Level Rise and Chesapeake Bay. Retrieved from: http://chesapeake.usgs.gov/sciencesummary-sealevelrise.html

[18] Larson, C., I. Clark, G. Gunterspergen, D. Cahoon, V. Caruso, C. Hupp, and T. Yanosky. 2004. *The Blackwater NWR Inundation Model. Rising Sea Level on a Low-lying Coast: Land Use Planning for Wetlands.* U.S. Geological Survey Open File Report 04-1302 http://pubs.usgs.gov/of/2004/1302/index.html

[19] Boicourt, W.C. 2003. Physical response of Chesapeake Bay to hurricanes moving to the wrong side: Refining the forecasts. *In* K.G. Sellner and N. Fisher (eds.), *Hurricane Isabel in Perspective*. Chesapeake Research Consortium, Edgewater, MD.

isolated in the Bay. Three years ago the United States had its costliest year to date in terms of storm damage with 11 weather and climate disaster events across totaling in $110 billion worth in damages.[20]

Most scientific models agree that storms will become more intense in the future. According to the Environmental Protection Agency (EPA), annual precipitation totals in the contiguous United States have risen 0.5 percent per decade since 1901.[21] Storm intensity and increased rainfall has an important impact on the Bay's ecological health. Increased scouring and runoff from more intense rain events, regardless of season, carry significantly higher loads of nitrogen, phosphorus, and sediment to tributaries, and thus to the Bay. Since this trio of pollutants is the primary target of the Chesapeake Bay Clean Water Blueprint, additional heavy loads during more intense storms and increased rainfall amounts in the Mid-Atlantic States may compound the Bay's restoration challenges.

The increased vulnerability will also be felt in the built environment, as roads, utilities, sewerage and drainage systems are threatened with inundation. We expect to see more erosion of developed shorelines and saltwater intrusion into aquifers. And we expect impacts not only on the Eastern Shore and the imperiled communities on Smith and Tangier Islands, but also here in Annapolis and in other places such as Hampton Roads, Baltimore, Alexandria and the Nation's Capital itself.

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[20] Sutton-Greir, A., Wowk, K., & Bamford, H. (2015). Future of our coasts: The potential for natural and hybrid infrastructure to enhance the resilience of our coastal communities, economies and ecosystems. *Environmental Science and Policy, 51*, 137-148. doi:10.1016/j.envsci.2015.04.006

[21] Weather and Climate. (2015, June 30). *Summary of Key Points: U.S. and Global Precipitation* Retrieved July 6, 2015, from http://epa.gov/climate/climatechange/science/indicators/weather-climate/index.html

Restoring and Protecting the Bay with a Changing Climate

As stewards of the Chesapeake Bay, we have a responsibility to review how we manage and impact the Bay in light of current scientific data and modelling. Thankfully, the centerpiece of our multistate cleanup efforts -- the Chesapeake Clean Water Blueprint -- will not only reduce nitrogen, phosphorus and sediment pollution to our waters, but will also help mitigate the effects of our changing climate. For example, the Chesapeake Bay watershed states are relying heavily on the implementation of agricultural conservation practices to achieve the pollution reductions necessary under the Clean Water Blueprint. Common agricultural practices that improve the health of the soil, such as planting winter cover crops and practicing rotational grazing and no-till farming can sequester carbon, while also helping to build soil quality that makes cropland less susceptible to both erosion and drought. Improved nutrient management will mean reduced dead zones as well as fewer emissions of nitrous oxide, a very potent greenhouse gas.

On the urban side, communities can use "green infrastructure" to increase the capacity of drainage systems to handle large storms, protect the water supply systems in times of drought, and mitigate the urban heat island effect. Urban vegetation can also reduce the levels of greenhouse gases in the atmosphere.[22]

Restoring the Chesapeake's oyster population can also help communities on the coast, and their ecosystems, better withstand more intense storms. Not only do oyster naturally filter pollution, and provide significant economic benefits to the region; but, a recent study found that there is substantial evidence that natural infrastructure, such as oyster reefs, enhance coastal

[22] Safford, H.; Larry, E.; McPherson, E.G.; Nowak, D.J.; Westphal, L.M. (August 2013). Urban Forests and Climate Change. U.S. Department of Agriculture, Forest Service, Climate Change Resource Center. www.fs.usda.gov/ccrc/topics/urban-forests/

resilience to climate change by providing storm and flood protection.[23]

In conclusion, I want to simply restate that the Chesapeake Bay is an ecosystem in serious trouble. The Bay is currently experiencing additional stresses due to changes in our climate and scientists predict these stresses will become significant. Implementing the Chesapeake Clean Water Blueprint will help protect against these stresses – to a point. As you work on this issue, I urge you to remember that the Bay is in the condition it is today because years ago we were not mindful of how our infrastructure, technology and lifestyle choices were impacting our water. A great deal of what will happen to the Chesapeake Bay depends on the actions that federal policymakers choose to take – or not to take. Today I thank you for your attention to this issue and urge you continue to be mindful. To use all that we know to both restore *and protect* the Bay. To maintain strong federal commitment to the Chesapeake Clean Water Blueprint and to particularly consider increasing federal support for pollution reduction practices that also help protect the Bay from the effects of our changing climate. To increase investments in our soil health on our farms, "green" infrastructure in our cities and oyster reefs in our waters. In this way, working together using all that we know in service of a clean and resilient Chesapeake, we will be able to look back and say we were, in fact, good stewards of our Bay. Thank you once more for the opportunity to be here today. I am happy to answer any questions that you might have.

[23] Sutton-Greir, A., Wowk, K., & Bamford, H. (2015). Future of our coasts: The potential for natural and hybrid infrastructure to enhance the resilience of our coastal communities, economies and ecosystems. *Environmental Science and Policy, 51*, 137-148. doi:10.1016/j.envsci.2015.04.006