STATEMENT OF
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BEFORE THE
COMMITTEE ON GOVERNMENT REFORM
HEARING ON "SAFEGUARDING THE CHESAPEAKE BAY"

Mr. Chairman and Members of the Committee, thank you for the opportunity to participate in this hearing about progress in safeguarding the Chesapeake Bay. My name is Scott Phillips and I am the Chesapeake Bay Coordinator for the U.S. Geological Survey (USGS). This morning my testimony will focus on the role of USGS in providing data and analysis to the Chesapeake Bay Program (CBP), how USGS science supports water quality goals of the Chesapeake 2000 agreement, and the use of USGS science in the issue of modeling versus monitoring as it relates to accurately reporting water quality progress.

USGS role in providing data and analysis to the Chesapeake Bay Program

Since the CBP started in 1983, the USGS has performed the critical role of providing unbiased scientific information that resource managers use to help understand and restore the Bay and its watershed. The USGS provides a combination of research, monitoring, modeling, and coordination with the partners in the CBP and the Department of the Interior (DOI). Findings from the USGS have been used by the CBP partners to help formulate approaches to meet and evaluate progress towards the restoration goals established in the Chesapeake 2000 agreement. To support the technical needs of the Chesapeake 2000 agreement, USGS scientists work:

(1) To improve watershed and land-use data and analysis.
(2) To understand the sources and impact of sediment on water clarity and biota.
(3) To enhance the prediction, monitoring, and understanding of nutrient and contaminant delivery to the Bay.
(4) To assess the factors affecting the health of fish, wildlife, and their habitats.
(5) To synthesize information and enhance decision-support tools to communicate results.

Over forty USGS scientists located in offices throughout the Bay watershed and at the CBP office in Annapolis, Maryland, are involved in studies and information dissemination to support the technical needs of the CBP partners. USGS interacts directly with CBP partners through active participation in the monthly meetings of all technical subcommittees of the CBP. Additionally, USGS results are disseminated through published reports and journal articles, as well as through Internet GIS-based data delivery and decision-support models and tools that are integrated with the CBP Chesapeake Information Management System (CIMS). The USGS Chesapeake Bay Studies depend on the coordination of multiple USGS programs that have a scientific interest in the Bay.

How USGS science supports water quality goals of the Chesapeake 2000 agreement

One of the primary goals of the Chesapeake 2000 agreement is to reduce the amount of nutrients and sediment that enter the Bay to improve dissolved oxygen, water clarity, and chlorophyll-*a* conditions to help restore the Bay ecosystem by 2010. The USGS has worked closely with the CBP partners: (1) to help develop water quality criteria for the Bay; (2) to analyze management strategies to reduce nutrients and sediment; (3) to monitor water quality in the Bay watershed and the principal rivers entering the Bay; (4) to compute annual changes in water quality; (5) to understand the factors affecting water quality changes; (6) to develop approaches to document water quality and living-resource conditions in the Bay and (7) to assess progress in restoring water quality. The water quality information from the watershed is used in conjunction with tidal monitoring data and CBP model results to help assess progress towards meeting the water quality criteria by 2010. The information provided by the USGS and many other CBP partners and universities has allowed for an adaptive management approach to restoration by setting and revising goals as scientific information improves the understanding of the ecosystem and the effectiveness of management strategies. The USGS has worked with the CBP partners to utilize both monitoring information and model results to address these issues.

The USGS was involved in several of the technical workgroups that developed water quality criteria to protect living resources in the Chesapeake Bay. The workgroups were organized by the CBP to review and utilize monitoring data, modeling results, and other data to develop the dissolved oxygen, water-clarity, and chlorophyll-*a* criteria. The water quality criteria guidance was published in April 2003 and is available on the following website: http://www.chesapeakebay.net/baycriteria.htm. The guidance is intended to assist the multiple jurisdictions in the Bay watershed (Maryland, Virginia, Delaware, and the District of Columbia) in adopting revised water quality standards to address nutrient- and sediment-based pollution in the Chesapeake Bay and its tidal tributaries.

In 2003 and 2004, the CBP used a Watershed Model to help set nutrient- and sediment-reduction allocations that were needed to help meet the water quality criteria. The model provided predictions of the amount of nutrient and sediment reductions that could be accomplished by different management strategies in States throughout the watershed. The States worked closely through the CBP to formulate management strategies to achieve their respective nutrient- and sediment-load reduction allocations. The USGS developed complimentary watershed models to help further identify high nutrient source and delivery areas to the Bay. The USGS has worked to provide information to help State and local jurisdictions target areas where the nutrient- and sediment- reduction actions could be implemented.

The USGS, in cooperation with State agencies, has the important role of monitoring the nine principal rivers that enter the tidal portion of the Bay watershed. Through the River-Input Monitoring project, the USGS has established nine monitoring sites that collectively represent 78 percent of the area of the Bay watershed. The remaining portion of the watershed is difficult to monitor due to the influence of tides in these rivers, which prevent accurate measures of river flow. The monitoring sites are located at the head of tide on the Susquehanna, Potomac, James, Rappahannock, Appomattox, Pamunkey, Mattaponi, Patuxent, and Choptank Rivers (see map below). Sampling of some of the rivers began in 1979, with sampling for all rivers implemented by 1990. At each site, the USGS measures the amount of river flow and collects between 15 and 30 samples each year that are analyzed for the concentrations of nutrients and sediment. The information is used to compute the amounts of nutrient and sediment (known as loads) that enter the tidal portion of the bay watershed and also document water quality changes over time to help assess the effectiveness of management actions in the nontidal portion of the watershed.

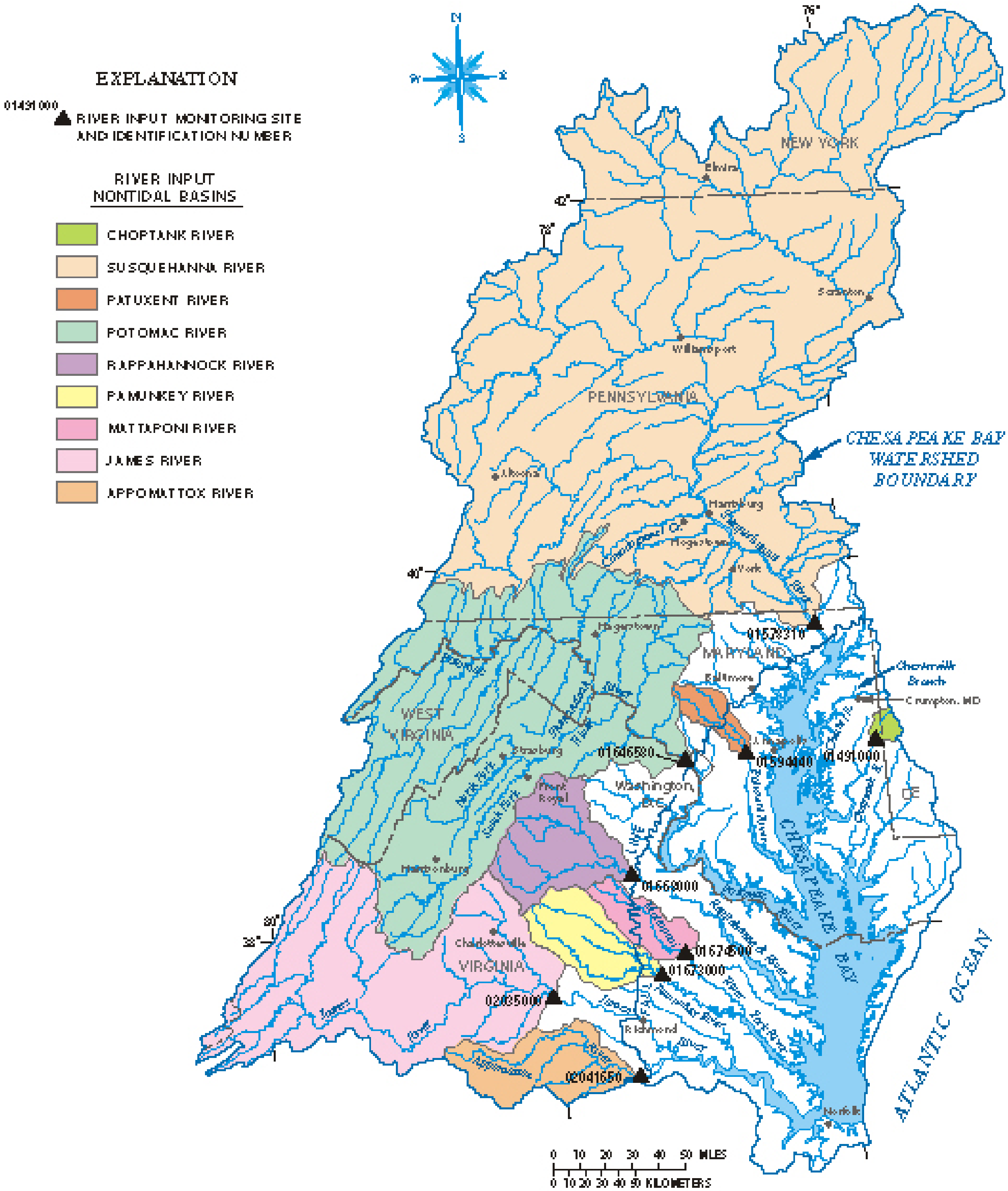


Figure 1. Map of Chesapeake Bay watershed and Chesapeake Bay River-Input Monitoring Program site basins.

In addition to the River-Input sites, the USGS compiled and analyzed data from another 1,000 sites in the Bay watershed. In the mid-1990s, the USGS worked in partnership with the CBP to develop a database of all the nutrient and sediment data collected by various agencies in the Bay watershed. Evaluation and analysis of data from 25 key sites that were selected by the States and the River-Input sites are conducted each year and shared with the CBP partners through several technical meetings and workshops.

Another important role for the USGS is identifying the factors affecting changes in water quality in the Bay watershed. From 1997 to 2000, the USGS conducted a joint project with the CBP to use the Watershed Model to help interpret water quality changes at River-Input Monitoring project sites. The Watershed Model results, USGS trend tests results, and additional data sets showing changes in nutrient sources proved to be valuable tools to help understand the changes in water quality. The study revealed that a combination of natural factors and human activities affected water quality conditions at the River-Input sites. Natural factors included variability of rainfall and streamflow, seasonal temperature changes, and watershed characteristics such as soils and the influence of ground water. Factors related to human activities included the amount of nutrients and sediment discharged into the watershed from both point sources, usually municipal and industrial treatment plants, and nonpoint sources, generally related to air deposition and urban, suburban, and agricultural activities. Another important human factor was the effectiveness and implementation of management practices to reduce contributions from these sources. This study and additional USGS studies on groundwater suggest that some of these factors result in a "lag time" between implementation of management practices to reduce nutrient and sediment sources and improvements in water quality. For these reasons, the USGS reported in 2003 that achieving the new water quality criteria for dissolved oxygen, water clarity, and chlorophyll-*a* criteria in the Bay by 2010 would be very difficult. Resource managers are using this information to consider increasing the rate of implementation of practices to reduce nutrients from all sources, particularly point sources from municipal treatment plants, as well as agricultural and urban sources.

Use of USGS Science in the Issue of Modeling and Monitoring to Assess Water quality Conditions and Progress

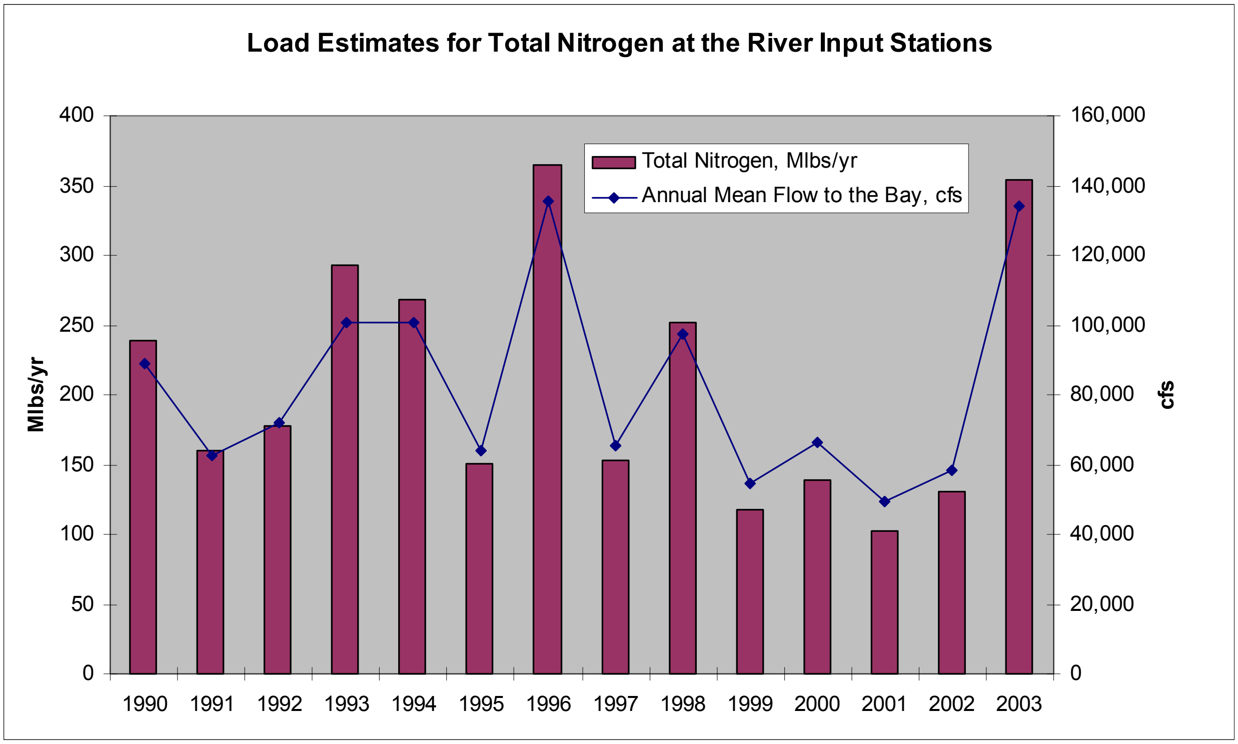
Each year, results from monitoring of rivers in the Bay watershed are used with other data from the monitoring of tidal waters and living resources and modeling results to help the CBP partners assess progress in meeting the water quality goals of Chesapeake 2000. Information is analyzed to assess the factors affecting changes in both the water quality criteria (dissolved oxygen, water clarity, and chlorophyll-*a*) and the amount of nutrient and sediment entering the Bay. The information is synthesized by the CBP and presented in annual updates and in the "State of the Bay" report that is published every two years.

Prior to the Chesapeake 2000 agreement, CBP had adopted the goal of reducing the loads of nutrients entering the Bay by 40 percent by the year 2000. At that time, actual water quality criteria for the Bay had not yet been developed. The two primary tools that were used to evaluate the reduction of nutrients entering the Bay were the Watershed Model "progress" runs, and monitoring of nutrients at the USGS River-Input sites. Both of these tools used approaches to compensate for the large yearly changes in river flow that affect nutrient concentrations and loads to the Bay in order to make a more direct evaluation of the effectiveness of management actions.

Results from both the Watershed Model progress runs and the USGS River-Input sites indicated that management actions have resulted in progress in reducing the flow of nutrients to the Bay. Analysis of concentration data from nine River-Input sites, using statistical techniques that compensate for the influence of river flow, show improvements in nitrogen and phosphorus at about half of the sites. Between the late 1980s and 2003, a decline in nitrogen concentrations occurred at four sites, statistically significant trends could not be detected at four sites, and one site had an increasing trend. Declines in total phosphorus concentration occurred at four sites, statistically significant trends could not be detected at two sites, and three sites had an increasing trend. Notably, the nine rivers vary greatly in size and the concentration reductions for nitrogen were seen in three of the largest rivers (Susquehanna, Potomac, and James) that comprise the majority (about 90 percent) of the river flow from the River-Input model Stations. Declines in phosphorus concentrations were detected in two of these large rivers (the Susquehanna and James). Results for estimates of load reductions from the Watershed Model are not available for 2003; however, analysis of data from years when results of both the Watershed Model progress runs and the USGS River-Input Sites are available and show general agreement of the results at the majority of the sites.

Since the Chesapeake 2000 agreement, there has been more focus on assessing progress in meeting the water quality criteria in the tidal areas of watershed and not just addressing progress in reducing nutrients in the Bay. Therefore, additional approaches are being developed to evaluate the annual changes in river flow, load, and concentration of nutrients in the Bay and relate them to changes in tidal waters. Evaluating and synthesizing the information to report progress in restoring the Bay and its watershed is a challenging task because there are multiple natural and human-induced factors that need to be assessed. In some cases, there is not a clear scientific understanding of how the interrelation of multiple factors affects water quality and living resources in the Bay and its watershed. For example, there are multiple factors in addition to water clarity that affect the amount of submerged aquatic vegetation in the bay.

Additional results from the USGS River-Input sites that are now emphasized to support assessment of progress in meeting the water quality goals of Chesapeake 2000 include the amount of river flow and the loads and observed concentrations of nutrients that enter the tidal waters of the Bay watershed each year. Results from the USGS River-Input sites showed that in 2003 the nutrient loads were the second highest since 1990 (see graph below for nitrogen loads and river flow). Analysis of the load of nutrients to the Bay from the major rivers is complicated by recent variations in river flows, which reflect year-to-year variations of weather in the Chesapeake Bay watershed. In just the last few years, the river flow into the Bay has gone from near-record lows due to the drought conditions from 1999-2002, to near-record highs in 2003. As a result of these natural variations, nutrient loads and concentrations have fluctuated, and after four years of very low amounts of nutrient inputs in 1999-2002, 2003 saw much higher nutrient loads. The high input rate of nutrients in 2003 is related to the high rates of runoff in this very wet year. These increased nutrient loads resulted in near-record, low dissolved oxygen levels in the Bay during the summer of 2003, and poorer water clarity that contributed to a decline of submerged aquatic vegetation (SAV).



The Watershed Model progress runs were not intended to reflect these annual changes in nutrient loads. They focus more on the long-term average river flow conditions to predict future load reductions. When large fluctuations in the nutrient load and water quality conditions occur from year to year, such as between 2002 and 2003, the amount of "progress" being made to restore water quality in the Bay appears to falter. These water quality variations, driven by weather variations, suggest a lack of progress. However, when the data are adjusted to account for these year-to-year weather-driven variations, the monitoring results are generally in agreement with the Watershed Model. They both point towards some improvement over time. However, very wet years such as 2003, and potentially 2004, can result in real problems for the Bay.

Conclusion

Because variable weather and other natural factors cause significant swings in sediment and nutrient loads from year to year, statistical adjustments based on models are necessary to identify trends in water quality in the Chesapeake Bay. We continue to believe that the river input monitoring data, coupled with statistical methods aimed at compensating for flow variations, indicate overall progress in improving the Bay's water quality. Wet years such as 2003 and possibly 2004 cause apparent reversals of the general trend, however. The Watershed Model is a critical tool to relate nutrient sources, effectiveness of implementation practices, rainfall, river flow, and watershed characteristics to simulate and predict nutrient- and sediment-load reductions to the Bay. The CBP has utilized new scientific findings on the effectiveness of management actions to improve these simulations. Further, the CBP partners, including the

USGS, are making enhancements to the current model to produce an improved model (Phase V) that incorporates additional data on river flow, water quality, and other watershed processes.

The Watershed Model progress runs are one of the tools that provide estimates of the amount of progress in reducing nutrient loads in the Bay. Ultimately, the evaluation of success of efforts to restore water quality in the Bay and its watershed will be based primarily on monitoring data. The CBP partners, including USGS, are working to increase the amount of monitoring and associated data analysis to improve the assessment of progress in restoring water quality and living resources in the Bay and its watershed.

Thank you, Mr. Chairman, for the opportunity to present this testimony. I will be pleased to answer questions you and other Members of the committee might have.