Chesapeake Bay Program
A Watershed Partnership

Backgrounder

410 Severn Avenue, Suite 109 · Annapolis, MD 21403
1 (800) YOUR BAY · www.chesapeakebay.net

River Flow, Long-term Trends and Stream Health In the Chesapeake Bay Watershed

2010 River Flow & Loads of Nitrogen, Phosphorus & Sediment

River flow is a fundamentally important force shaping the conditions in the Bay and thus influencing the water quality and habitat conditions for most species living in the Bay. In recent years, it has fluctuated considerably influencing pollutant loading and altering the salinity and stratification (layering) of the Bay waters.

The amount of water flowing into the Bay from tributaries has a direct impact on how much pollution is in the estuary. Generally, as river flow increases, it brings more nutrient and sediment pollution to the Bay. Therefore, winter snows and spring rains and the runoff that comes with them have a direct effect on water quality in the Bay each summer.

Each year, the U.S. Geological Survey (USGS) monitors and reports on river flow and nutrient and sediment loads to the Bay.

In the 2010 water year (October 2009 – September 2010):

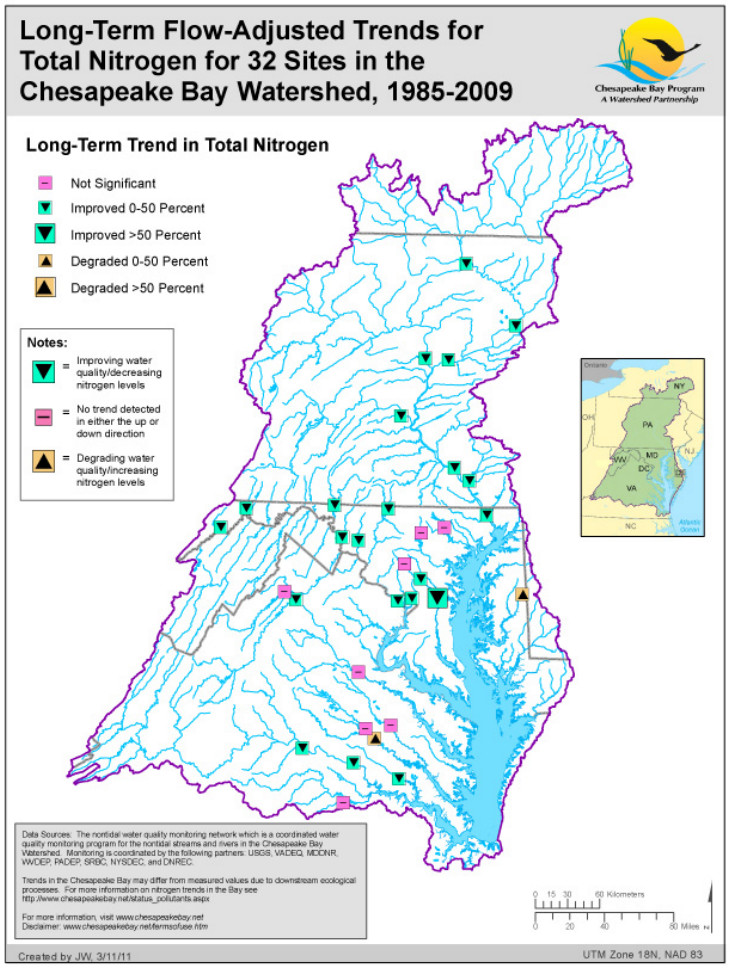
- The average **river flow** was 52 billion gallons per day (BGD). Although this is 11 BGD more than 2009, it is close to the twenty-year average flow of 53 BGD.
- Preliminary estimates show that approximately 278 million pounds of **nitrogen** reached the Bay. This is 43 million pounds more than 2009 but less than the 356 million pound average load from 1990-2010.
- Preliminary estimates show that approximately 16 million pounds of **phosphorus** reached the Bay. This is 7 million pounds more than the revised loads in 2009 but less than the 20 million pound average load from 1990-2010.
- Preliminary estimates show that approximately 9 million tons of **sediment** from non-tidal rivers reached the Bay. This is a 7 million ton increase from 2009 and more than the average load from 1990-2010. The 2010 sediment load is four times the 2009 load of sediment to the Bay (2 million tons) and two times the long-term average (4 million tons).

Watershed-derived nitrogen is commonly delivered by rivers and groundwater to the Bay, whereas phosphorus is typically attached to particles resulting in levels being elevated during storm-related events. For both, the total amount transported to the Bay is largely determined by river flow. In 2010, river flows were slightly below the 1990-2010 long term average which helped contribute to nitrogen and phosphorus loads in 2010 being below long term loading averages. Initial results indicate that two high runoff events in January and March of 2010 in the Potomac River basin combined to generate the 2010 sediment load, which is one of the highest in the last twenty years.

(Cont'd)

Long term Trends (1985-2009)

An analysis of data from long-term stream monitoring sites across the watershed shows trends toward decreasing flow-adjusted concentrations of nitrogen, phosphorus and sediment. A decreasing trend may indicate improvements in health, since it means that smaller amounts of the specific pollutant are reaching the stream.



Nitrogen, phosphorus and sediment concentrations are highly variable and strongly related to river flow conditions. Flow-adjusted trends are calculated in order to statistically determine whether concentrations have changed over time and to remove the effects of natural variations in river flow. In this way, flow-adjusted trends make it possible to evaluate changes in stream quality that may result from pollution reducing actions or other changes within the watershed.

<u>Between 1985 and 2009 pollutant trends are as follows:</u>

- Nitrogen: 22 out of 32 sites showed downward flow-adjusted trends for nitrogen concentrations, two sites showed upward trends and eight sites showed no or small trends that are not statistically significant. (See image at right.)

- Phosphorus: 22 out of 32 sites showed downward flow-adjusted trends for phosphorus concentrations, four sites showed upward trends and six sites showed no or small trends that are not statistically significant. (Image available at: http://www.chesapeakebay.net/status_flowadjustedphosphorus.aspx?menuitem=50309

- Sediment: Twelve out of 32 sites showed downward flow-adjusted trends for sediment concentrations, four sites showed upward trends, sixteen sites showed no or small trends that are not statistically significant. (Image available at: http://www.chesapeakebay.net/status_flowadjustedsediment.aspx?menuitem=50310

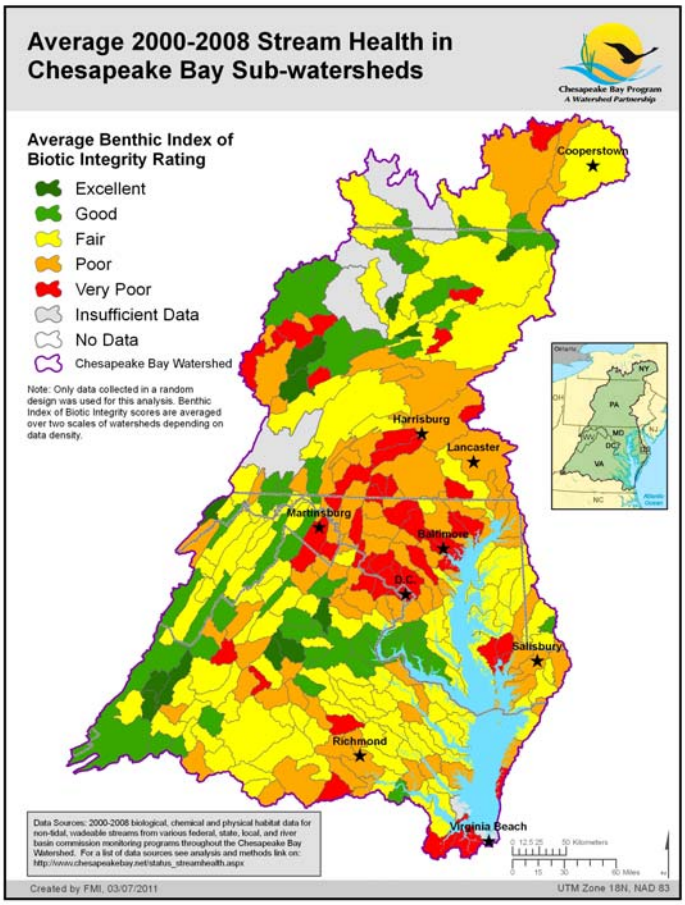
At many monitored locations, long-term trends indicate that management actions, such as pollution controls for improved wastewater treatment plants and practices to reduce nutrients on farms and suburban lands have reduced concentrations of nitrogen. While these reductions provide evidence of improving conditions in some upstream areas, additional reductions will be needed to have healthier streams and meet water-quality goals for the Bay.

It is important to recognize that flows of pollutants are not only from runoff. Some water seeps into the soil, carrying nutrients into groundwater. The travel time of nutrients through the watershed ranges from weeks to centuries. This can result in a lag time between implementing management actions and improvements in water quality.

(Cont'd)

Stream Health in the Watershed

Between 2000 and 2008 the average stream health scores at 7,886 sites in the watershed indicated that 3,584 (45 percent) of the waterways were in fair, good or excellent condition and 4,302 (55 percent) were in very poor or poor condition. In general, it can be said that a healthy Bay watershed would have a majority of streams ranked as fair, good or excellent.



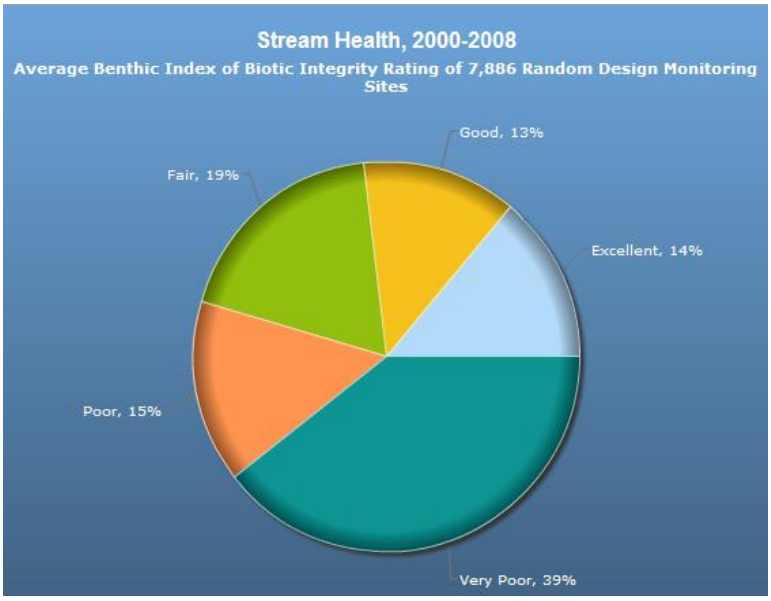
An effective way to measure the health of freshwater streams and rivers is to study the many tiny critters that live in these waters, called "benthic macro-invertebrates". The abundance and diversity of snails, mussels, insects and other bottom-dwelling organisms are good indicators of the health of streams because these critters can't move very far and they respond to pollution and environmental stresses. Benthic macroinvertebrates are generally harmed by pollutants such as metals, acidity, sediment, pesticides, nitrogen and phosphorus. These pollutants come from sources such as mining, agriculture, urban and suburban runoff, automobile and power plant exhaust, and wastewater treatment facilities.

Health of streams was evaluated by the Chesapeake Bay Basin-wide Benthic Index of Biotic Integrity (or "Chessie B-IBI"), which was developed from benthic macroinvertebrate data collected across the entire Chesapeake Bay watershed.

Data collected in a random design (7,886 sites) were used for the analysis portrayed in the pie chart (below) that shows rating by *monitoring sites* and the map (above) that shows average B-IBI ratings in Chesapeake Bay *Sub-watersheds*.

<u>Of those sites, between 2000 and 2008:</u>

- 14 percent (1,100 sites) were in excellent condition
- 13 percent (1,023 sites) were in good condition
- 19 percent (1,461 sites) were in fair condition
- 15 percent (1,195 sites) were in poor condition
- 39 percent (3,107 sites) were in very poor condition



These results show a clear link between the watershed-wide B-IBI scores and land-based activities in individual watersheds.

- The poorest stream index scores occur in highly urbanized watersheds such as those in the Baltimore-Washington D.C. metropolitan region. Stream health is compromised in urban areas by extreme land disturbance and an abundance of paved surfaces. These stressors result in high levels of pollution, altered stream flow, and poor quantity and quality of streamside vegetation.

(Cont'd)

- Poor stream index scores in the Chesapeake Bay basin are also present in areas with intense agricultural activity such as the lower Eastern Shore and south central Pennsylvania. Excess nutrients and sediment compromise stream health in these areas. The Upper West Branch of the Susquehanna River in Pennsylvania appears to be compromised by mining activity which causes habitat alterations and toxic plumes that negatively impact benthic stream populations.
- The highest (or best) stream index scores are typically found in minimally disturbed watersheds with low levels of pollution and stable in-stream and streamside habitats. These watersheds tend to be clustered in forested areas of the upper James and Potomac rivers and the West Branch of the Susquehanna River.

For more information about:

- **Flow adjusted trends** and **pollutant loads** to the Bay, visit: http://www.chesapeakebay.net/status_factorsimpacting.aspx?menuitem=15049 and http://www.chesapeakebay.net/status_watershedhealth.aspx?menuitem=26057 or http://chesapeake.usgs.gov/.

- **Stream health**, visit http://www.chesapeakebay.net/status_streamhealth.aspx?menuitem=50423

The Chesapeake Bay Program is a regional partnership that has coordinated and conducted the restoration of the Chesapeake Bay since 1983. Partners include the U.S. Environmental Protection Agency; the U.S. Department of Agriculture; the states of Delaware, Maryland, New York, Pennsylvania, Virginia and West Virginia; the District of Columbia; the Chesapeake Bay Commission, a tri-state legislative body; many federal agencies; and advisory groups of citizens, scientists and local government officials.

###