

# U.S. Geological Survey (USGS) Maryland-Delaware-District of Columbia Monthly Water Conditions Summary

**April 2016 Highlights:** Record low monthly mean streamflow at three streamgages. Fourth lowest April freshwater flow to the Chesapeake Bay. Fifty-four percent of groundwater levels and 64 percent of streamflow levels were below normal at sites monitored by the U.S. Geological Survey across Maryland, Delaware, and the District of Columbia.

## Why is it important for the USGS to collect and analyze water-resources data?

USGS water data are valuable to the public, researchers, water managers, planners, and agricultural users, especially during floods and droughts. These data can be used to assess how water resources respond to changes in climate. Scientists at the USGS have measured streamflow and groundwater levels to assess water resources for over 125 years.

In addition to providing the most extensive set of historical streamflow and groundwater data available to the public, the USGS continues to collect water data and quality-assures the data using standardized techniques across the country. The uniformity of the dataset enables multi-state comparisons and other comparative statistical analyses that better inform policy makers of the possible water-resources conditions they might encounter in the future.

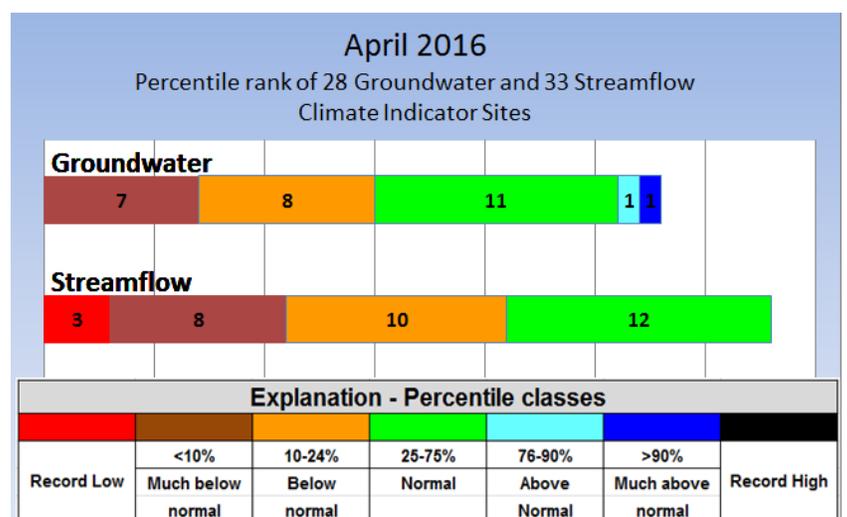
The sites used in this water summary were carefully selected to show the response of streamflow and groundwater levels to weather conditions. Ideally, these sites will show no effects from human influences. The streamflow and groundwater data are ranked in comparison to the historical record and summarized. Precipitation and reservoir data are also presented to give a more complete picture of the region's water resources.

## USGS April 2016 Water Conditions Summary

Below average precipitation throughout much of the Mid-Atlantic region resulted in over 50 percent of groundwater levels and monthly mean streamflows being below normal. In April, 54 percent (15 of 28) of groundwater levels at USGS observation wells were below normal and 64 percent (21 of 33) of the monthly mean streamflows were below normal at sites used to monitor the response of water resources to changes in climatic conditions in Maryland, Delaware, and the District of Columbia.

Groundwater was above normal at two USGS observation wells in Baltimore County, Maryland and normal (between the 25<sup>th</sup> and 75<sup>th</sup> percentiles) in 39 percent (11 of 28) of USGS observation wells in April.

Monthly mean streamflow dropped at 31 of the 33 streamgages used to monitor climatic conditions, although streamflows typically decrease this time of year until about the end of the September. Streamflow was in the normal range at 36 percent (12 of 33) of USGS streamgages.

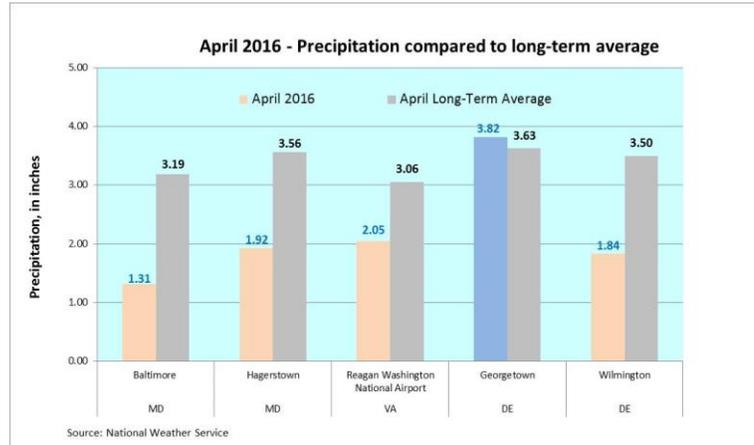


A **percentile** is a value on a scale from 0 to 100 that indicates the percent of a distribution that is equal to or below it. A percentile between 25 and 75 is considered normal. For example, a groundwater level in the 90th percentile is equal to or greater than 90 percent of the values recorded for that month.

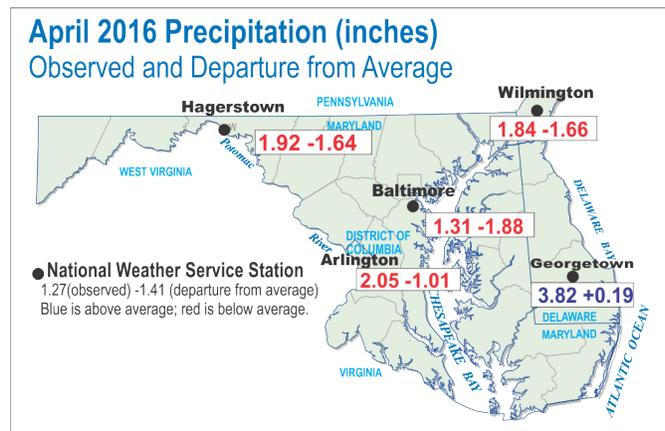
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## April 2016 Precipitation and Weather

April precipitation was below the long-term average at four of the five National Weather Service (NWS) Mid-Atlantic weather stations. Below average precipitation is shown in tan in the plot, while above normal is shown in blue. The NWS weather station in Georgetown, Delaware was the only weather station with above average precipitation, and it only exceeded the average amount by 0.19 inches. April precipitation at Georgetown, Delaware was 3.82 inches, which was almost double the precipitation at the other four Mid-Atlantic weather stations.



For the second consecutive month, precipitation at three Mid-Atlantic weather stations was less than 2 inches in April. The weather station in Arlington, Virginia was also below normal at 2.05 inches. At the Baltimore, Maryland and Wilmington, Delaware weather stations, there were zero days with more than 0.50 inch of precipitation. At the Georgetown, Delaware weather station, there was one day with precipitation over 1.0 inch and two days with precipitation greater than 0.50 inches.



### National Weather Service Stations

- Baltimore** = Baltimore/Washington International Thurgood Marshall Airport (BWI)
- Georgetown** = Georgetown, Sussex County Airport
- Hagerstown** = Hagerstown Regional Airport
- Arlington** = Ronald Reagan Washington National Airport
- Wilmington** = New Castle Airport

Below normal precipitation in March and April caused the NWS Middle Atlantic River Forecast Center's (MARFC) 365-day precipitation totals for the District of Columbia and all counties in Maryland and Delaware to be below normal.

Average April temperatures (Fahrenheit) ranged from a -1.0 to +0.6 degrees departure from average at the five Mid-Atlantic NWS weather stations. The largest departure from average was in Georgetown, Delaware, where the temperature was 1.0 degrees below normal. The weather station in Arlington, Virginia had the warmest monthly average temperature at 56.9 degrees, which was 0.1 degrees above average. The lowest average temperature was in Wilmington, Delaware for the second consecutive month, at 52.7 degrees, which was 0.7 degrees Fahrenheit below average.

Sources: National Weather Service and Middle Atlantic River Forecast Center (MARFC)  
MD and DC: <http://www.weather.gov/climate/index.php?wfo=lmw>  
DE: <http://www.weather.gov/climate/index.php?wfo=phi>  
MARFC: [http://www.weather.gov/marfc/Precipitation\\_Departures](http://www.weather.gov/marfc/Precipitation_Departures)

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## Groundwater

The USGS monitors groundwater levels in unconfined aquifers, providing observations that can be compared to both short-term and long-term changes in climatic conditions. The groundwater wells used for the monthly water summary were selected based on the following criteria:

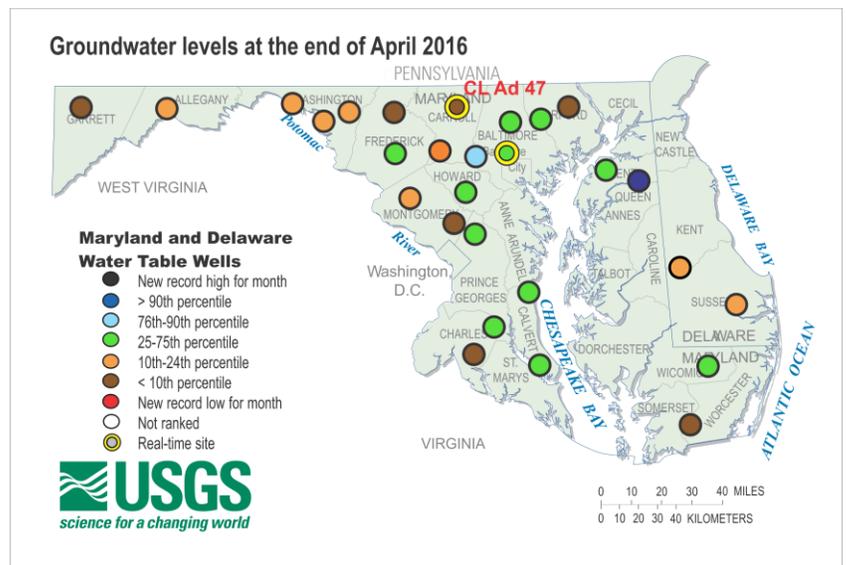
- Located in an unconfined (water-table) aquifer;
- Open to a single, known hydrogeologic unit/aquifer;
- Groundwater hydrograph reflects changes in climatic conditions;
- No indicated nearby pumpage and likely to remain uninfluenced by pumpage, regulated streamflow, or changes related to human activities;
- Minimum period of record is 10 years of continuous/monthly records;
- Minimally affected by irrigation, canals, drains, pipelines, and other potential sources of artificial recharge;
- Well has a casing – dug wells are generally not used;
- Water levels show no apparent hydrologic connection to nearby streams;
- Well has never gone dry; and
- Long-term accessibility likely.

## April 2016 Groundwater Levels

For the second consecutive month, groundwater levels ranged from the lowest 10<sup>th</sup> percentile to the highest 90<sup>th</sup> percentile in USGS wells used to monitor climatic conditions in Maryland and Delaware in April. Thirty-nine percent (11 of 28 wells) of the groundwater levels were normal (25<sup>th</sup>-75<sup>th</sup> percentiles; green on map) in April in Maryland and Delaware.

Groundwater levels were above normal at two USGS observation wells. An observation well in Baltimore County, Maryland was in the 76<sup>th</sup>-90<sup>th</sup> percentiles (cyan on map) and the well in Queen Anne's County was above the 90<sup>th</sup> percentile (blue on map) for the third consecutive month.

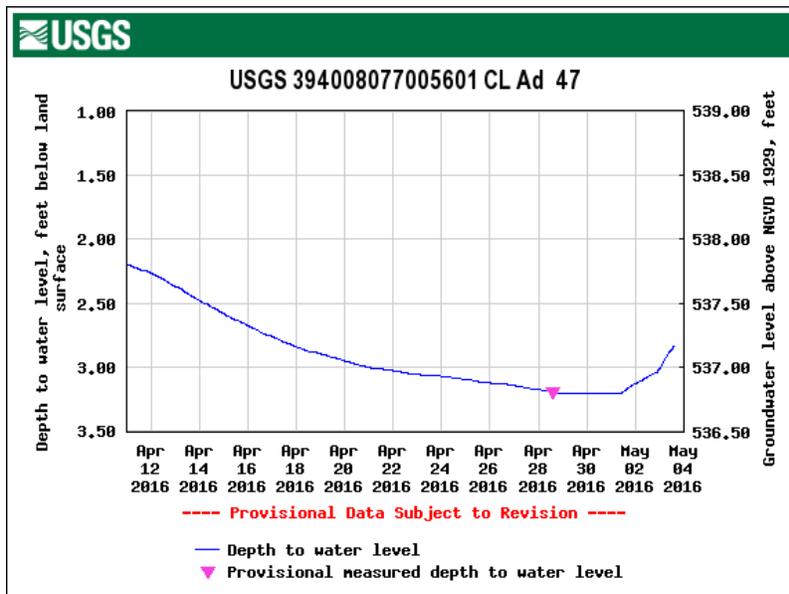
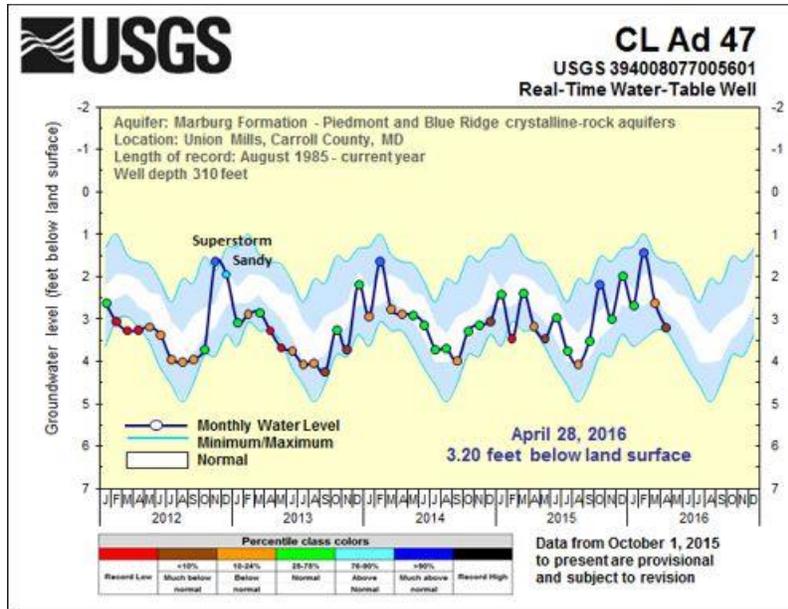
There were 15 USGS observation wells with groundwater levels below normal. Eight USGS observation wells had groundwater levels between the 10<sup>th</sup> and 24<sup>th</sup> percentiles (orange on map) and seven wells had groundwater levels below the 10<sup>th</sup> percentile (brown on map), several of which were near record April lows. These data are provisional and subject to revision.



To access the clickable groundwater map, go to:  
[http://md.water.usgs.gov/groundwater/web\\_wells/current/water\\_table/counties/](http://md.water.usgs.gov/groundwater/web_wells/current/water_table/counties/)

## U.S. Geological Survey (USGS) Maryland-Delaware-District of Columbia Monthly Water Conditions Summary

The groundwater level in USGS observation well CL Ad 47 in Carroll County, Maryland has dropped continuously since February and especially in April, where the final April value ranked in the less than 10<sup>th</sup> percentile, near a record April low. Rainfall at the beginning of May caused the groundwater level to rise, as can be seen in the continuous water-level graph below.



Five-year groundwater hydrographs can be viewed at:  
[http://md.water.usgs.gov/groundwater/web\\_wells/current/water\\_table/counties](http://md.water.usgs.gov/groundwater/web_wells/current/water_table/counties)

The 5-year hydrograph shows groundwater levels as a dark blue line, the minimum and maximum monthly values, and the normal range (between the 25<sup>th</sup> and 75<sup>th</sup> percentiles) as a white band based on the period of record. The maximum water level is at the top of the upper blue section and the minimum water level is at the bottom of the lower blue section in the graph. Each monthly measurement is colored according to the percentile rank in which it falls for the month.

# U.S. Geological Survey (USGS) Maryland-Delaware-District of Columbia Monthly Water Conditions Summary

## Streamflow

Streamflow data are used for many purposes. A few of the most common uses are to assess water supply and the risk of droughts and floods. Streamflow data are also used to calculate loads of chemical constituents and assess how biological communities are affected by hydrologic conditions. The USGS operates the most extensive network of streamgages in the region.

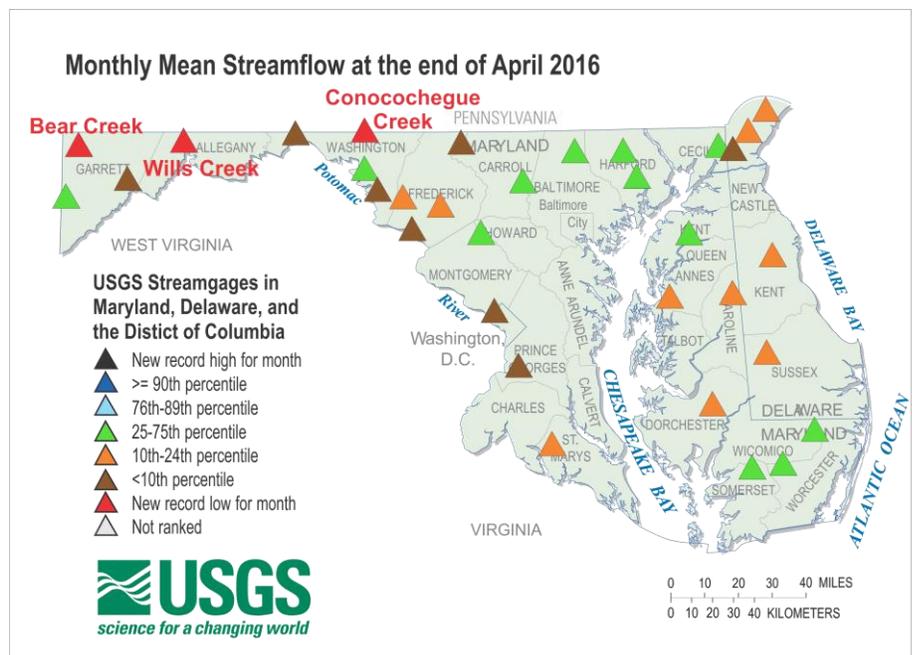
The streamflow locations chosen for the monthly water summary were selected based on the following criteria:

- Minimum period of record is 10 years of continuous data;
- Watershed areas greater than 5 square miles;
- Streamflow is not regulated, or has relatively natural flow;
- Streamflow data reflect climatic conditions; and
- The surrounding area and watershed are not urban.

## April 2016 Streamflow

At streamgages used to monitor climatic response in Maryland, Delaware, and the District of Columbia, monthly mean streamflow was at monthly April record lows at three sites, shown as red triangles on the map: Bear Creek, Conococheague Creek, and Wills Creek, all in western Maryland. Overall, monthly mean streamflow was below normal (orange, brown or red on map) at 64 percent (21 of 33) of the streamgages, and normal (25<sup>th</sup>-75<sup>th</sup> percentiles, green on map) at 36 percent (or 12) of the remaining streamgages.

There were 10 USGS streamgages in the 10<sup>th</sup>-24<sup>th</sup> percentiles (orange on map) and 8 USGS streamgages with monthly mean streamflow below the 10<sup>th</sup> percentile (brown on map), several of which were near record April lows.

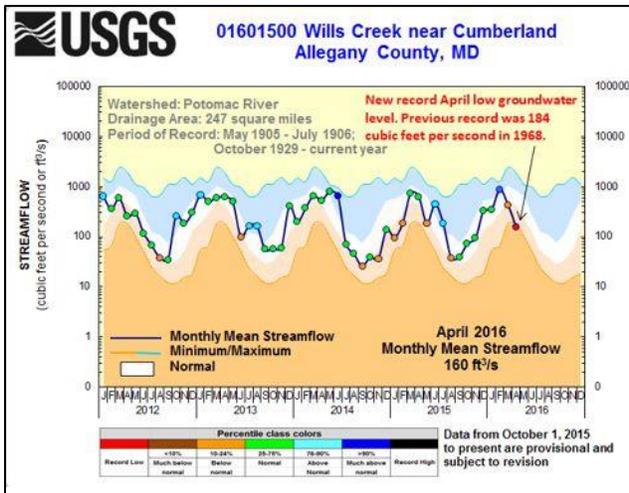
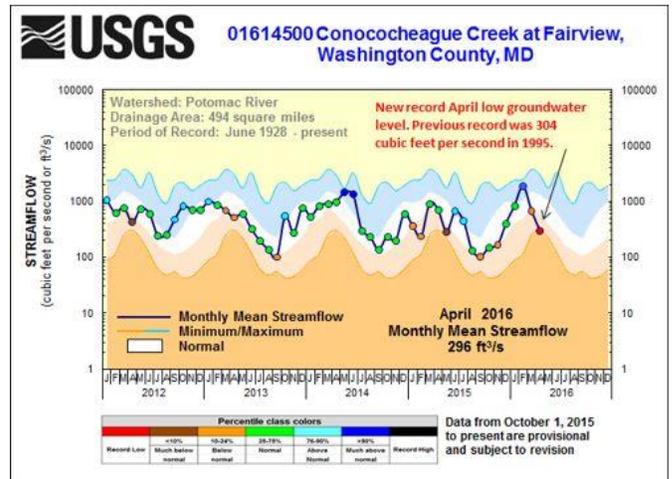
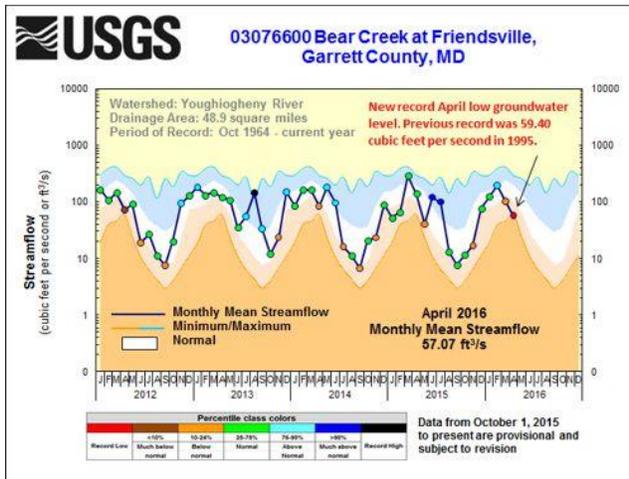


To access the clickable streamflow map, go to:  
<http://md.water.usgs.gov/surfacewater/streamflow/>

# U.S. Geological Survey (USGS) Maryland-Delaware-District of Columbia Monthly Water Conditions Summary

Monthly mean streamflow dropped from below normal (10<sup>th</sup>-24<sup>th</sup> percentiles) in March to record lows in April at the Bear Creek, Conococheague Creek, and Wills Creek streamgages. The average peak monthly mean streamflow (shown as the white band) at these three streamgages normally occurs around May, then decreases in discharge from May to October when evapotranspiration increases (air temperatures warm and actively growing plants take up water). However in 2016, the monthly mean streamflow data peak was 1-2 months earlier, occurring in February or March.

This year, the monthly mean streamflow decreased at a quicker rate since the peak in February than the historical normal trend. See the slope of the white band compared to where the current data plots. This could be due to the below normal rainfall in April, which led to reduced runoff to streams.



Most notable of the three records lows is the one set on Wills Creek near Cumberland, Maryland. Continuous data collection began at this streamgage in 1929, meaning this month's value was the lowest April monthly mean streamflow in 87 years. Additionally, the new April record low (160 cubic feet per second) monthly mean streamflow broke the 48-year-old record of 184 cubic feet per second set during the drought in 1968.

Five-year hydrographs can be viewed at:  
<http://md.water.usgs.gov/surfacewater/streamflow/>

The dark line in the 5-year hydrograph represents the monthly mean streamflow for this period and the white band shows the normal range (25<sup>th</sup>-75<sup>th</sup> percentiles) based on the period of record. The maximum monthly mean streamflow is at the top of the blue shaded section, and the lowest monthly mean streamflow is at the top of the dark orange area. Each monthly mean measurement is colored according to the percentile rank in which it falls for the month.

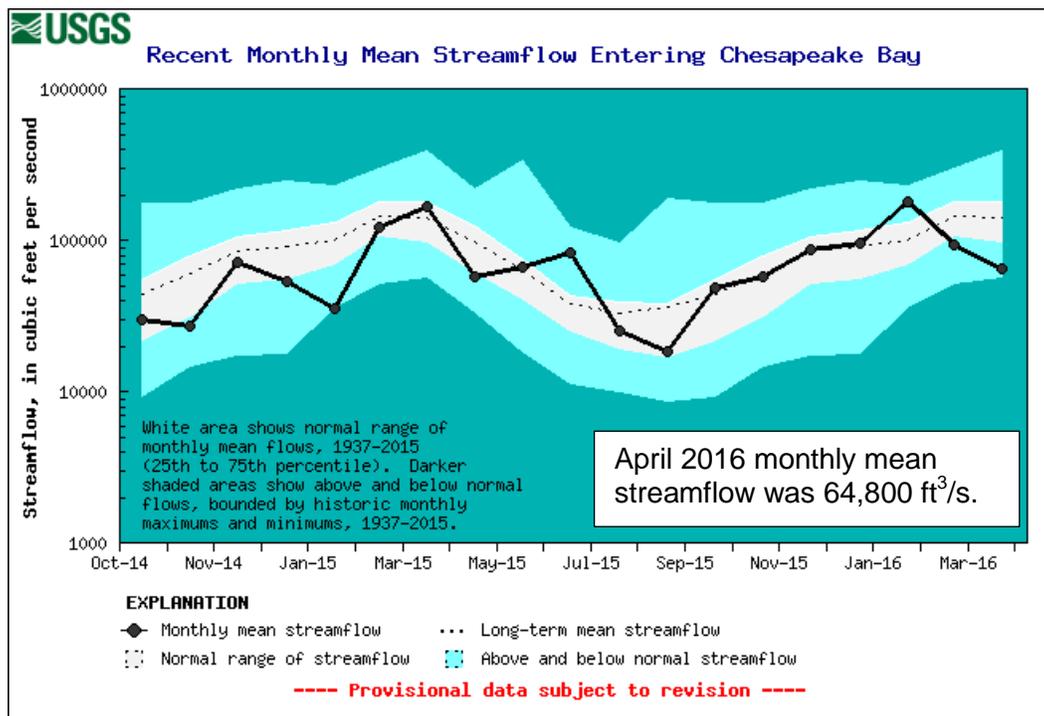
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Monthly Water Conditions Summary**

**Estimated Streamflow to the Chesapeake Bay**

The USGS estimates monthly mean freshwater streamflow to the Chesapeake Bay using streamflow measurements from the Susquehanna, Potomac, and James Rivers. In April 2016, the monthly mean freshwater flow to the Chesapeake Bay was 64,800 cubic feet per second (ft<sup>3</sup>/s; provisional, and subject to revision), which is below normal and the fourth lowest April value since record keeping began in 1937. This value is less than the April 1968 value. The long-term April average (mean) is 143,000 ft<sup>3</sup>/s, and the normal range is between 95,700 ft<sup>3</sup>/s and 179,000 ft<sup>3</sup>/s, the 25<sup>th</sup> and 75<sup>th</sup> percentiles of all April values. These provisional statistics are based on a 79-year period of record.

Rank	Date	Total Freshwater Flow to Chesapeake Bay In cubic feet per second
1	04-2012	56,200
2	04-1995	59,000
3	04-1946	59,500
4	04-2016	64,800
5	04-1968	66,800

Runoff in the Chesapeake Bay watershed carries pollutants, such as nutrients and sediment, to rivers and streams that drain to the Bay. The amount of water flowing into the Chesapeake Bay from its tributaries has a direct impact on how much pollution is in the estuary and it also affects the salinity levels that are important for fish, crabs, and oysters. Generally, as river flow increases, it brings more nutrient and sediment pollution to the Bay.



More information on the freshwater flow to the Bay can be found here:  
<http://md.water.usgs.gov/waterdata/chesinflow/>

## U.S. Geological Survey (USGS) Maryland-Delaware-District of Columbia Monthly Water Conditions Summary

### Reservoir Levels

Available reservoir storage at the end of April 2016 in the Baltimore reservoirs (Loch Raven, Liberty, and Prettyboy) was 100.00 percent of available storage capacity, or a total of 75.85 billion gallons of water. The Baltimore City Environmental Services Division manages the Baltimore reservoirs.

Total normal storage in the Triadelphia and Duckett Reservoirs, which serve parts of Howard, Montgomery, and Prince George’s Counties in suburban Maryland around the District of Columbia, was 98.79 percent of normal storage capacity at the end of April 2016 with 10.49 billion gallons of water.

Not all of the water in the Patuxent Reservoirs is usable; for operational purposes, percent of normal storage capacity is used, but this value can exceed 100 percent of the usable storage. In the graph below, 100 percent is the maximum. The Washington Suburban Sanitary Commission (WSSC) manages the Patuxent reservoirs.

April 2016	Percent available/normal storage	Volume (billion gallons)
<b>Baltimore Reservoirs</b> Baltimore City – Environmental Services Division		
Liberty	100.00%	36.80
Loch Raven	100.00%	21.20
Prettyboy	100.00%	17.85
<b>Total</b>	<b>100.00%</b>	<b>75.85</b>
<b>Patuxent Reservoirs</b> Washington Suburban Sanitary Commission (WSSC)		
Triadelphia	99.80%	5.59
Duckett	97.78%	4.90
<b>Total</b>	<b>98.79%</b>	<b>10.49</b>

