

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

September 2011—Record High Rainfall in Maryland Leads to Record High Streamflow and Groundwater Levels

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

USGS water data is 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 in wells 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 collects water data and quality-assures the data by employing standardized techniques across the country. The uniformity of the dataset allows for multi-state comparisons and other comparative statistical analyses that better inform policy makers of the possible water resource conditions they might encounter in the future.

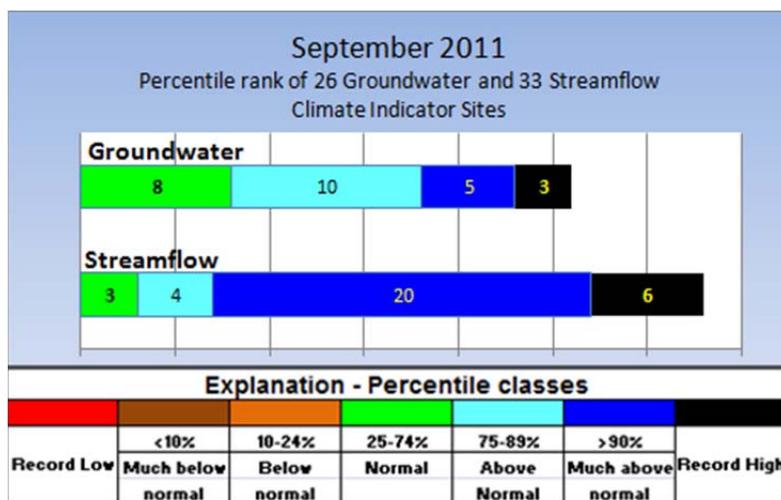
The sites used in this water summary were carefully selected to show the response of streamflow and groundwater levels to precipitation. Ideally, these sites will show no effects from human influences. The streamflow and groundwater data are ranked in comparison to the historical record and summarized.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

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By the beginning of September, Hurricane Irene (August 27 and 28) had dropped heavy rain over large parts of Maryland, Delaware, and the District of Columbia. Additional rainfall from Tropical Storm Lee and several more days of rain in September led to the wettest 2-month period (August and September) on record in Baltimore. September 2011 was the wettest September on record in Baltimore, and the fifth wettest in the District of Columbia. The record-setting rainfall led to record high groundwater levels and streamflows, as well as the highest September streamflow to the Chesapeake Bay.

Streamflow and groundwater levels were normal to above normal throughout Maryland, Delaware, and the District of Columbia. Six streams reached record high flows in September. Five streams had been at record high levels in August. Monthly mean streamflow was above normal at 30 of 33 sites in September.

In September, all groundwater levels were normal to above normal in wells monitored by the USGS to assess the response to climatic conditions in Maryland, Delaware, and the District of Columbia region.



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. For example, a groundwater level in the 90th percentile is equal to or greater than 90 percent of the values recorded for that month.

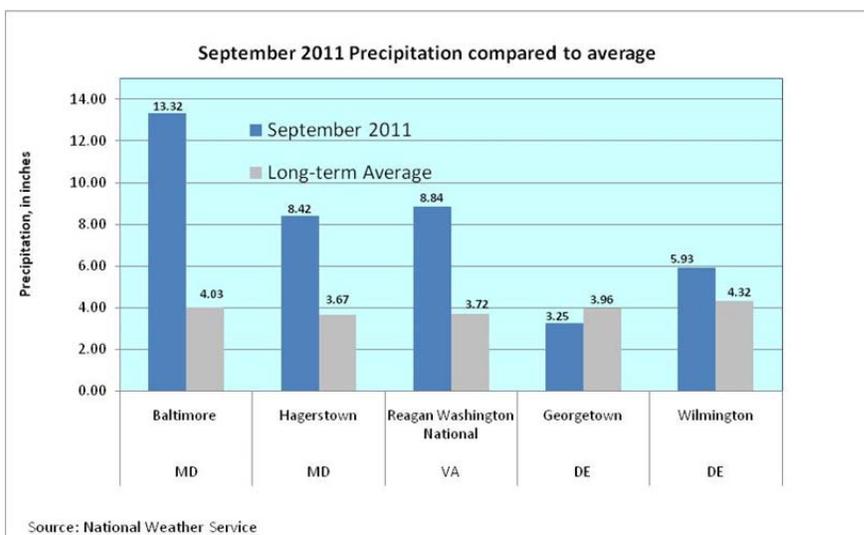
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Precipitation

For the second consecutive month, rainfall was above the long-term average at National Weather Service (NWS) stations in Maryland and the District of Columbia. Rainfall at the weather station in Georgetown, Delaware was below normal in September.

Many records were broken at the Baltimore/Washington International Thurgood Marshall Airport weather stations, according to the National Weather Service's Monthly Weather Summary (<http://www.nws.noaa.gov/climate/index.php?wfo=lwj>) including:

- September 2011 rainfall was 13.32 inches, which was the wettest September in Baltimore, breaking the old September record of 12.41 inches set in 1934.
- Rainfall during September 2011 was the third wettest month on record.
- The combined 2-month rainfall total of 23.70 inches for August and September 2011 makes it the wettest 2-month period on record for Baltimore. The old 2-month rainfall record was 19.04 inches in August--September 1934.
- Measurable rainfall was reported on 16 days in September. Only 1888 and 1889 had a higher number of days in September with measurable rainfall (17 days).



The Middle Atlantic River Forecast Center's 365-day precipitation data show all counties in the Maryland and Delaware region at average levels, except for three counties adjacent to the Chesapeake Bay (Anne Arundel, Cecil, and Kent Counties in Maryland), and New Castle County in Delaware, which were above average.

Note from the National Weather Service: September 2011 was the first month to incorporate the new 1981-2010 climate normals that were calculated by the National Climatic Data Center. The new normals replaced the 1971-2000 normals.

Sources:

National Weather Service

MD and DC: <http://www.weather.gov/climate/index.php?wfo=lwj>

DE: <http://www.erh.noaa.gov/phi/>

Middle Atlantic River Forecast Center (MARFC): <http://www.erh.noaa.gov/marfc/Maps/precip.shtml>

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Streamflow

Streamflow data are used for many purposes. A few of the most obvious 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 to 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:

- At least 10 years of continuous data;
- Watersheds greater than 5 square miles;
- Streamflow is not regulated, or has relatively natural flow;
- Streamflow data reflects climatic conditions; and
- The surrounding area and watershed are not urban.

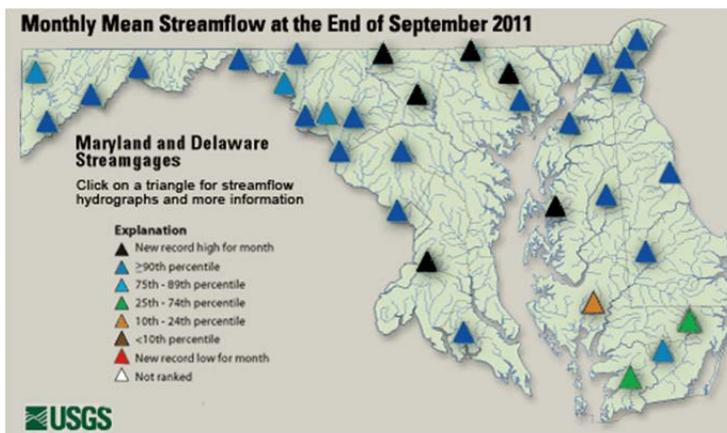
Streamflow for September 2011

Record high rainfall over the past 2 months resulted in six record high monthly mean streamflow levels in September. There were five record highs in August, but only Piscataway Creek set record highs in August and September (see hydrograph on page below). The September monthly mean was also the highest of all time at Piscataway Creek. The table below shows the six sites that set record high monthly mean streamflow levels for September. Four of the previous records were set in 1975, as a result of Hurricane Eloise.

September 2011 Record High Monthly Mean Streamflow-cubic feet per second (ft ³ /s)					
Stream name	September 2011 record high streamflow (ft ³ /s)	Previous September record high streamflow (ft ³ /s)	Year of previous September record high	Normal range of September streamflow (ft ³ /s)	Data collection period
Maryland					
USGS 01492500 Sallie Harris Creek near Carmichael, MD	26.2	17.1	2003	3 - 5	1951-1956, 2000-current year
USGS 01580000 Deer Creek at Rocks, MD	402	345	1975	48 - 104	1926-current year
USGS 01582000 Little Falls at Blue Mount, MD	269	227	1975	26 - 53	1944-current year
USGS 01586210 Beaver Run near Finksburg, MD	37.7	26.9	2003	6 - 13	1982-current year
USGS 01639000 Monocacy River at Bridgeport, MD	1150	1030	1975	11 - 70	1942-current year
USGS 01653600 Piscataway Creek at Piscataway, MD	361	256	1975	5 - 33	1965-current year

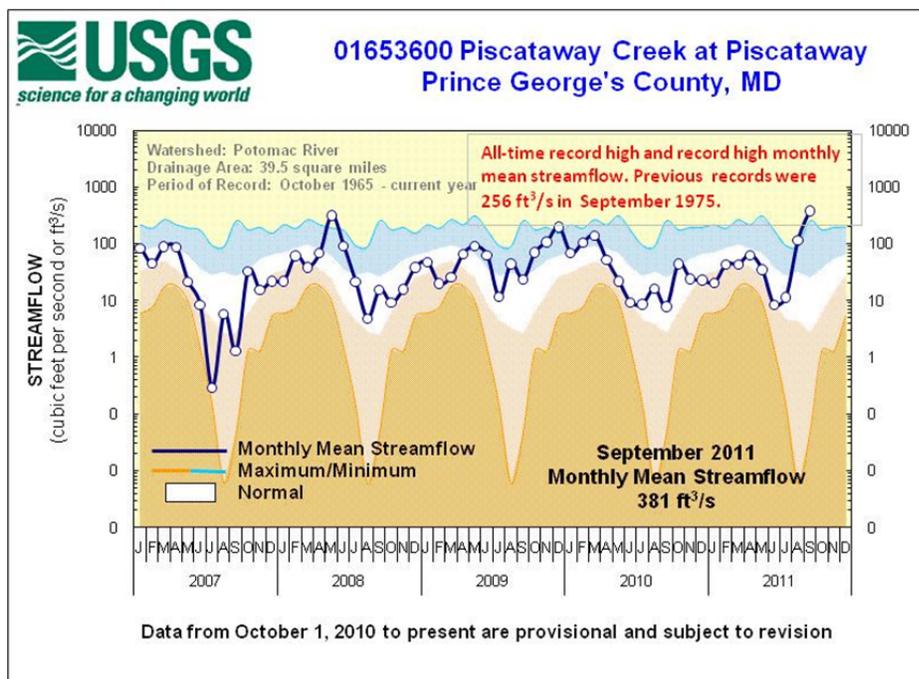
Monthly mean streamflow was above normal in over 90 percent of the monitored streams in Maryland, Delaware, and the District of Columbia. There were three streams in the normal range.

In August and September, the high monthly mean streamflows were mostly at streamgages in central Maryland and the upper Delmarva Peninsula. The weather systems moved in a south to north direction in this region for an extended period, resulting in large amounts of runoff and high streamflows. In many areas, the ground was saturated or close to saturated from the rain from Hurricane Irene and Tropical Storm Lee.



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The September 2011 monthly mean streamflow at Piscataway Creek was the highest monthly mean streamflow since record-keeping began in 1965. For the second consecutive month, the September monthly mean streamflow was at a record high.



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

The dark line in the 5-year hydrograph represents the current monthly mean streamflow and the white band shows the normal range (25th to 74th percentile) 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.

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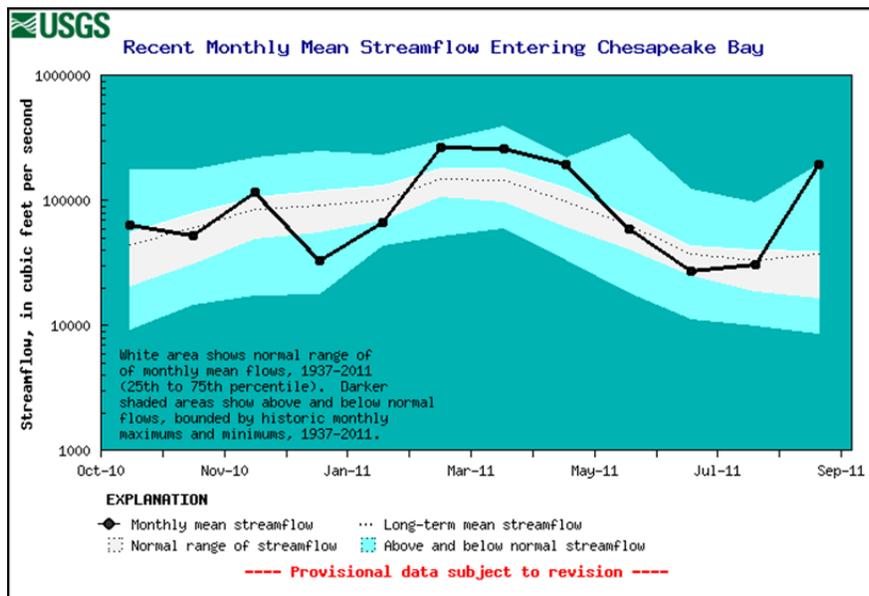
Estimated Streamflow Entering Chesapeake Bay

Estimated streamflow entering the Chesapeake Bay is computed on a monthly and annual basis using a documented statistical relation that uses streamflow measurements from the three largest tributary rivers: the Susquehanna, Potomac, and James Rivers.

The ecological health of the Chesapeake Bay is significantly affected by changes in streamflow and the influx of sediment and nutrients carried into the Bay by the rivers. Scientists can use estimates of streamflow entering the Chesapeake Bay to assess the health of the Bay and anticipate potential changes in ecological conditions.

Based on USGS streamflow data at the three reference streamgages, the estimated monthly mean streamflow entering Chesapeake Bay during September 2011 was 193,000 ft³/s (cubic feet per second), which is the highest September flow and the third highest monthly flow since record-keeping began in 1936. Average (mean) monthly streamflow for September is 37,400 ft³/s, based on 75 years of record. These values are provisional and subject to revision.

The table shows the five highest mean monthly streamflows to the Bay for September. Three of the highest flows over the last 75 years have occurred since 2000.

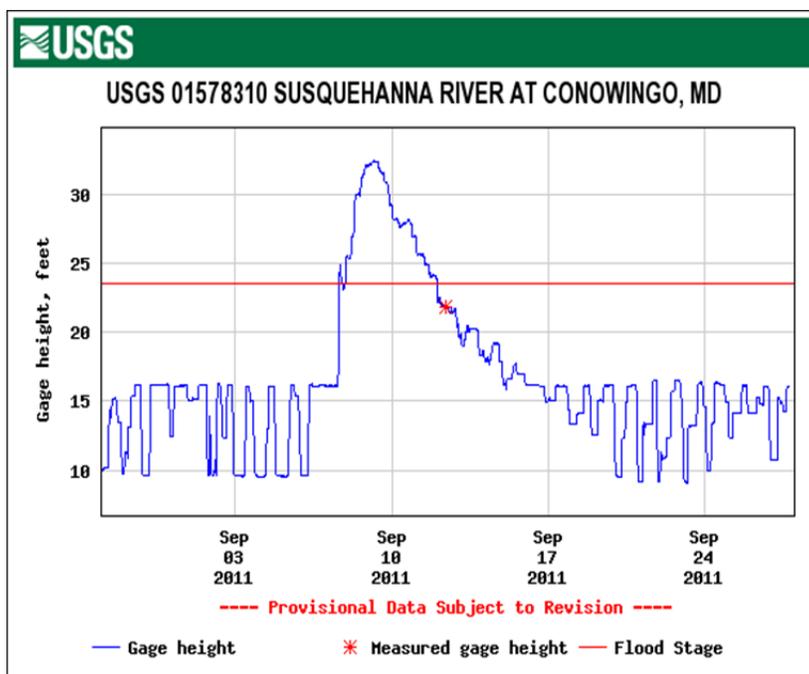
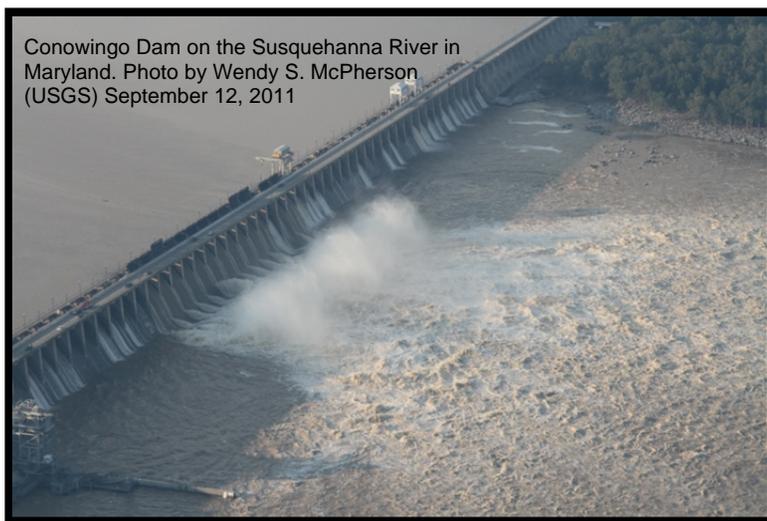


To see this graph and more information on flow to the Chesapeake Bay, visit: <http://md.water.usgs.gov/waterdata/chesinflow/wy/current>

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The USGS measures the flow on the Susquehanna River at the Conowingo Dam in Maryland, near where the river enters the Chesapeake Bay. More than half of the 53 floodgates were opened on September 9 to accommodate the high flows on the Susquehanna River. The town of Port Deposit downstream of the Conowingo Dam was flooded as a result of these high flows.

The all-time largest mean monthly freshwater flow was 389,000 ft³/s in April 1993, followed by 342,000 ft³/s in June 1972 (Hurricane Agnes). The highest mean mean September flow was 193,000 ft³/s in 2011.



On September 9, 2011, the gage height at the Susquehanna River at Conowingo, Maryland reached 32.41 feet. During Hurricane Agnes, the gage height was 36.83 feet (record highest) and in January 1996, the gage height was 34.18 feet (second record highest)..

For more information on freshwater flow to the Chesapeake Bay, go to:

<http://md.water.usgs.gov/waterdata/chesinflow/>

For information on USGS programs in the Chesapeake Bay, visit: <http://chesapeake.usgs.gov/>

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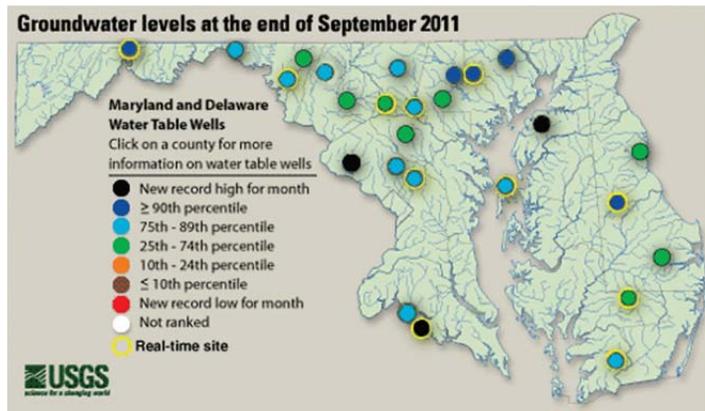
Groundwater

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. Twenty-six groundwater wells were selected based on the following criteria:

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

September 2011 Groundwater Levels

The record-setting rainfall also affected groundwater levels, and water levels in three wells in central Maryland set record highs in September. These were observation wells in Charles, Kent, and Montgomery Counties (black circles on map). Groundwater levels were in the highest 10th percentile in another five wells. Overall, groundwater levels in 18 of the 26 wells used by the USGS to assess climatic conditions in the region were above normal. There were no water levels below normal in September.

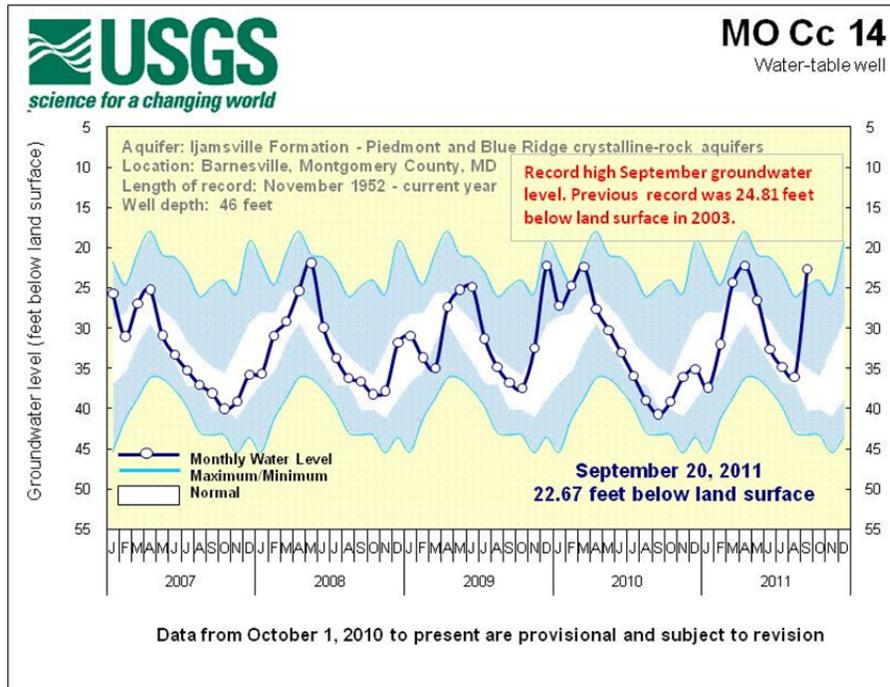


To access the clickable groundwater map, go to:
http://md.water.usgs.gov/groundwater/web_wells/current/water_table/counties/index.html

September 2011 Record High Groundwater Levels, in feet below land surface						
Well name	County	September 2011 record high	Previous September record high	Year of previous September record high	Normal range	Data collection period
Maryland						
CH Bg 12	Charles	2.69	3.41	2006	7.03 - 9.18	1983-current year
KE Bc 185	Kent	7.63	9.69	2003	12.85 - 15.29	1991-current year
MO Cc 14	Montgomery	22.67	24.81	2003	34.90 - 40.25	1952-current year

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The groundwater level in the observation well in Montgomery County, Maryland (MO Cc 14) reached a record high September level, surpassing the record of 24.81 feet set in 2003. Tropical Storm Isabel hit the East Coast in September 2003.



Five-year groundwater hydrographs can be viewed at:

http://md.water.usgs.gov/groundwater/web_wells/current/water_table/counties

The 5-year hydrograph shows groundwater levels as a dark line, the maximum and minimum monthly values, and the normal range (between the 25th and 74th percentiles) as a white band based on the period of record. The maximum water level is at the top of the blue section and the minimum water level is at the bottom of the blue section in the graph.

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Reservoir Levels

All regional reservoirs were near full as of September 2011. Storage in the Baltimore reservoirs (Loch Raven, Liberty, and Prettyboy) rose to 100 percent of available storage capacity, or 75.48 billion gallons.

Storage in the Triadelphia and Duckett Reservoirs, which serve parts of Howard, Montgomery, and Prince George's Counties in suburban areas around the District of Columbia, rose to 100 percent of normal storage capacity, with 10.62 billion gallons at the end of September.

September 2011	Percent available/ normal storage	Volume (billion gallons)	Source
Baltimore Reservoirs			Baltimore City – Environmental Services Division
Liberty	100%	36.80	
Loch Raven	100%	21.20	
Prettyboy	98%	17.48	
Total	100%	75.48	
Patuxent Reservoirs			Washington Suburban Sanitary Commission (WSSC)
Triadelphia	100%	5.61	Increased 16 percent since August 2011
Duckett	100%	5.01	Increased 23 percent since August 2011
Total	100%	10.62	