

August 2011—Hurricane Irene Impacts Streamflow and Groundwater Levels

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

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 and predict how water resources respond to changes in climate. Scientists at the USGS have measured water in streams and groundwater levels in wells to assess water resources for over 125 years.

In addition to providing the most extensive dataset 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.

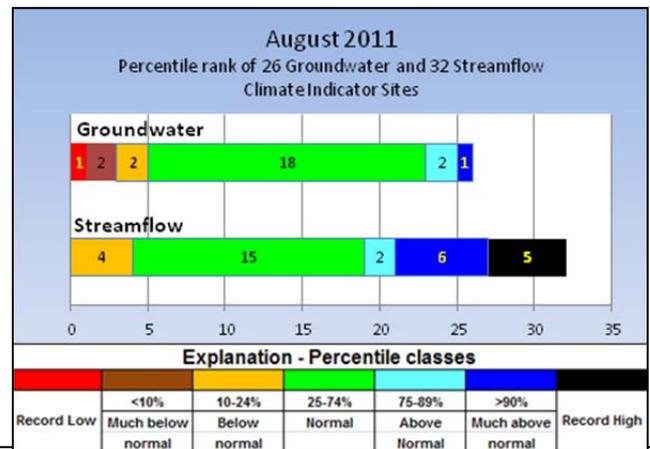
The sites used in this water summary were carefully selected to show the response of streamflow and groundwater levels to precipitation. Ideally, these sites will show no effects from human influences. The streamflow and groundwater data are ranked in comparison to the historical record and summarized.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

USGS August 2011 Water Conditions Summary

More than 10 inches of rain associated with Hurricane Irene fell in the Baltimore, Maryland region at the end of August. Over 14 inches of rain fell in the eastern part of the State on the Eastern Shore and Delmarva Peninsula. The rainfall deficit that the southern Delmarva region had been experiencing since last May no longer exists.

Streamflow and groundwater levels rose in central and eastern Maryland, Delaware, and the District of Columbia. Five streams reached record high flows for August. Preliminary data show three rivers set record peaks. Monthly mean streamflow was normal at 15 of the 32 sites in August and below normal at 4 sites in western Maryland.

Groundwater levels were normal in more than half of the wells monitored by the USGS to assess the response to climatic conditions in Maryland, Delaware, and the District of Columbia region. The groundwater level in a well in Frederick County, Maryland was at a record low for the third consecutive month. Groundwater was below normal in another 4 wells, and above normal in 3 wells.

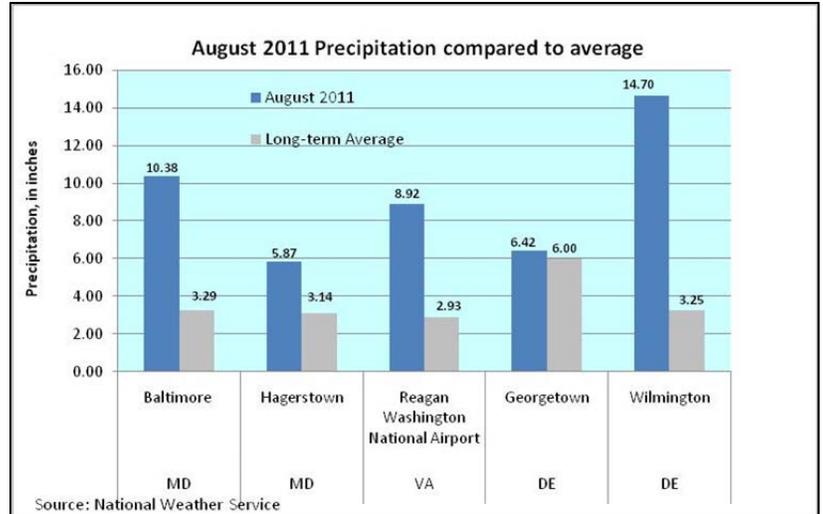


A **percentile** is a value on a scale from 0 to 100 that indicates the percent of a distribution that is equal to or below it. For example, a groundwater level in the 90th percentile is equal to or greater than 90 percent of the values recorded for that month.

Precipitation

After 4 months of below average precipitation, abundant rain associated with Hurricane Irene resulted in precipitation above the long-term average at all five National Weather Service (NWS) stations in Maryland, Delaware, and the District of Columbia. The NWS station in Wilmington, Delaware reported 14.70 inches of rain in August. The long-term average is 3.25 inches.

Areas west of the Hagerstown, Maryland weather station were less affected by Hurricane Irene. However, central and eastern Maryland, northern Delaware, and the District of Columbia had 2-3 times the normal monthly rainfall.



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 six counties adjacent to the Chesapeake Bay, which were above average.

Note from the National Weather Service: August 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=lwx>

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

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

Streamflow

Streamflow data are used to assess water supply and the risk of droughts and floods. The USGS operates the most extensive network of stream-gaging stations in the region. The data provided by this network are used for monitoring water quantity, and to interpret water-quality data.

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

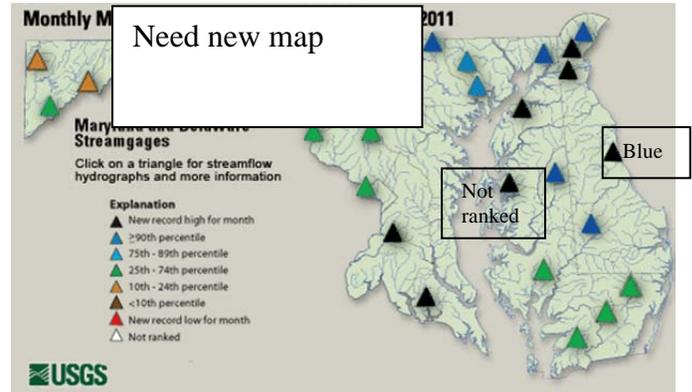
- At least 10 years of continuous data;
- Watersheds greater than 5 square miles;
- Streamflow is not regulated, or has relatively natural flow;
- Streamflow data reflects climatic conditions; and
- The surrounding area and watershed are not urban.

Streamflow for August 2011

After 3 months of record-setting low levels, streamflow on the Nassawango Creek in Worcester County, Maryland rose to normal in August. Streamflow had been below normal on the Nassawango Creek for a year, or since last summer. Half of the streams in the remaining parts of Maryland, Delaware, and the District of Columbia had streamflow levels in the normal range. Four streams in western Maryland were below normal and 41% of streams in Maryland, Delaware, and the District of Columbia were above normal in August.

Most of the runoff that made the streams rise to record-high levels occurred during the last few days of the month when Hurricane Irene moved up the East coast.

The table below shows the five sites that set record high monthly mean streamflow levels for August.



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

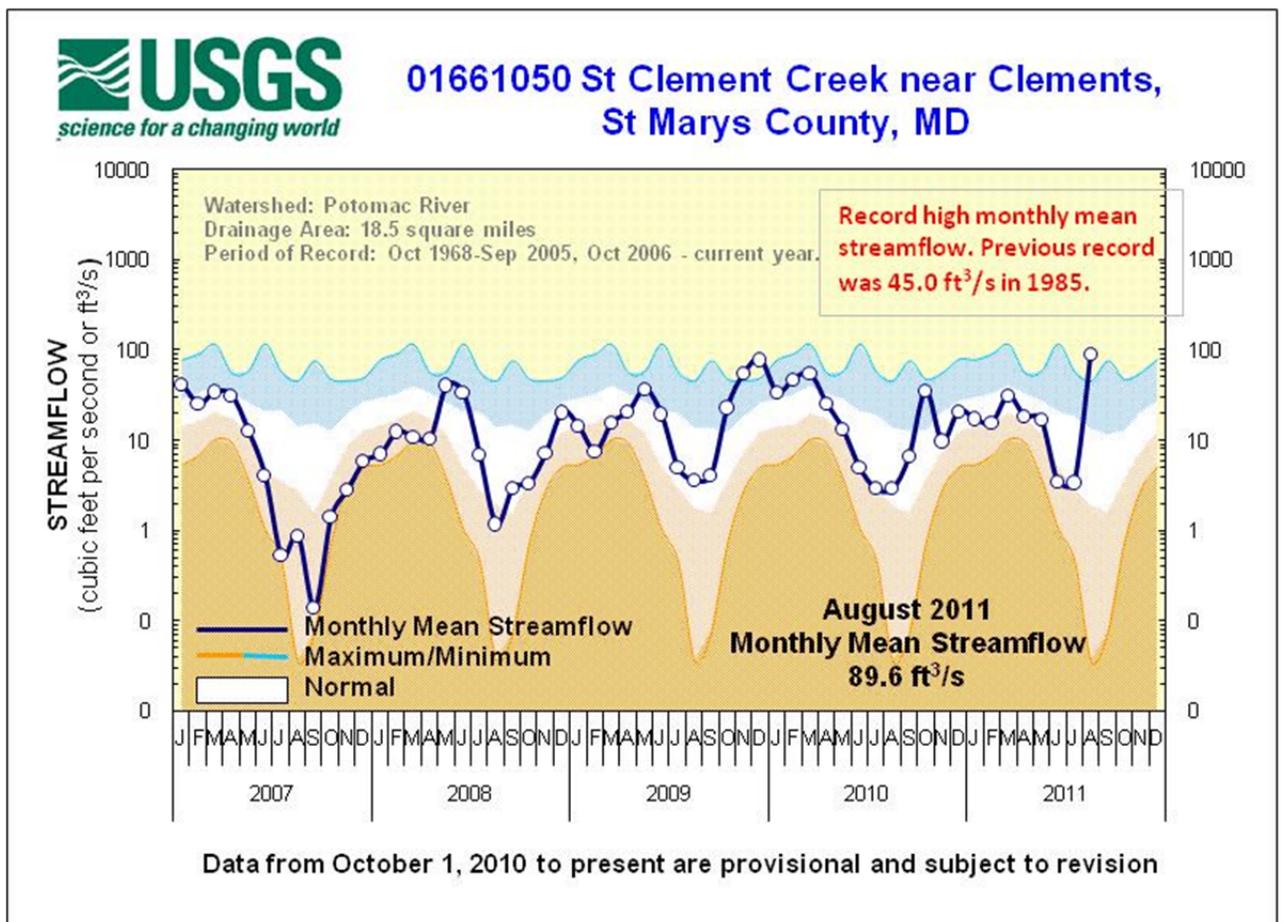
| August 2011 Record High Monthly Mean Streamflow-cubic feet per second (ft ³ /s) | | | | | |
|--|---|---|---|--|----------------------------|
| Stream name | August 2011 record high streamflow (ft ³ /s) | Year of previous August high streamflow | Previous August record high streamflow (ft ³ /s) | Normal range of August streamflow (ft ³ /s) | Year data collection began |
| Delaware | | | | | |
| Christina River at Coochs Bridge, DE | 150 | 1967 | 117 | 7-17 | 1943 |
| White Clay Creak near Newark, DE | 435 | 1967 | 301 | 42-97 | 1931 |
| Maryland | | | | | |
| Morgan Creek near Kennedyville, MD | 67 | 1971 | 28 | 4-10 | 1951 |
| Piscataway Creek at Piscataway, MD | 114 | 1971 | 89 | 5-33 | 1965 |
| St Clement Creek near Clements, MD | 90 | 1985 | 45 | 2-14 | 1968 |

Streamflow on St. Clement Creek rose to a record high monthly mean streamflow and set an all-time record high for this rainfall event. In August, the streamflow reached 8,100 ft³/s, which exceeded the record of 4,500 ft³/s set on September 6, 1979. Two additional peaks were set on the Choptank River and St Jones River (see table below).

| Streamflow Peaks of Record-cubic feet per second (ft ³ /s) | | | | | |
|---|--------------------------------------|-----------|-------------------------------------|---|----------------------------|
| Provisional and Subject to Change | | | | | |
| Stream name | Peak streamflow (ft ³ /s) | Date | Number of years of peak flow record | Previous peak streamflow (ft ³ /s) | Year data collection began |
| Delaware | | | | | |
| St Jones River at Dover, DE | 1,900 | 8/28/2011 | 53 | 1,900 | 9/13/1960 |
| Maryland | | | | | |
| Choptank River near Greensboro, MD | 9,000 | 8/28/2011 | 63 | 6,970 | 8/4/1967 |
| St Clement Creek near Clements, MD | 8,100 | 8/28/2011 | 41 | 4,500 | 9/6/1979 |

Additional information is available at this website:

http://water.usgs.gov/osw/floods/2011_HIrene/index.html



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.

Estimated Streamflow Entering Chesapeake Bay

The estimated monthly mean streamflow entering Chesapeake Bay for August 2011 was **31,100 cubic feet per second** (ft³/s). This value, which is provisional and subject to revision, is considered to be in the **normal range**. Normal August streamflow entering the Bay is between 18,700 and 40,900 ft³/s, the 25th and 75th percentiles, respectively, of all August values. Average (mean) monthly streamflow for August is 33,500 ft³/s. These statistics are based on a 74-year period of record.

For more information, go to: <http://md.water.usgs.gov/waterdata/chesinflow/>

Groundwater

The USGS monitors groundwater levels in unconfined aquifers, providing observations that can be compared to climatic conditions. Twenty-six groundwater wells were selected based on the following criteria:

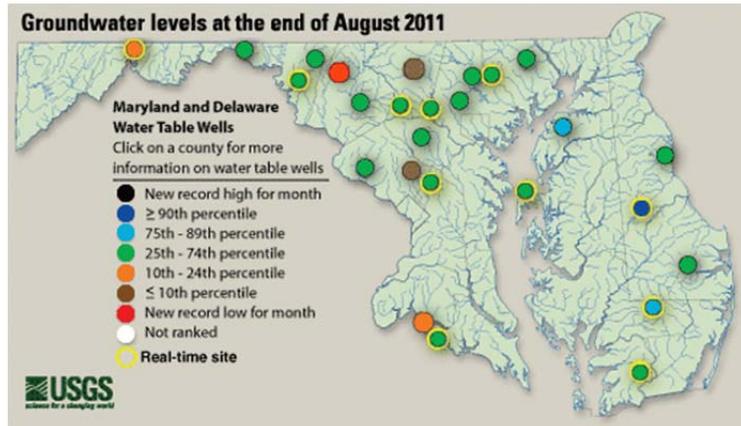
1. Located in an unconfined (water-table) aquifer;
2. Open to a single, known hydrogeologic unit/aquifer;
3. Groundwater hydrograph reflects climatic conditions;
4. No indicated nearby pumpage and likely to remain uninfluenced by pumpage;
5. Minimum period of record is 10 years of continuous/monthly records;
6. Minimally affected by irrigation, canals, 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.

August 2011 Groundwater Levels

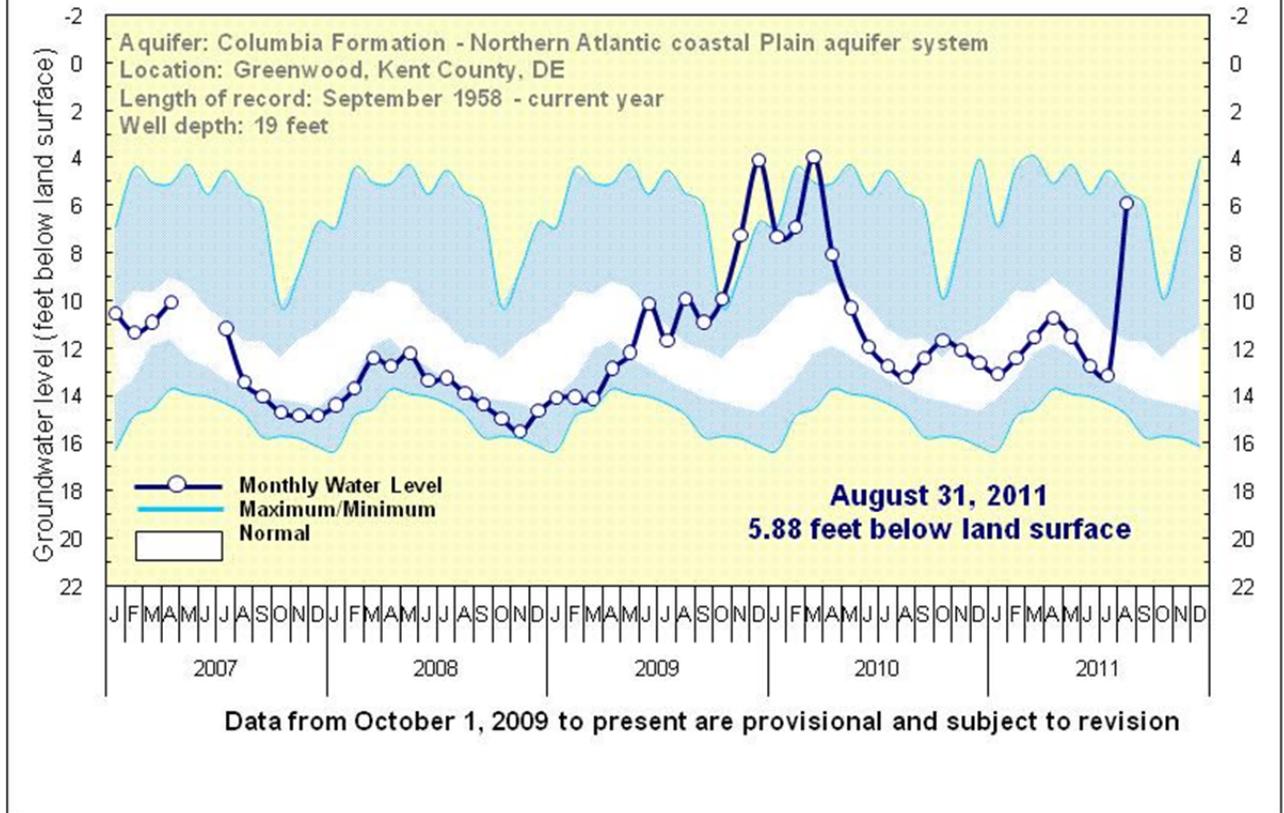
Groundwater levels ranged from a record low to the highest 10th percentile. For the third consecutive month, the groundwater level set a record low in an observation well in Frederick County, Maryland. This part of the State did not receive as much rainfall from Hurricane Irene as the central and eastern part of the state. In contrast, a well in Delaware was in the highest 10th percentile, only 0.41 feet from the record.

Groundwater levels continue to be low in wells in Montgomery and Carroll Counties in Maryland, where they were in the lowest 10th percentile.

Despite the low and high groundwater levels, 18 of the 26 wells used by the USGS to assess climatic conditions in the region were in the normal range.



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



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.

Reservoir Levels

Storage in the Baltimore reservoirs (Loch Raven, Liberty, and Prettyboy) rose to 96 percent of available storage capacity, or 72.27 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, dropped from 96 percent in June 2011 to 76 percent of normal storage capacity, with 8.08 billion gallons at the end of August.

| August 2011 | Percent available/ normal storage | Volume (billion gallons) | Source |
|-----------------------------|--------------------------------------|--------------------------|---|
| Baltimore Reservoirs | | | Baltimore City – Environmental Services Division |
| Liberty | 90% | 33.22 | |
| Loch Raven | 100% | 21.20 | |
| Prettyboy | 100% | 17.85 | |
| Total | 96% | 72.27 | |
| Patuxent Reservoirs | | | Washington Suburban Sanitary Commission (WSSC) |
| Triadelphia | 84% | 4.72 | |
| Duckett | 67% | 3.36 | |
| Total | 76% | 8.08 | |