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Water Monitoring to Support the State of Illinois Governor's Drought Response Task Force – July 11, 2012

The U.S. Geological Survey (USGS) collects streamflow, groundwater levels, and water-quality data for the State of Illinois and the Nation. Much of these data are collected every 15 minutes (real-time) as a part of the national network, so that water-resource managers can make decisions in a timely and reliable manner. Coupled with modeling and other water-resource investigations, the USGS provides data to the State during droughts and other hydrologic events. The types of data, capabilities, and presentation of these materials are described in this document as USGS Real-Time Data, Supplementary Data Collection and Analysis, and National Resources Available.

USGS Real-Time Data

USGS real-time data are commonly collected every 15 minutes, and transmitted hourly. Transmission and data routing time results in data being available on the Web generally within 30 to 90 minutes. Data are quality checked weekly.

Streamflow

Current (real-time) and historical streamflow information are available on the USGS web site for over 230 USGS streamgages in Illinois (figure 1). The daily, monthly, and annual discharge statistics are generally also provided. Figure 2 shows a map of average streamflow and drought severity. Streamflow conditions at three index streamgages (figure 3) are compared to previous significant droughts (1953-54, 1988-89, 2004-05, and current), as well as the normal streamflow over a 30-year period (purple band). The sites selected represent the geographic distribution of climate areas in the state.

http://waterwatch.usgs.gov/

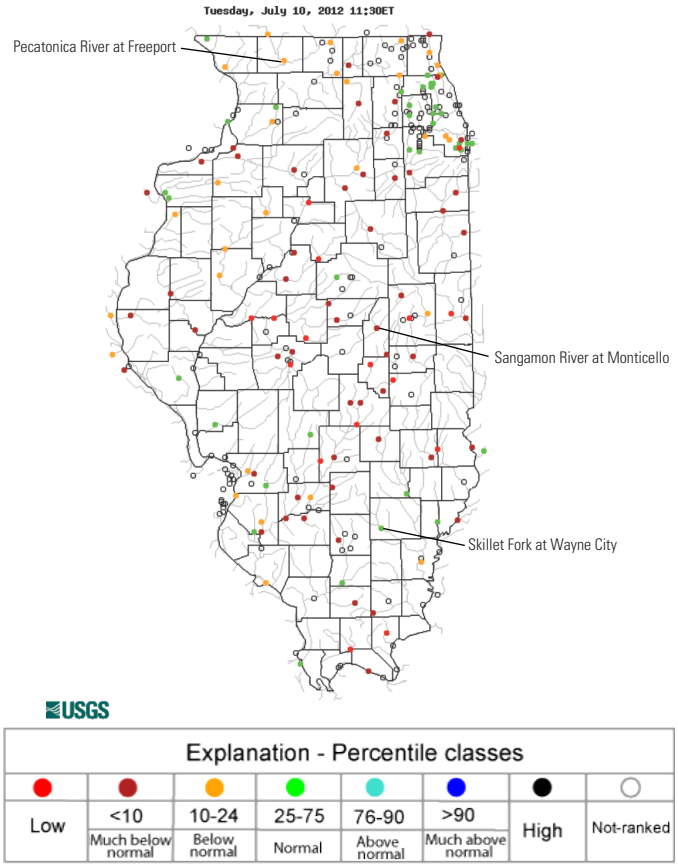


Figure 1. Real-time streamflow data for July 10, 2012.

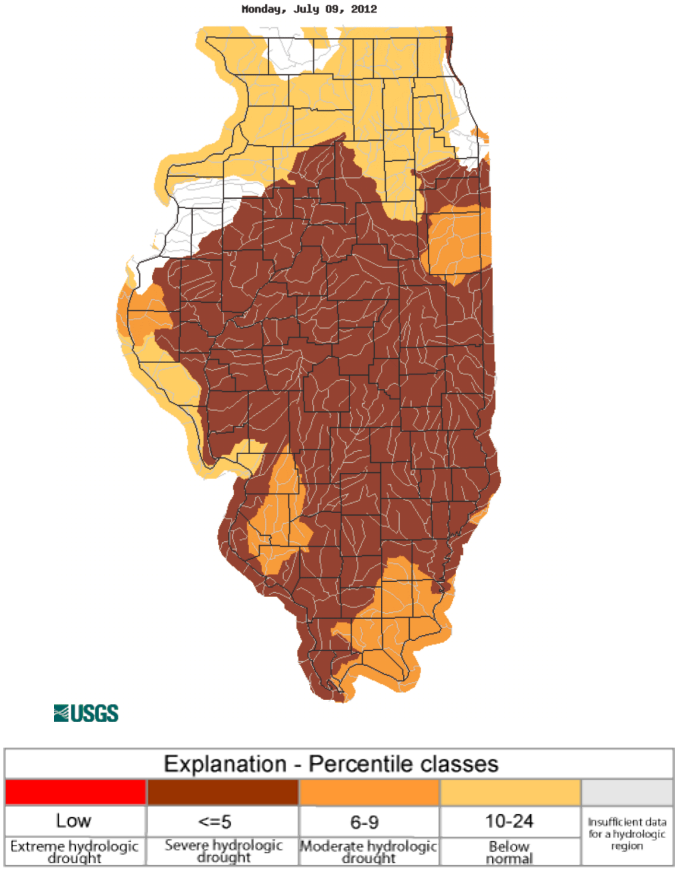


Figure 2. 7-day average streamflow compared to historical streamflow for the day of year for July 9, 2012.

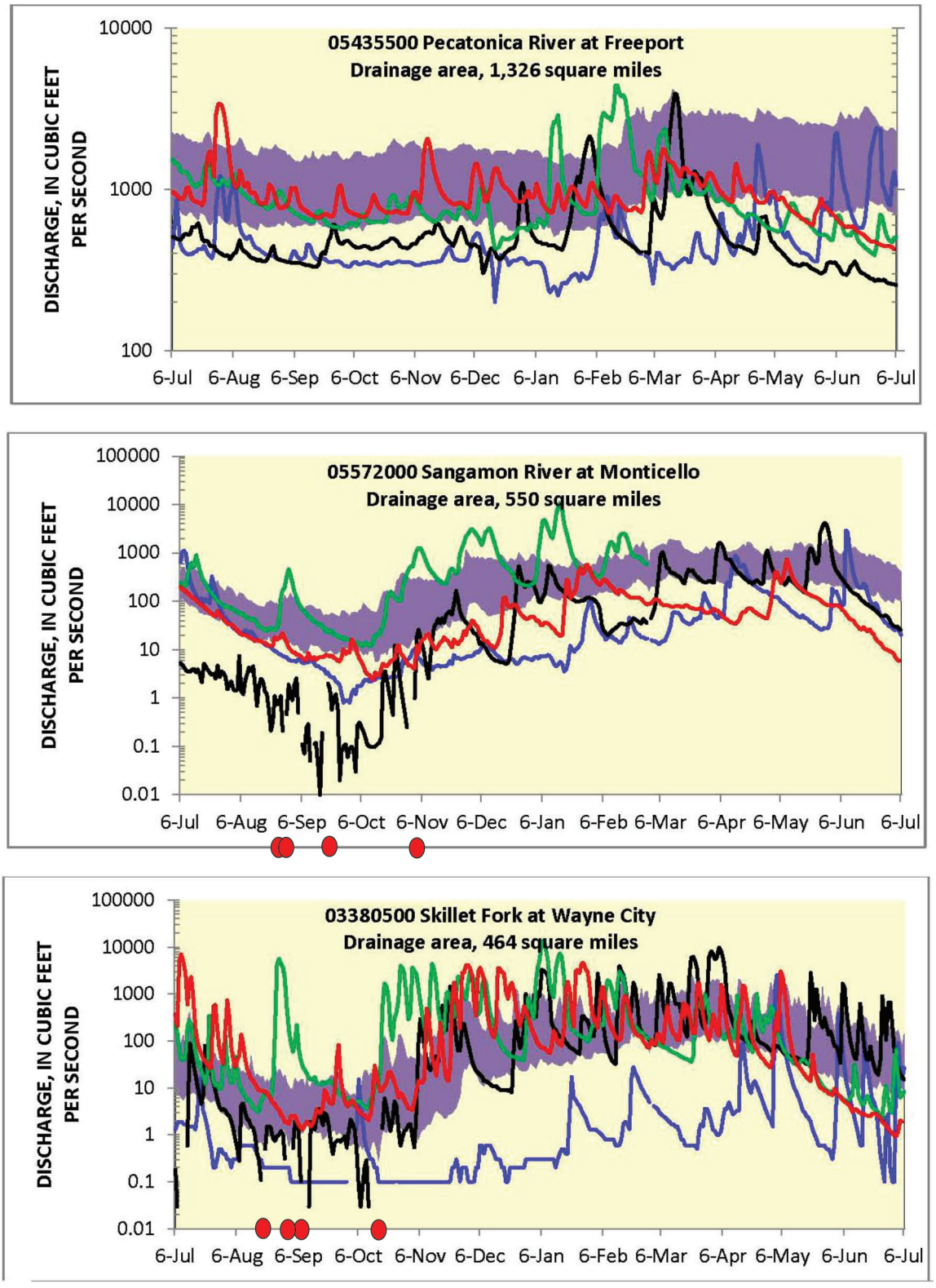


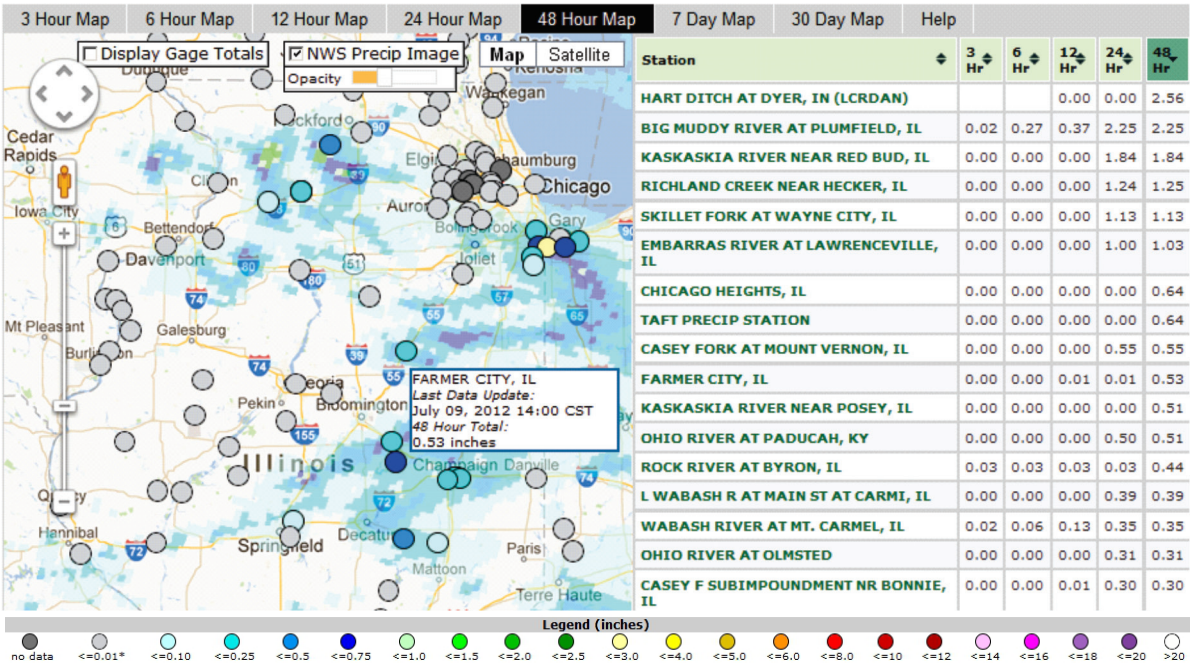
Figure 3. Duration hydrographs of daily average streamflow for 3 index stations in Illinois.

Precipitation

The USGS has developed a web-based tool displaying provisional precipitation data that are collected throughout Illinois. These data are transmitted to the USGS from federal, state, and local agencies at about 130 sites, and are posted as color-coded amounts for selected time periods on a Google Map platform (figure 4).

NEXRAD imagery of precipitation from the National Weather Service can be optionally displayed for comparison with raingage totals. The data can be sorted by precipitation totals, enabling water-resource managers to pinpoint areas that have received short-term rainfall relief from the drought. The USGS, in cooperation with State and local cooperators, also operates, maintains, and publishes precipitation data from a network of 56 precipitation gages.

http://il.water.usgs.gov/gmaps/precip/index.php



Station	3 Hr	6 Hr	12 Hr	24 Hr	48 Hr
HART DITCH AT DYER, IN (LCRDAN)			0.00	0.00	2.56
BIG MUDDY RIVER AT PLUMFIELD, IL	0.02	0.27	0.37	2.25	2.25
KASKASKIA RIVER NEAR RED BUD, IL	0.00	0.00	0.00	1.84	1.84
RICHLAND CREEK NEAR HECKER, IL	0.00	0.00	0.00	1.24	1.25
SKILLET FORK AT WAYNE CITY, IL	0.00	0.00	0.00	1.13	1.13
EMBARRAS RIVER AT LAWRENCEVILLE, IL	0.00	0.00	0.00	1.00	1.03
CHICAGO HEIGHTS, IL	0.00	0.00	0.00	0.00	0.64
TAFT PRECIP STATION	0.00	0.00	0.00	0.00	0.64
CASEY FORK AT MOUNT VERNON, IL	0.00	0.00	0.00	0.55	0.55
FARMER CITY, IL	0.00	0.00	0.01	0.01	0.53
KASKASKIA RIVER NEAR POSEY, IL	0.00	0.00	0.00	0.00	0.51
OHIO RIVER AT PADUCAH, KY	0.00	0.00	0.00	0.50	0.51
ROCK RIVER AT BYRON, IL	0.03	0.03	0.03	0.03	0.44
L WABASH R AT MAIN ST AT CARMI, IL	0.00	0.00	0.00	0.39	0.39
WABASH RIVER AT MT. CARMEL, IL	0.02	0.06	0.13	0.35	0.35
OHIO RIVER AT OLMSTED	0.00	0.00	0.00	0.31	0.31
CASEY F SUBIMPOUNDMENT NR BONNIE, IL	0.00	0.00	0.01	0.30	0.30

Figure 4. Precipitation gage data collected in the 48 hours before July 9, 2012, in Illinois.

Groundwater Levels

The USGS, in cooperation with the Illinois State Water Survey and the Illinois State Geological Survey of the Prairie Research Institute of the University of Illinois, presently monitors real-time groundwater levels in clustered, deep, and shallow wells in Champaign, Lee, Madison, and Tazewell Counties. Levels are also monitored in a single well in Vermilion County (figure 5), and at 27 sites (44 wells) in, and in cooperation with, McHenry County.

National Water Information System at:
http://waterdata.usgs.gov/nwis

Groundwater Watch at:
http://groundwaterwatch.usgs.gov/

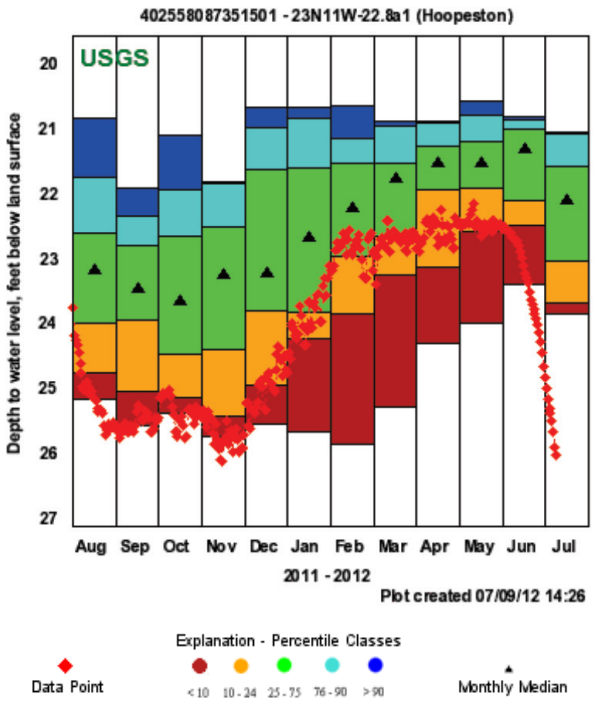


Figure 5. An example of groundwater statistics for a site near Hoopeston in Vermilion County. At sites such as this one, where five or more years of data are available, comparisons to long-term trends are automatically calculated. In this example, water levels from June and July of 2012 are lower than 90% of all water levels measured in the last five years.

Water Quality

The USGS currently operates continuous multi-parameter water-quality instruments at the Illinois River at Florence, IL, and Kickapoo Creek near Bloomington, IL. These instruments measure and record temperature, dissolved oxygen (figure 6), pH, and specific conductance, . The USGS has several additional multi-parameter instruments that can be deployed at select sites. Also, the USGS is operating 6 real-time continuous nitrate sensors throughout the State (figure 7), almost all in cooperation with the Illinois Environmental Protection Agency. Real-time water temperature readings may be of particular interest during drought conditions. The USGS collects water temperature at 10 streamflow sites (figure 7) and 57 groundwater wells.

http://waterwatch.usgs.gov/wqwatch/

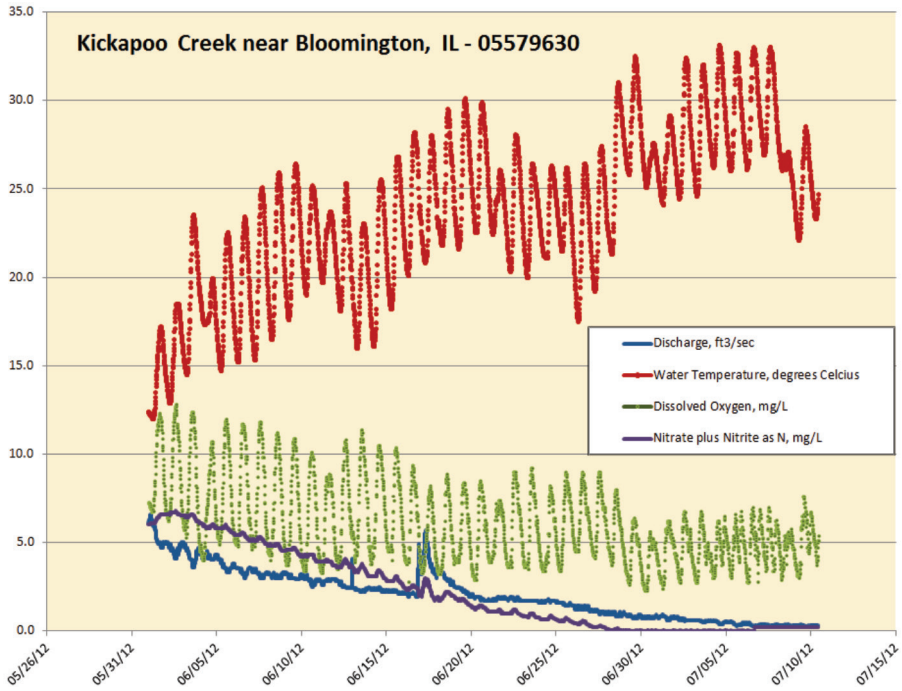


Figure 6. Real-time data recorded by sensors at a Kickapoo Creek site near Bloomington in cooperation with the Illinois Environmental Protection Agency. These data show that flow is decreasing and water temperature is increasing with declines in dissolved oxygen and nitrate observed.

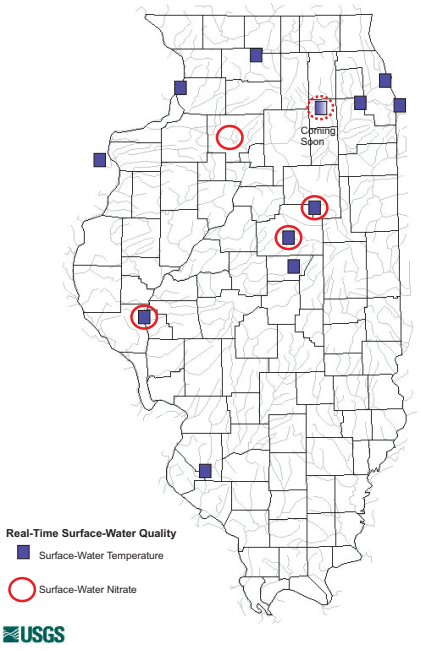


Figure 7. Real-time continuous nitrate and temperature sensors operated by the USGS in Illinois.

Supplementary Data Collection and Analysis

Supplementary data may be necessary to better characterize drought conditions. Listed are some USGS activities that are already ongoing, and others that may be beneficial in the future.

Low-Flow Discharge Measurements

Low streamflows may adversely affect water supply or wastewater discharge operations. To supplement USGS real-time streamflow data currently collected at over 230 streamgages across the State, the USGS collects discrete streamflow information at other stream locations as needed. Potential locations include high areas of concern for water-resource managers and sites for which historic streamflow information is available for comparison. The USGS has already collected over 100 low-flow measurements this year, which are regularly updated on the USGS website at:

http://il.water.usgs.gov/drought/

Seepage Run Measurements

The determination of gaining or losing reaches may be important to water-resource managers whose pumping wells may have an impact on nearby streams. This information is similarly important for those concerned with potential ecological impacts in specific areas. Seepage runs can be conducted within specific river reaches as needed. During seepage runs, several discharge measurements are made within a defined stream or river reach to help identify any gaining or losing reaches.

Groundwater Synoptic Measurements

Periodic to continuous groundwater levels (some of which are transmitted in real time) are monitored routinely in a network of observation wells. The network includes water-table wells that can provide useful information on the impact of present and future drought conditions on shallow groundwater levels, discharge to streams, and future recharge to deep aquifers. If needed, an increased frequency of manual measurements may be collected. A synoptic measurement of all available groundwater wells and access to the logs of levels continuously recorded in wells could be beneficial to water-resource managers, especially when seasonal rainfall is limited and temperatures are extremely high. For the past three months the USGS collected more frequent groundwater levels from a subset of wells in the central portion of the Mahomet Aquifer because of substantial declines. An example from one well is shown in figure 8. Recent groundwater levels are available through the Illinois Active Water Level Network, available at:

http://groundwaterwatch.usgs.gov/StateMaps/IL.html

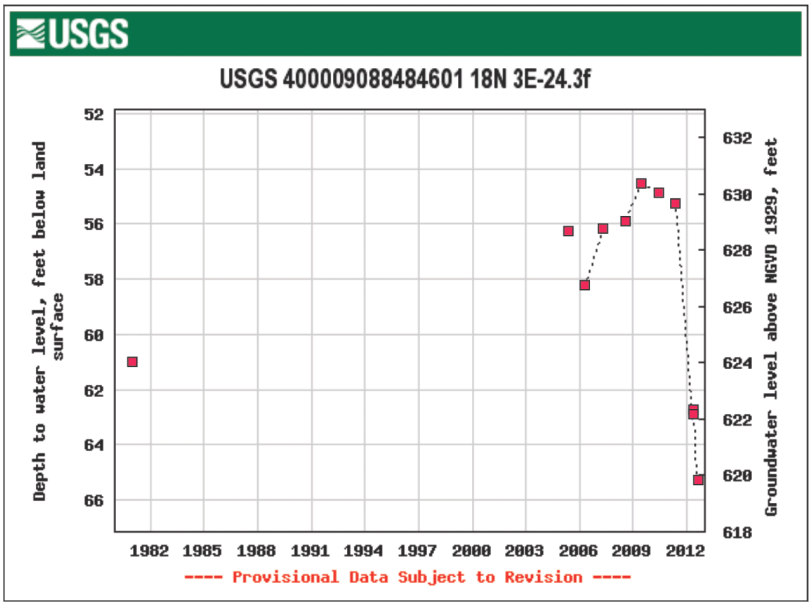


Figure 8. Groundwater level of a well in the Mahomet Aquifer showing substantial decline.

Algae and Blue-Green Algae Monitoring

Hot and dry climatic conditions can promote excessive algal and aquatic plant growth resulting in levels of blue-green algae and cyanobacteria that can adversely affect the health of bathers and recreationalists as well as taste and odor of raw and finished drinking water. Real-time monitoring of in-situ cyanobacteria can provide early warning signs of impending problematic conditions and monitoring of existing growth conditions. The USGS has several instruments that are capable of detecting blue-green algae in-situ that can be coupled with real-time GPS tracking to produce spatial data on blue-green algal communities.

Analytical Tools to Assess Groundwater Withdrawals on Streamflow

The USGS, with several other Michigan agencies, has developed a Water Withdrawal Assessment Tool (WWAT) to estimate the likely impact of a water withdrawal on nearby streams and rivers. As a part of this tool, the USGS has developed an analytical model to calculate streamflow depletion by nearby pumping wells. These types of analysis can be useful for water-resource managers to balance water withdrawals with ecological concerns or public safety.

Low-Flow Statistics

Flow duration and low-flow statistics, such as the 7-day 10-year flow, can be computed and regionalized to extend the value of collected data to ungaged watersheds. This information puts current conditions into long-term context and is useful for planning sustainable surface-water withdrawals.

Dissolved Oxygen And Nitrate Surveys

Lower-than-normal dissolved oxygen (DO) conditions would be expected under drought conditions because of growth and decomposition of algal blooms, higher water temperatures, and reduced streamflow. These drought conditions can further degrade water quality, impact surface water used for water supply, and reduce biological community health. Additional sampling of DO in targeted locations may provide a greater understanding of drought impacts, provide data for future forecasting efforts, and guide water and biology resource managers for potential responses. Nitrate surveys using a portable nitrate sensor for longitudinal nitrate profiles, synoptic nitrate studies, or discrete real-time measurements are additional tools for responding to the possible concentration of chemicals in a stream due to low flow and less dilution.

National Resources Available

The USGS collects national data sets for streamflow, groundwater, precipitation, and water quality, which provide Illinois with comparable data outside the state boundary. This allows a regional comparison of data. There are numerous other national data sets available through other parts of the USGS, including the Earth Resources Observation and Science (EROS) Center (Sioux Falls, SD), and biological resources from the Upper Midwest Environmental Sciences Center (La Crosse, WI) and the Columbia Environmental Research Center (Columbia, MO).

WaterWatch

Streamflow data collected by USGS on a national scale is maintained in the WaterWatch database and viewer. The Water Watch viewer (figure 9) shows the below normal 7-day average streamflow compared to historical streamflow for that day of the year. Comparisons to surrounding states indicate that Illinois is experiencing relatively severe drought conditions. This type of national data set may help water-resource managers understand the scope of a drought.

http://waterwatch.usgs.gov/

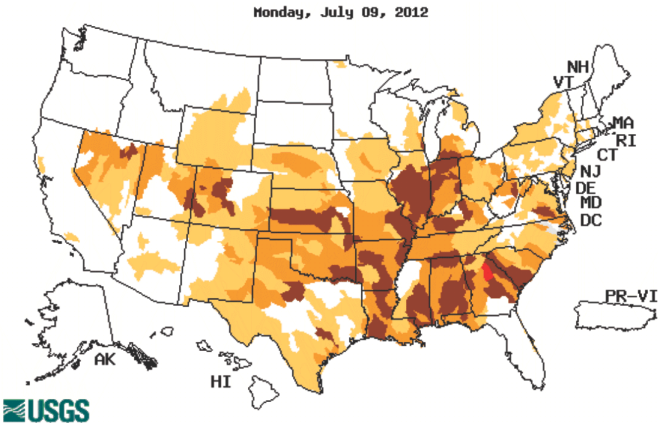


Figure 9. Below normal 7-day average streamflow compared to historical streamflow for July 9, 2012, for the United States.

Drought Monitoring Viewer

Among the variety of USGS-maintained national databases is the Drought Monitoring Viewer (figure 10). This satellite-derived imagery captures on-the-ground information weekly about the relationship between climate variables and vegetation health. The interactive nature of the system allows the users to locate and further investigate an area of interest.

http://vegdri.cr.usgs.gov/viewer/viewer.htm

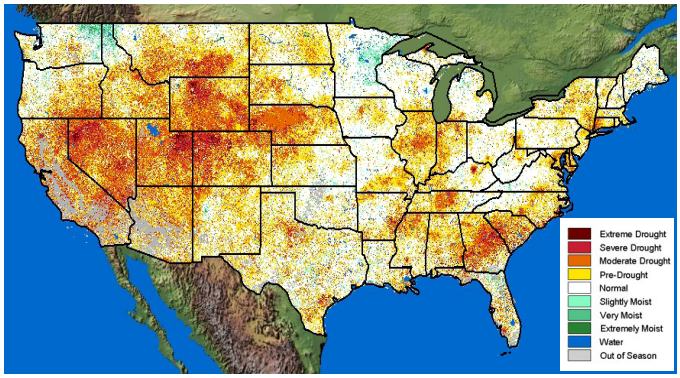


Figure 10. eMODIS VegDRI image for July 8, 2012, for the United States.

For more information contact:

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http://il.water.usgs.gov