

## Water Monitoring to Support the State of Illinois Governor’s Drought Response Task Force – October 17, 2012

The U.S. Geological Survey (USGS) collects streamflow, groundwater level, 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

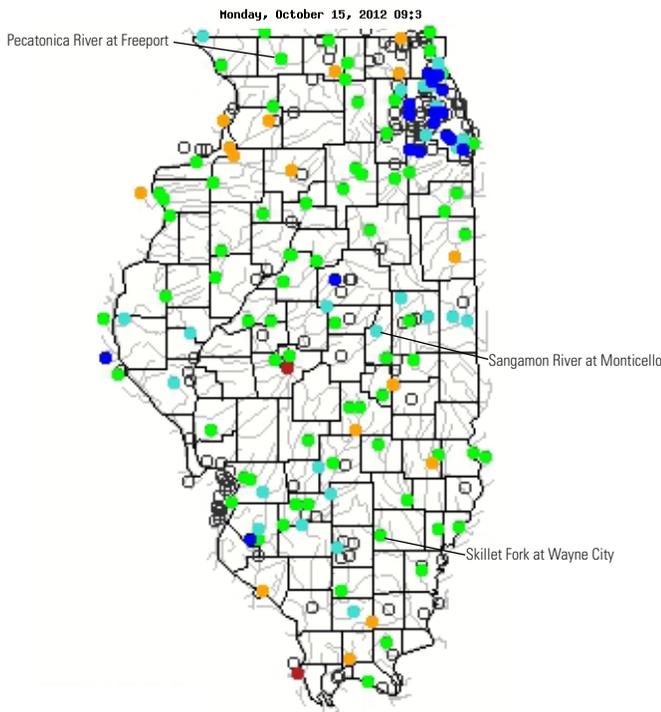
USGS real-time data are commonly collected every 15 minutes, and transmitted hourly. Transmission and data routing time results in data being available on the Web generally within 30 to 90 minutes. Data are quality checked daily.

### Streamflow

Current (real-time) and historical streamflow information are available on the USGS web site for over 230 USGS streamgages in Illinois (figure 1). Generally, the daily, monthly, and annual discharge statistics are provided. Significant precipitation occurred throughout August, September, and early October, which resulted in a decrease in the drought severity, but Illinois still has zones of below normal stream-

flow based on the 7-Day average streamflow when compared to the historical streamflow for October 14, 2012 (figure 2). Streamflow conditions at three index streamgages representing the geographic distribution of climate areas in the state (figure 3) are compared to the previous drought of 1987-88, as well as the normal streamflow over a 30-year period.

<http://waterwatch.usgs.gov/>



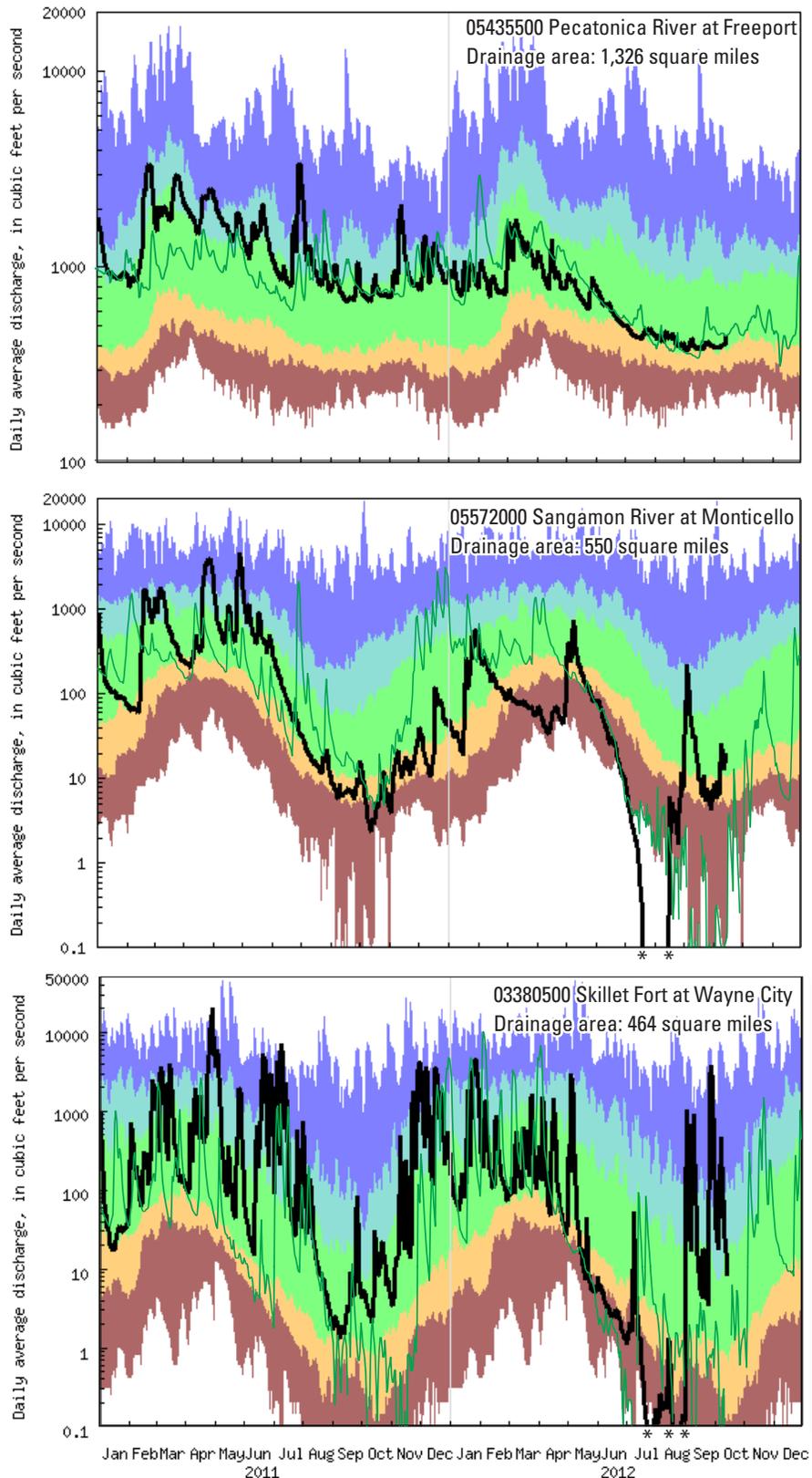
Explanation - Percentile classes							
●	●	●	●	●	●	●	○
Low	<10	10-24	25-75	76-90	>90	High	Not-ranked
	Much below normal	Below normal	Normal	Above normal	Much above normal		

Figure 1. Real-time streamflow data for October 15, 2012.



Explanation - Percentile classes				
Low	<=5	6-9	10-24	Insufficient data for a hydrologic region
Extreme hydrologic drought	Severe hydrologic drought	Moderate hydrologic drought	Below normal	

Figure 2. 7-day average streamflow compared to historical streamflow for the day of year for October 14, 2012.



Explanation - Percentile classes					Flow	1987-88 daily mean streamflow
lowest - 10th percentile	10-24	25-75	76-90	highest - 90th percentile		
Much below normal	Below normal	Normal	Above normal	Much above normal		

Figure 3. Duration hydrographs of daily average streamflow for 3 index stations in Illinois shown in Figure 1. Asterisk (\*) indicates flow less than 0.1 cubic feet per second (cfs). Significant precipitation in August, September, and October 2012 resulted in increases in streamflow in Monticello and Wayne City.

## Precipitation

The USGS has developed a Web-based tool displaying provisional precipitation data that are collected throughout Illinois. Figure 4 presents such precipitation data from a rain gage in DeWitt County. 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. Precipitation for most of Illinois was significant over the past 30 days, providing significant relief to the drought (figure 5).

There is an option to display NEXRAD imagery from the National Weather Service for comparison with rain gauge totals. The data can be sorted by precipitation totals, enabling water-resource managers to pinpoint areas that have received

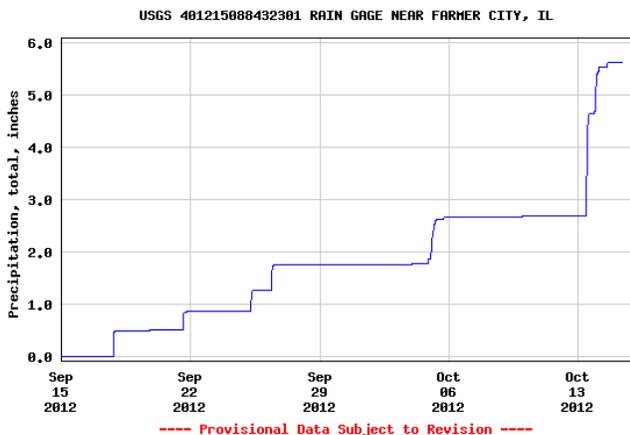


Figure 4. 30-day total precipitation at a rain gage in DeWitt County.

## 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 6), and at 27 sites (44 wells) in, and in cooperation with, McHenry County. At sites where four or more years of groundwater data are available, various groundwater-level statistics are automatically calculated to allow at-a-glance information about long-term water-level trends.

National Water Information System at:  
<http://waterdata.usgs.gov/nwis>  
 Groundwater Watch at:  
<http://groundwaterwatch.usgs.gov/>

Figure 6. An example hydrograph generated when 10 or more years of data are available is shown for a site near Hoopeston in Vermilion County. Water levels in June through early August 2012 are indicated to be lower than 90% of all water levels measured since August 1993. Rising groundwater levels in August, September, and October 2012 coincide with significant precipitation events.

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>

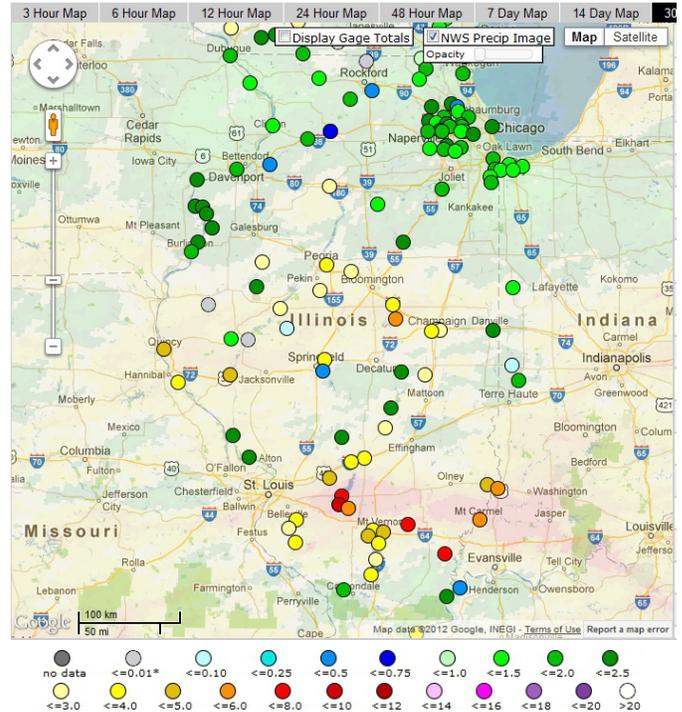
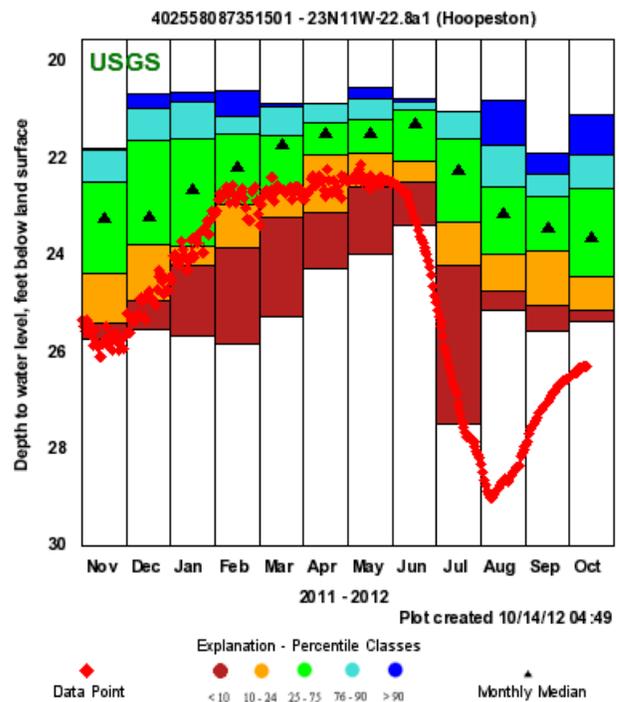
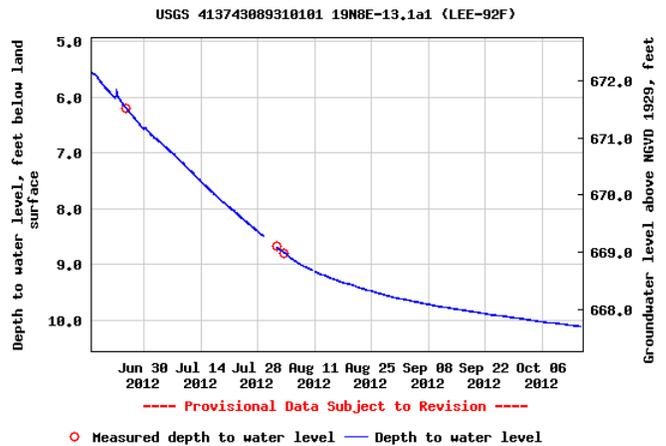


Figure 5. Precipitation gage data collected in the 30 days before October 15, 2012, in Illinois.



Significant precipitation in August and early September has resulted in the rise of groundwater levels in some monitoring wells in Illinois. Groundwater levels in McHenry County show some recent rises in selected wells, but most of the shallowest wells continue to show declining groundwater levels. Figure 7 provides an example of continued decline in groundwater levels from a well in Lee County, despite approximately 2 inches of precipitation in the area in the past 30 days.

Figure 7. Graph showing the decline of groundwater levels from a water-table well in Lee County since June 17, 2012.



## 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 8), 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 9), almost

all in cooperation with the Illinois Environmental Protection Agency (IEPA). Real-time water temperature readings may be of particular interest during drought conditions. The USGS currently collects water temperature at 15 surface water sites (figure 9) and 4 groundwater wells.

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

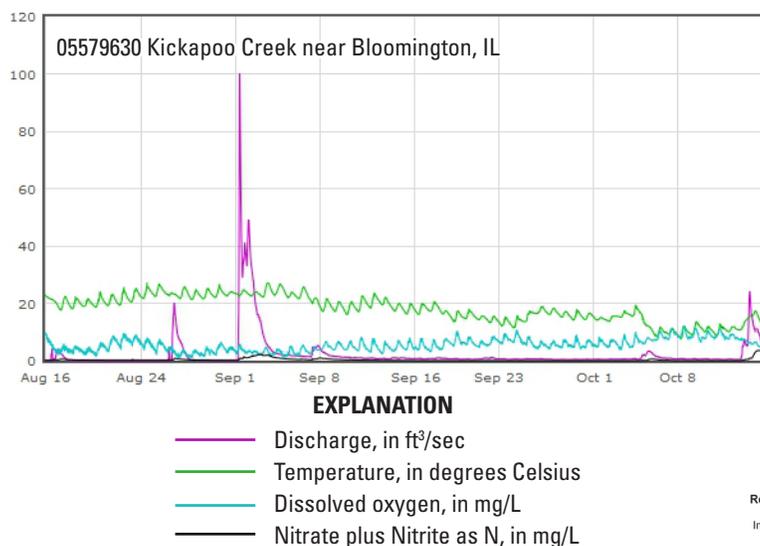


Figure 8. Real-time data recorded by sensors at a Kickapoo Creek site near Bloomington in cooperation with the IEPA.

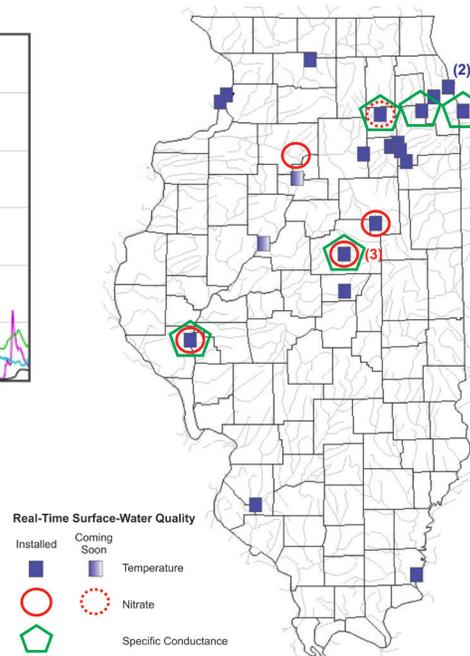


Figure 9. Real-time continuous nitrate and temperature sensors operated by the USGS in Illinois.

## 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 collected over 200 low-flow measurements in the midst of the drought that are listed 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.

## Algae and Blue-Green Algae Monitoring

Hot and dry climatic conditions can promote excessive aquatic plant growth resulting in levels of blue-green algae (or cyanobacteria) that can adversely affect the health of water users and recreationalists. These algal blooms can contain toxins and may foul the taste and odor of raw and finished drinking water. The IEPA and the USGS sampled 13 lake and stream sites throughout Illinois (figure 10) for the presence blue-green algae and related toxins in response to the drought. Three of the sites contained levels of the microcystin toxin considered to be high or very high risk to humans. Additional analyses of these samples are still ongoing. Real-time monitoring of in-situ blue-green algae can provide early warning signs of impending problematic conditions and monitoring of existing growth conditions.

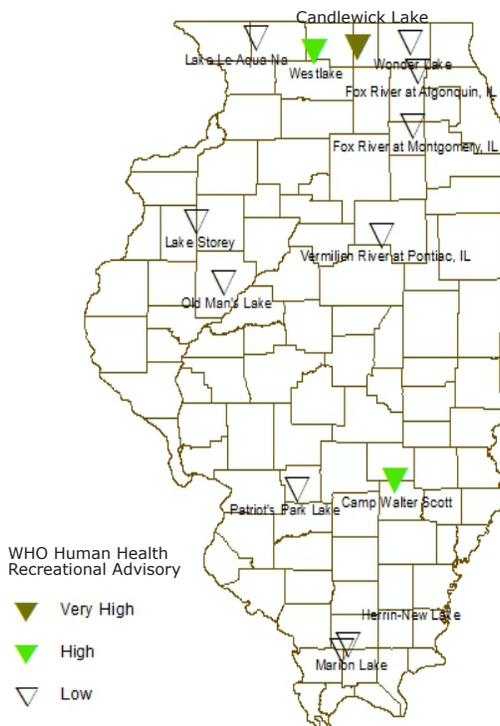


Figure 10. Lakes and streams sampled by the IEPA and the USGS for microcystin toxins in late August and early September 2012.

## 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 recommended and is already being collected by the USGS in some parts of Illinois. Synoptic measurement of all available groundwater wells and access to continuously recorded groundwater levels could be beneficial to water-resource managers, especially when seasonal rainfall is limited and temperatures are extremely high. For the past five months the USGS has collected more frequent groundwater levels from a subset of wells in the central portion of the Mahomet Aquifer because of substantial declines (figure 11). A datalogger has been installed since August 24 in one Mahomet Aquifer well about 2 miles from the Decatur well field recording groundwater levels every 15 minutes. Recent groundwater levels are available through the Illinois Active Water Level Network, available at:

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

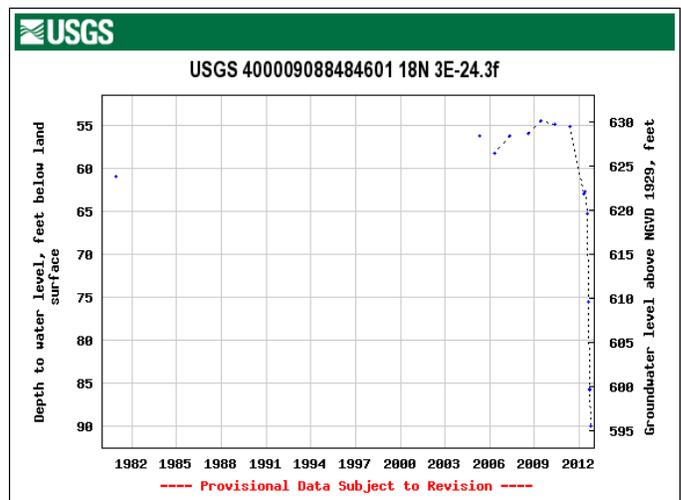


Figure 11. Example of continued substantial decline observed in groundwater levels in one of the Mahomet Aquifer wells monitored by the USGS.

## 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 the USGS on a national scale is maintained in the WaterWatch database and viewer. The WaterWatch viewer (figure 12) 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 mild drought conditions as of October 14, 2012. This type of national data set may help water-resource managers understand the scope of a drought.

<http://waterwatch.usgs.gov/>

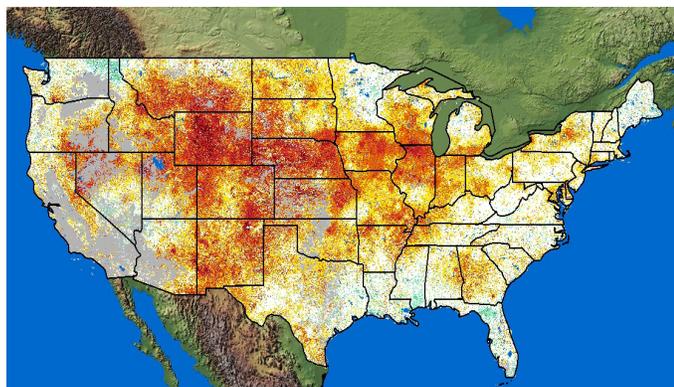


Figure 13. eMODIS VegDRI image for October 14, 2012, for the United States.

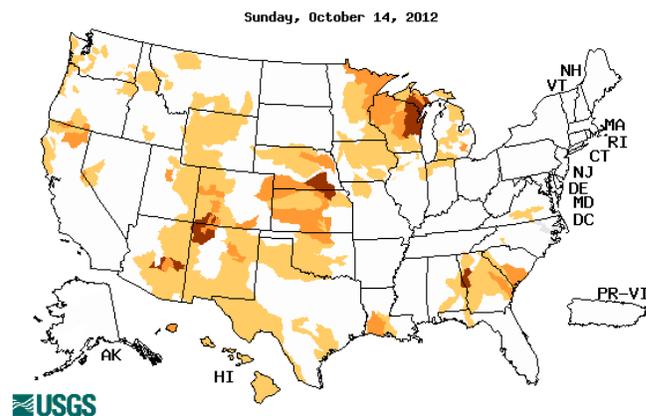


Figure 12. Below normal 7-day average streamflow compared to historical streamflow for October 14, 2012, for the United States.

## Drought Monitoring Viewer

Among the variety of USGS-maintained national databases is the Drought Monitoring Viewer (figure 13). This satellite-derived imagery captures on-the-ground information weekly about the relation 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://vegdi.cr.usgs.gov/viewer/viewer.htm>

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