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Summary of Hydrologic Conditions in Kansas, Water Year 2015

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The U.S. Geological Survey (USGS), in cooperation with Federal, State, and local agencies, maintains a long-term network of hydrologic monitoring sites in Kansas. In 2015, the network included about 200 real-time streamgages (hereafter referred to as "gages"), 12 real-time reservoir-level monitoring stations, and 30 groundwater-level monitoring wells. These data and associated analyses provide a unique overview of hydrologic conditions and help improve the understanding of Kansas's water resources.

Real-time data are verified by the USGS throughout the year with regular measurements of streamflow, lake levels, and groundwater levels. These data are used in protecting life and property; and managing water resources for agricultural, industrial, public supply, ecological, and recreational purposes. Yearly hydrologic conditions are characterized by comparing statistical analyses of current and historical water year (WY) data for the period of record. A WY is the 12-month period from October 1 through September 30 and is designated by the year in which it ends.

Statewide Precipitation Overview and Associated Recent Trends

Kansas was in drought conditions during WYs 2011–12. Drought conditions improved with increased precipitation in WY 2013 and remained nearly steady in WY 2014 despite below average precipitation. Drought conditions in Kansas shifted from the western one-half in WY 2013 to mainly the southwest and south-central areas in WY 2014. In WY 2015, Kansas largely received at or above average precipitation (National Oceanic and Atmospheric Administration, 2015a). The May through July period of 2015 ranked as the seventh wettest for the State out of 121 years of record (National Oceanic and Atmospheric Administration, 2015b). The west, southwest, north-central, and northeast areas of Kansas received above normal precipitation throughout the WY. The southeast and a diagonal strip spanning the center of Kansas received at or slightly below normal precipitation (fig. 1). At the beginning of WY 2015, about 17 percent of Kansas was classified as severe drought, 27 percent as moderate drought, and 35 percent as abnormally dry. By the end of the WY, only about 4 percent was classified as moderate drought and 15 percent as abnormally dry (fig. 2; Fuchs and National Drought Mitigation Center, 2015). The most substantial change was noted in the south and southwest regions of Kansas, where drought conditions were the most severe at the beginning of the WY. By the end of the WY, nearly all of these areas were out of drought classification; only

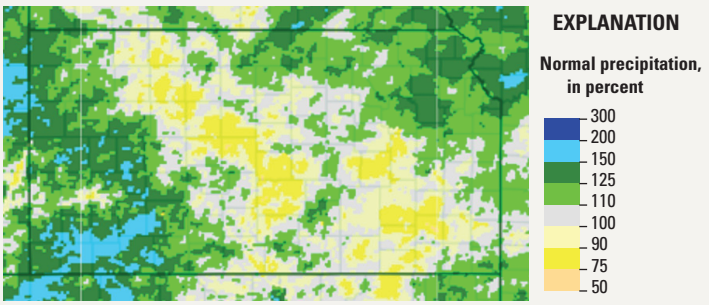

Figure 1. Percent of normal (1981–2010) precipitation for water year 2015, Kansas (National Oceanic and Atmospheric Administration, 2015a).

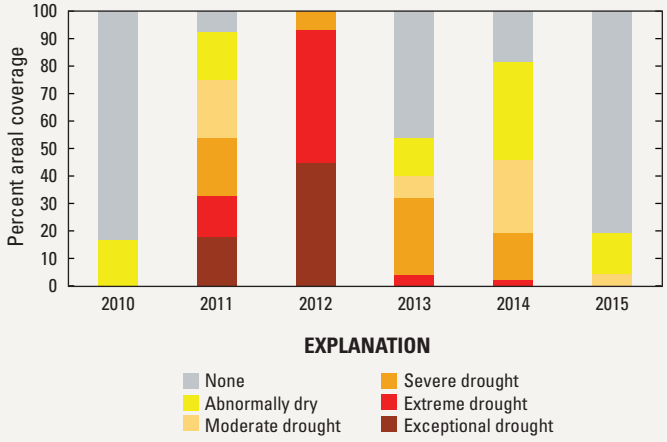

Figure 2. Percent areal coverage of drought conditions at the end of the water years 2010–15, Kansas (Fuchs and National Drought Mitigation Center, 2015).


Little Blue River near Barnes, Kans., (USGS gage 06884400) looking downstream during the May 8, 2015, flood event.


Little Blue River near Barnes, Kans., (USGS gage 06884400) looking downstream on May 22, 2015.

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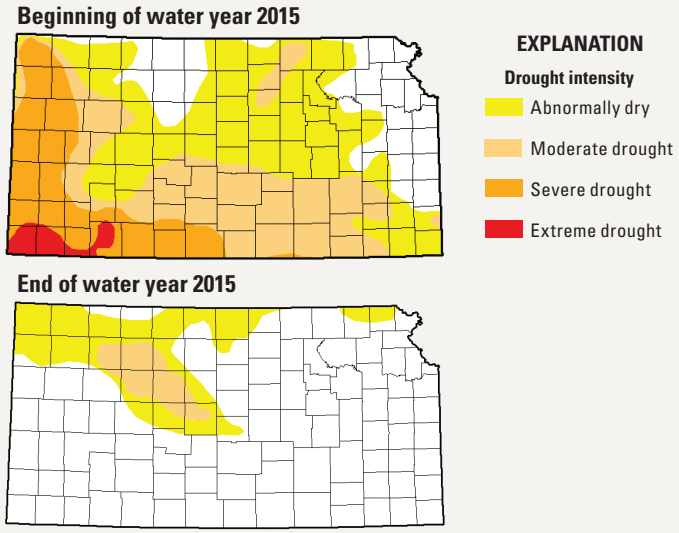


Figure 3. Drought condition intensity at the beginning compared to the end of water year 2015, Kansas (Fuchs and National Drought Mitigation Center, 2015).

the northwest part of the State was still affected (fig. 3; Fuchs and National Drought Mitigation Center, 2015). This location coincides with the area of below normal precipitation.

Streamflow Conditions and Drainage Basin Runoff

At the beginning of WY 2015, monthly average streamflow was predominately normal in Kansas. By April, monthly average streamflow was below normal, much below normal, or record low in more than one-half of the State. Average streamflow was normal, above normal, or much above normal in most of Kansas by May except for parts of northwest Kansas, which remained below normal. Most of southern and eastern Kansas ended the WY with normal streamflow conditions despite other regions of the State having below normal, much below normal, and record low streamflow (fig. 4; U.S. Geological Survey, 2015a).

Runoff, or streamflow per unit area, is a good indicator of precipitation and streamflow for a given basin (Langbein and Iseri, 1960). Quarterly maps of drainage basin runoff can provide insight into the variability of hydrologic conditions during a WY (fig. 5), including development or improvement of drought conditions (fig. 3). For Kansas, runoff in WY 2015 was more than twice that of WY 2014 and fell in the 59th percentile of computed runoff (calculated since 1901; U.S. Geological Survey, 2015a). Runoff was normal in Kansas at the beginning of the WY, except in parts of west and south-central Kansas, which were below or much below normal. By the second quarter, runoff in most of Kansas was below normal, whereas runoff was much below and record low in the western one-half of Kansas; however, in the third quarter, increased precipitation caused elevated runoff across most of Kansas that resulted in above and much above normal runoff in east and northeast Kansas. This trend continued through the end of the WY; only runoff in northwest and central Kansas was below normal.

Runoff is not solely dependent on precipitation inputs to an area, as infiltration of precipitation and streamflow losses to underlying aquifers or storage in reservoirs can prevent water from leaving a drainage basin; thus, although precipitation in parts of the western one-half of Kansas was above normal, increased groundwater storage and water storage in reservoirs likely reduced runoff.

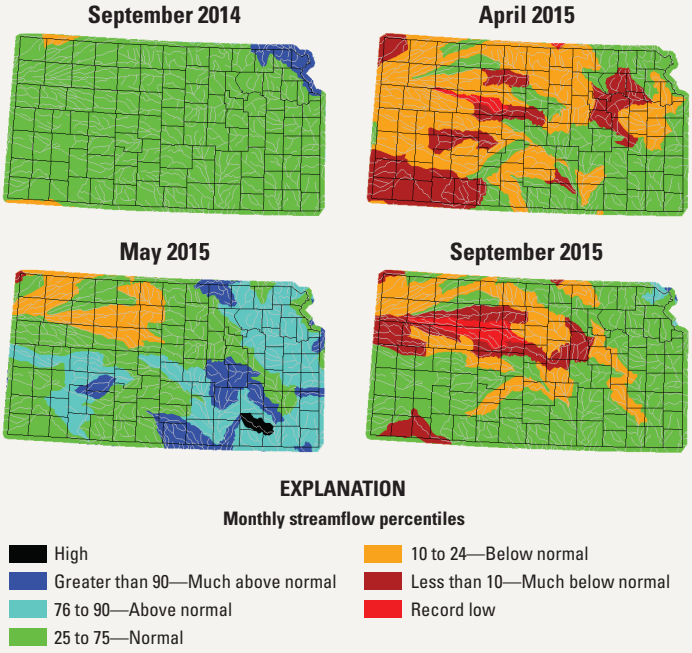


Figure 4. Monthly streamflow percentiles in September 2014, April 2015, May 2015, and September 2015, Kansas (U.S. Geological Survey, 2015a).

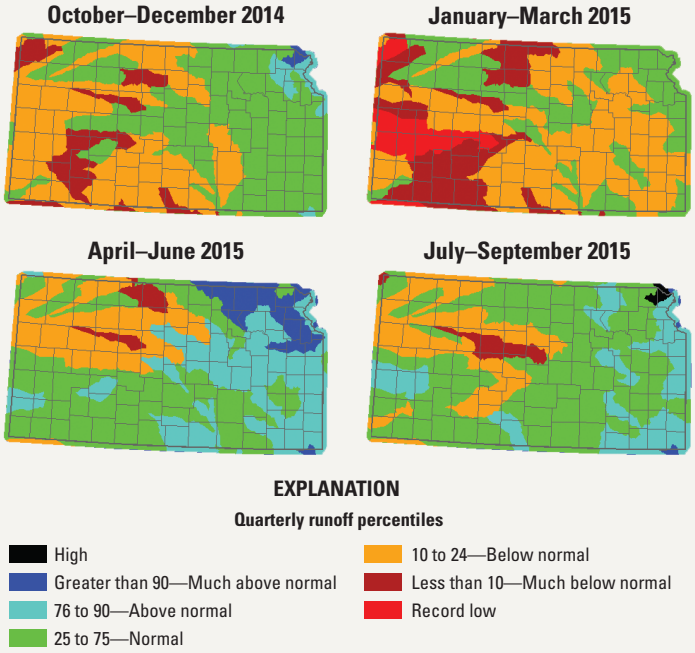


Figure 5. Quarterly runoff percentiles for water year 2015, Kansas (U.S. Geological Survey 2015a).

Table 1. Change in storage during water year 2015 in 12 U.S. Geological Survey monitored reservoirs with complete records.

[Storage percent is based on percent of conservation pool storage; WY, water year]

USGS station number	Reservoir name	Storage at beginning of WY 2015 (percent)	Peak storage during WY 2015 (percent)	Storage at end of WY 2015 (percent)	Percent change in storage, end compared to beginning of WY
06857050	Milford Lake near Junction City, Kansas	109	146	109	0
06861500	Cedar Bluff Reservoir near Ellis, Kansas	36.7	36.7	32.7	-10.9
06865000	Kanopolis Lake near Kanopolis, Kansas	122	132	103	-15.6
06868100	Wilson Lake near Wilson, Kansas	74.6	74.6	67.4	-9.7
06886900	Tuttle Creek Lake near Manhattan, Kansas	118	407	98.2	-16.8
06890898	Perry Lake near Perry, Kansas	113	236	108	-4.4
06891478	Clinton Lake near Lawrence, Kansas	94.6	175	112	18.4
06910997	Melvern Lake near Melvern, Kansas	96.3	155	99.3	3.1
06912490	Pomona Lake near Quenemo, Kansas	92.9	275	100	7.6
06914995	Hillsdale Lake near Hillsdale, Kansas	94.1	148	106	12.6
07140885	Horsethief Reservoir near Jetmore, Kansas	33.9	104	82.7	144
07144790	Cheney Reservoir near Cheney, Kansas	94.1	110	99.2	5.4

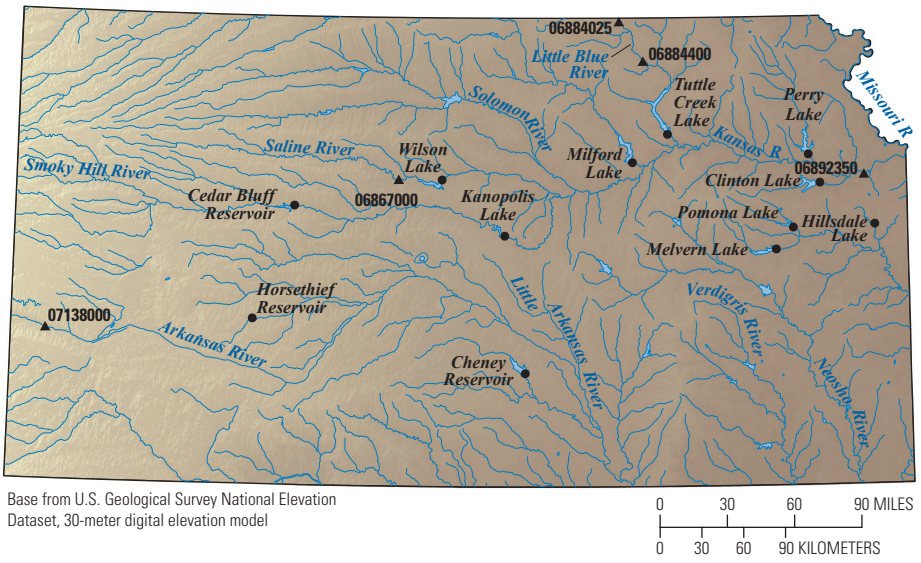
Reservoirs

Many of the primary Federal reservoirs in Kansas were at normal levels at the beginning of WY 2015 (table 1). Intense precipitation in May and June caused 10 out of 12 USGS monitored reservoirs to exceed their conservation (multi-purpose) pool elevations and partially fill the flood-control pool. Because of the above normal water-surface elevations, nearly all USGS monitored reservoirs released higher outflows, with higher annual streamflow observed at the downstream gages than the previous year, in order to maintain the target water-surface elevation (U.S. Geological Survey, 2015b). Five USGS monitored reservoirs ended the WY with less water than at the beginning of the WY, six reservoirs ended with more water, and one reservoir was unchanged.

Storage water in Horsethief Reservoir near Jetmore, Kansas (station 07140885; fig. 6), changed substantially during WY 2015, and the conservation pool was filled for the first time since the reservoir's completion in 2009 (U.S. Geological Survey, 2015b). The conservation pool was 34 percent full at the beginning of WY 2015, 104 percent full at the end of May, and 83 percent full at the end of WY 2015 (table 1). This reservoir is in the region of southwest Kansas where precipitation was above normal, drought conditions ended, and streamflow conditions returned to normal (figs. 1, 3, and 4).

Streamflow Conditions at Selected Streamgages

Three gages were chosen to represent the WY 2015 streamflow conditions; the precipitation gradient across western,



EXPLANATION

- **U.S. Geological Survey continuous lake-level monitoring station with reservoir name**
- **U.S. Geological Survey continuous streamflow station and site identifier**

Figure 6. U.S. Geological Survey lake-level monitoring stations in reservoirs and streamgages, water year 2015, Kansas.

central, and eastern Kansas can be seen in the streamflow and runoff conditions at these gages.

The Arkansas River at Syracuse, Kansas (gage 07138000; fig. 6), largely represents streamflow for the area of western Kansas that received above normal precipitation in WY 2015 (fig. 1), which ended drought conditions (fig. 3). Normal flow conditions at the site for WY 2015 were in stark contrast compared to the previous 4 years of below normal and much below normal flow; flow even stopped for a short period in WY 2013 for the first time in its 98-year history before reaching normal flow conditions at the end of WY 2014 (U.S. Geological Survey, 2015a).

The Saline River near Russell, Kansas (gage 06867000; fig. 6), represents streamflow in most of central Kansas where precipitation and runoff were below normal and drought conditions persisted in WY 2015 (figs. 1, 3, and 5). Streamflow has been predominately below normal since WY 2012. Streamflow remained below normal in WY 2015 except in late April and mid-May when streamflow was normal (U.S. Geological Survey, 2015a).

The Kansas River at De Soto, Kansas (gage 06892350; fig. 6), represents streamflow in eastern Kansas, which received above normal precipitation that caused above normal streamflow and runoff (figs. 1, 4, and 5). Streamflow generally remained normal in WYs 2010–14, except from late WY 2012 to late WY 2013 when streamflow was below normal. Streamflow was mainly normal in WY 2015, except from May to July when streamflow was above and much above normal (U.S. Geological Survey, 2015a).

Flooding and Record-High Streamflows

During May–June 2015, multiple sites in Kansas experienced high flow and flood conditions. Two peak of record streamflows (for gages with 30 or more years of record) took place during WY 2015. The Little Blue River at Hollenberg, Kansas (gage 06884025; fig. 6), had its highest instantaneous discharge in 40 years of record (59,000 ft^3/s) on May 7, 2015, after an intense precipitation event. The downstream gage near Barnes, Kansas (gage 06884400; fig. 6), had its highest instantaneous discharge in 57 years of record (56,000 ft^3/s) on May 8, 2015 (U.S. Geological Survey, 2015a). Cumulative streamflow near Barnes remained above the 75th percentile for the remainder of the WY, which almost surpassed the highest observed cumulative flow in June (fig. 7).

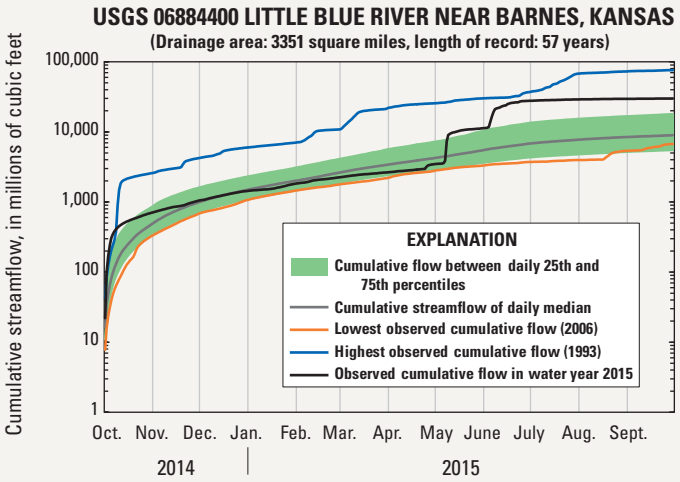


Figure 7. Time-series plot of cumulative discharge for streamgage 06884400 (fig. 6; U.S. Geological Survey, 2015a).

Summary

After the severe drought in water years (WYs) 2011–13, drought conditions ended in WY 2015 for most of Kansas, which had the smallest area affected since WY 2010. Despite high flows in Kansas during May–June, many streamgages ended the WY with below normal streamflow. Northwest and central Kansas received below normal precipitation, which led to persisting drought conditions and below normal streamflow. The remaining areas of Kansas received at or above normal precipitation, which led to normal and above normal streamflow and runoff and drought recovery in western Kansas. Most U.S. Geological Survey monitored reservoirs filled their conservation pool; however, in northern Kansas, five of these reservoirs ended the WY with less water than at the beginning of the WY.

References Cited

Fuchs, Brian, and National Drought Mitigation Center, 2015, U.S. Drought Monitor—Kansas: National Drought Mitigation Center, U.S. Drought Monitor Web page, accessed October 3, 2015, at http://droughtmonitor.unl.edu/.

Langbein, W.B., and Iseri, K.T., 1960, General introduction and hydrologic definitions: U.S. Geological Survey Water-Supply Paper 1541–A, 29 p.

National Oceanic and Atmospheric Administration, 2015a, Advanced hydrologic prediction service—2015 precipitation maps for Kansas: National Oceanic and Atmospheric Administration, National Weather Service, accessed October 3, 2015, at http://water.weather.gov/precip/.

National Oceanic and Atmospheric Administration, 2015b, National temperature and precipitation maps: National Oceanic and Atmospheric Administration, National Centers for Environmental Information, accessed October 3, 2015, at http://www.ncdc.noaa.gov/temp-and-precip/us-maps/.

U.S. Geological Survey, 2015a, WaterWatch—Current water resources in Kansas: U.S. Geological Survey, WaterWatch Web page, accessed October 3, 2015, at http://waterwatch.usgs.gov/.

U.S. Geological Survey, 2015b, USGS water data for Kansas: U.S. Geological Survey, National Water Information System Web page, accessed October 3, 2015, at http://waterdata.usgs.gov/ks/nwis/.

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