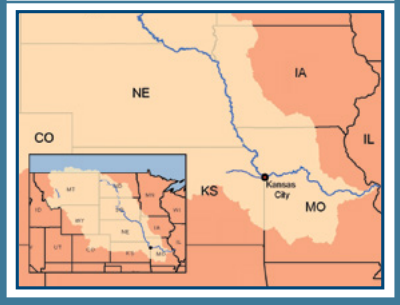
# Case Study

# Kansas/Missouri: Lower Missouri River Basin

Water Resource Strategies and Information Needs in Response to Extreme Weather/Climate Events

**Lower Missouri River Basin**




## Water Trends

The LMR stretches from Gavin's Point Dam to its confluence with the Mississippi River. Snowmelt originating in the Rocky Mountains makes up 75% of its water from March-July. The Kansas River, a major tributary joining the LMR at Kansas City, is fed by four reservoirs for water supply, flood control, and endangered species habitat.

The region is known for extreme weather variability. The northern areas of the Great Plains are likely to get wetter while the south and west are likely to get drier due to reduced rainfall and higher temperatures. The LMR lies at the intersection of climate regions, making local water projections difficult. The Rockies are likely to experience earlier spring snowmelt.

## Governing Structures

On the Missouri River, USACE operates six major dams for flood control, navigation and bank stabilization, irrigation, hydropower, water supply, water quality, recreation, and fish and wildlife. The Missouri Water Resources Center manages quantity and quality of the state's water resources, advised by the State Water Plan Inter-Agency Task Force. The Kansas Department of Agriculture's Division of Water Resources regulates water through the Water Appropriation Act, and the Kansas Water Office oversees reservoir storage contracts.

Drinking water service in Kansas City, MO, is provided by the city's Water Services Department, operating water, stormwater, and wastewater utilities. Johnson County, a Kansas City suburb, operates its own stormwater and wastewater departments. Drinking water is supplied by WaterOne, a quasi-municipal government. Smaller cities and communities in the metro Kansas City area provide their own water services, including stormwater management.

Twenty-eight Indian tribes live in the Missouri River basin. The tribes have not fully exercised their water rights to date.

## The Story in Brief

*The Lower Missouri River (LMR) basin has long experienced extreme weather and climate events. Over the last 20 years, the basin has faced increasing frequency and severity of flood and drought. Communities endured record floods in 1993 and again in 2011. Recent droughts, including the ongoing drought of 2012/13, have ignited tension over water supplies and river flows in a region that perceives itself as having plenty of water. For utilities on the Missouri River, the issue is low water levels due to riverbed degradation, not availability of water itself. Water utilities also are struggling with the lack of sufficient water storage in the Kansas River tributary. Managing the LMR to control flash flooding, protect water quality and habitat for endangered species, as well as support the agriculture and barge-based economy, provides a challenging context.*

## Great Floods of 1993 and 2011

### Impacts

During the flood of 1993 the LMR combined with the Mississippi River to become the largest recorded flood in the United States, with water levels topping the previous flood of record by 20%, affecting 150 major rivers and tributaries. It caused 50 deaths, hundreds of failed levees, and thousands of evacuations that lasted months. Damages totaled $85 million for water and wastewater utilities. Some 200 municipal water and 388 wastewater systems were damaged, many in the Lower Missouri River Basin. Repeated flooding along with dredging and other activities has contributed to riverbed erosion.

The Kansas City, Missouri, Water Treatment Plant during the flood of 1993.

In 2011, a new record flood hit the Lower Missouri. In the upper basin, melting snowpack combined with record rainfall from May to July (102 inches vs. a normal 25 inches) resulted in runoff that exceeded the 1993 flood by another 20%, flooding the lower basin. The US Army Corps of Engineers (USACE) opened two spillways on the dam system that had never before been operated under wet conditions, reducing water levels by seven feet to accommodate the deluge.

In Missouri, Kansas City's only water plant experienced high flows, creating turbidity and debris that settled in primary tanks. In Kansas, Johnson County Wastewater's seven treatment plants experienced power failures, and communities endured sanitary sewer overflows and basement backups.

### Utility and Community Response

Localities collaborated to find regional solutions to flooding and river issues. The Mid-America Regional Council (MARC), the planning organization for the bi-state Kansas City region, began working on solutions to prevent riverbed degradation, improve bank stabilization, and accelerate sustainable ecosystem restoration projects. The USACE protected the metro area with a system of seven levees. In 2011, flood levees largely performed as designed.

WaterOne, which supplies drinking water to most of Johnson County, KS, reported that impacts from the 2011 flood were minimal because it planned for 500-year floods. However, floodwater isolated its Missouri River intake collector, which continued to operate during the event.

More than 25 years ago, Johnson County Wastewater accelerated its program to prevent rainwater infiltration and inflow into sewer lines by implementing a program to remove or upgrade private sources and to improve prevention and maintenance. After the 2011 flood, Johnson County's disaster recovery plan added data backups, real-time monitoring at standby locations, and redundant communication systems. The utility installed electrical power from a second, independent feed, and it put in both mobile and onsite generators. Its combined heat and power capability could run one plant independently in "island" mode.

A series of workshops focusing on extreme events and water resources, co-sponsored by the National Oceanic and Atmospheric Administration (NOAA), US Environmental Protection Agency (US EPA), Water Environment Research Foundation (WERF), Water Research Foundation (WaterRF), Concurrent Technologies Corporation (CTC), and NOBLIS.

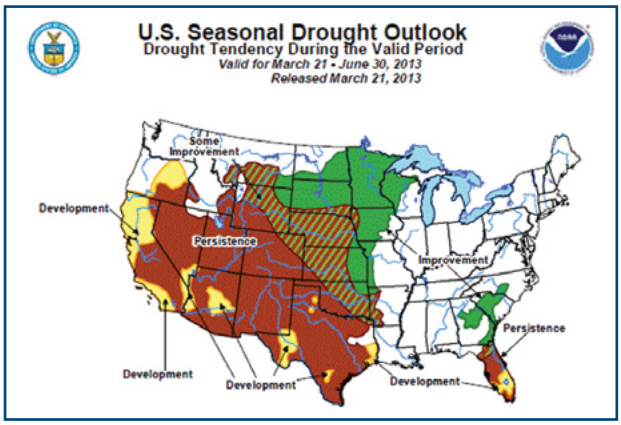
NOAA EPA WERF WaterRF CTC Noblis

Local entities coordinated throughout the 2011 flood with the Kansas State Department of Emergency Management, the Kansas City Emergency Operations Center, and the Missouri River Joint Operations Center. After the flood, utilities recognized the valuable role for Missouri and Kansas Water and Wastewater Agency Response Network (WARN).

## Drought of 2012/13

### Impacts

Drought conditions began in 2012 and were expected to persist through 2013. The water levels in the Missouri River fell six to ten feet in some stretches by Kansas City. As of April 2013, more than three to nine inches of rain were needed to bring soil moisture back to normal. The region was expecting temperature increases and greater evaporation. Low river levels had already resulted in $500 million in economic losses since 2012.




NOAA forecasts reduced rainfall and higher temperatures, increasing the risk of drought in much of the basin.

Low reservoir releases in the winter created problems for municipal and industrial water intakes along the Lower Missouri River. Because of past floods and man-made activities, the river bottom degraded, lowering the river elevation over the last 30 years at Kansas City by ten feet. This degradation exacerbated the impact of low flows during drought. As a result, Kansas City, MO, Water Service Department installed structural solutions at the intakes in the 1980s and 2009 to address declining water levels. Expensive new retrofits were on the horizon unless USACE's operating rules change to allow greater dam releases. At the WaterOne intake, the low Missouri water levels required more energy for the low water pumps, costing $20,000 additional per year.

In 2012, questions arose about the need to release water from reservoirs on the smaller Kansas River tributary to protect navigation and habitat on the much larger Missouri when future drinking water supply was at stake. Soaring temperatures fostered toxic algal blooms in reservoirs, raising health concerns and causing severe taste and odor problems for drinking water, requiring treatment at $750,000 per year.

Several water utilities with shallow or older pipes had expensive breaks as lines shifted in extremely dry soil. Kansas City was considering burying small mains deeper, a costly endeavor.

### Utility and Community Response

Potable water service was not interrupted in the basin, but the drought seriously threatened the economy, water utility infrastructure, and water access. It worsened tensions between USACE and water users in Kansas, a western water rights state. Competition for water throughout the basin has stimulated debate about asking Congress to prioritize power and water supply among USACE's authorized purposes for the Missouri River. It remains to be seen how the communities will balance competing needs as the current drought persists.

Over the years, WaterOne had responded to river level decline by installing low water pumping equipment on the LMR intake and a permanent weir on the Kansas River intake to sustain channel flows. Estimated capital costs for fixing existing intakes would top $128 million, with new intakes costing $286 million across water service providers throughout the LMR basin. During this drought, the Kansas Water Office encouraged conservation measures.

To encourage regional planning and sustainable watershed management, MARC began promoting water quality conservation, green infrastructure, and additional efforts in watershed planning. To date, projects involved multiple local sponsors, including WaterOne, Kansas City, KS, and USACE. For water utilities that depend on fees for revenue, water demand reduction measures were seen as revenue reducers. Further, public perception that there is plenty of water in the Missouri River caused resistance to conservation measures.

## Looking Forward

The long history of efforts to control the Missouri River has yielded disparate authorities, different legal frameworks, and water rights that confound a ready resolution to these complex issues. Utilities are improving planning and infrastructure, as well as building on collaborations and seeking innovative solutions. They are expecting that federal agencies will provide better access to useful forecasting and data. However, water utilities worry that a proposed Missouri River Compact could create multiple lawsuits, which delay solutions. Many believe that USACE, emerging stakeholder alliances, and top-rate data sets remain the most likely mechanisms for balancing intertwined and entrenched water management needs.

**To learn more about how the water sector is responding to extremes, visit:**
http://www.cpo.noaa.gov/ClimatePrograms/ClimateSocietalInteractionsCSI/SARPProgram/ExtremeEventsCaseStudies.aspx

### Lessons Learned and Challenges

- People do not understand residual flood risk and relationship-to-return (e.g., 100 year) floods.
- Floods are inevitable; better pre-planning for logistics is required.
- State water laws differ between Missouri and Kansas, impacting the opinions and perceptions of water users in each state.
- Trusted information sources are critical. Informal communication prevails.
- Access to and interpretation of data is an issue for operations and emergency response. Users need to identify what is most useful for their stakeholders.
- Mutual aid agreements are important to collaborative regional networks.
- Insurance policies need to discourage building in flood plains.
- Aging infrastructure, payment for true cost of water, and inefficient water use must be addressed.
- Asset management is key to being prepared for extreme events.

### Useful Tools and Resources

- FEMA floodplain maps – msc.fema.gov
- US EPA WaterSense program – www.epa.gov/watersense/
- USGS Water ALERT rain gauges, gauge-adjusted radar system
- USACE interactive monitoring website – http://www.nwd-mr.usace.army.mil/rcc/
- Stormwatch.com (24-hour real-time monitoring system) – www.stormwatch.com
- Kansas Water Assurance District Display – www.ksda.gov/water_management_services/about/
- Sediment transport model built by USACE
- NOAA Missouri Basin Experimental Monitoring and Forecasting Portal – www.esrl.noaa.gov/psd/csi/monitor/mobasin/index.html

### Information Needs

- Information at decadal time scales.
- Level-of-service design standards for community infrastructure by location.
- Relevant, practical science and technology translated into useful tools.
- A dashboard to navigate among many federal data websites and to customize needed data that can be manipulated for daily, weekly, and monthly views.
- Large spatial and temporal-scale determinations converted for support of shorter-scale decision making.
- Real-time data and monitoring in key locations for soil moisture, precipitation, snow pack, and water level.
- Accurate and localized flood data.
- Regional information exchanges.