## Irrigation Water Demand

### Introduction

Irrigation is the dominant use of water in Kansas, averaging 85% of water reported used from 1990 to 2011. There are 34,633 points of diversion for irrigation in the state. More than 86% of the approximately 33,000 water rights issued are for irrigation, primarily from the High Plains aquifer (Figure WD-03).

Irrigation allows water to be diverted from its original place of occurrence or storage so that it can be applied to agricultural crops or vegetation such as lawns, parks and golf courses. Irrigation allows high-value crops to be produced in areas of the state where it would be very challenging to grow them under natural precipitation levels and allows many agricultural producers to supplement natural precipitation levels that are insufficient to grow a cultivated crop. Irrigation can stabilize and improve crop yields, improve crop quality and in turn benefit the economy. Corn, both a high water demand and a high value crop, is currently a major crop in arid southwest Kansas where average annual precipitation alone would not result in high yield corn. The top irrigated acreage crops in Kansas are corn, wheat, grain sorghum, alfalfa and soybeans.

### Sources of Irrigation Water

Irrigation is most prevalent in western Kansas where average annual rainfall is less than 20 inches; too little for many high water demand crops. Irrigation water use decreases from western to eastern Kansas, where precipitation is greater.

Groundwater is the source of the majority (>90%) of irrigation water, with federal reservoirs and surface streams providing smaller amounts. The table below provides quantity and acres authorized for surface and groundwater as of November 2012.

**Table WD-01**

**Authorized Irrigation-November 2012**

| Surface Water Authorized Acre feet | Acres Irrigated | Groundwater Authorized Acre feet | Acres Irrigated |
|---|---|---|---|
| 498,895 | 175,318 | 6,496,635 | 4,238,442 |
| | | | |
| **Total Amount Authorized** | 6,995,530 | | |
| **Total Acres Irrigated** | 4,413,760 | | |

Most of the groundwater used for irrigation is from the High Plains aquifer, particularly the Ogallala portion. Alluvial aquifers along the streams are also well developed. The Dakota aquifer, which underlies the western two thirds of Kansas, is becoming more developed, particularly in southwest Kansas where it accounts for about nine percent of the total groundwater wells, with 78% of them permitted for irrigation. There is also minor irrigation in the southeast corner of Kansas from the Ozark Plateau aquifer system.

Five irrigation districts are authorized at Bureau of Reclamation reservoirs in Kansas. Keith Sebelius (Almena Irrigation District), Kirwin (Kirwin Irrigation District), Webster (Webster Irrigation District), Waconda (Glen Elder Irrigation District) and Lovewell (Kansas Bostwick Irrigation District) use water stored in the reservoirs for irrigation when it is available. Conservation pool storage in these reservoirs is 463,907 acre feet after sedimentation losses. Authorized irrigated acres from these federal reservoirs is 75,303 with storage of about 16% of the conservation pools.

Kanopolis Reservoir, a U.S. Army Corps of Engineers (Corps) reservoir, had irrigation storage made available in 2012 through legislation to allow formation of a Special Access District formation.

Irrigation water available to Kansas is also stored in two out of state federal reservoirs, John Martin in Colorado and Harlan County in Nebraska. John Martin Reservoir has capacity to store approximately 338,000 acre feet for irrigation. The Kansas-Colorado Arkansas River compact allows Kansas to call for our portion of the stored water to be released from the reservoir for six active irrigation ditches in Hamilton, Kearny and Finney counties in addition to other beneficial uses. Vested authorized quantity for all six ditch companies is over 145,800 acre feet. These ditches historically irrigated approximately 70,000 acres; more recently, they have provided surface water supply to approximately 44,000 acres due to decreases in river flows entering Kansas. Some years there is not sufficient water in storage for Kansas to call for that water to be released and reach the Kansas ditches. Harlan County Reservoir has storage capacity for irrigation of 193,060 acre feet. Two irrigation districts operate as part of this federal project: the Bostwick Irrigation District in Nebraska and the Kansas Bostwick Irrigation District No. 2. Kansas Bostwick Irrigation District has a right to the stored water not to exceed 102,521 acre feet annually with a maximum diversion rate of 700 cubic feet per second (cfs) at the Superior Courtland Diversion Dam. The Courtland Canal system originates at Superior Courtland Diversion Dam, at Guide Rock, Nebraska and presently serves 42,500 acres in Kansas.

### Demand for Irrigation Water

The amount of precipitation is a major factor in quantities used each year for irrigation. Table WD-02 shows the progressive increase in irrigation water use from 2009 to 2011 as a significant drought developed in western Kansas.

The three year average water use for irrigation from 2009 to 2011 was 3,539,832 acre feet with an average of 3,365,911 acres irrigated. Irrigation accounted for 83 to 86 percent of all reported water use during 2009 to 2011, similar to 85% reported from 1990 to 2008.

**Table WD-02**
**Reported Irrigation 2009 to 2011**

| Year | Surface Water Used in Acre Feet | Acres Irrigated | Groundwater Used in Acre Feet | Acres Irrigated |
|---|---|---|---|---|
| 2009 | 189,929 | 121,474 | 2,953,542 | 2,950,031 |
| 2010 | 184,075 | 130,270 | 3,111,357 | 2,856,618 |
| 2011 | 172,745 | 138,313 | 4,008,575 | 3,063,325 |

The droughts and high temperatures of 2010, 2011 and 2012 are reflected in a greater use of groundwater, particularly for irrigation, during those years, resulting in steeper declines in groundwater levels. In 2012, the High Plains aquifer declined an average of 2.25 feet. Southwest Kansas experienced the greatest annual declines, averaging 3.5 feet in 2012 and 4.25 feet in 2011.

For the period between 2009 and 2011 shown above, the total authorized amount has exceeded the reported use. Reasons for this are numerous and include acres in conservation programs that do not require irrigation, crops grown that do not require irrigation and wells not capable of pumping the authorized quantity for a water right, among others.

Another reason for authorized quantities exceeding reported use is areas closed to new permits to divert water, indicating the area is fully appropriated. However despite many areas being closed to new appropriations, and authorized amounts exceeding reported amounts, groundwater levels have continued to decline.

### Trends in Water Use for Irrigation

In the past two decades around three million acres have been irrigated per year. During this time the technology for irrigation has changed from predominantly flood to sprinkler systems. The advent of intensive groundwater use for crop irrigation came as the ability to pump water from underground aquifers was made easier due to the availability of energy required to operate high capacity pumps. Irrigated agriculture was initially developed in Kansas using surface flood irrigation systems but has shifted to using center pivot irrigation systems, many with drop nozzles. Crop yield and irrigation water use efficiency have improved with new technologies and management, allowing more crops to be produced with the same amount of water use.

Irrigation use records beginning in 1970 indicate reported irrigation use developing (increasing into the 1980s) with some variation in quantities and acres, peaking in 1988 at a high of 4.9 million acre feet and 3.25 million acres irrigated. This is partially due to more areas closed for additional appropriation and in some cases, previously irrigated acres being converted to non-irrigation uses such as conservation programs and dry land farming.

Because many areas are now closed to additional appropriations, irrigation demand is not growing by a significant amount.

**Table WD-03**
**2010 Regional Irrigation Water Use as Reported to KDA-DWR**

| Regional Location | Points of Diversion | Water Use in Acre Feet[1] | Acres Irrigated |
|---|---|---|---|
| **Western Kansas** | | | |
| Western KS GMD 1 | 2,505 | 178,079 | 201,025 |
| Southwest KS GMD 3 | 9,731 | 1,828,072 | 1,449,200 |
| Northwest KS GMD 4 | 3,446 | 361,303 | 378,117 |
| Remainder of Western KS | 2,180 | 100,173 | 103,570 |
| **Central Kansas** | | | |
| Equus Beds GMD 2 | 1,747 | 115,268 | 129,488 |
| Big Bend GMD 5 | 4,447 | 503,815 | 455,817 |
| Remainder of Central KS | 5,076 | 147,772 | 232,667 |
| **Eastern Kansas** | | | |
| All of Eastern Kansas | 1,472 | 23,734 | 69,829 |
| **State Total** | **30,604** | **3,258,216** | **3,019,713** |

[1]Water use does not include approximately 154,021 acre feet of surface water withdrawn in 2010 under ditch irrigation water rights in southwest Kansas and by irrigation districts in north-central Kansas.