The 2021 KANSAS WATER PLAN

Kansas Water Office | KANSAS WATER PLAN

Prepared by
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Summary of Comments on draft_kansaswaterplan_081121 [comments].pdf

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A few overall points regarding formatting:

1) The fonts and font sizes throughout the document are not consistent. This makes it very difficult to read in some cases.

2) The formatting for the paragraphs throughout the document is inconsistent and difficult to read in some cases.

3) The text boxes in the throughout the document have the text cutting across lines in weird places making them difficult to read. The overall formatting of these sections seems odd as well.

Acknowledgements

OF THE KANSAS WATER PLAN

The *Kansas Water Plan (KWP)* is, by design, the product of numerous contributors. The levels of expertise, insight and experience necessary requires the involvement and participation of ~~a number of~~ [1] state agencies, local entities, individuals and stakeholders.

Many thanks go to Governor Laura Kelly, the Kansas Water Office as well as the following:

- Kansas Department of Agriculture (with its Division of Water Resources and Division of Conservation)
- Kansas Department of Health and Environment
- Kansas Department of Wildlife and Parks
- Kansas Geological Survey
- Kansas Biological Survey
- Kansas Department of Commerce
- Kansas Corporation Commission
- Kansas State University
- University of Kansas

Recognition also goes to the members of the Kansas Water Authority, Regional Advisory Committees statewide, Groundwater Management Districts, numerous entities, stakeholders and individuals whose input proved invaluable in the development of this *KWP*.

This document would not be possible nor complete without countless source materials providing much of the information and analysis provided in this report. The work of numerous professionals is relied upon and cited throughout this report, with links to those works embedded within the text of the *KWP* to guide readers to the primary documents and additional information.

The Kansas Water Office (KWO) also provides a separate annual *State of the Resource* report that operates as a companion to the *KWP*. This complementary document provides a status check on the various water issues and programs identified in the *KWP*, on a more frequent basis.

IMPACTS OF COVID-19 PANDEMIC

It should be noted that publication of this updated KWP is a bit delayed. This delay was primarily caused by the disruptive impacts of the COVID-19 pandemic. This report reflects the admirable efforts of so many to overcome that challenge. As was true of nearly every aspect of life, the COVID-19 pandemic, beginning in the spring of 2020, interrupted and upended the anticipated schedule for development, stakeholder input and completion. Notably, this KWP is the first to include goals and action plans provided by the 14 Regional Advisory Committees. The pandemic prevented these committees from meeting in person. In order to gather in some fashion and develop this content, the RACs met virtually, collaborating through online communications, via phone calls and computer screens. The same was true for the Kansas Water Authority and all the state agencies whose input has been critical to the preparation of this document.

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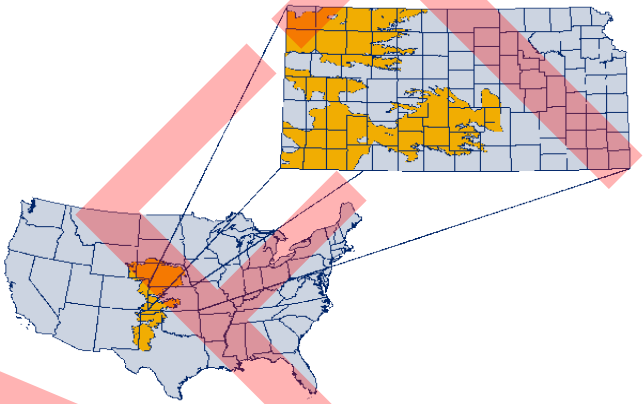
Guiding Principles

OF THE KANSAS WATER PLAN

(1) Conserve and Extend the High Plains Aquifer

This network of underground water sources serves as the primary water supply for much of central Kansas and most of western Kansas. The High Plains Aquifer has three components in Kansas: the Ogallala Aquifer, the Great Bend Prairie Aquifer and the Equus Beds Aquifer. Of these three, the Ogallala is suffering the most severe depletion, with some areas already effectively dry in terms of economic feasibility. It is not an overstatement to say that the future of habitability in much of western Kansas is at stake; water users of all kinds will need to adopt practices amendable to less groundwater use if these populations and economies are to remain viable.



(2) Secure, Protect and Restore Our Kansas Reservoirs

Kansas has fourteen federal reservoirs which supply water for two-thirds of the state's population. A critical issue facing these reservoirs is sedimentation, which has been reducing storage capacity at these reservoirs, some to an alarming level. Tuttle Creek Lake, for example, which serves users throughout the entire Kansas River Basin, is at 51% capacity (as of the 2020 bathymetric reservoir survey) due to sedimentation. Other challenges include Harmful Algal Blooms (HABs) with toxicity levels that threaten public health, and contractual financial obligations the state carries due to contracts with the federal government for storage and local use of the water in federal reservoirs.

technologies may provide options for safely passing accumulated sediment downstream, while improved land use practices upstream help prevent excessive sedimentation from entering reservoirs.

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Guiding Principles

OF THE KANSAS WATER PLAN CONTINUED

(3) Improve the State's Water Quality

The primary agency charged with assessing and managing water quality is the Kansas Department of Health and Environment (KDHE), although other agency partners have roles to play, as well. KDHE is the state entity that administers the federal Clean Water Act. Water quality issues affecting surface waters include nutrients, sedimentation, HABs and nitrate contamination. Groundwater quality is threatened by mineralization (uranium, selenium), chloride contamination and nitrates. KDHE assesses and monitors surface waters and groundwater throughout the state, maintaining and sharing essential data such as the List of Impaired Waters (Section 303(d) List). KDHE administers the Water Restoration and Protection Strategy (WRAPS) program, a framework that engages citizens and other stakeholders in a teamwork environment aimed at protecting and restoring Kansas watersheds. On another front, ~~a number of~~ innovative water reuse programs are demonstrating the economic and environmental benefits of re-purposing water as compared to sole reliance on single-use supplies.

(4) Reduce Our Vulnerabilities to Extreme Events

Effective water planning must account for the occurrence of extreme events, such as droughts and floods. As already evident from climate change, these events are becoming more intense and less predictable. The *KWP* acknowledges that employing state of the art science and technology is imperative to securing a safe, secure water supply for the state. Municipal conservation plans, public water supply emergency response plans, and proper reservoir management in partnership with the federal government are among the essential tools and strategies to prepare for, and respond to, extreme events. This is an area in which adaptive planning is particularly critical, ~~in order~~ to understand how and when extreme events are likely to occur and, ideally, how to create policies and plans that will prevent as much damage as possible.

(5) Increase Awareness of Kansas Water Resources

The water planning process in Kansas relies heavily on public and stakeholder input. Perhaps the most consistent message received from these entities is the need for increased education and outreach. Success in dealing with water problems is far more likely when the public is aware, concerned and engaged. Indeed, success is unlikely without it. This was a key principle in the *Vision*, which contained recommendations that remain relevant, such as including water conservation in academic curriculum at all levels, providing outreach events and opportunities for public involvement, and implementing a social marketing campaign statewide. The *Kansas Runs on Water* marketing campaign has been launched to achieve this goal.

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Brief History

OF KANSAS WATER PLANNING

The *KWP* is one of the primary tools used by the State of Kansas to address current water resources issues and to plan for future needs. The *KWP* guides coordination of local, state and federal actions. Statutory authority and basic guidance for formulating the *KWP* is contained in the State Water Resources Planning Act.

Early Planning Efforts

Kansas water issues have been studied, characterized and documented since creation of the Kansas Water Commission in 1917. The commission was directed by the legislature to "work out a systematic general plan for the complete development of each watershed in the state". The commission produced a 400-page report, "*Surface waters of Kansas, 1895-1919*." In 1927, the commission was dissolved and replaced with the Division of Water Resources within the State Board of Agriculture (K.S.A. 74-506, et seq.). The Legislature again directed that "general plans for the complete development of each watershed in the state" be prepared. Funding was not provided, and it was not until 1947 that the first report was officially prepared.

As many as 50 companies are thought to have made windmills in Kansas between 1880 and the mid-1950s.

During these years, the emphasis was on data gathering to characterize the water resources of the state. Many technical studies were prepared as officials recognized that to assess needs and identify priorities, baseline conditions of water resources across the state needed to be established.

1950s to 1960s

Disastrous widespread flooding in 1951 followed by severe droughts in the mid-1950s focused attention on weather extremes of the state. In 1954, funding for a comprehensive water resource study was allocated from the State Emergency Fund. The resulting document "*Water in Kansas*" was presented to the Governor and Legislature on January 2, 1955. A key recommendation was "to provide the necessary organizational structure, personnel and funds to prepare and maintain a state plan of water resources development." The Kansas Water Resources Board (KWRB) was established in 1955 to fulfill this recommendation. The KWRB determined that the 12 major river basins in the state would delineate hydrologic boundaries for subsequent resource inventories, problem identification and planning needs that were compiled between 1955 and 1963.

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Brief History

OF KANSAS WATER PLANNING CONTINUED

The culmination of this work was the State Water Plan Act of 1963 which mandated the preparation of a state water plan by the KWRB in cooperation with other agencies. In 1965, the KWRB submitted a draft of proposed legislation which was enacted as the *Kansas Water Plan.*

Flood of 1951, Topeka Municipal Airport

During the 1960s, the KWRB prepared reports on special water districts, groundwater, water quality control needs, irrigation, water law, and water demands for industrial, municipal and rural domestic uses. Over the next decade, KWRB became an important partner with local and state stakeholders and the federal government in many water resources development projects. These included the construction of federal dams and reservoirs by the U.S. Army Corps of Engineers (USACE) and the Bureau of Reclamation (USBR), construction of watershed dams by the U.S. Department of Agriculture (USDA) Natural Resource Conservation Service (NRCS) and development of rural water districts using financial assistance from the USDA Farmer's Home Administration. Much of this activity was federally driven and some state laws were developed to complement federal programs. Water resource development was in full swing during these decades.

1970s to 1980s

Continuing into the 1970s, the KWRB expanded into studies of mineral intrusion areas as well as placing increased emphasis on conservation and management in the *KWP*. By the 1970s, rising costs and public environmental concerns altered the water resources development landscape. The era of intense water resources development was coming to an end as the need for a more management-oriented approach to water resources was recognized. Drought again gripped much of Kansas in 1976 and there was increasing concern about rapid depletion of groundwater supplies in western Kansas. Recognizing this change in priority, the Governor's Task Force on Water Resources was created in 1977. The Task Force reinforced the importance of the *KWP* in achieving interagency coordination for water resource and policy planning. A proposed reorganization to consolidate the functions of the KWRB, the Kansas Department of Agriculture -Division of Water Resources (KDA-DWR) and the water related functions of the Division of Environment of KDHE was discussed but not recommended.

Siphon Irrigation, tubes were used to take water from a canal and distribute it through channels in the field.

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Brief History

OF KANSAS WATER PLANNING CONTINUED

2000s

With a new century came a renewed evaluation of the water planning process. In 2002, an extensive review of water resource agencies was again undertaken. An enhanced coordination process was established, including a Natural Resources Subcabinet comprised of agency executives named by the Governor. The subcabinet met weekly through 2011 to discuss and coordinate common issues. While the authority establishing the Subcabinet was not renewed, agency personnel have continued to meet regularly, recognizing the benefit of enhanced communication and agency coordination.

Beginning in 2013, the Governor requested the development of a *50-year Long-Term Vision for the Future of Water Supply in Kansas*. A team comprised of the KWO, KDA and KWA conducted more than 600 public meetings, received input from more than 15,000 stakeholders, collected data and conducted research over a period of a year. As reflected in the mission statement, the overall purpose of the document was to "Provide Kansans with the framework, policy and tools, developed in concert with stakeholders, to manage, secure and protect a reliable, long-term statewide water supply while balancing conservation with economic growth." Since its publication in 2015, *The Vision* (as it was commonly called) provided guidance statewide for long-term management of water. Its initial focus was on ensuring adequate quantity, although it also reflected water quality concerns. The KWA and RACs, among others, referenced *The Vision* during ~~the course of~~ their program planning and budget recommendation activities.

While *The Vision* served a useful purpose, its role was as an advisory document and it focused primarily on water supply, not quality. In contrast, the overarching water policy, planning and management document has remained the *KWP*, as mandated by statute. In the interest of clarity and strength of purpose and message, this 2021 version of the *KWP* has been developed to incorporate relevant aspects of *The Vision*, to create a single document to address current water needs, both quantity and quality, and to address future needs to ensure a long-term reliable safe supply of water for Kansas. The process of composing the *Guiding Principles* and the regional sections of this *KWP* involved careful review of pertinent sections of *The Vision* for inclusion into the *KWP* where appropriate.

> **"The writing is on the wall and if we don't act today, our future is bleak." At this rate, with no changes in the next 50 years, the Ogallala will be 70 percent depleted and our reservoirs will, on average, be 40 percent filled with sediment, with some already at this low level.** *- The Vision*

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Brief History

OF KANSAS WATER PLANNING CONTINUED

The KWA, through the state water planning process, annually recommends to the Legislature and the Governor how the SWPF should be allocated, in accordance with the programs and priorities identified in the *KWP*. The KWO is charged with administering the SWPF payments. These payments from the SWPF are made by the KWO to the state agencies that implement the programs identified for funding through the budgeting process ending with the legislative appropriation actions. The agencies receiving typically receiving SWPF payments are the KDHE, the KWO and the Kansas Department of Agriculture's Division of Water Resources (KDA-DWR) and Division of Conservation (KDA-DOC). These agencies receive portions of the SWPF associated with the programs they respectively implement.

While the SWPF is a fund specifically dedicated by statute to implement the *KWP* (including $6 million to come from the SGF and $2 million to come from the EDIF), for several years the Legislature has consistently appropriated significantly less than those amounts. As of 2021, the cumulative deficit in the SWPF for the prior 13 years was approximately $80 million. The SWPF appropriation for the next fiscal year remains below the statutory mandate.


The Topeka Capital-Journal

Legislature adjourns record-long session

Dramatic arrival of senator for vote caps closing day

The KDA-DOC is the largest recipient and utilizes funds for the following programs: Water Resources Cost Share Program, Aid to Conservation Districts, Multipurpose Small Lakes Program, Nonpoint Source Program, Watershed Dam Construction, Water Quality Buffer Initiative, Conservation Reserve Enhancement Program (CREP), Water Supply Restoration Program and Riparian and Wetland Protection Program.

The KDHE uses the SWPF for Contamination Remediation, Total Maximum Daily Load (TMDL) Initiatives, WRAPS, and the Nonpoint Source Program. The Kansas Department of Wildlife and Parks (KDWP) uses funds to support stream biological monitoring among other programs. The KDA-DWR uses SWPF to address Interstate Water Issues and Subbasin Water Resources Management. The Kansas Geological Survey (KGS) utilizes funds for Assessment of the Ogallala-High Plains Aquifer.

The KWO uses funds for Assessment and Evaluation, Geographical Information System (GIS) Database Development, Reservoir Storage Operation and Maintenance, Technical Assistance to Water Users, Water Resource Education, Weather Stations, Weather Modification.

Use of the funds by the recipients may vary from year to year. However, the above uses are typical of SWPF expenditures in the timeframe of this plan.

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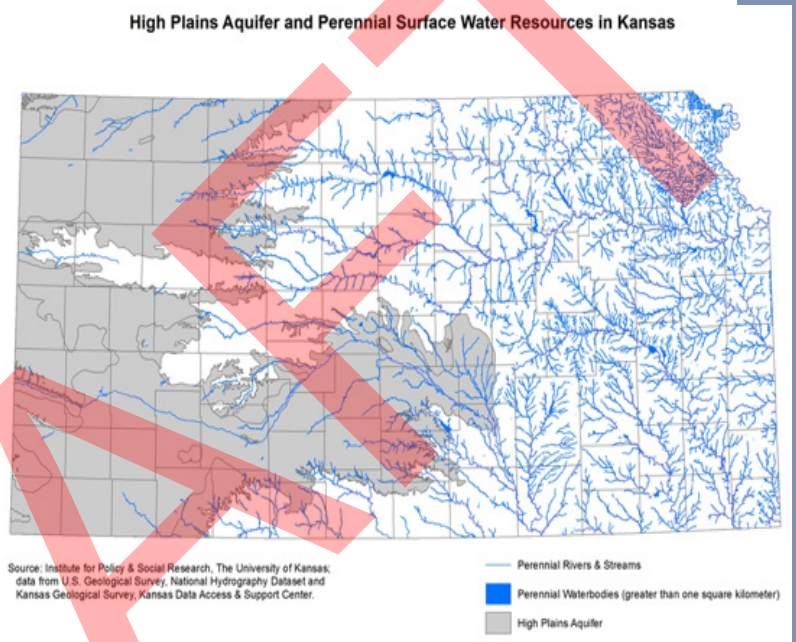
Management of

WATER IN KANSAS CONTINUED

Management of Kansas groundwater and surface water fits into six categories:

- River-reservoir management;
- Stream reaches with established Minimum Desirable Streamflow (MDS)
- Streams outside of MDS protected areas
- The Ogallala-High Plains Aquifer;
- Groundwater outside of the Ogallala-High Plains Aquifer
- Interstate water management

In addition to state laws and policies for water management, other significant management entities include Groundwater Management Districts (GMDs), public water suppliers, conservation districts, watershed districts and individuals who make wise water use decisions.



Overall, Kansas water resources present daunting challenges as to supply availability and safe quality. Effective short and long-term management, including significant reduction in groundwater use and practices to improve surface water contamination as well as address sedimentation are crucial to assure an adequate supply of safe water for the future. Potential for development of new water resources is very limited.

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This phrasing seems odd. Suggest revision.

Conserve & Extend the High Plains Aquifer

Background

The High Plains Aquifer (HPA) is the largest, most economically important groundwater source in Kansas. It underlies western and ~~south central~~ Kansas and is composed of several hydraulically connected aquifers(1). The Ogallala, which is the largest of these, occurs in the western third of Kansas, an area that is semi-arid with limited surface water. The eastern extension of the HPA is composed of younger sediments that make up the Great Bend Prairie and Equus Beds aquifers. Lying above the Ogallala Formation are Pleistocene and younger stream valley deposits that bear water. Where these are connected to the underlying aquifer, they are considered part of the HPA.

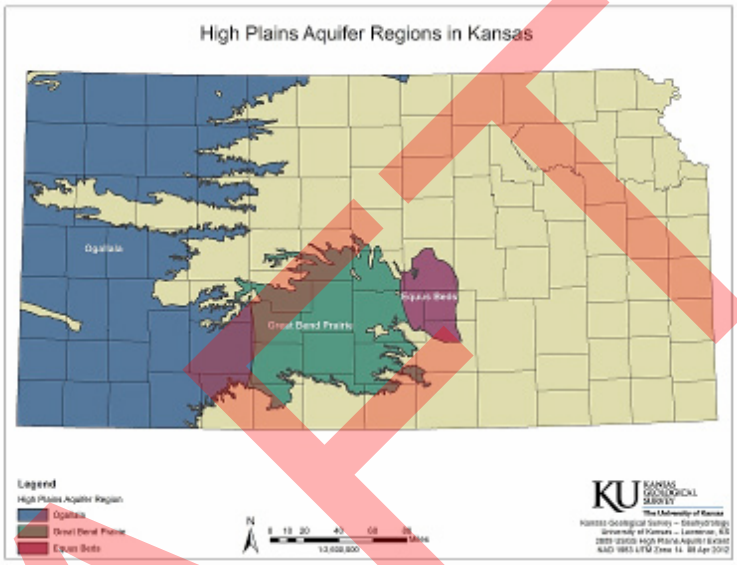

Figure 1. Map of the High Plains Aquifer in Kansas[1]

In western and ~~south central~~ Kansas, groundwater has historically been the most reliable source of large volumes of water for irrigation, stock watering, municipal, and industrial use. To date, there have been over 50,000 water rights approved in all of Kansas with a majority of those approved for groundwater use in the HPA (~~figure~~ (1).

The total average reported irrigated acres for 2010 to 2020 in the HPA is estimated to have been around 2.7 million acres(22). Corn has been the most ~~commonly grown~~ crop in the HPA region in recent years. Given that corn may need up to two feet of water per acre per year, the HPA region may require up to 5.58 million acre-feet of water per year to grow corn and other crops. Although this total includes contribution from precipitation and some surface water, groundwater from the HPA has and will continue to be a very significant source of supply for crop production throughout the state.

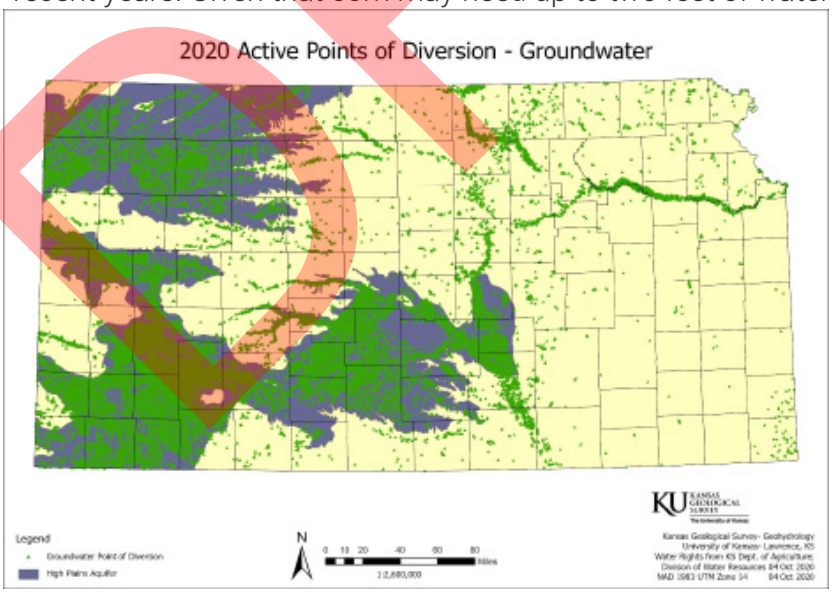

Figure 2. 2020 active groundwater points of diversion in Kansas[1]

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south-central

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Conserve & Extend the High Plains Aquifer

When pumping exceeds the amount of water that recharges an aquifer, groundwater declines occur (Figure 3)[1]. In the HPA, water levels are measured by the Kansas Geological Survey (KGS) and the Division of Water Resources, Kansas Department of Agriculture (KDA-DWR) each winter in approximately 1400 wells, primarily irrigation wells[25].

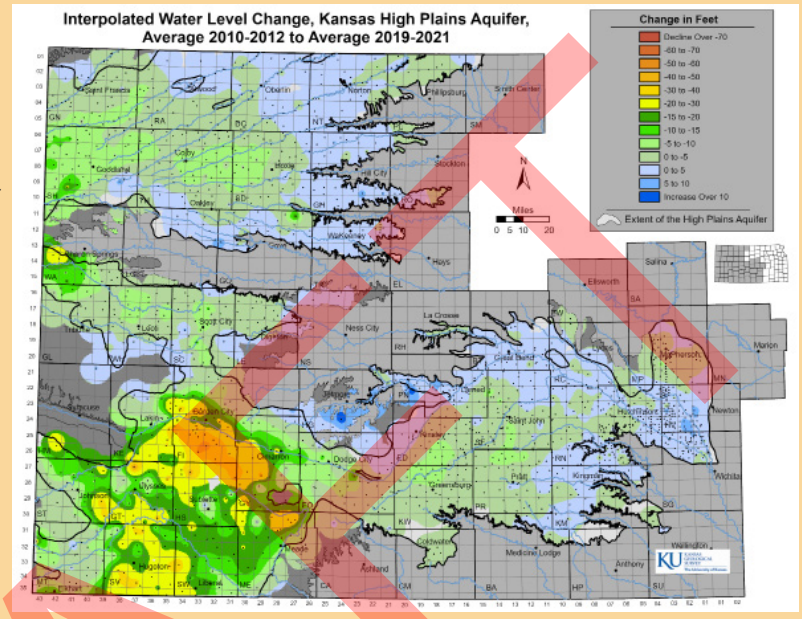

Figure 3. High Plains Aquifer region in Kansas showing the total water-level changes from 2010-2012 to 2019-2021[1]

Kansas has more than 35,000 wells with active water rights; over 27,000 of these wells overlie the HPA, with approximately 87% of them used for irrigation[25]. Groundwater levels have appreciably declined over the Ogallala region of the aquifer since the onset of substantial irrigation development (1940s to 1950s in most areas). The water levels have dropped so much in some areas of the Ogallala region that less than 40% of the original saturated thickness is left[25].

According to the KGS, the average declines in groundwater levels in the Ogallala region since predevelopment are 25 ft, 56 ft, and 103 ft for Groundwater Management Districts (GMDs) 4, 1, and 3, respectively. The average aquifer thicknesses remaining in GMDs 4, 1, and 3 are 69 ft, 31 ft, and 151 ft, respectively[25].

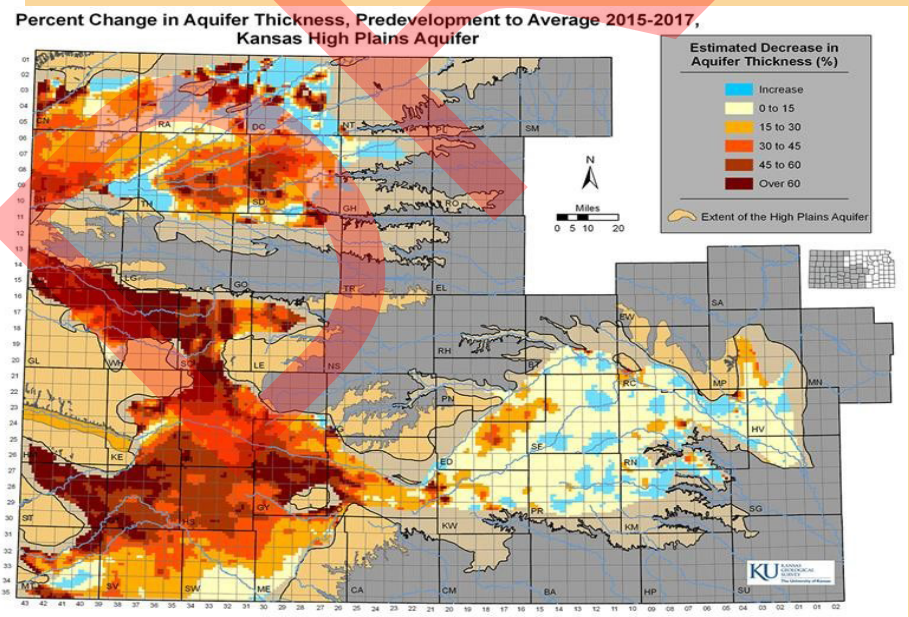

Figure 4. High Plains Aquifer region in Kansas showing the various reductions in availability of water from the time before large scale irrigation to the period 2015-2017. The darker the color, the larger the reduction in saturated thickness (water availability). [1]

During the period of 1996 to 2016, the trends in the average annual water-level decline and the cumulative water-level declines for the three GMDs in the Ogallala region have been the following:

- GMD4: steady decline rate; average -0.60 ft/yr; cumulative -12.6 ft
- GMD1: steady decline rate: average -0.50 ft/yr; cumulative -10.4 ft
- GMD3: increasing rate of decline; average -1.69 ft/yr; cumulative -35.4 ft. (Id.)

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, Groundwater Management Districts (GMDs),

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Conserve & Extend the High Plains Aquifer

The GMDs located over the Equus Beds and Great Bend Prairie segments of the High Plains Aquifer in south-central Kansas (GMD 2 and GMD 5, respectively) manage the aquifer based on safe yield policies, where the amount of water allowed for appropriation under water rights must be equal to or less than the amount of recharge, depending on the impact on water quality and minimum streamflows[26].

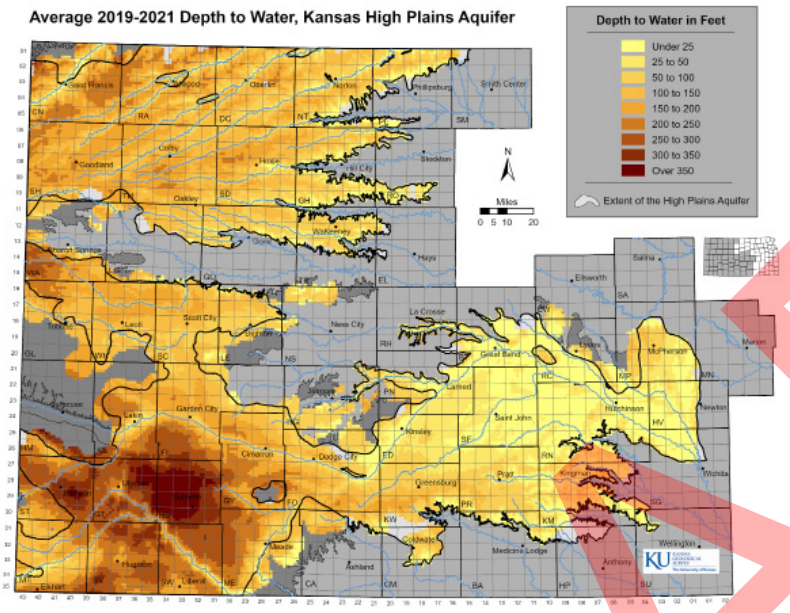

Figure 5. High Plains Aquifer region in Kanas showing the average depth to water for 2019-2021[1]

~~The GMDs located over the Equus Beds and Great Bend Prairie segments of the High Plains Aquifer in south-central Kansas (GMD 2 and GMD 5, respectively) manage the aquifer based on safe yield policies, where the amount of water allowed for appropriation under water rights must be equal to or less than the amount of recharge, depending on the impact on water quality and minimum streamflows~~[2].

The GMDs overlying the Ogallala portion of the HPA do not impose this kind of safe-yield limitation. To do so would require substantial decreases in the amount of water used. In studies to determine the amount of reduction in use needed to hold at the current rate of decline, much less achieve safe yield, would require 27% reduction in GMD4, 31% in GMD1 and 33% in GMD3. These reductions are averages for each district; greater reductions would be needed in the areas of more intensive water use. In addition, the KGS notes that these values are considered to be short-term, applicable to only 10 to 20 years, with more reductions required beyond then[25]. These levels of reduction in water use would affect all users dependent on the Ogallala Aquifer, calling for a shift in behaviors for towns, farms, feedlots and industries, among others. Because agricultural water use (irrigation and stockwatering) comprises most of the water use from the Ogallala Aquifer, the widespread adoption of meaningful, and feasible, water-saving practices is essential. The climatic changes underway intensify this need ~~all the~~ more[3].

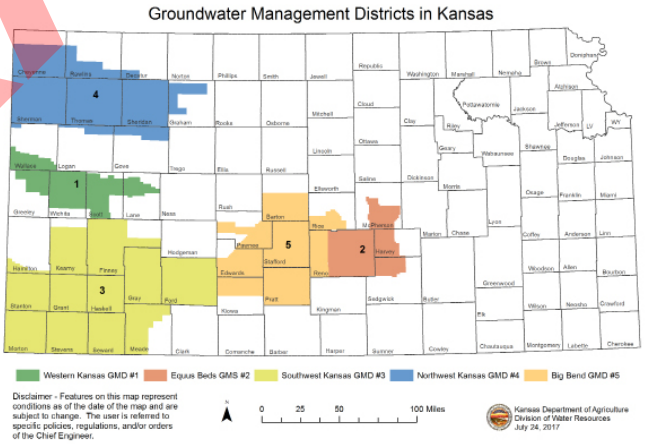

Figure 6. Groundwater Districts in Kansas[2]

The Ogallala Aquifer supports an extensive agricultural complex, including irrigated crops, a large cattle and dairy industry and biofuel plants. Each of these economic drivers requires water, as does each municipality's population and the services they provide for themselves and the surrounding regions. The continued existence of these economic activities, and the communities they support, relies on protecting and preserving the Ogallala Aquifer.

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Conserve & Extend the High Plains Aquifer

Management Approach

The HPA is essential to the economy and environment, as well as to the well-being of our citizenry. A variety of local, state and federal entities are charged with the duty to help implement water conservation efforts within the region. These entities assist producers through cost-share and incentives programs, conservation and environmental programs, and education and outreach efforts. The entities responsible for providing these services include local groundwater management districts, KDA-DWR, Kansas Water Office (KWO), Kansas Department of Agriculture's Division of Conservation (KDA-DOC), Kansas Department of Health and Environment (KDHE), Kansas Geological Survey (KGS). K-State Research and Extension, United States Department of Agriculture's Natural Resources Conservation Service (USDA-NRCS), United States Department of Agriculture's Farm Services Agency (USDA_FSA) and local conservation districts.

In addition to these voluntary financial assistance programs, regulatory mechanisms exist to ensure the lawful use of water and to secure reductions in use when necessary to preserve the availability (and sometimes the quality) of a given water supply. The KDA-DWR administers the Kansas Water Appropriation Act, K.S.A. 82a-701, et seq., which, among its provisions establishes a "first in time, first in right" doctrine for priority among water rights during times of shortage, regardless of type of use. The KDA-DWR is also mandated by law to administer this rule between water right owners when an impairment complaint is lodged. The KDA-DWR has also required the installation of water flow meters on diversion works for water rights across the state, which has allowed data-driven management decisions and supported research empowering effective conservation strategies.

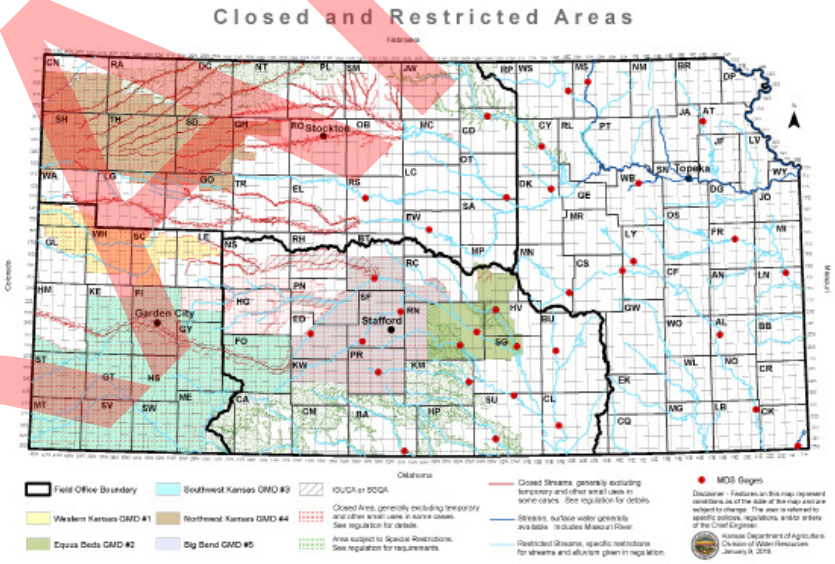

Figure 7. Closed and restricted areas in Kansas to new water appropriations and the Groundwater Management Districts[2]

Kansas water law also allows the KDA-DWR to establish Intensive Groundwater Use Control Areas (IGUCAs) in ~~specifically identified~~ areas where a declining groundwater supply meets certain critical criteria. There are currently eight IGUCAs, the most recent having been established in 1992 (Walnut Creek IGUCA).

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Conserve & Extend the High Plains Aquifer

Regional Conservation Efforts

Cost-Share & Incentives

- Water Transition Assistance Program (WTAP): A program offered by KDA-DOC that pays water right owners in targeted areas that are closed to new water rights appropriations, to permanently dismiss all or a portion of their active water right(s)[3].
- Conservation Reserve Enhancement Program (CREP) – Kansas Upper Arkansas River: USDA-FSA offers a program to producers in the Upper Arkansas River counties in Kansas that pays irrigators to permanently transition acreage out of irrigated production and into grasslands or other conservation practices[4].
- Irrigation Technology Initiative: KDA-DOC offers cost-share funds to assist landowners with irrigation efficiency technology. This initiative is designed to promote irrigation efficiency and water conservation by providing cost-share assistance to landowners for automated soil moisture probes[6].
- Environmental Quality Incentives Program (EQIP): USDA-NRCS program that provides financial and technical assistance to producers to implement water conservation practices[7].

Conservation & Environment

- ~~Regional Advisory Commitee (RAC): Regional planning committees were established by the Kansas Water Authority (KWA) to focus on priority goals for the region and develop an action plan to help address water concerns and other issues within their region[8].~~
- Local Enhanced Management Area (LEMA): A program that allows a GMD to take action to conserve water usage in ~~portions or all of~~ their district. If recommended by the GMD and ordered by the Chief Engineer, the conservation measures temporarily override the appropriated water rights in the region. A LEMA has the potential to be highly effective due to local commitments and changes in farming practices[9].
- Water Conservation Areas (WCA): A program offered by KDA-DWR that allows individual farms the flexibility of their water right(s) on their land for a limited time ~~period~~, as long as they officially agree to reduce water use during that period[10].

Education & Outreach

- KState Research and Extension (KSRE): Offers information and guidance through their Mobile Irrigation Lab, KanSched, and Crop Water Allocator that help producers make the most efficient, economic use of their crop water. KSRE is looking into more water-tolerant crops and experimenting with multiple crop varieties ~~order~~ to learn what works best in different climates and if any new crop variety can be obtained for further water conservation[11].
- Water Technology Farms (Water Tech Farms): KWO collaborates with producers and other partners to help demonstrate and educate other producers on the benefits of utilizing new irrigation technologies, practices, and services[12].
- HPA Index Well Network: A KGS program that is focused on developing an improved understanding of aquifer dynamics at scales appropriate for management. The program has a monitoring network of 25+ wells with much of the data being presented in real-time on the KGS website to allow Kansans to understand conditions in the HPA in their area. An additional goal is to directly examine water resource issues and areas of particular interest to the GMDs and KDA-DWR[13].

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Number: 2 Author: GMD5 Subject: Comment on Text Date: 9/22/2021 10:29:29 AM
Since the RACs are advisory to KWA and an outreach for information at the regional level, suggest this be moved to the education and outreach section below.

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Committee

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Number: 5 Author: GMD5 Subject: Cross-Out Date: 9/22/2021 11:54:38 AM

Number: 6 Author: GMD5 Subject: Cross-Out Date: 9/22/2021 10:29:42 AM

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Regional Advisory Commitee (RAC): Regional planning committees were established by the Kansas Water Authority (KWA) to focus on priority goals for the region and develop an action plan to help address water concerns and other issues within their region(8).

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Conserve & Extend the High Plains Aquifer

In addition to the index well program, the KGS and KDA-DWR measure roughly 1,400 wells across the HPA each winter to monitor regional changes in the groundwater supply. The data collected can be accessed through the KGS WIZARD Water Well Levels Database available on the KGS website[24].

Precipitation-based aquifer recharge is highly variable across Kansas. It can be influenced by a variety of factors including depth to water, intensity of water inflow, total precipitation and rate, temperatures, soil types, and regular land use. Research is also being conducted to explore if there is a potential recharge source from the 20,000 plus playa lakes[14] in central and western Kansas. While infiltration of water at the land surface is helpful, it may take years, decades, or even longer, for a drop of water to travel from the surface to the water table, depending on the location, depth, and material in the subsurface. The best method to keep groundwater available longer is to pump less.

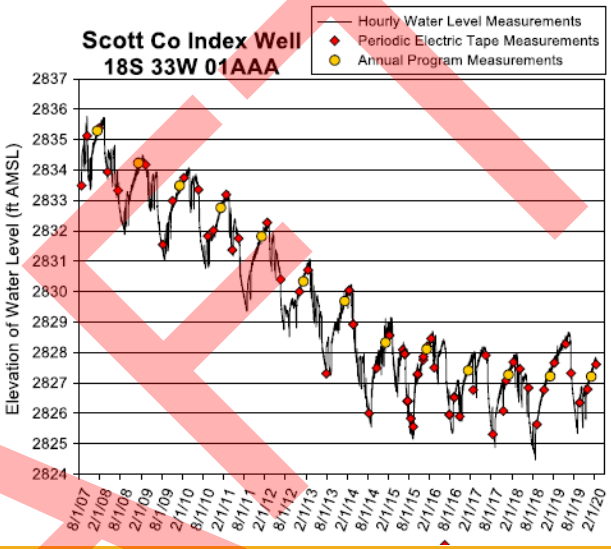

Figure 10. Scott County index well hydrograph. The increase in water level from 2018 to 2019 was due to a lengthy recovery period with virtually no pumping; the bottom of the aquifer is at an elevation of 2,744 ft[13]

Groundwater rights in Kansas allow for specific maximum annual authorized quantities can be pumped year to year. Water right holders have incentives to individually use all they are entitled to, to reap short term benefits, causing water declines to be spread across many users. However, some users are successfully managing the common aquifer with locally-developed plans that have clearly defined goals, rules and regulatory oversight. An example of this is the LEMA program[9].

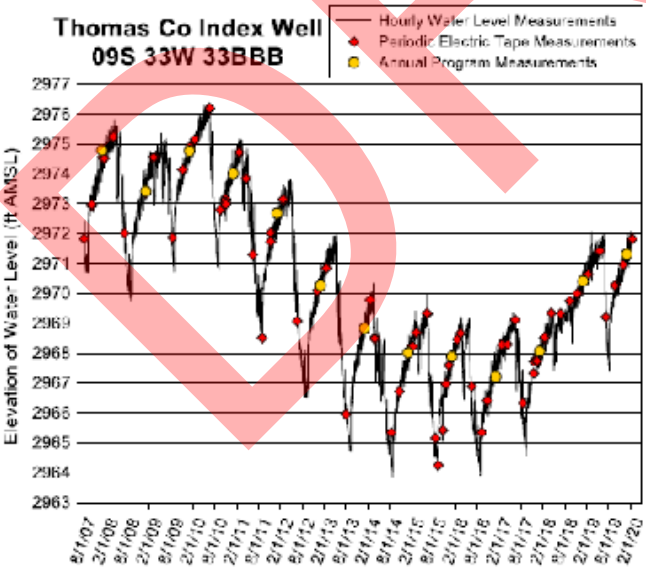

Figure 11. Thomas County index well hydrograph. The water-level increase in 2018 was due to a late-spring hailstorm that destroyed the crops in the immediate vicinity and ended the 2018 pumping season; the bottom of the aquifer is at an elevation of 2,904 ft[13]

Sheridan County 6 (SD-6) was the first approved LEMA in Kansas. After initially meeting a water conservation goal of 20%, they almost doubled it, reducing withdrawals by 39%. LEMA participants renewed the program for another 5-year cycle in 2018[15]. GMD4 has since developed another LEMA, which regulates nearly their entire district[15]. The success of GMD4's execution of LEMAs has motivated other GMDs to look towards implementing them within their regions as well, with GMD1 initiating a new one in Wichita County in 2021[16].

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and GMDs

Conserve & Extend the High Plains Aquifer

In April 2015, a new law established WCAs[10]. WCAs are a simple, streamlined, and flexible tool that allows any water right owner or group of owners the opportunity to develop a management plan to reduce withdrawals[1] ~~in an effort~~ to extend the usable life of the aquifer in their area. As of 2021, KDA-DWR has approved 53 WCA plans in the HPA region with a total of over 86,000 irrigated acres.

Water Tech Farms continue to showcase the latest in irrigation technology, field-scale research, and water conservation efforts[12]. The farms are public-private partnerships that began in 2016 and continue to demonstrate producers can reduce water use and input costs while increasing overall profitability. This program is for the demonstration of technologies, such as:

- soil moisture probes.
- mobile drip irrigation (MDI).
- sub-surface drip irrigation (SDI).
- more efficient nozzle packages
- variable rate pivot systems, observational index wells.
- farm weather stations.
- direct crop sensing probes.
- dairy ice sweepers and water reuse systems.
- services that include aerial imagery, soil sampling and mapping.
- soil health analysis.
- water tracking.
- cover crops.
- no-till farming practices.

Northwest Kansas Technical College Water Technology Farm

With growing interest each year, more and more producers are realizing the impact that water-smart technology can have on their operations and the water-saving benefits for future generations.

Recent studies show that by using less water and introducing new farming practices, the same amount of yield or more can be produced[27]. Crop varieties are also being introduced that use less water. By encouraging producers in the region to consider adopting new tools and practices, the concept of "less water use with a greater economic return" is being realized. These new water-saving and profit-enhancing practices have generated innovative partnerships between producers, private entities and regulators. In improving soil health, these practices help the soil retain water, enhancing drought and flood resiliency and boosting water quality. Of particular importance, as climate change impacts our world, is the fact that soil health practices sequester carbon into the soil at a time when reducing carbon emissions is critical to our planet. Corporations are increasingly seeking to partner with, and financially support, producers who implement soil health practices. In so doing, the corporations benefit by reducing their carbon emissions, obtaining carbon credits, meeting consumer demand for more climate-friendly processes, and/or qualifying for sustainability investment ratings[28].

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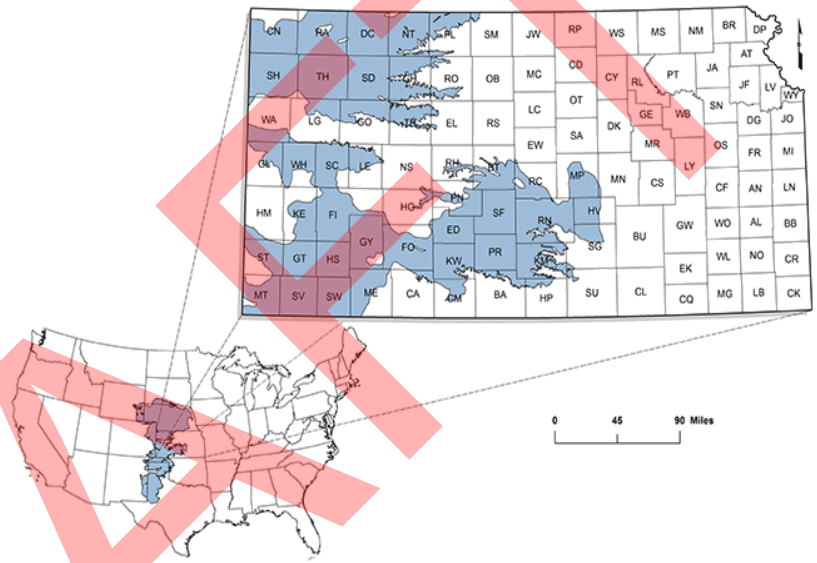
Conserve & Extend the High Plains Aquifer

For example, General Mills has partnered with KDHE, the Ecosystem Services Market Consortium and the Cheney Lake Watershed Inc., to implement new technologies and management strategies with 24 farmers in five Kansas counties to improve soil health, reduce water use and nutrient runoff, while increasing yields. In addition, Truterra, the sustainability business and subsidiary of Land O'Lakes, has launched TruCarbon, a new carbon storage program to help farmers generate and sell carbon credits to private-sector buyers, maximizing the value and return for farmers with premium carbon credit value(30).

Further efforts that have taken place in the HPA region are with the Ogallala Water Coordinated Agriculture Project (OWCAP), a project funded by the United States Department of Agriculture National Institute of Food and Agriculture (USDA-NIFA) to provide multidisciplinary research and outreach focused on addressing issues related to groundwater declines and long-term agricultural sustainability in the High Plains region.(17). The OWCAP team's research aims to help producers and other decision-makers in the region to sustain productive and profitable agriculture and to advance the knowledge needed to mitigate risks related to the aquifer's decline.(18)



In 2018, OWCAP and the Kansas Water Office hosted the first Ogallala Aquifer Summit which for the first time ever brought all Ogallala state together to discuss this vital resource. During the Summit attendees participated in interactive workshop sessions, panels Q&A periods, and heard from the featured Kansas Water Technology Farm (19) producers. A report summarized the ideas and input shared and identifies 'next steps' needed to continue the momentum generated at the Summit for cross-state relationship building and collaboration (19,20)

Another Summit took place in 2021 that was hosted virtually. The ~~even~~ [1] as designed to build on and expand beyond the information shared and activities catalyzed by the inaugural 2018 summit. It aimed to increase networking and collaboration among the region's agricultural water management and sustaining the vitality of the High Plains region communities; and identify common vision, practices and opportunities applicable across state lines to benefit the aquifer and regions. More than 200 individuals participated in the summit including, producers, water district and city managers, technology and commodity group representatives, state and federal agency staff, university/extension staff, students and others. Keynote speakers and panelists served as springboards for thought -provoking and action-oriented discussions among participants (21) Helping to educate and change the mindset of Kansans in the HPA region is crucial for helping to conserve water.

Another outcome of the 2021 Ogallala Summit was the increased attention to the impacts of direct and indirect financial incentives for irrigators to use more groundwater than may be necessary for either profitability or productivity. Banking, insurance and property valuation influences can all encourage and reward the unnecessary use of groundwater. For example,

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event

Conserve & Extend the High Plains Aquifer

Implementation Actions

- Continue to share pertinent HPA information.
- Develop a curriculum to be taught in schools explaining the past, present, and future of the HPA and related issues.
- Continue to bring the eight Ogallala states together to work on collaborative projects.
- Pursue opportunities to facilitate recycling and reuse of stockwater and other sources.
- Collaborate with crop consultants and other agricultural advisors to support farmers interested in water conservation and less water-intensive crop production.

Data, Research, and Studies

- Continue evaluation of emerging innovations on Water Tech Farms in collaboration with KSU and other partners.
- Expand research on drought tolerant and ~~low water~~ crops to determine suitability for area.
- Expand research on optimum plant development stages to determine most efficient irrigation water application.
- Provide the public with reports that include studies demonstrating the benefits of pumping less water.
- Evaluate and identify most efficient system technologies for use by Kansas irrigators.
- Evaluate and identify ways to create new and strengthen existing markets for less water-intensive crops.

Funding and Resource Needs

- Fully fund the KWP.
- Coordinate with the Kansas Department of Commerce and the Marketing Division of the KDA to consider incentives to recruit businesses and focus economic development on businesses that value water conservation, use water-efficient technologies, and reduce the removal of water from the state.
- Encourage value-added processing within Kansas by providing financial or water right credit incentives to dairies and feedlots.

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low water

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Secure, Protect and Restore Kansas Reservoirs

Background

Surface water reservoirs serve to protect the public interest and facilitate multiple diverse beneficial uses within the State of Kansas. The future of Kansas reservoirs will impact water supply for all water user groups including agricultural, domestic, industrial, municipal, and recreational water user groups.

Over two-thirds of the state's population are served from municipal water diversions downstream of reservoirs. They are dependent on Kansas reservoirs (figure 1) maintaining streamflow for diversions, maintaining sufficient water quality for human uses, and providing drought resiliency. For many rural communities, the water supply supported by reservoir releases is the only source of water through periods of prolonged drought. Many rural communities and areas in the eastern half of the state receive water supply from rural water districts that are supplied from reservoirs and can distribute costs. Loss of reservoir water supply will inhibit rural revitalization efforts and be a regressive expense burden for lower income Kansans, as water suppliers incur elevated costs for water sourcing.

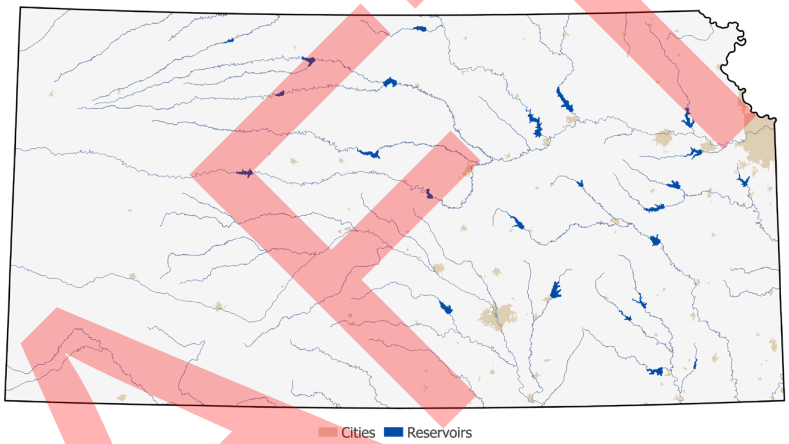

Figure 1. Reservoir and city locations within Kansas

Reservoirs support the water supply needs of a substantial amount of industry and commerce within the state, with a large amount of the state's industrial production being supplied by municipalities, rural water districts, or direct intakes of surface water. Reservoirs supply water to electrical generating facilities, aeronautical production, refinery operations, cement production, and a growing amount of irrigated agricultural acres, all of which require reliable quantity and quality of water supply to continue providing economic benefits to the state.

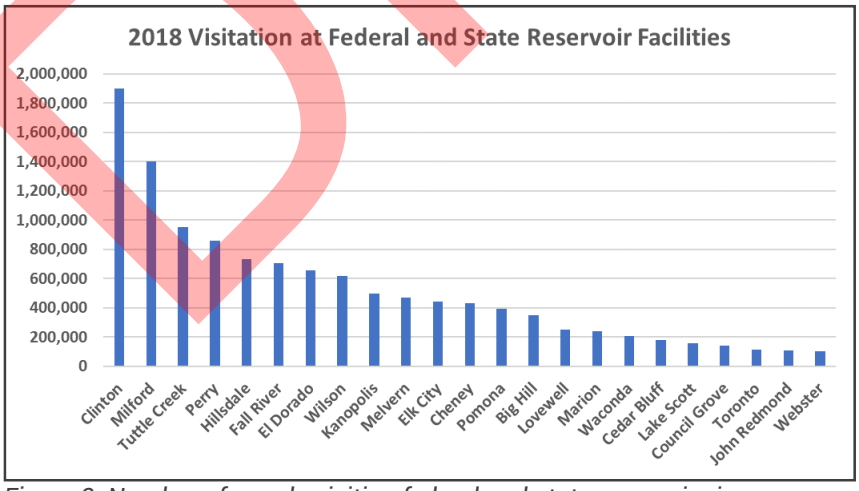

Figure 2. Number of people visiting federal and state reservoirs in Kansas in 2018, data derived from KDWP and USACE.

Recreation is a growing economic role of reservoirs, with several million visitors annually (Figure 2) participating in on-water and on-shore activities. This provides millions of dollars in economic benefits from visitor expenditures within the state. With more cities looking to develop riverfront recreational areas, maintaining reservoir water supply will allow for sufficient streamflow for recreational activities.

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uses

Secure, Protect and Restore Kansas Reservoirs

The reservoirs serve to reduce the impacts of climate variability in Kansas by reducing the impacts of flooding events that, in the recent past, would have caused widespread damage to agricultural production, in addition to loss of homes, livelihoods, and life. At times, the reservoirs serve as the sole source of water supply through prolonged drought for many Kansans by using storage to support instream uses and maintaining an adequate flow of water to user's intakes. See the *Kansas Water Plan* Guiding Principle section on Reduce our Vulnerability to Extreme Events for more information on the impacts of climate variability in Kansas.

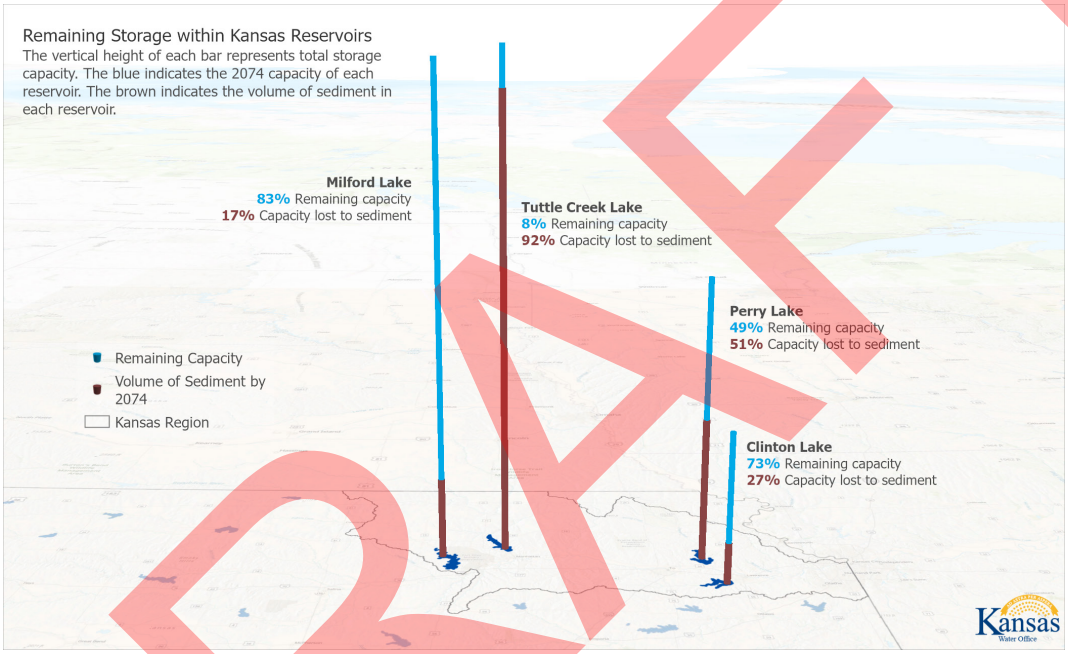

Figure 3. Projection of remaining reservoir storage within the Kansas River basin in the year 2074 if the historical sedimentation pattern continues. It is projected that 92% of Tuttle Creek Lake's initial conservation storage volume will be lost to sedimentation without implementation of sediment and basin management actions. Reductions in state owned water capacity at each reservoir on this path.

As calculated by the United States Corps of Engineers during the Kansas River Reservoirs Flood and Sediment watershed study in 2020.

There are several varied issues impacting the future of the Kansas reservoirs:

1. Storage capacity is continually being lost to sedimentation in reservoirs (~~figure~~ 2. ~~Land~~ 1thin the watersheds of reservoirs are losing soil which is then transported to the reservoirs through varied climatic events. Soil is trapped in the reservoirs, which reduces water supply available for future economic growth, future populations, and water supply needs through extreme climate events. Reduced reservoir water storage capacity leads to increased risk of loss for all water user groups dependent on reservoir water supply, flood protection, and water quality support.
2. A significant proportion of *Kansas Water Plan (KWP)* funding comes from fees that are paid by users that rely on reservoir water supply. The State's growing unfunded liability and inability

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Secure, Protect and Restore Kansas Reservoirs

with the multiple Water Assurance Districts, and the Water Access District, with flood pool operations being managed by the USACE and in coordination with out-of-state downstream river systems. Rights to water storage within the conservation or multi-purpose pools of 14 federal reservoirs have been contracted for use by the State of Kansas. Multiple cities and agricultural irrigation groups also have water storage agreements in place, such as the City of Wichita within Cheney Reservoir. This multi-purpose pool storage is operated in collaboration with the Federal Government to meet the needs of the many diverse water users and instream water quality demands.

For multiple reservoirs, there exists a financial liability that will need to be addressed by the State of Kansas, specifically where the State has agreed to the purchase of reservoir storage volume but has not needed to call the use of the storage into service. As demands rise, storage volumes are lost to reservoir sedimentation and that storage is needed to meet Kansas needs. The State will need to make the financial payments to call additional water supply into service, as outlined in the Public Water Supply Program Comprehensive Capital Development Plan[3].

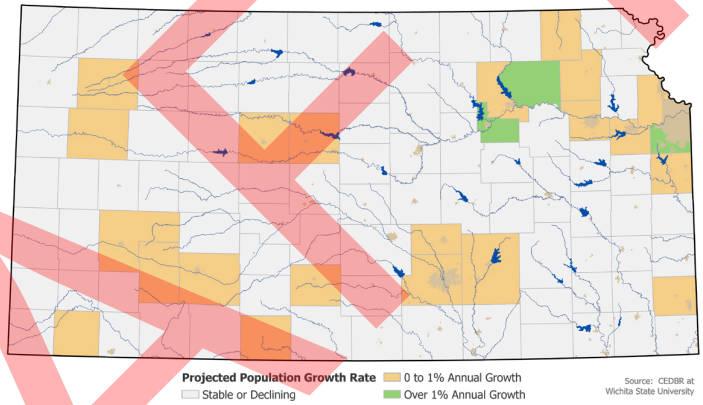

Figure 4. Projected 2070 Population Growth Rate by County, CEDBR at Wichita State University

The State must take advantage of favorable bond market conditions to reduce financial obligations to the federal government for reservoir water supply. Taking on this financial challenge in the near-term will save Kansas water users and the State millions of dollars while addressing the water supply needs for several regions of the state.

The federal reservoirs of the state were built with expected operational lifespans for their conservation storage capacity, as projected during initial design. With many of these reservoirs now over forty years old, recent and historic bathymetric surveys are showing that reservoir storage capacity is being lost in a trend similar to the initial projections for several Kansas river basins. There is a projected and observed loss of storage as sediment carried by inflowing rivers and creeks is trapped within the reservoirs, with some Kansas reservoirs trapping over 98% of the sediment carried from their upstream watersheds. This makes for future conflicts where the amount of water able to be retained in reservoir storage will be insufficient to meet the demands of multiple user groups and puts the state in the position of being unable to supply adequate amounts of water for anticipated future uses (~~figure~~ 1).

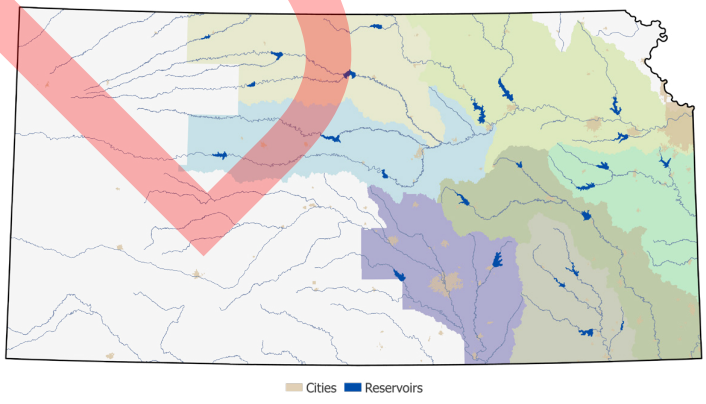

Figure 5. Regional Planning Areas with water supply reservoirs located within their boundaries

As previously stated within the *Vision for Future Water Supply in Kansas (The Vision*[4], there have been targeted investments in the watersheds above

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Figure

Secure, Protect and Restore Kansas Reservoirs

multiple reservoirs used for water supply purposes, such as streambank stabilization projects, watershed dam construction, and increased support for soil health initiatives. However, the acres of agricultural lands that have had conservation practices implemented and the number of streambank stabilization sites completed, with past and current levels of funding have not remediated reservoir sedimentation issues.

As previously identified by the Blue Ribbon Water Funding Task Force for Water Resource Management[5] additional funding support is necessary to adequately reduce sedimentation rates to protect future water supply. This task force consisted of a diverse group of stakeholders, legislators, and government officials, who identified a funding need of $21 million per year to support conservation and remediation activities to secure future reservoir water supplies. Regional Advisory Committee (RAC) action plans for the Equus-Walnut (Goals 2 & 3), Kansas (Goals 1- 3), Marais des Cygnes (Goals 1 & 2), Neosho (Goals 1, 3, & 4), Smoky Hill-Saline (Goal 3), Solomon-Republican (Goals 2 & 3), and Verdigris (Goals 1) ~~basins~~ support and advocate for investments to secure and develop reservoir water supplies.

Initial reservoir designs included projections of storage loss and operational plans designed to account for historical flood and drought conditions; however, preservation of storage and adaptable operations of this vital infrastructure are necessary for the future. It is of growing importance for future water supply and recreational opportunities to fund adequate levels of reservoir research. Adequate funding of reservoir research is necessary to measure the impacts of conservation initiatives that have been funded with taxpayer and water user fee support. This includes efforts such as studying the sedimentation reduction provided by streambank stabilization sites, conducting HAB pilot studies with monitoring, and measuring the impact of soil health initiatives on the nutrient and sediment loads entering the reservoirs of the state.

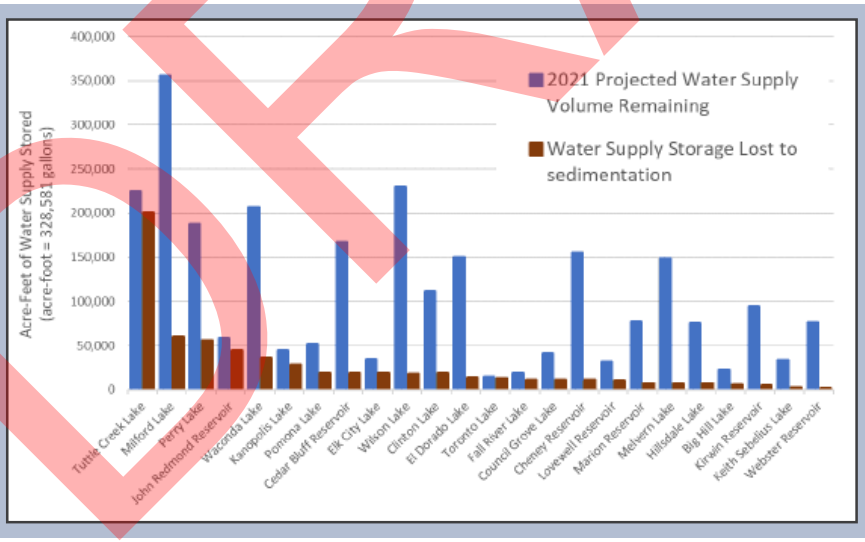

Figure 6. Amount of reservoir water supply storage remaining and lost to reservoir sedimentation.

Reservoir data and research support is needed to:

- Identify and implement innovative strategies to reduce flooding and damage reduction.
- Utilize new technologies to ~~more efficiently conduct remote sensing and information transfer~~ to impacted stakeholders.
- Identify alternative sediment, nutrient, and basin management strategies to reduce impacts to

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conduct remote sensing and transfer information more efficiently

Secure, Protect and Restore Kansas Reservoirs

reservoirs, while avoiding downstream impacts.
- Better quantify the sedimentation issue (~~figure~~ 1) through updated reservoir bathymetric surveys and surface water monitoring where feasible.
- Identify if the reservoirs are losing storage capacity as initially projected or impacts from behavioral changes within the watersheds.
- Identify impacts of large-scale climatic events, such as the extensive flood events of 2019.

Water users along the Kansas River will financially, environmentally, and recreationally benefit from having additional storage designated as Water Quality within Milford Lake and Perry Lake multi-purpose storage pools. The Water Quality pools are dedicated to supporting the low flow quantity and quality requirements of all water user groups dependent on reservoir supported streamflow and instream uses.

Reservoirs of the state, including federal reservoirs, multi-purpose small lakes, municipal reservoirs, and watershed dams all play a role in reducing the impacts of extreme flood events on the state and its citizens. Following the prolonged and, in some regions of the state, record flooding of 2019, several improvements the State should make to prepare before the next destructive flood event were identified. See the *Reducing Our Vulnerability to Extreme Events* section for more information on flood impacts to Kansans.

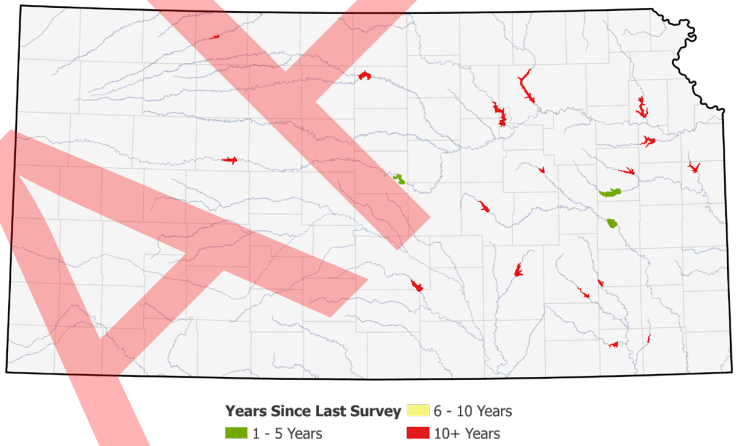

Figure 7. Years since last reservoir volumetric survey has been completed.

With flood operations being conducted in accordance with river and reservoir operations manuals by the USACE, there is an opportunity for the State to invest in the review and development of recommendations to be incorporated into operational manuals. The ongoing Lower Missouri River study with the USACE and states of Iowa, Kansas, Missouri, and Nebraska is studying the current impacts of flood operations and if there are alternatives that could reduce flooding impacts to the states along the Missouri River. For Kansas specifically, as seen in 2019, operational limits on the amount of allowable Missouri River flow during various flood stages required record breaking amounts of water to be stored in Kansas reservoirs. This increased the risk to Kansans by having almost no available flood control storage for additional precipitation events, and severely impacted recreational user groups. Modifications to the Missouri River control manual could allow the USACE to make earlier releases of water stored in flood control pools of Kansas reservoirs, reducing potential impacts to the state.

~~Additonally,~~ 2 the ongoing Kansas River Reservoirs Flood and Sediment Study[6] is a collaborative initiative between the USACE and State to review current reservoir conditions, needs, and operations, while also planning 3 ~~for the future~~ water supply needs, challenges, and limitations within the Smoky Hill-Saline, Solomon-Republican, and Kansas Regional Planning Areas. Additionally, the study incorporates how future climatic variability may impact water supply and recreational reservoir uses, including analysis of what happens if no actions are taken to sustain the usable lifetimes of the federal reservoirs.

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Secure, Protect and Restore Kansas Reservoirs

Measuring Success

To identify and measure the impact of investments in supporting reservoir goals, there needs to be increased observation and measurement of the condition of the reservoirs. Observing changes to sedimentation and stream channel geomorphology through additional and more frequent data collection will help agricultural, industrial, municipal, and recreational water user groups better plan for their future demands and capital investments.

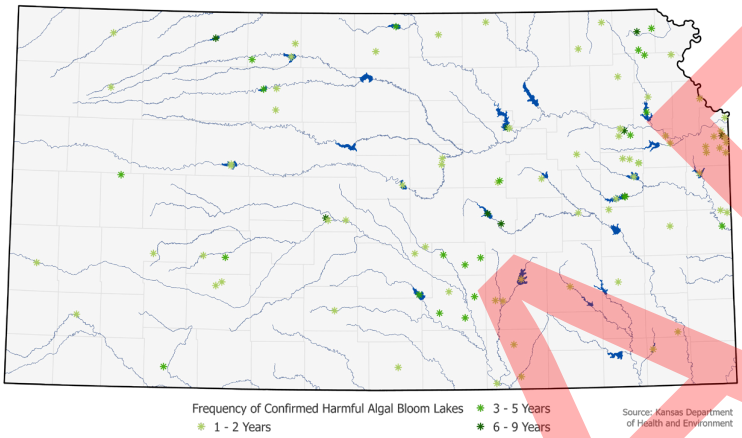

Figure 8. Reservoirs with Harmful Algal Blooms confirmed by Kansas Department of Health and Environment testing 2010 – 2020, KDHE.

Additional reservoir monitoring and research will help to better predict, monitor, and respond to harmful algal bloom events (~~figure~~ 1) that impact recreational and water supply user groups and to further develop algal bloom response and mitigation techniques.

It is necessary to incorporate both quantitative and qualitative metrics into future water resource plan development to monitor whether public funds and user fees are being utilized productively and efficiently to support the future of reservoirs within the state. With the requirements of Performance Based Budgeting at the state level, there has been increased incorporation of regionally-supported budget initiatives into State Water Plan Fund (SWPF) proposals and development of performance metrics for expenditures.

The Kansas Water Authority (KWA) approved the *KWP* Budget Guidelines in January 2020, stating how funds should be used to:

- meet statutory obligations.
- tie projects to *The Vision* or *KWP*.
- support appropriate metrics and benchmarks.
- allocate water user groups' fees to reasonably support that group's future water supply, as seen with sedimentation reduction projects being funded above reservoirs that provide water supply for downstream water user groups and fee payers.
- allow the flexibility to fund expenditures that can be justified to be in response to an emerging threat to water resources or public health.

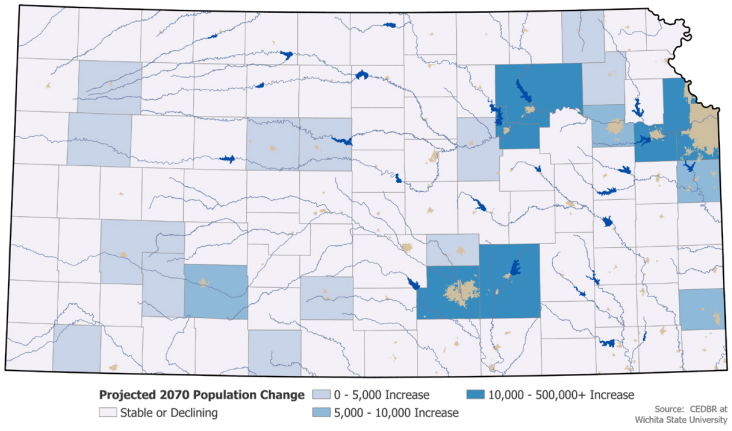

Figure 9. Projected 2070 Population Change by County.

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Secure, Protect and Restore Kansas Reservoirs

Recommended Actions

Though the reservoirs in the state were designed with projected losses to their water supply capabilities, the needs of a growing Kansas population (~~igure~~ 2) and agricultural use downstream of reservoirs do not have finite lifetimes or projected demand reductions. Multiple regions of the state need to have reservoir water supply secured, protected, or restored to meet the water needs of the future.

Recommended Actions and Strategies - Secure, Protect and Restore Kansas Reservoirs

Policy or Program Recommendations

- Continue support, development and sustained technical capacity to ensure groundwater and surface water models are current, ~~defendable~~ and ready for use ~~at all times~~.
- Continue support for RAC Goals addressing reservoir issues (EW, KS, MdC, NEO, SHS, SR & VE).
- Continue to support Kansas Department of Health and Environment (KDHE) in Water Quality management.
- Continue to support KDHE nutrient reduction work group.
- Continue to support reservoir research priorities as developed by the Kansas Water Research Coordination Group.
- Identify and overcome hurdles with federal permitting for practices and structures that decrease sedimentation to federal reservoirs.
- Assess the most suitable locations for the formation of additional Water Assurance Districts where appropriate, to expand and improve coordination of the use of available supplies from Kansas reservoirs.
- Actively pursue the goal of reservoir restoration and sustainability with intentional intervention.
- Evaluate potential additional water supply through inter-connectivity of reservoir storage, reallocation and/or operational efficiency.
- Develop multi-state relationships to address interstate river reservoir system management, ensuring that Kansas is represented in any policy or operational changes.

Implementation Actions

- Collaborate with USACE to increase Water Quality pool allocations where needed, which will ensure sufficient flows to support instream uses and maintain water quality for users.
- Support watershed conservation practices with soil health initiatives, streambank stabilization, and riparian corridor restoration.
- In regions where it is infeasible to restore water supply storage in current reservoirs, explore additional storage possibilities with the construction of multipurpose small lakes to alleviate regional water supply issues.
- Pursue innovative in-lake sediment management measures to restore and sustain reservoir storage.
- Develop a stream-aquifer model of the Kansas River alluvial aquifer from Junction City to the junction with the Missouri River to examine the effect of scenarios of future development and management on groundwater and river water levels.

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defensible

Secure, Protect and Restore Kansas Reservoirs

Data, Research, and Studies

- Work to increase efficiency of reservoir operations through low-flow release modifications and operating reservoirs as a system. As data resources and climate conditions allow, incorporate Forecast Informed Reservoir Operations to increase water supply resiliency and efficiency.
- Develop future climatic scenario reservoir water supply planning capabilities.
- Support HAB data collection and remediation projects.
- Study benefits of watershed conservation practice implementation on sedimentation and nutrient loading rates, utilize budgetary guidelines and performance metrics to direct future funding sources to those that are shown to improve reservoir conditions.
- Engage in active sediment management studies with federal partners as cost share and funding opportunities arise.
- Increase the frequency of reservoir bathymetry to monitor progress on sedimentation trends, show reservoir storage ~~loss~~, and conduct future water supply planning projections.

Funding and Resource Needs

- Utilize low borrowing rates to secure reservoir storage. Complete principal and interest payments to the federal government to fulfill contractual obligations and maintain a solvent Water Marketing Program.
- Fund and implement strategies supported by RACs to reduce sedimentation and nutrient loading rates within water supply reservoirs. In reservoirs where conservation alone will not satisfy future water supply demands, work towards implementation of active sediment management strategies.
- The Blue Ribbon Water Funding Task Force for Water Resource Management identified some funding levels for conservation practices that have not been supported thus far. Additionally, RACs are having discussions on new methods to fund reservoir conservation initiatives, with some privately funded initiatives being implemented.

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loss

Improve the State's Water Quality

of pollutants[5] to the waters of the state. The 2019-2028 Kansas Water Quality Monitoring and Assessment Strategy[6] is a tool to use when reviewing regulatory expectation, budgetary realities and technological, and methodological advances in environmental surveillance.

General Water Quality Issues

SURFACE WATER

The Kansas 2020 303(d) list identified 486 station/pollutant combinations of water quality impairment on lakes, wetlands, and stream systems (watersheds), encompassing 2,278 stream segment/pollutant combinations, and needing the development of TMDL plans to address the offending pollutants. The 2020 list also identified 514 station/pollutant combinations of waters that were cited as impaired in prior lists but now meet water quality standards, with 44 of these being new in 2020. Waters listed on the 303(d) list are individually targeted for TMDL development, according to a priority ranking established by KDHE and approved by Environmental Protection Agency (EPA).

To address some of these water quality concerns, multiple agencies and non-governmental organizations (NGO's) collaborate to provide viable management tools. Several of these agencies and organizations continue to promote Best Management Practice (BMP) implementation, which has proven to reduce the movement of sediment, phosphorus, and nitrogen into Kansas waters.

A significant amount of research has been conducted concerning the effects of wetlands on water quality. The research indicates there are positive effects a healthy, functioning wetland has on water quality. The Kansas Water Office (KWO) serves as the wetland[8] coordinating agency for the State, engaging with numerous partners across Kansas on wetland-related activities.

Aquatic Nuisance Species (ANS) are a source of significant ecological and socio-economic problems throughout North America. As of 2020, there were more than 30 water bodies and streams in Kansas infested with zebra mussels (figure 1). In 1999, non-indigenous species

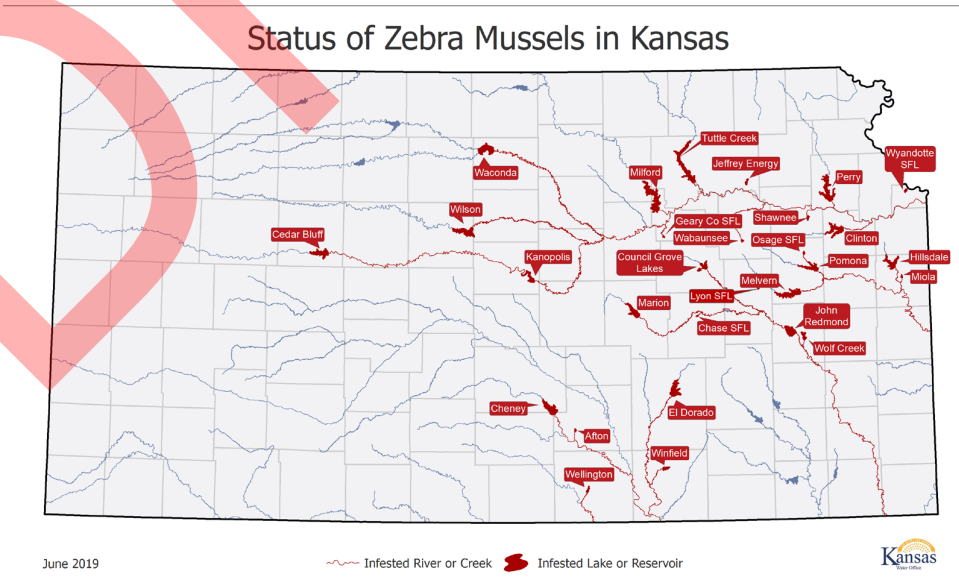

Figure 1. Zebra Mussel Infested Waters[10].

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Figure

Improve the State's Water Quality

(aquatic and terrestrial) in the United States were estimated to cause major environmental damages and losses adding up to more than $138 billion per year[9]. The Kansas Department of Wildlife and Parks (KDWP) continues to work diligently to limit the spread of ANS species though public awareness campaigns shared through multiple media outlets, such as their webpage[10]. There are multiple regional and national entities[11] working in collaboration to address ANS issues.

Zebra Mussels. Photo Credit: NOAA.

The KDHE Harmful Algae Bloom (HAB) Response Program was established in 2010, with this program identifying over 100 water bodies affected by HABs in the past 10 years. A HAB refers to a dense growth of algae that has the potential for creating toxins that have acute and chronic effects on liver, kidney, lungs, and nervous system, and there are no known antidotes to the toxins. There is an upward trend on the number of water bodies affected by HABs in Kansas; Figure 2 illustrates the affected waters in 2020. KDHE's complaint-based program addresses blooms on public waters[12], with no agency sampling or laboratory analysis being conducted on private waters[13]. Managers of private waters are encouraged to perform a jar test and use private labs if they believe they are experiencing a bloom. Under the KDHE program, there are three levels of Advisories: Watch, Warning, and Hazard. With this emerging issue occurring across the country, the EPA[14] has compiled information and research on HABs. KDHE has considered a number of HAB mitigation strategies at Milford Lake, including reservoir drawdown to reduce cyanobacteria habitat, vegetation to remove nutrients, ~~peroxide based~~ algaecide, ultrasound, and rough fish removal.

HAB outbreak, Marion Reservoir 2021, Photo Credit: Tulsa USACE

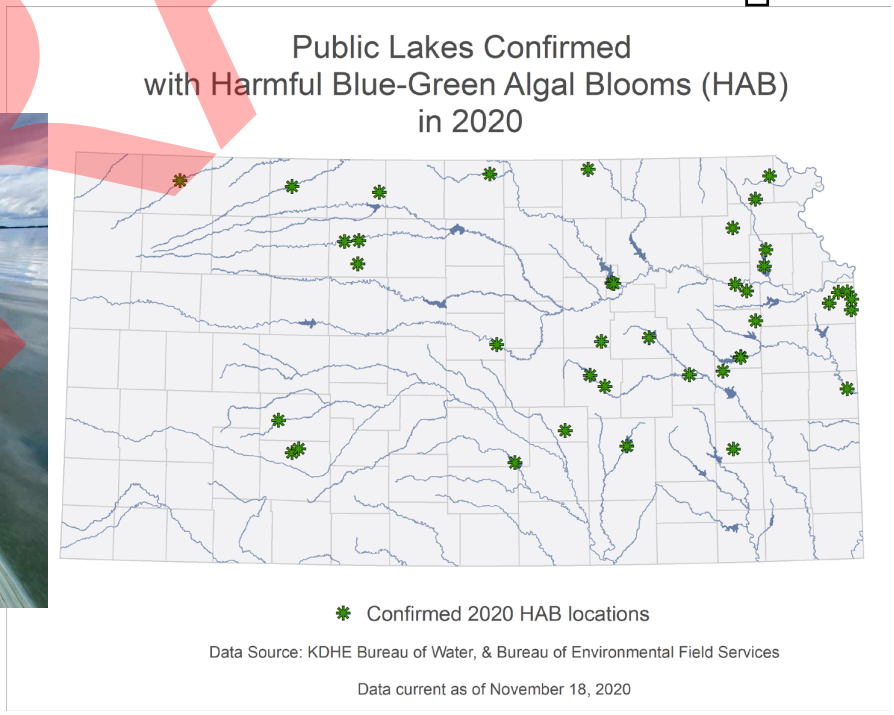

Figure 2. 2020 HAB Lakes[12].

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peroxide-based

Improve the State's Water Quality

The Kansas Water Plan Guiding Principle: *Securing, Protecting, and Restoring our Kansas Reservoirs* mentions the use of stored water supply to provide dilution of naturally occurring water quality concerns. As seen in 2018 and 2020 within the Kansas and Smoky Hill Rivers, the use of water stored within reservoirs was necessary to dilute chlorides and sulfates that are naturally occurring in the upper portions of the watersheds. In 2018, Tuttle Creek and Milford Reservoir releases were required to dilute high chlorides that were released from Wilson Reservoir. In 2020, during periods of prolonged low flows in the Smoky Hill and Kansas Rivers, releases were also needed from Tuttle Creek and Milford Reservoirs to dilute high chloride waters that were being discharged from the Smoky Hill River alluvium after the flooding seen in 2019.

The Tuttle Creek Reservoir Water Control Manual states that water stored within a water quality pool of Tuttle Creek Reservoir will be used to maintain downstream chlorides below 250 mg/L to improve water quality and protect water supply uses. The U.S. Geological Survey (USGS) has multiple gages that monitor dissolved chlorides[15] at several locations around the state. With the projected loss[16] of storage at Tuttle Creek Reservoir, there will be reduced quantities of water available to be held in storage for dilution and the support of improved water quality through periods of drought and low flows on the Kansas River.

GROUNDWATER

Currently there are several groundwater projects being conducted across the state to assess water quality concerns. The KWO is currently funding one such study in the Missouri Region Planning Area to evaluate groundwater quality[17] with the Kansas Geological Survey (KGS) conducting the work. Nitrate is the most common inorganic contaminant in Kansas groundwater. Previous studies have found that about 30% of domestic wells in Kansas have nitrate levels greater than the Maximum Contaminant Level (MCL) for public drinking water[31]. Figure 3 illustrates how the nitrates get into the water supply and ~~figure~~ 1 shows areas in the state that have nitrate problems.

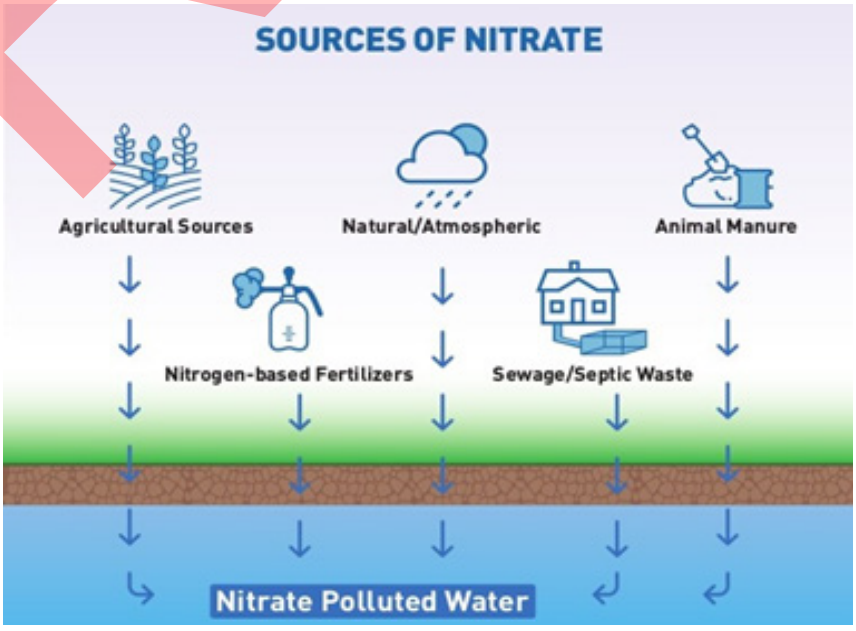

Figure 3. How nitrate moves into groundwater, Beta Analytic Inc.

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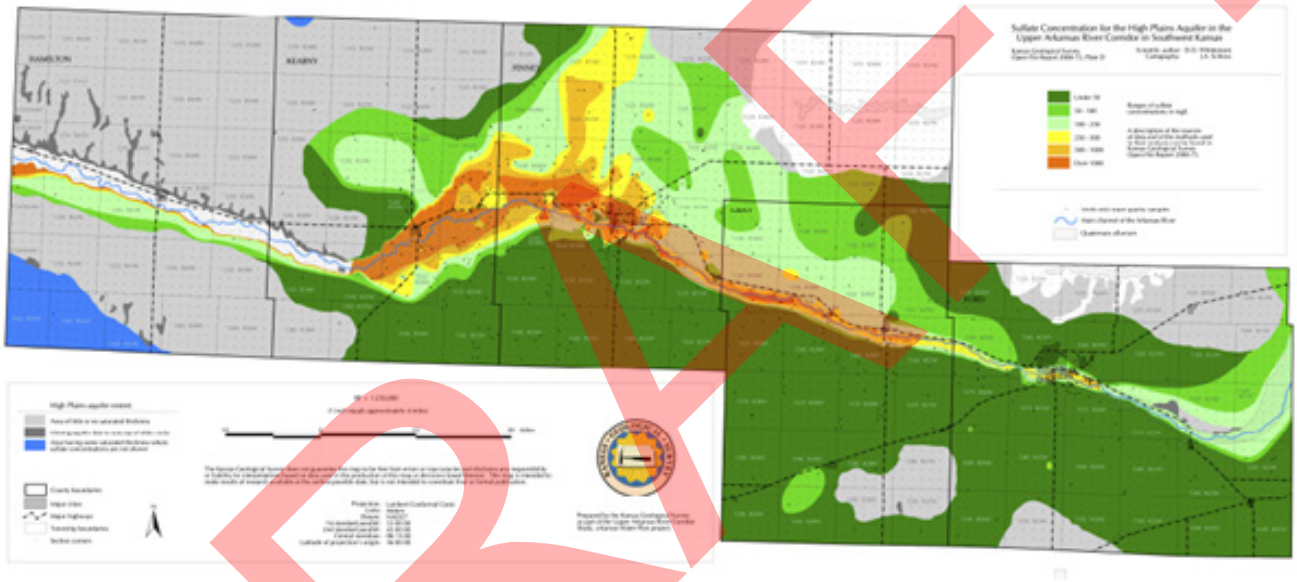
Figure

Improve the State's Water Quality

The KDHE is leading a group of agencies in continuing a 2009 groundwater study[20] looking at naturally-occurring minerals in private water wells in southwest Kansas. A total of 13 parameters, from arsenic to uranium, are being analyzed for presence and levels. Additionally, beginning in 2019, KWO, KDHE, Kansas Department of Agriculture (KDA), and KGS partnered on a groundwater study focused on analyzing the impacts of naturally occurring minerals on water used for human consumption from private water wells within the Upper Arkansas Regional Planning Area[21]. The project invited homeowners within the study area (portions of Hamilton, Kearny, Finney, Gray, and Ford counties) to provide voluntary water samples.

Figure 6. Sulfate Concentration for the High Plains Aquifer[31].



KDHE is collaborating with Fort Hays State University (FHSU) on a 2-year study in the northwestern[22] part of the state on a similar project. Private well owners within the study area will be given the opportunity to have their wells tested for common minerals and contaminants, allowing KDHE to understand the extent of contamination issues in the region. The study area includes portions of Norton, Phillips, Decatur, and Rawlins counties, aiming to analyze water samples for minerals including arsenic, selenium, nitrate, chloride, iron, manganese, sulfate, and uranium.

Surface Water Monitoring Programs

KDHE's Stream Chemistry Monitoring Program's sampling network is comprised of 327 monitoring sites spanning all the major river basins in Kansas. With 160 permanent sites, 40 sites are sampled per quarter, whereas the remaining 167 sites are monitored using a four-year rotational approach. Sampling stations are chosen to represent water quality conditions in more than 97% of the state's contributing drainage area.

KDHE has maintained a Stream Biological Monitoring Program since 1972. This program examines the structural attributes of aquatic macroinvertebrate assemblages and utilizes this information to provide a more refined picture of the ecological status of streams in Kansas. Unlike water chemistry measurements alone, which reflect conditions occurring at the ~~moment~~ 1

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time

Improve the State's Water Quality

NONPOINT SOURCE POLLUTION MANAGEMENT PLAN

The Kansas Nonpoint Source (NPS) Pollution Management Plan[28] is intended to outline a strategic plan for NPS management in Kansas that addresses the nine key program elements required by EPA and provide a framework for coordination and collaboration among agencies and organizations involved in NPS-related management activities. The plan's management objectives include projects implemented and documented improvements in water quality attributable to NPS pollution control efforts.

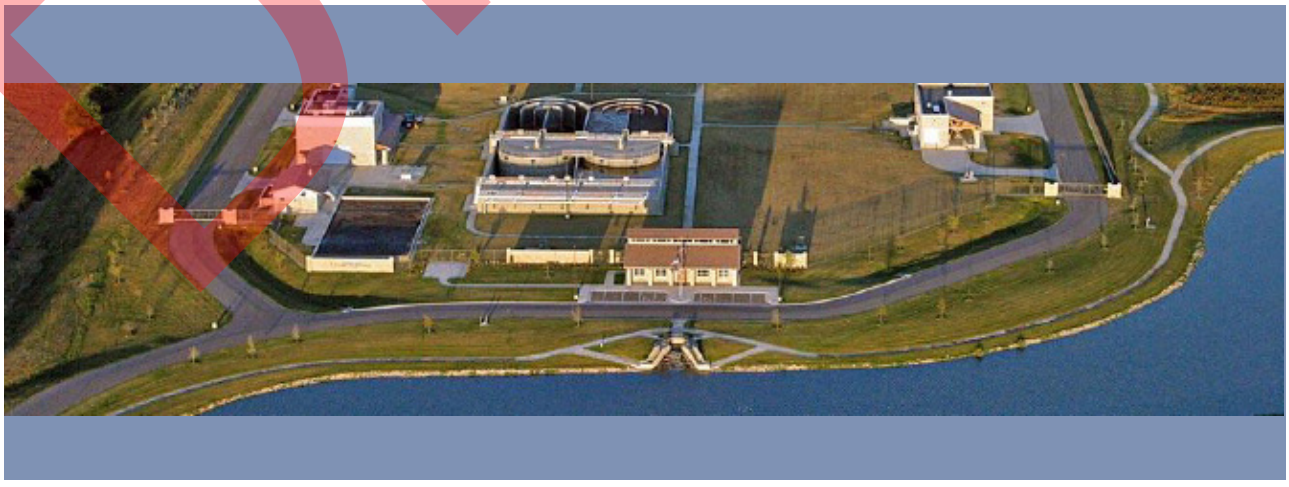
Groundwater Monitoring Program

Kansas no longer maintains a statewide groundwater quality monitoring program and funding for the renewal of such an effort appears unlikely ~~in the near future~~. However, an earlier monitoring program (suspended in 2002 due to budgetary constraints) evaluated groundwater quality at more than 200 sites in Kansas. Individual wells in the monitoring network were sampled on a two-year rotational basis, with approximately half of these wells being sampled in any given year. The program's surviving electronic database contains roughly 150,000 records spanning 120 different physical, chemical, and radiological parameters and 327 groundwater quality monitoring locations.

Water Reuse

There are reuse projects taking place statewide, some with large amounts of water being reused. For example, Spirit AeroSystems in Wichita is treating 2-3 million gallons of water a day for reuse, as well as using treated effluent water from the City of Wichita. Most of the reuse water across the state is applied to ball fields, golf courses, or agriculture fields. The technology is available to treat water from toilet to tap; however, there is still a negative public perception and a significant financial investment, which limits further utilization. A Water Reuse presentation[29] was given at the 2017 Governor's Water Conference outlining issues with water reuse. Water reuse is one of the areas that multiple cities and industries are utilizing as it provides environmental and economic benefits.

Photo Credit: City of Wichita.



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anytime soon

Reduce Vulnerability to Extreme Events

State ~~niversity~~ upports multiple state agencies and water resource managers through their network of weather stations, weather summaries, and climate analyses. In addition to housing the Kansas Weather Data Library, the Mesonet provides education and outreach to agriculture producers and K-12 stem initiatives, research support for our state's universities, and many other ~~ecision~~ support tools to Kansans. To access the Weather Data Library or to learn more about the services provided by the Kansas Mesonet, visit their website.

The USGS streamgaging network (~~figure~~ provides near real-time, continuous flow monitoring throughout Kansas. Monitoring data are used to generate flow statistics and duration curves and are posted on the USGS website through the National Water Information System. This information helps provide context as to how extreme events have impacted Kansas in the past and project how they may continue to do so in the future.

FLOODING IN KANSAS

Flooding usually occurs quickly when precipitation exceeds infiltration and then exceeds channel capacity. Preparations to warn of flooding, protect infrastructure, and prevent sediment and nutrients from entering water bodies can decrease adverse effects and duration of impacts. Intense precipitation events also increase the presence of sediment, nutrients, and various pollutant loads in streams, which can ultimately end up in reservoirs that store flood waters. Once sediment enters a reservoir during a flood event, it is deposited on the lake bed, decreasing the available storage space needed to withstand future floods and droughts. Much of the state's lost storage in reservoirs can be attributed to inflows of sediment during flood events. Local and regional water utility infrastructure can also be at risk, threatening the delivery of safe drinking water to users.

In 2019, saturated conditions in the Great Plains early in the year were amplified by the wettest spring on record and additional summer rains. Thanks to the State's system of federal reservoirs, levees and watershed dams, Kansas was able to concentrate the majority of flood damage to our reservoirs and riparian corridors. This localized damage, however, came at a cost to Kansas. Significant water storage space was lost in our reservoirs due to the substantial sediment and debris inflows. Low-lying riparian areas, often accompanied by productive farm ground, public infrastructure, and other assets, endured the erosive forces of flood waters and long periods of inundation.

Flooding in Elmdale, KS - May 8, 2019.
Photo Credit: Chase County Emergency Management Director Scott Wiltse.

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Figure

Reduce Vulnerability to Extreme Events

Measuring Success

In Kansas, our best measure for extreme event resiliency is economic impact. A high economic impact from flooding or drought suggests vulnerability or inability to withstand such an event. From 1980 to 2021, 6 flooding and 17 drought billion-dollar (CPI-adjusted) disaster events affected Kansas[14] (~~figure~~ 7). Weather and climate disaster statistics are collected and distributed by NOAA's National Center for Environmental Information. Assessment data are provided by a number of sources including insurance companies and state and federal agencies.

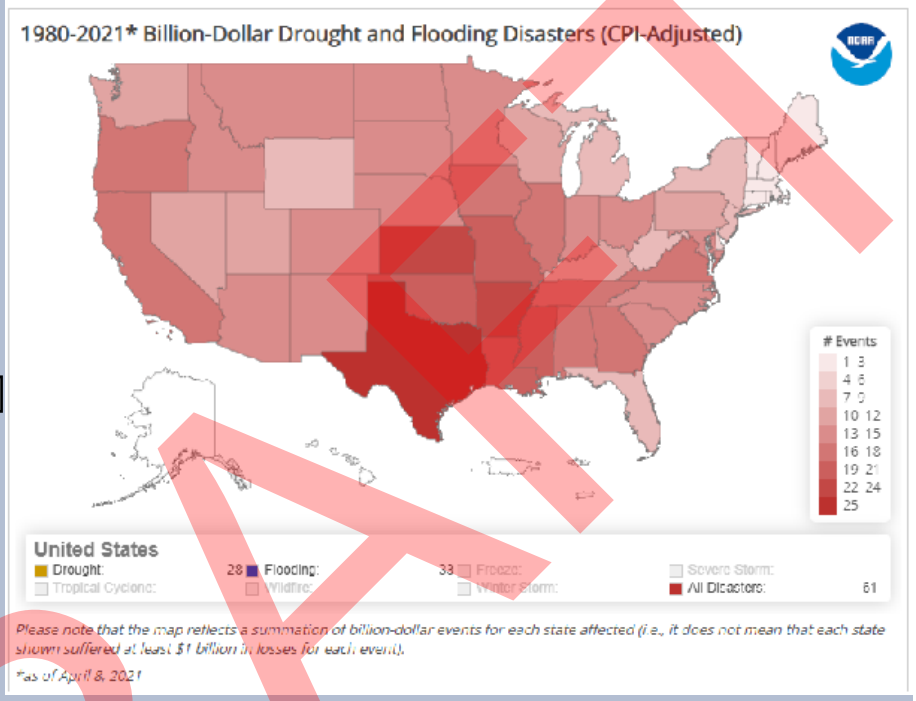

Figure 7: 1980-2021 billion-dollar drought and flooding disasters.[14]

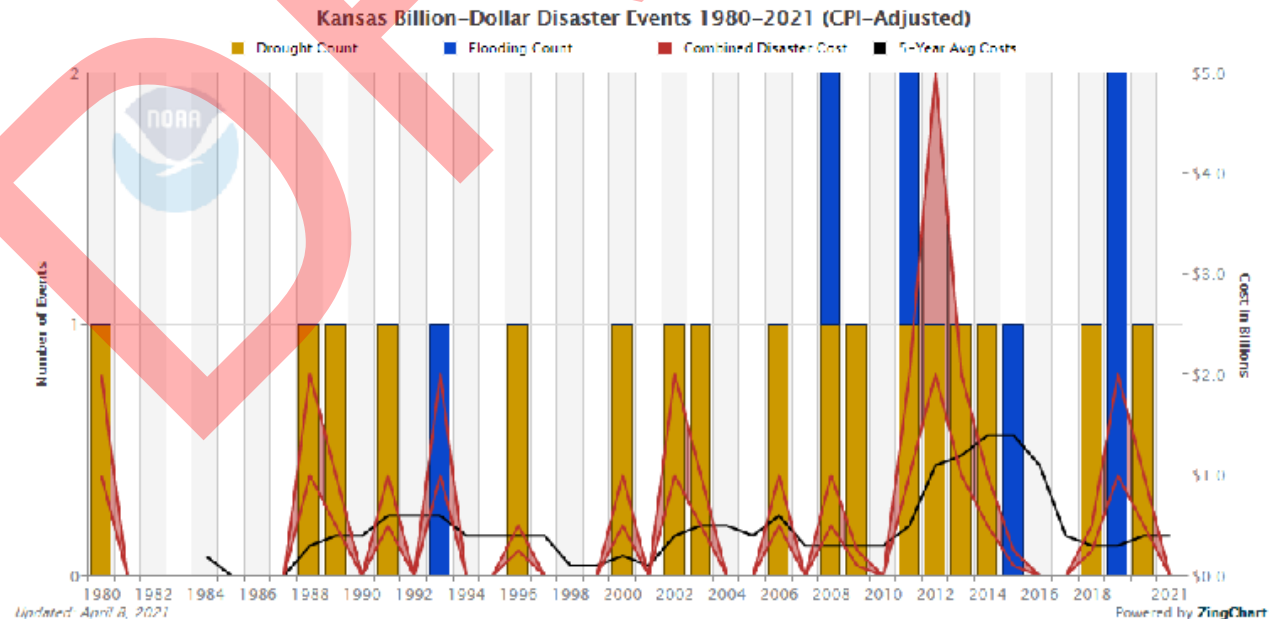

Figure 8: 1980-2021 billion-dollar disasters.[14]

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Figure

Increase Awareness of Kansas Water Resources

Background

As the *Long-Term Vision for the Future of Water Supply in Kansas* (*The Vision*) was being developed and more than 600 public input meetings were held across Kansas, one message heard repeatedly was the need for increased education and outreach for Kansans of all ages on water resource issues within the state. While there are many existing water-related educational programs available for both youth and adults, it was noted through these public input meetings that a central message and coordinated educational resources were lacking in helping to better connect users to their Kansas water resources.

Many of the action items previously developed in association with *The Vision*, as well as some goals developed by Regional Advisory Committees (RACs), highlight the need for additional development of a state-wide water message and a "one-stop-shop"[1] for information and learning resources. To meet this goal, an inter-agency and inter-organizational coordinating team was previously developed in 2015. This team met throughout 2016 and hosted a series of outreach meetings to solicit input into the development of statewide education and public outreach materials as well as to develop tangible action plans aimed at strengthening Kansans' knowledge and awareness of water and water-related issues. From those meetings, a *Vision Education Public Outreach Supplement Section* was created and now serves as the foundation for the Kansas Water Plan Guiding Principle: *Increasing Awareness of Kansas Water Resources*.

KACEE Field Day.

Included within this document are overarching principles which directed the development of the *Vision Education Public Outreach Supplement Section* to *The Vision*. These overarching principles will continue to serve as precepts for this guiding principle. No actions are intended to displace current water education programs. Instead, these initiatives are designed to promote such programs and to encourage the development of complementary programs.

Long-standing water education programs include: youth conservation poster and essay contests hosted through the County Conservation Districts, local community water festivals, Kansas Association of Conservation and Environmental Education (KACEE) Project WET, as well as the Awesome Aqua magazine and natural resource educator's guides developed through Kansas Foundation for Agriculture in the Classroom[2]. KACEE, Kansas Department of Wildlife and Parks (KDWP), Conservation Districts, and others provide an avenue for delivery of critical information.

Kansas Runs on Water

The initiatives and concepts described are strategic in nature and, as such, do not describe the details of the implementation of the initiatives. The initiative implementation plans will be developed following the approval of the initiatives. Any local, regional or state agency, educational institution, non-government organization, private company or individual stakeholders interested in water education programs are invited and encouraged to provide input and feedback regarding the

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, GMDs

Increase Awareness of Kansas Water Resources

implementation plans and to participate in these initiatives. These initiatives will be unified through a social marketing campaign and the *Kansas Runs on Water* website[3]. All strategies and action items for this principle support *Kansas Water Plan (KWP)* implementation and associated priorities.

Measuring Success

This collaborative effort represents an opportunity to build upon and maximize the many successful education organizations and activities currently in place in Kansas. While we have many successes related to water resource education in Kansas to celebrate, gaps still exist and opportunities to strengthen Kansans' knowledge and awareness of water and water-related issues remain. Filling the gaps and success in the end will require everyone on all levels working together with a common goal of conserving and protecting our water resources for future generations.

Measuring success may be recognized in numerous ways with varying metrics. Success may be simultaneously measured based on improving attitudes towards water conservation, motivation, cooperative behaviors, and confidence in knowledge of where water comes from, in addition to physically measurable results based on monitoring. Establishment of region-specific, targeted improvements for household, agricultural, and industrial/municipal water conservation will need to be made. These measures will be shared through community outreach, workshops, and educational events[4]. The value of water education is held deeply by Kansans and is documented in the Goals and Action Plans[5] for the RACs across the state (~~figure~~ 1).

Field Day.

	Education & Outreach-Related Goals				
Region	Goal 1	Goal 2	Goal 3	Goal 4	Goal 5
Cimarron		X	X	X	
Equus-Walnut	X	X	X		X
Great Bend Prairie	X		X	X	X
Kansas			X		X
Marais des Cygnes	X	X	X		
Missouri			X	X	
Neosho	X				
Red Hills	X				
Smoky Hill-Saline		X	X	X	
Solomon-Republican					
Upper Arkansas	X				
Upper Republican		X		X	X
Upper Smoky Hill	X	X	X		

Figure 1: RAC Education and Outreach Related Goals

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Figure

Cimarron Region

Primary Water Resources in the Region

SURFACE WATER

The majority of the region is drained by the Cimarron River and tributaries, the North Fork of the Cimarron and Crooked Creek (Figure 5). The Cimarron River flows into the Arkansas River near Tulsa, Oklahoma. Streamflow of these sources has not been sustained within the Cimarron Regional Planning Area. They have characteristics of ephemeral streams with localized flow for brief periods in response to rainfall and climatic events.

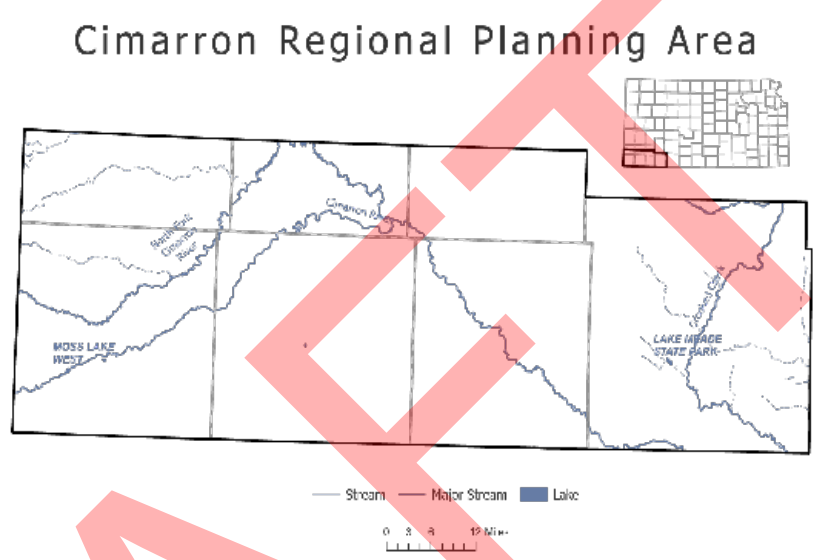

Figure 5. Major water resources in the Cimarron Region

~~Playas~~ Lakes are present throughout much of the region. These shallow and ephemeral ponds that are seen after rainfall events can act as areas of enhanced groundwater recharge and provide habitat for many species of plants and wildlife.

GROUNDWATER

The principle aquifers (Figure 6) in the area include the Ogallala portion of the High Plains Aquifer (Ogallala Aquifer) and alluvial aquifer, as discussed in the *Kansas Water Plan (KWP) Conserve & Extend the High Plains Aquifer* section.

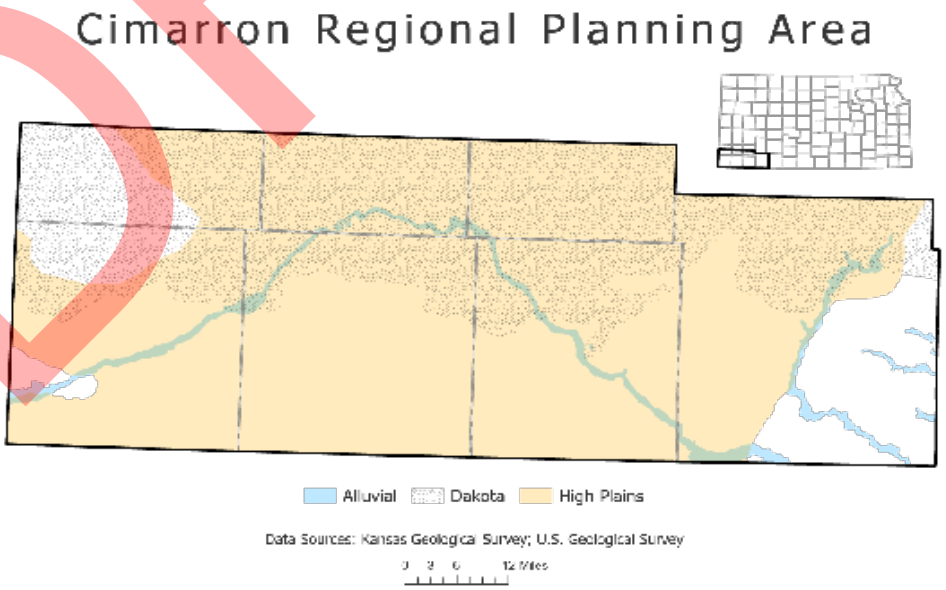

Figure 6. Principle aquifer boundaries in the Cimarron Region

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Playa

Equus-Walnut Region

Primary Water Use by Source

GROUNDWATER

Groundwater is the primary source of water, with sources that include the Equus Beds Aquifer, a primary water supply source for the City of Wichita, and alluvial deposits along major streams. Irrigation and municipal usage account for 52% and 40%, respectively, of the reported water use within the region. Other reported water use within the region includes industry (7%), recreation (1%) and stock (less than 1%) (Figure 7).

SURFACE WATER

There are 106 public water suppliers in the region, including 35 rural water districts and 2 public wholesale water supply districts. Groundwater and/or surface water sources are both prevalently used by public water suppliers within the region. There are 52 municipalities in the region with approved water conservation plans.

Cheney Reservoir and El Dorado Lake serve as major water supply sources within the Equus Walnut Regional Planning Area. The City of Wichita draws approximately 60% of its daily water supply from Cheney Reservoir, but this number can fluctuate on an annual basis depending on available water supply within Cheney Reservoir in relation to the Equus Beds Aquifer.

El Dorado Lake is a primary water supply source for the City of El Dorado with enough capacity to allow El Dorado to draw approximately 23 million gallons per day during a 50-year drought.

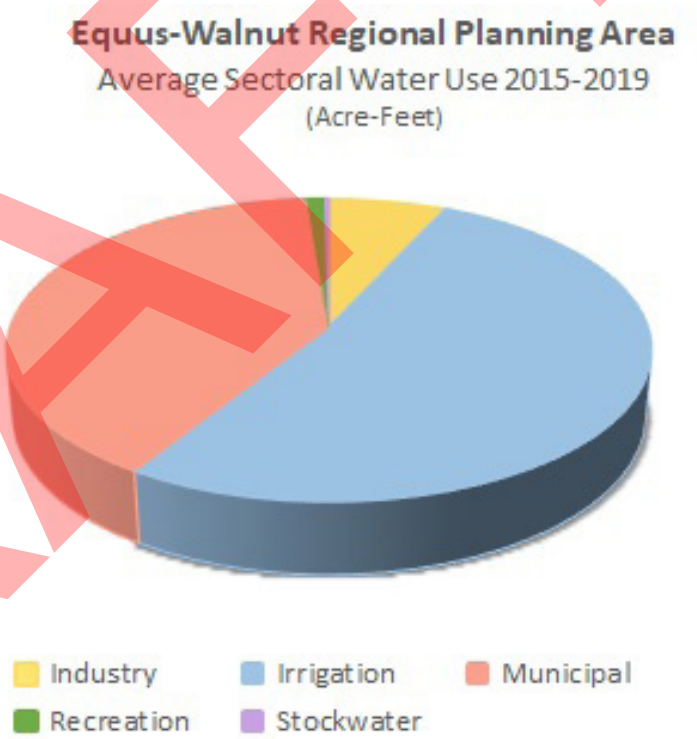

Figure 7. Average sectoral water usage

Regional Issues & Priorities

WATER SUPPLY AVAILABILITY

Groundwater Sustainability

Sustainable use of groundwater within the Equus-Walnut Region is an identified priority of the Regional Advisory Committee. Analysis of groundwater levels indicate groundwater levels over the last 20 years are generally steady (+/- 5' change) within most areas within the GMD2 portion of the region, with areas of greater increase in Harvey County in the general area of the City of Wichita's well field as well as areas of greater decrease in portions of ~~south central~~ McPherson County. In January 2017, the Kansas Geological Survey completed the Equus Beds Groundwater Management District No. 2 Sustainability Assessment, using their Qstable

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south-central

Equus-Walnut Region

methodology to determine the average annual water use that would produce stable[1] ~~really~~ averaged water levels at the GMD, county, township, and other defined area intervals. At the GMD level, this analysis revealed that average annual reported water use appears to have been very close to the sustainable level for the 1996-2014 and 2005-2014 assessment periods. Information from this assessment can be utilized by GMD2 to review and update safe yield for areas within and adjacent to the GMD.

Technology & Crop Varieties

Stakeholder input provided through the water planning process in Kansas has previously shown broad support for promotion of irrigation efficiency technologies, adoption of less water intensive crop varieties, promotion of technologies for the treatment of alternative/lower quality sources of water and implementation of research-based technology aimed at better understanding our state's water supply as areas where efforts could be focused to positively impact Kansas water resources. This is particularly true within the Equus-Walnut Regional Planning Area, where both surface and groundwater quantity as well as quality concerns exist which could benefit from any of these previously noted approaches. With both irrigated and dryland crops viable across many portions of the Equus-Walnut Region, continued research and adoption of advances in new technologies and crop varieties provide the opportunity for water conservation without decreases in crop yields.

Wichita Aquifer Storage & Recovery (ASR)

The City of Wichita currently operates an ASR project which allows for the diversion of water from the Little Arkansas River during high flow periods, treatment of the diverted water to drinking water standards, then injection of the treated water into the Equus Beds Aquifer for later recovery and use. Through this process, the city accumulates recharge credits with Kansas Department of Agriculture Division of Water Resources (KDA-DWR) allowing Wichita to subsequently withdraw this additional water from the Equus Beds Aquifer beyond their native water rights. With the recent recovery of the Equus Beds Aquifer in the Wichita wellfield area to near pre-development conditions, recharge activities are being hampered by limited space within the aquifer, leading to the development of a proposal by Wichita for a new way to develop recharge credits.

Wichita ASR. Photo Credit: Burns & McDonnell

In March 2018, Wichita submitted to KDA-DWR a proposal for modifications to the conditions associated with Wichita's existing Phase II ASR permits. The request included lower minimum index levels used to determine when Wichita can withdraw accumulated recharge credits, as well as authorization of new credits. Credits would be accumulated during times of limited aquifer recharge capacity, where Wichita would receive recharge credits for treating surface water diverted at its ASR Project on the Little Arkansas River and sent directly to Wichita, offset by reduced Equus Bed Aquifer use. Public meetings and the formal phase of public hearings took place from 2018 through 2021, with a written recommendation to the Chief Engineer anticipated later in 2021.

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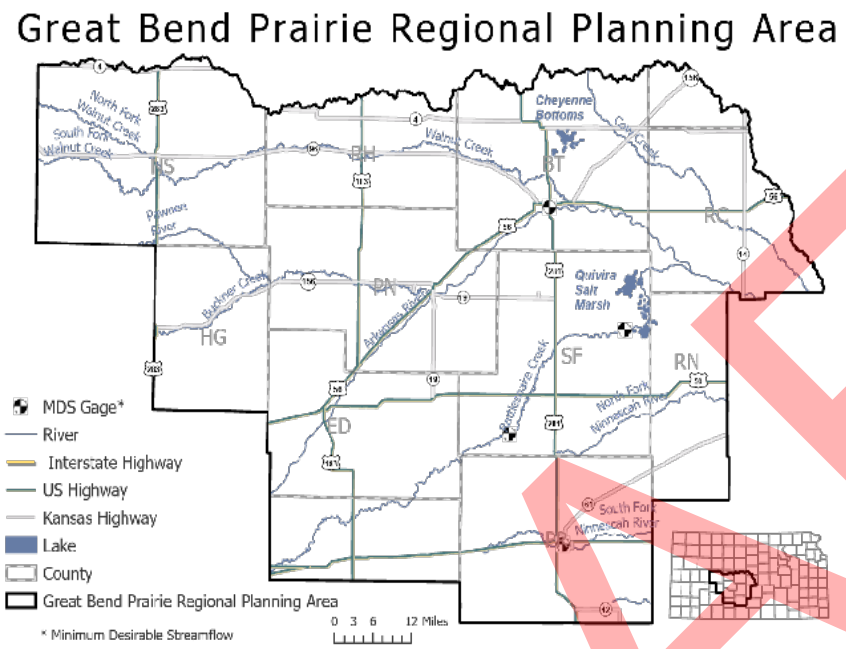
Great Bend Prairie Region

Regional Description



The Great Bend Prairie Regional Planning Area is located in central and South-central Kansas and covers approximately 6,769 square miles. It includes all or parts of Barton, Edwards, Ellsworth, Hodgeman, Kiowa, Ness, Pawnee, Pratt; Reno, Rice, Rush, and Stafford counties (Figure 1).

Figure 1. Great Bend Prairie Regional Planning Area

CLIMATE & LAND USE

As is common across all of Kansas, the climate of the Great Bend Prairie Region is characterized by extremes with highly variable precipitation and temperature. Average annual precipitation ranges between 20 and 32 inches (Figure 2). Normal annual mean temperatures for the region range from around 52 to 56 degrees Fahrenheit.

Land use activities can have a significant impact on the region. The two major land uses in this region are cultivated crops (61%) and herbaceous (32%) as derived from the National Land Cover Database (NLCD) 2016 dataset.

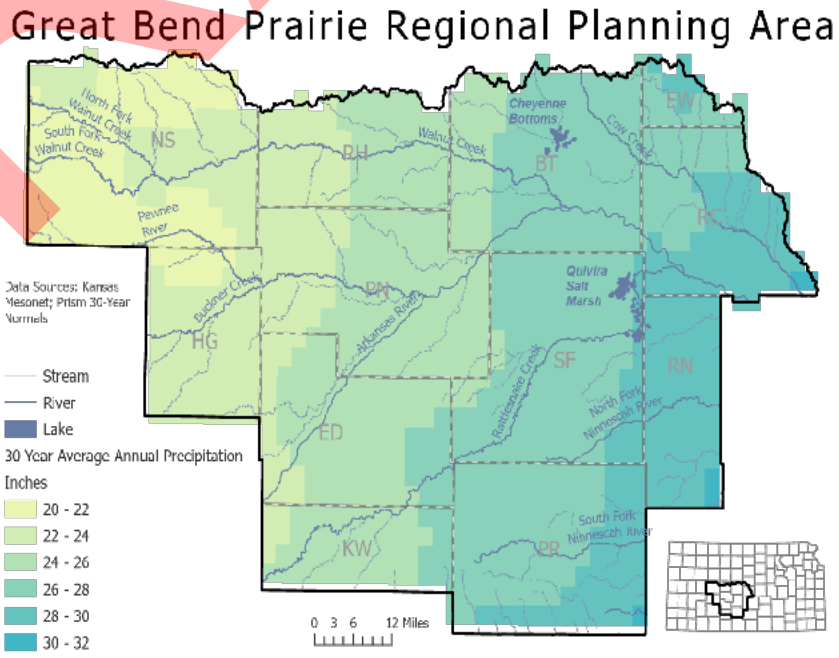


Figure 2. 30-year average annual precipitation in the Great Bend ~~Prarie~~ 1gion

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Great Bend Prairie Region

Figure 3 lists the remaining land uses in the region, including: deciduous forest, developed/urban open space, and water.

The Great Bend Prairie Region is characterized by undulating to rolling sand plains. Windblown sand, sandy outwash, and dunes support native prairie grasses. Dryland farming of winter wheat and large areas of center-pivot irrigation of corn, soybeans, cotton, grain sorghum, and alfalfa crops now dominate the landscape.

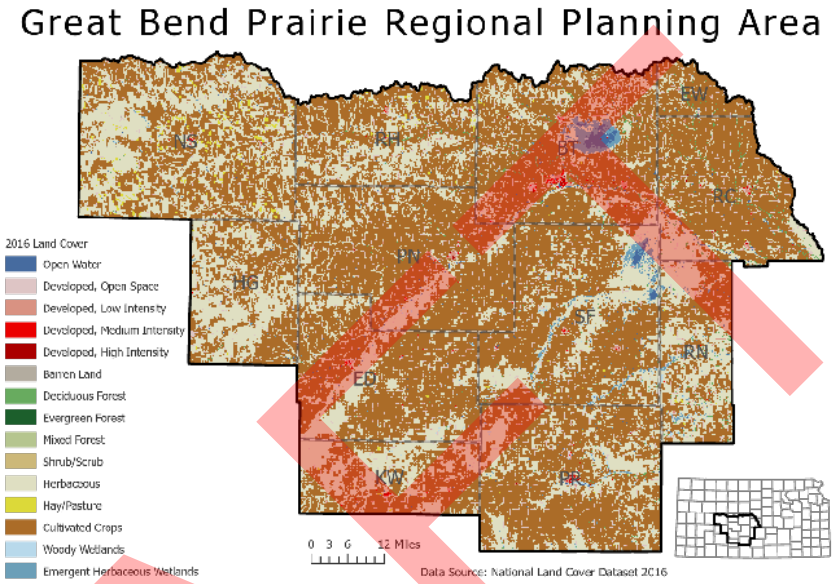

Figure 3. 2016 Great Bend Prairie regional land cover

POPULATION & ECONOMY

Based upon 2019 information derived from state-released information to the U.S. Census Bureau, there were an estimated 75,361 residents in the region (Figure 4). For counties in which only a portion of the area falls within the region, the population estimates were calculated by first determining the total area and estimated population of the respective county then multiplying that population by the proportion of the county within the Regional Planning Area. For these areas, population estimates could be over or ~~under represented~~. No further refining of population information for water supply planning purposes will be possible following certification and release of the 2020 Census.

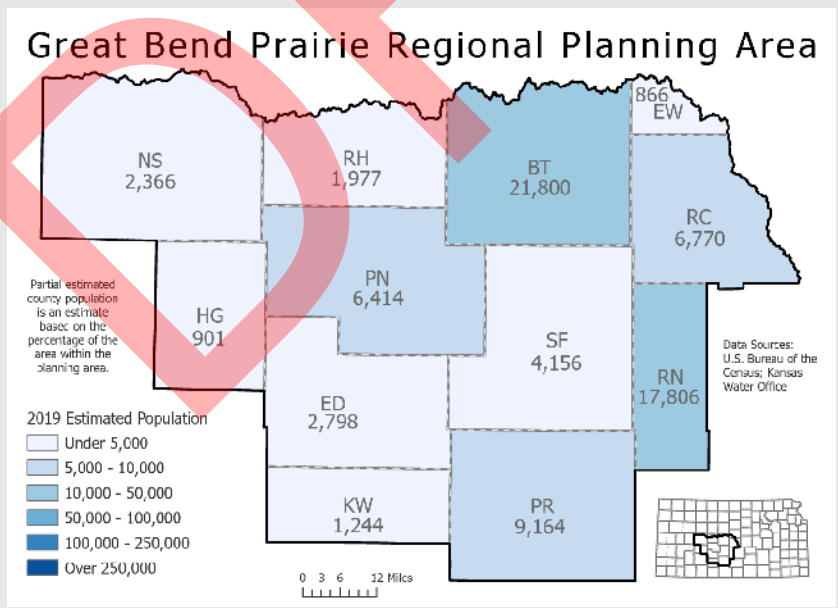

Figure 4. 2019 estimated population by county

Agriculture is a mainstay of the regional economy. Dry land farming began to give way to irrigated crops around 1970, though both types of production are still practiced. Wheat, corn, and livestock are the principal agricultural products. Recreation is an important part of the local economy. Quivira National Wildlife Refuge and Cheyenne Bottoms, both vast wetland complexes, draw thousands of hunters and bird watchers to the area. The population for the region by 2070 is predicted to remain stable or decline, with only Pratt County anticipated to see an increase.

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Example: Reno County: the major town (Hutchinson) is outside of the region boundary and skews the numbers for that county in Figure 4. Isn't the population for each town known in the Census Bureau information? Once that is calculated for the towns within the county/region, then the remaining rural population could be calculated as a proportion of the total area within the region boundary. It is more work but would be vastly more accurate.

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Spelling: underrepresented

Great Bend Prairie Region

Primary Water Resources in the Region

GROUNDWATER

Groundwater is the primary source of water in the region, principally from the Great Bend Prairie Aquifer and alluvial deposits along major streams. There are 54 public water suppliers in the region, including 4 rural water districts. 42 of the public water suppliers in the region have approved water conservation plans.

The primary aquifer within this region is the Great Bend Prairie portion of the High Plains Aquifer (Great Bend Prairie Aquifer). Other aquifers present within the region include the Dakota, along with alluvial aquifers along and near major tributaries within the region (Figure 5).

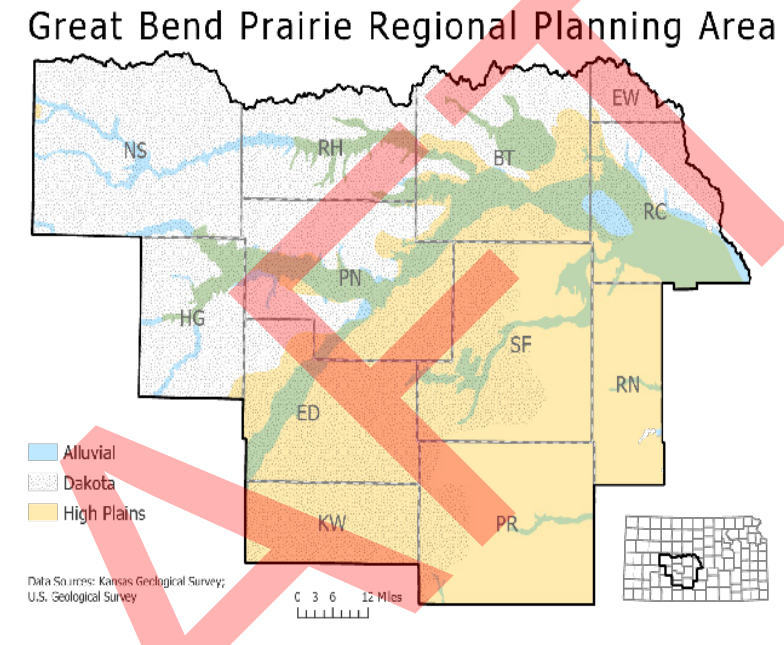

Figure 5. Principle aquifer boundaries in the Great Bend Prairie Region

SURFACE WATER

The principal tributaries in the Great Bend Prairie Region are the Arkansas River, Rattlesnake Creek, Walnut Creek, the Pawnee River, and Cow Creek (Figure 6).

There are also two ~~additional areas~~ surface water in the region: Cheyenne Bottoms and Quivira National Wildlife Refuge.

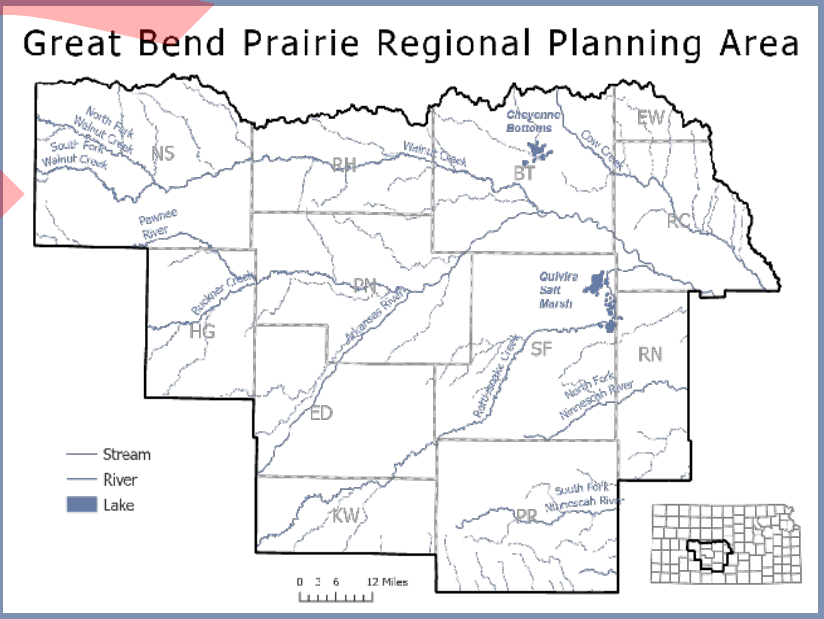

Figure 6. Major water resources in the Great Bend Prairie Region

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bodies

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of significant importance

Great Bend Prairie Region

Primary Water Use by Source

SURFACE WATER

Major rivers and streams in the region include the Arkansas River, Rattlesnake Creek, Walnut Creek, Pawnee River, and Cow Creek. Due to streamflows often being insufficient, surface irrigation is limited.

Important surface water features include the Cheyenne Bottoms in Barton County and Quivira National Wildlife Refuge in Stafford County. Cheyenne Bottoms is owned by the State of Kansas and managed by the Kansas Department of Wildlife and Parks (KDWP). The federally owned Quivira National Wildlife Refuge is managed by the U.S. Fish and Wildlife Service (USFWS). Both hold water rights that allow for management of the areas as wetlands, a recreational water use.

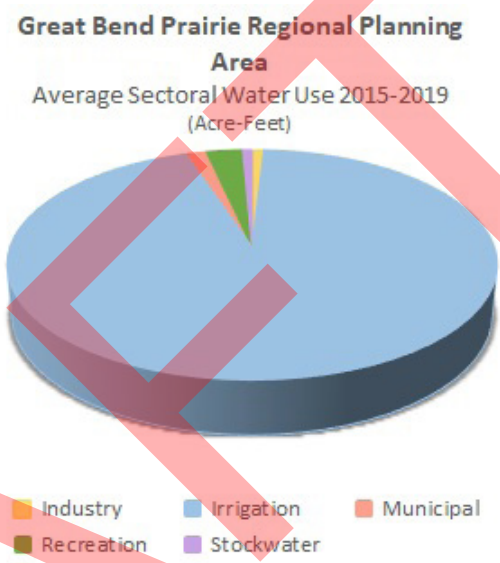

Figure 7. Average sectoral water usage

GROUNDWATER

Groundwater supplies 98% of water used in the region. Of that percentage, irrigation is the primary use, accounting for about 94% of reported usage. The remainder is accounted for by municipal (2%), industrial (1%), recreation (3%), and stockwater (1%) (Figure 7).

Big Salt Marsh area of Quivira National Wildlife Refuge, Stafford County, KS. Photo Credit: Jamil Moody

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Great Bend Prairie Region

Regional Issues & Priorities

Groundwater in the region is managed for sustainability, with the local leadership of Big Bend Groundwater Management District No. 5 (GMD5) and the Kansas Department of Agriculture-Division of Water Resources (KDA-DWR). GMD5 operates under a "safe yield concept" in which appropriations are managed so that the quantity of groundwater withdrawn is approximately equal to the average annual recharge. A majority of the region is restricted or closed for new water appropriations. The entire portion of the region within GMD5 is closed to new appropriations by regulation.

In 1978, the Kansas Legislature amended statutes to enable the State's Chief Engineer to designate certain areas as intensive groundwater use control areas, or IGUCAs. An IGUCA is a groundwater management tool that works in conjunction with the Kansas Water Appropriation Act providing flexible solutions to the complex problem of groundwater declines. The IGUCA statutes allow the Chief Engineer to implement an IGUCA when local conditions require it, or when local stakeholders request it. There are two IGUCAs in the region: the Wet Walnut IGUCA and the Pawnee IGUCA (Figure 8).

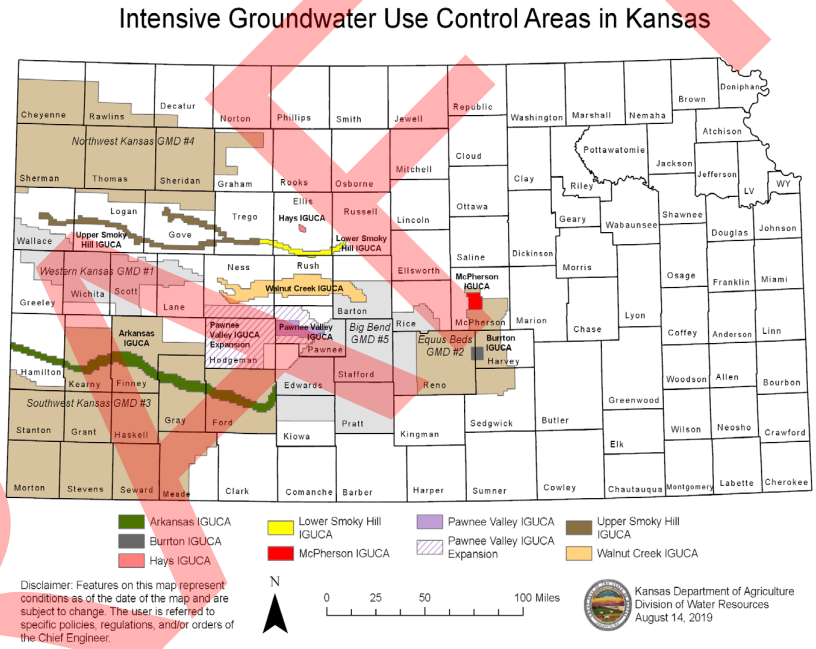

Figure 8. Intensive Groundwater Use Control Areas in Kansas, KDA

Water appropriations and use are overseen by the KDA-DWR. Minimum desirable streamflow thresholds have been set for sites on the South Fork Ninnescah, Rattlesnake Creek, and the Arkansas River. The Wet Walnut and Pawnee watershed districts cover portions of the region.

GROUNDWATER SUSTAINABILITY

Sustainable use of groundwater within the Great Bend Prairie Region is an identified priority of the Regional Advisory Committee. Analysis of groundwater levels indicates a slight declining trend within the GMD5 portion of the region, with portions of Edwards and Pawnee counties observing higher decline rates. In order to reach long term sustainability of groundwater resources, the Regional Advisory Committee has identified a diverse set of actions including voluntary water conservation programs, education, protection of water quality, less water intensive crop production, and watershed structures to aid in water management. Ultimately, all are components thought to help reach sustainable water use while not adversely affecting the regional economy.

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Great Bend Prairie Region

GROUNDWATER QUALITY

Chlorides

~~Groundwater sources within the region contain high salinity, due to the conditions and composition of the aquifer and underlying bedrock~~ (Figure 9). Based on water quality monitoring wells located within the region and maintained by the Kansas Geological Survey (KGS), the quality of the Great Bend Prairie aquifer ranges from saltwater in the northwest and central portions of the aquifer to fresh water in the southernmost area. ~~According to KGS, the saltwater is caused by the intrusion of the underlying Permian bedrock, with varying salinity levels across the formation.~~

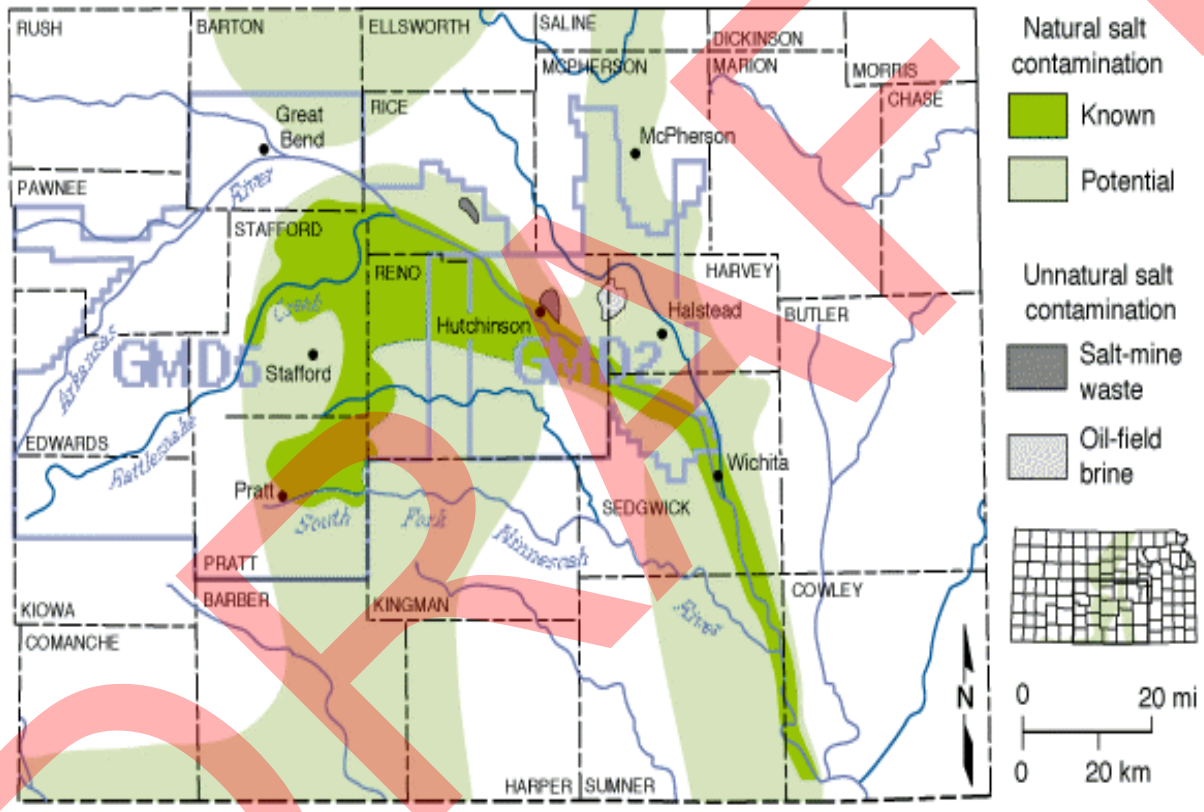

Figure 9. Areas affected by or vulnerable to salt contamination in south-central KS, KGS

Saline water intrusion to the shallow aquifer is mainly controlled by discharge along streams, especially Rattlesnake Creek and parts of the South Fork of the Ninnescah River and the Arkansas River, and in the Big and Little Salt marshes. In addition to the natural sources affecting the groundwater salinity, there is concern that oil-field brines and agricultural activities have affected the water quality of the aquifer.

Knowledge of the present distribution, concentration, and source of the saline waters and contaminated areas is necessary for the development of water-quality models of the region and for management of the groundwater resources to minimize salinity effects. As such, the maintenance and operation of the KGS monitoring well network continues in the region to monitor and document chloride levels.

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Due to the conditions and composition of the aquifer and underlying bedrock, groundwater sources within the region contain high salinity

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According to KGS, the Permian bedrock formation, with variable salinity, causes the intrusion of saltwater into the aquifer.

Great Bend Prairie Region

Nitrates

In addition to elevated chloride levels within the region, rural water wells in the region have experienced a significant increase in nitrate levels over a 40-year period according to a study released by Kansas State University. The study, which included groundwater samples from 22 monitoring wells, revealed that nitrate levels measured in some wells within the region were above EPA standards. High nitrate levels in drinking water can cause health issues to humans and livestock. Elevated levels in the body interfere with the transport of oxygen by blood and can increase the risk of cancer. While municipalities are required to test and provide safe drinking water to the public/city residents, private well owners are urged to test water quality at least annually.

As the data indicates, groundwater sources within the Great Bend Prairie region are vulnerable to contamination. Efforts to expand the adoption of management practices to protect source water within the region are vital.

LESS WATER-INTENSIVE CROPS

Increased utilization and adoption of feed wheat as well as other alternative crops provide the potential to lessen demand on groundwater resources within the region as well as provide sources of locally grown livestock feed for utilization within the Great Bend Prairie Region and elsewhere within and outside Kansas borders.

Continued research and development on livestock feeding with less water-intensive crops as well as advances in plant breeding provide the opportunity to improve water resource management within the Great Bend Prairie Region and enhance markets for ~~regionally grown~~ feed produced with a low water footprint.

WATERSHED STRUCTURES

There are two active Watershed Districts within the Great Bend Prairie Regional Planning Area: Pawnee Watershed Joint District No. 81 and Wet Walnut Watershed Joint District No. 58. Previous analysis conducted by the Kansas Water Office reveals that approximately 30-35% of the drainage area within these two Watershed Districts is controlled at the present time.

Additional construction of planned structures within these ~~Watershed Districts~~ could further increase floodwater management potential within the region as well as provide increased alluvial aquifer recharge in locations where subsurface geology is conducive.

Watershed Dam in Kansas. Photo Credit: KDA

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watershed districts

Great Bend Prairie Region

QUIVIRA NATIONAL WILDLIFE REFUGE/RATTLESNAKE CREEK

The Quivira National Wildlife Refuge (NWR) located 30 miles west of Hutchinson and 35 miles southeast was established in 1955. The refuge offers vital habitat for migratory birds, and is considered a wetland of international significance, due in part to its unique salt marshes created by the high salinity of the groundwater in the area. The United States Fish & Wildlife Service (USFWS) holds a surface water right (established in 1957) on Rattlesnake Creek to support the refuge and the habitat is provides (Figure 10).

For decades, the USFWS expressed concern that its senior water right on Rattlesnake Creek was being impaired by junior water right groundwater pumping. The Rattlesnake Creek/ Quivira Partnership was formed in 1993 with local residents, state and federal agencies working to provide voluntary solutions to the problem in an effort to maintain sustainable water supplies within the region. ~~After decades of efforts to resolve the impairment concerns were unsatisfactory, in~~ April 2013, the USFWS filed an impairment complaint with KDA-DWR. In 2016, KDA-DWR found that junior groundwater pumping impaired the USFWS from exercising its senior water right for Quivira NWR.

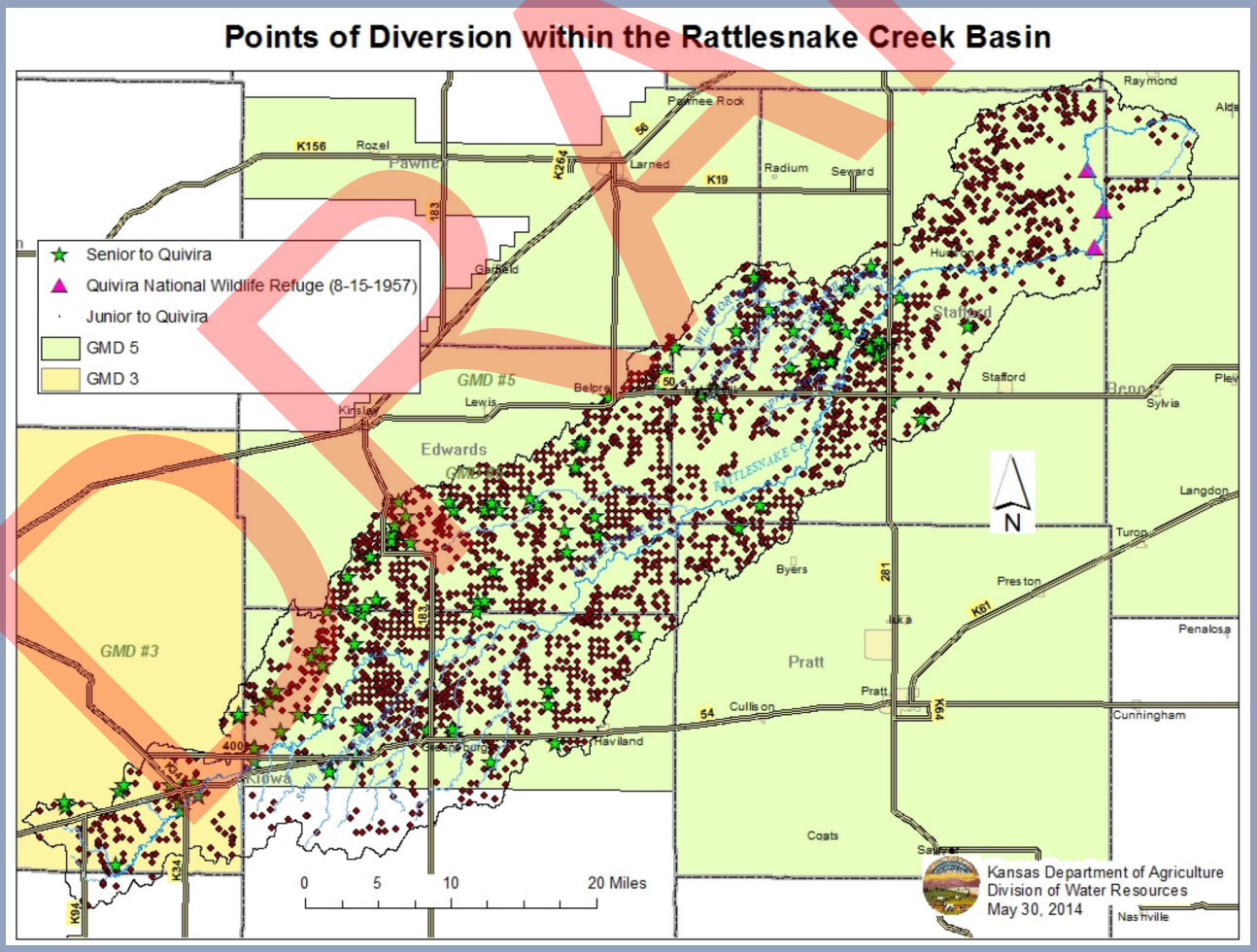

Figure 10. Points of Diversion within the Rattlesnake Creek Basin, KDA

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Great Bend Prairie Region

From 2016 through July 2019, KDA-DWR worked with ~~Big Bend Groundwater Management District (GMD No. 5 (GMD5),~~ the groundwater district in the region, to find a solution to the Quivira NWR impairment that would minimize the adverse effect on the region's economy, focusing those efforts on the development of a Local Enhanced Management Area, or LEMA . During that time, no water right administration occurred.

The USFWS and GMD5 agreed that the development and implementation of an augmentation well field will be the primary mechanism to address the impairment. ~~GMD5 applied for a grant to assist in paying for the augmentation well field, and also agreed~~ that the development of a water rights purchase program, a water rights movement program, and a program to incentivize the removal of end guns within the district may be pursued to adjust the amount of water augmented for the refuge by the well field.

While local efforts to address the impairment continued to take shape, In January of 2021 the Audubon of Kansas filed suit in federal court against the U.S. Department of the Interior and ~~various state and local officials~~ alleging they had failed to protect the senior water rights belonging to the Quivira NWR. The lawsuit seeks an injunction that would ensure the refuge has sufficient water supplies by ordering the defendants to protect the refuge and its water right. The litigation is on-going as of July 2021.

0.00 cfs at Rattlesnake Creek near Macksville, KS on July 16, 2012. Photo Credit: Sonja McDanel, USGS

WATER BANKING

The first chartered and only ~~currently~~ active water bank in Kansas is the Central Kansas Water Bank Association (CKWBA) within the geographic footprint of GMD5. The CKWBA facilitates the sale or lease of water rights, providing an electronic bulletin board that helps bring sellers and buyers together. ~~Three types of accounts are available within the CKWBA: 1) water deposit, 2) water lease, and 3)~~ safe deposit boxes referred to as savings accounts. Water rights must be in good standing to participate water banking activities and must remain ~~so, with Section 901 of the Bank Charter stating that violations of contract provisions shall result in a forfeiture of that water user's access to all future Bank activities.~~

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GMD5 received federal funding through the Watershed Protection and Flood Prevention Act to complete a Watershed Plan-Environmental Assessment that meets NRCS requirements. Additionally, the USFWS and GMD5 agreed

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Two programs are available within the CKWBA: 1) water deposit/lease transfers and 2)

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Great Bend Prairie Region

R9 RANCH APPLICATION AND PROPOSED WATER TRANSFER

In 1995 the City of Hays purchased the R9 Ranch near Kinsley, KS (Figure 11), later selling an interest to the City of Russell. The cities have a cumulative water right authorization for irrigation use of approximately 7,700 acre-feet with a calculated consumptive use of 6,750 acre-feet, which could be requested to convert to municipal use. The proposed $80 million project would move water approximately 69 miles to support 35,000 people and a $2 billion economy.

Hays and Russell began the process to request permission to convert the water rights to municipal purposes and transfer the water. Based on a modeling analysis with the change application process, they have agreed to a 30% reduction in the quantity that would be diverted from those wells for municipal use. The 10-year rolling average amounts to 4,800 acre-feet which is sustainable allowing for aquifer recharge.

In 2019, following consideration of comments from local individuals and entities, including ~~the local groundwater management district~~, the Chief Engineer of the KDA-DWR contingently approved the change applications submitted by Hays and Russell to convert the R9 Ranch irrigation rights to municipal use for the cities. In May 2019, the Water Protection Association of Central Kansas (WaterPACK) filed a request for judicial review of the contingent approval of the change application in Edwards County District Court where a legal ruling is still pending as of July 2021.

Figure 11. Map of R9 Ranch Location, KWO

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It is advised that, since KWO Director will serve on the water transfer hearing panel, statements that could be perceived as biased should be revised.

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Acronyms

KANSAS WATER PLAN

ANS: Aquatic Nuisance Species
ARCA: Arkansas River Compact Administration
ASR: Aquifer Storage and Recovery Project
AVC: Arkansas Valley Conduit
BBGMDMOD: Big Bend Groundwater Management District Model
BMP(s): Best Management Practice(s)
BNSF: Burlington Northern Santa Fe
BOR: Bureau of Reclamation
CAFO(s): Confined Animal Feeding Operation(s)
CIG: Conservation Innovation Grant
CREP: Conservation Reserve Enhancement Program
CRP: Conservation Reserve Program
CWA: Clean Water Act
EQIP: Environmental Quality Incentives Program
EPA: Environmental Protection Agency
~~ERPs~~[1]mergency Response ~~Plans~~[2]
FEMA: Federal Emergency Management Agency
FHSU: Fort Hays State University
FIRM: Flood Insurance Rate Maps
FIRO: Forecast Informed Reservoir Operations
GMD(s): Groundwater Management District(s)
GPCD: Gallons Per Capita per Day
GRASP: Groundwater Recharge and Sustainability Project
HAB(s): Harmful Algal Bloom(s)
HPA: High Plains Aquifer
I&E: Information & Education
IGUCA: Intensive Groundwater Use Control Areas
KACEE: Kansas Association for Conservation & Environmental Education
KCC: Kansas Corporation Commission
KDA-DOC: Kansas Department of Agriculture-Division of Conservation
KDA-DWR: Kansas Department of Agriculture-Division of Water Resources
KDEM: Kansas Division of Emergency Management
KDHE: Kansas Department of Health & Environment

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Plan(s)

Acronyms

KANSAS WATER PLAN CONTINUED

KDWP: Kansas Department of Wildlife and Parks
KGS: Kansas Geological Survey
KRPI: Kansas Reservoir Protection Initiative
KRWA: Kansas Rural Water Association
KSRE: Kansas State Research & Extension
KSROW: Kansas Runs on Water
KSU: Kansas State University
KSWQS: Kansas Surface Water Quality Standards
KWA: Kansas Water Authority
KWO: Kansas Water Office
KWP: Kansas Water Plan
LAWMA: Lower Arkansas Water Management Association
LEED: Leadership in Energy and Environmental Design
LEMA(s): Local Enhanced Management Area(s)
MCL: Maximum Contaminant Level
MDI: Mobile Drip Irrigation
MDS: Minimum Desirable Streamflow
MEKRO: Multi-Basin Evaluation of Kansas Reservoir Operations
MOA: Memorandum of Agreement
MRRIC: Missouri River Recovery Implementation Committee
MSL: Mean Sea Level
NCEI: National Centers for Environmental Information
NFIP: National Flood Insurance Program
~~NGOs~~: Non-Governmental ~~Organizations~~
NLCD: National Land Cover Database
NOAA: National Oceanic and Atmospheric Administration
NPDES: National Pollution Discharge Elimination System
NPS: Nonpoint Source
NWS: National Weather Service
OWCAP: Ogallala Water Coordinated Agriculture Project
PACE: Partnership for Agricultural Conservation and Excellence
PAS: Public Assistance to States

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