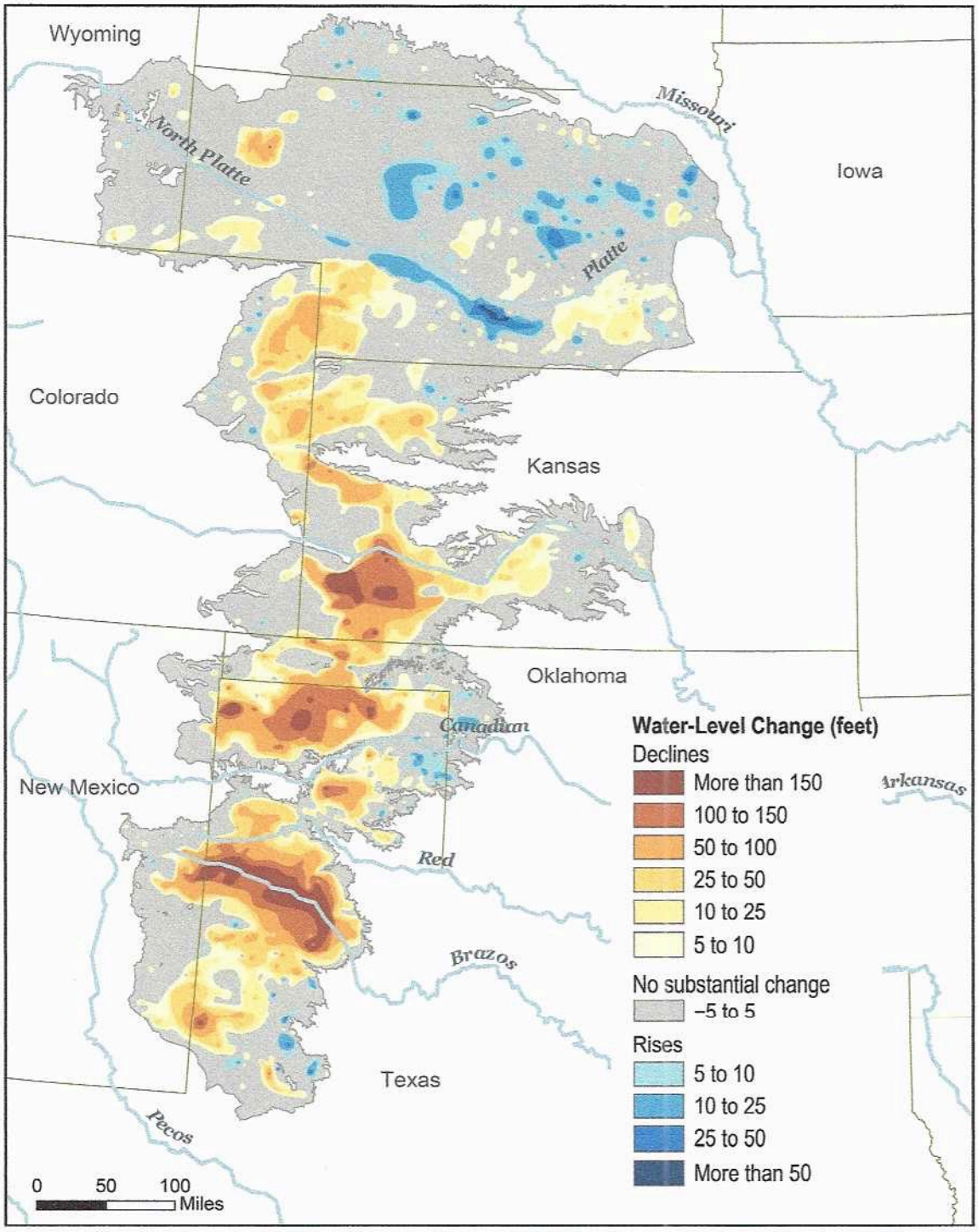
Kansas Aquifer Policy Primer: Choices for the Future



Map: McQuire. V.L, "Aquifer Pre-development to 2015," Fourth National Climate Assessment.

Kansas Aquifer Policy Primer: Choices for the Future

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Kansas Aquifer Policy Issue Book Discussion Outline

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Acknowledgements

The "Alternatives and Consequences" Approach to Public Policy Education

In the 1970s, Dr. Barry L. Flinchbaugh led a Kansas Policy Education Program on "Use Value Appraisal of Farmland for Property Tax Purposes." Under his tutelage, Use Value became my thesis topic as a graduate student. We calculated county by county impact estimates comparing market values and use values for a Kansas Interim Legislative Study Committee. We updated the study for Barry's Extension Education Programs prior to a statewide vote on an Amendment to the Kansas Constitution. Using "Flinchbaugh's Alternatives and Consequences Public Policy Education Methods," we found that one policy issue was often related to several others. Each policy question had a different set of alternatives and consequences. Barry simplified and broke the issues apart to discuss one issue at a time and then related it to the next issue. Barry would say, "Increasing understanding on policy issues is like peeling an onion. Each layer reveals something new and related." When done, you see the "big picture."

Kansas Groundwater Policy in 2025 is similar and involves several related policy problems. Each involves multiple choices. Water policy decisions are not only made by irrigators and others using aquifer water, but also the decisions involve whether they collaborate and who they will collaborate with, and whether they agree with area groundwater management district goals and criteria used by the Kansas Chief Engineer who approves water conservation plans. The purpose of this policy education issue book is to bring students of water policy up to speed and assist stakeholders in making more informed choices. Users face different circumstances at different locations and people have diverse values. Flinchbaugh's method was to define policy problems, outline policy alternatives and probable consequences with fact-based information, and allow members of the audience to apply their own values and make their own decisions.

After leaving Kansas in 1978 for Purdue University, I had the opportunity to learn from Barry's Policy Education mentors, J.B. "Heavy" Kohlmeyer and J. Carrol Bottum. They developed and practiced the Purdue methods of "Alternatives and Consequences" policy education during the 1940s, 50s and 60s. They worked with Farm Foundation's National Policy Conference to spread their methods and principles through the national network of Land Grant Universities, Extension Agricultural Economists and other Coop Extension professionals. After Purdue, I joined South Dakota State University in 1981 as an Ag Policy Economist during the Farm Crisis. I joined Iowa State University in 1986 as an Ag Policy Economist and became Community Vitality Center Director in 2002. I retired in 2020 as Professor Emeritus. I currently serve on boards for 4 nonprofits, a coop venture capital fund, and a bio-stimulant fertilizer company. I'm part owner in a dryland Century Farm in Nemaha County, Kansas. So, there is no axe to grind or conflict of interest on aquifer issues. I've been an interested student of aquifer policy issues for the past year. My goals are to continue my learning as an educator, enhance understanding for others, remain objective, and provide a model program using Flinchbaugh's methods on the Center's 2024 top priority issue and first Public Policy Education Program.

This issue book provides an issue analysis framework for emerging students and leaders on aquifer policy issues. A seminar and/or expert panel discussion on the policy alternatives can be followed by audience discussion in small groups and a survey process for group reporting of results. Thus, the audience receives an indication of neighbor attitudes and policy preferences. Policy choices involve discussion and compromise on the pathway to the future decisions.

Evidence that an Aquifer Policy Problem Exists.

The Kansas Geological Survey (KGS) indicates the western Kansas population and economy have been using water from the High Plains-Ogallala Aquifer faster than aquifer recharge rates at many locations. The High Plains-Ogallala Aquifer in Kansas has experienced groundwater declines of 25 to 200 feet since pre-development. From 1989 to 2017, more than 11% of western Kansas irrigated land converted to dryland. While the thickness and depth vary widely across the aquifer, one western Kansas region reportedly was to reduce water use by 17.5 percent of historical use to stabilize and sustain aquifer levels. In addition, water use on one farm can impact water availability on a neighboring farm, and area impacts vary depending on geology. About 85% of water use is for agriculture and 15% for other uses. Value-Added investment in ag supply chain industries like feedyards, meat packing, and dairy plants, provide higher values per unit of water use, and higher multipliers for income and employment, which contributes to sustaining population and regional economy (The Directions Group).

The High Plains- Ogallala Aquifer depicts a classic case in resource economics called "the Tragedy of the Commons." A common pool resource is limited and the rights for use are owned by many. Some owners may take more than a "sustainable share" which may deplete a common pool resource over time. "Free Riders" may emerge when institutions and criteria for sustainable use are ignored, rules are not clearly defined, or the rules do not have effective implementation and enforcement. Mandatory monitoring, enforcement, penalties for over-use, and transparency can foster greater accountability to reduce "Free Rider" issues. Coordinated management can sustain longer life for common pool resources that are limited (Ostrom).

Policy Choice 1: What should be the Policy Goals for Aquifer Water Use?

1. Full Use of Groundwater Permit Allocation Amount.
2. A Percentage Reduction from previous historic use for the geographic area.
3. A Uniform Quantity of water drawn over a 5-year period for each user.
4. Q-Stable Water Use: Water use equals recharge for sustaining the aquifer at each location.
5. Water Use location conditions exist requiring transition to dryland in an optimal manner.
6. Other Goals: Human and animal health, optimum economy, and conservation practice credit.
7. Aquifer Water Use Policy that is "Fair and Equitable" for all Kansans.

Policy goals describe the intended purpose for implementing a public policy. Since various stakeholders face different circumstances in life, they hold differing values on what should be done. Most policies have multiple objectives and must appeal to a larger coalition for passage. Understanding the facts and principles are used to address issues of the commons (Ostrom). Policy goals help to guide proposals into solutions hammered out through the political process. Broader coalitions are formed by compromise to reach a majority in voting. Accomplishing the "greatest good for the greatest number," is a common objective when there is a high degree of consensus among leaders and citizens. Protecting minority interests may involve further compromise, which may be required to build a broader coalition for passage of a policy. Lines of compromise are redrawn over time as policies are re-evaluated by leaders and citizens.

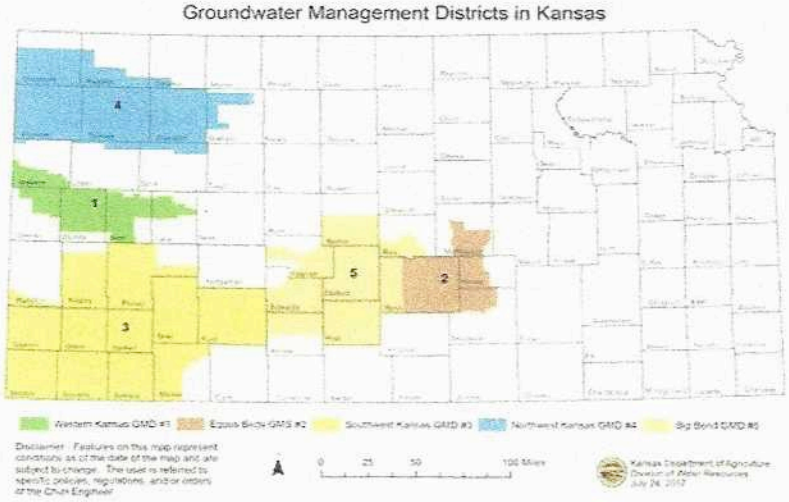
The water contained in the High Plains-Ogallala Aquifer is mostly fossil water that was once part of "continental ice sheets" during the ice ages. Once used, fossil water is not replaced. Other water in the aquifer is rainfall and snowmelt from the region and basin flows from the Rocky Mountains. As such, the aquifer is slow to replenish, particularly in the Southern High Plain-Ogallala Aquifer Region. The hydrologic cause of rapid groundwater depletion is "over-pumping," while a less obvious indirect factor is "over-appropriation." Over-appropriation is not a legally defined term. The conventional meaning is that a state has granted more water rights and permits that allow for more water use than the aquifer can sustainably provide. Innovation and greater efficiency are among the options for avoiding slower economic growth and slowing the return to dryland agriculture. Over-appropriation gives rise to water equity issues among various interests as well as between current and future generations who would otherwise hold rights to use aquifer waters (Stein). "Fair and Equitable" water use policy is like "prettiness," each citizen is entitled to their own opinion, but not their own set of facts. Politics represents the "art of compromise" in reaching solutions hammered out in the political process.

Policy Choice 2: What Institutional Structures for Groundwater Use Decisions?

Water policy choices are not independent of location and those who makes the decisions. Kansas has 5 Groundwater Management Districts (GMDs) meaning a minimum of 6 decision-making processes. Each water conservation plan depends on location, collaboration, agreement on goals, and may involve working with an area GMD, an IGUCA, LEMA, or forming a WCA.

GMD – Groundwater Management District. In 1972, the Groundwater Management District Act was passed (KSA82a-1020). GMDs are local area government agencies authorized by the state and formed by local citizens in accordance with state law to promote water conservation for a geographic area. GMDs impose an annual assessment against each landowner of $0.05 for each acre of land owned within the boundaries of the district. Special assessments may also be levied against land specially benefited by a capital improvement without regard to the other limits prescribed (K.S.A. 82a-1030). GMDs have authority to charge a fee for water use. The charge is based on the amount of water allocated to water rights. It cannot exceed $2 per acre-foot of groundwater pumped or allocated to a water right (K.S.A. 82a-1030).

Groundwater Management Districts in Kansas



IGUCA – Intensive Groundwater Use Control Areas became law in 1978. The Chief Engineer, GMD, or local irrigators (by petition) may initiate proceedings to form an IGUCA. Hearings are held to see if conditions merit an IGUCA, determine boundaries, and identify corrective actions for all water users within the boundaries. IGUCAs are formed by Chief Engineer approval and may involuntarily reduce irrigator water rights quantities. There were eight IGUCAs in 2021. IGUCAs are designed to address specific water conservation issues while mitigating income loss. IGUCA procedures reportedly created some unpredictability and uncertainty for irrigators. However, the Chief Engineer has generally avoided "heavy-handed" IGUCA initiations (Griggs).

LEMA – Local Enhanced Management Area. LEMAs are formed by two or more irrigation water permit users who develop a water conservation plan and set of control measures that are presented to a GMD. After reviewing the LEMA plan, GMD recommendations are submitted to the Chief Engineer for consideration. Chief Engineer hearings are conducted but limited to input on the management plan. If approved by the Chief Engineer, the LEMA plan applies to all water users in the LEMA boundaries. LEMAs receive program benefits and services from their GMD and cover all irrigators in the geographic area specified. There are currently 4 LEMAs, including the Sheridan 6 LEMA, GMD4 LEMA, Wichita County LEMA, and Four County LEMA in GMD1.

WCA - Water Conservation Area. Since 2015, a group of two or more irrigation permit users may voluntarily work together in setting goals and water conservation procedures. All participants agree with the WCA plans, otherwise they are free not to join. WCAs provide greater flexibility and less "red tape" compared to LEMAs and IGUCAs. WCAs develop a water conservation plan with conservation practices that all participants agree to for the period covered. WCA plans are directly submitted to the Chief Engineer for approval. Currently, 25 WCAs are active and/or proposed under consideration by the Chief Engineer. GMD3 in Southwest Kansas has seen 15 to 20 WCAs develop. GMD3 is the largest GMD region with parts of 12 counties and wide variability in aquifer depth, thickness, and hydrology conditions.

In 2012, a policy question before Kansas policymakers after stakeholder feedback was: "What institutional policy structure should be used to facilitate voluntary 'bottom-up' goal setting, planning, and groundwater use practices?" Reportedly, public sentiment expressed desire NOT to have "top-down" "one-size fits all" programs. So, "bottom-up" approaches emerged.

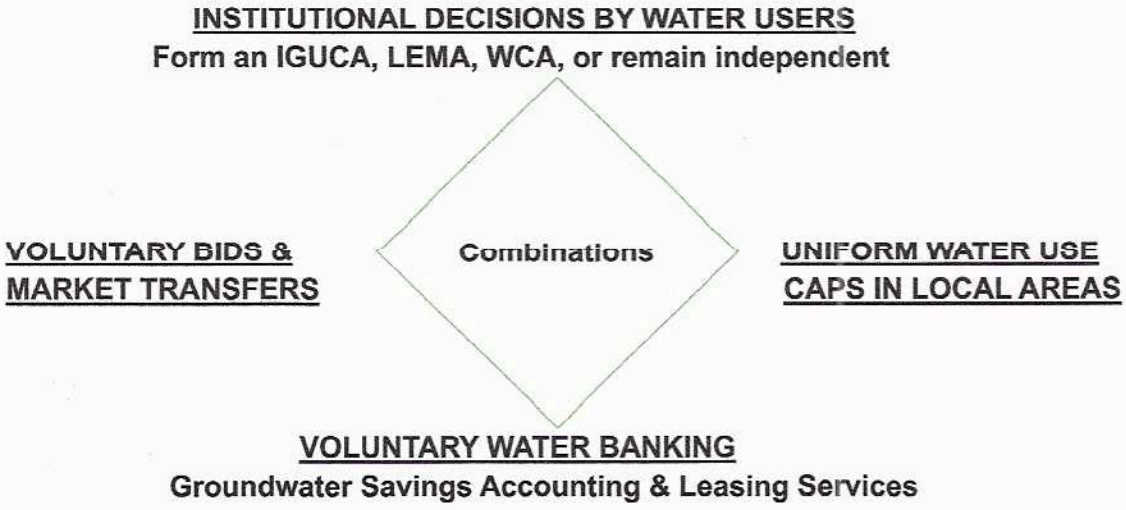
1. Evolving Policy on Prior Appropriation Water Rights

The 1945 Kansas Water Appropriation Act specified all water—surface and groundwater--within the state is to be dedicated to the use of the people of the state and is subject to the control and regulation of the state in the manner prescribed by the state. The manner prescribed is defined in Kansas statutes (KSA 82a-702). The term "use" is focused on beneficial use. "Control and regulation" is exercised in the form of state police powers, as delegated to the Chief Engineer in the Kansas Department of Agriculture Division of Water Resources. The "manner" is the doctrine and procedures for granting, administering, and protecting water rights. Water allocation and use generates issues of public interest and public trust that do not arise

with other resources such as oil and gas rights. State police power is an aspect of authority that underlies Kansas private water rights (Griggs). Federal law pre-empts state law if applicable.

Private water rights are based on prior appropriation policy, which means first in time, then first in right to use the water. The implementation of Kansas Statutes has resulted in over-appropriation of water in many areas western Kansas—meaning the water available is not sufficient to serve all permitted rights previously issued. Protections for water rights do not happen automatically. The Chief Engineer is a reactive officer who responds to calls by owners with senior rights for protection. With language adopted in 1957, new applications for water rights are generally approved unless there is an impairment "beyond a reasonable economic limit." If water shortage occurs, the chief engineer has authority in deciding how to protect senior water rights when a senior right holder makes a call on the water supply and requests a shut down on junior rights. Senior permit holders for irrigation have generally avoided calling for shut down of neighboring junior permits because of the lag time involved in remedy impacts and many owners have both permits for senior and junior water rights (Griggs). Kansas allows "over-appropriated" water use permits to continue if water permit owners maintain continued use standards and their permits are not challenged by senior rights. Some GMDs have imposed safe-yield distance requirements and/or closed areas to new permits since the1980s by forming IGUCAs to limit future over-appropriation and/or address water quality issues.

In 2012, Kansas policymakers created multiple bottom-up strategies for organizing groundwater conservation, mandatory metering and reporting to foster transparency and accountability. To create a LEMA or WCA, two or more aquifer water permit users develop plans for reducing groundwater use. LEMAs present their plans to GMDs and then to the Chief Engineer for approval in the Division of Water Resources (DWR) at the Kansas Department of Agriculture. The Chief Engineer conducts hearings to gather public input on the plans submitted before a final decision is made on whether to approve the plan.



WCAs only need to present their plans to the DWR Chief Engineer for approval. WCAs may develop in areas not covered by a GMD, or in areas where WCA organizer goals or practices

differ from the GMD in the area. The voluntary institutional structures have created flexibility and resulted in varied goals, planning strategies, innovations, and practices to address water conservation across the state. GMD's may comment on WCA plans before approval by the Chief Engineer. However once approved, plans by LEMAs and WCAs have force of state law.

Kansas law exempts individual wells for household consumptive use from groundwater permit application requirements, but such wells are key to farm and household success. Domestic wells are required to meet health regulations. Municipal Water and Rural Water Districts are required to have water use permits and may serve industrial, commercial, various public uses, as well as private households for domestic consumptive use. Kansas law, however, allows areas with dense residential housing to avoid water permit application requirements, as long as, each house has a separate well for domestic consumptive use. As housing density and rural subdivisions increase with individual wells for consumptive use in areas of over-appropriated or impaired water use, public policy discussions about requirements for joining municipal or rural water systems may likely increase or added consideration may be given to safe-yield calculations for aquifer availability and water use for permit approval.

Enacted by the Kansas Legislature in 2023, K.S.A. 82a-1044 requires the board of directors of each GMD to identify priority areas of concern and submit a report to the Chief Engineer, by July 1, 2024, detailing their priority areas of concern, the nature of such concern, and how the areas were identified and developed. The GMD is to conduct public education and outreach in each of their priority areas so the GMD board may develop an action plan to reasonably address the identified concerns based on input from the water right owners and users within the area. Such action plans are to be submitted to the Chief Engineer by July 1, 2026. In addition, all 5 GMDs, the Kansas Water Office, Kansas Department of Agriculture-Division of Conversation are implementing a Regional Conservation Partnership Program to reduce irrigation and/or consumptive water use where appropriate to conserve the Central and Western Kansas aquifers.

2. Uniform Caps on Groundwater Use in the Area

A safe-yield criteria is a uniform calculation formula used for new non-domestic wells to assure there is enough water for beneficial use without causing declines in the local aquifer. A two-mile circle has traditionally been considered and compared to existing water rights. GMD2 was an early adopter in establishing safe-yield criteria for reviewing new water permit applications with a goal of reducing risks of over-appropriation. In the 1980s, GMD2 formed 3 Intensive Groundwater Management Control Areas (IGMCAs). The IGMCAs address water quality issues such as saltwater contamination. GMD2 covers the Equus Beds Aquifer in the south-central Arkansas River basin. GMD2 has been proactive in over-appropriation prevention by establishing uniform regulations, programs, and special management areas. An active aquifer re-charge area was developed in GMD2. GMD2 reports near Q-Stable aquifer levels.

A uniform groundwater quantity cap for irrigators of 55" per acre-foot for a 5-year term was approved for the Sheridan 6 LEMA in April 2013. GMD4 in north-west Kansas facilitated the

Local Enhanced Management Area (LEMA) referred to as Sheridan 6. Multi-year crop mix flexibility and annual water use variation is allowed during the 5-year cap. The Sheridan #6 goal was to conserve water use by 20 percent. A Sheridan 6 impact study found that a 26% reduction in water use was achieved. Water use efficiency was enhanced. Net returns were the same or higher on average compared to non-participating control areas. Sheridan 6 is approaching Q-Stable for aquifer sustainability. Similar subsequent LEMA plans were adopted by Sheridan 6 and whole GMD4 region due to the original results from Sheridan 6.

A uniform groundwater reduction percentage goal was applied to all irrigators in a Wichita County-wide Water Conservation Area (WCA). GMD1 is located in West-central Kansas and facilitated the Wichita County WCA plan approved in March 2017. Participants committed to a 29% reduction goal from average use in 2009-2015. There were 24 WCA participants covering 9,250 acres. During 2017-2023, average use was 65% of the average allocation allowed and 45% of the 2009-2015 average use. Water savings was 2009-2015 average use minus the 2017-2023 average use which equaled 4,711 acre-feet per year. Wichita County is now approaching Q-Stable aquifer levels. The Wichita County WCA success led GMD1 to facilitate development of a Wichita County-wide LEMA approved in 2021 and a Four-County LEMA approved in 2023.

3. Voluntary Bidding and Market Transfer of Groundwater Use Rights

Voluntary bidding to transfer and retire groundwater use rights is used by state and federal agencies for special circumstances. The Kansas Water Transition Assistance Program (WTAP) is a similar voluntary bidding program funded and managed by the Kansas Department of Agriculture (KDA). For example, a 2021 WTAP target area in GMD1 was adopted in Greeley and Wichita counties. Priority for 2025 Fall enrollment is retirement of irrigation water rights that have the greatest impact on the local aquifer system within a 2-3 mile radius around municipal water supplies of Leoti and Tribune. Dryland farming is permitted after a water right is retired. Limited irrigation can be temporarily allowed to establish permanent cover on dryland transition. Partial water right reductions will also be considered for retirement grants. WTAP grants up to $2,750 per acre-foot on the historic 10 years of reported annual water use.

The Conservation Reserve Enhancement Program (CREP) is a USDA program administered in partnership with states, reservations, and/or nongovernment entities designed to address specific conservation challenges in targeted areas. CREP retires land and groundwater. Farm owners with water permits in eligible target areas are informed about the CREP program before launched for a defined area. Farm owners voluntarily submit bids to retire their land and water permits. In return, they may receive cost-share assistance for establishing the conservation practice and receive annual payments for a period of 10 to 15 years.

In another example, a streamflow impairment in GMD5 was imposed for the Quivira National Wildlife Refuge (NWR). The Chief Engineer proposed a mandatory action affecting 1,300 wells and reduction in water use by 40% to 60% as an option for addressing and restoring

the streamflow. The Quivira NWR provides habitat in the Central Flyway for migratory waterfowl and other wildlife. To address the Quivira NWR impairment, local groundwater permit holders in the Rattlesnake Creek region were encouraged to voluntarily consider providing bids for annual compensation for their water rights starting at $200 per acre-foot for up to five years. Initial funding was from state sources and augmentation funding above the initial proposal was to be provided by private sources. Dryland farming would be allowed to continue, thus providing an example of decoupling water rights from farmland ownership. This approach allows farmland owners who wish to submit bids for retiring the water rights to still operate their farm for dryland production. Some farmland owners may wish to retire the land in addition to water rights, but others do not. Similar to partial and whole farm retirement (Bottum), more water rights are likely retired when funding is not a limiting and if low bidders from both groups are accommodated.

Market sales transfer of groundwater use rights from willing sellers to buyers with ability to pay. Buyers of water rights may be farmers or other entities, private or public. For example, the City of Hays purchased the R9 Ranch in 1995 with intent to construct a 69-mile pipeline. The City of Russel purchased 18% of R9 Ranch project in 1996. In March 2019 the Chief Engineer contingently approved an application submitted by the Cities of Hays and Russell to convert R9 Ranch irrigation rights in Edwards County to municipal use. After spending $10 million on legal and engineering costs related to regulatory compliance and expert witnesses for hearings since the 2015 plan filing, a Kansas Administrative Law Judge affirmed the Chief Engineer's approval in 2024. Well field and pipeline design plans are nearly completed. Water Transfer Act authority has received preliminary approval by an Administrative Law Judge. Final approval by a Transfer Hearing Panel is pending and follows a Kansas Supreme Court decision on an appeal of the use conversion. When and if completed, a precedent will have been established.

A precedent for sale of water rights for ag use has recently been placed on public auction. In GMD5, 188 acre-feet of water rights in Stafford County were offered on June 13, 2025. No land was being offered for sale, only water rights for transfer. The winning bid was $2,875 per acre-foot. The winning bidder received a temporary permit and will submit a water use plan to the Chief Engineer before final approval. With a water rights sale precedent in Stafford County, other public auctions may emerge across the state. The sale was near the Quivira NWR streamflow impairment and Rattlesnake Creek area where accommodation efforts are occurring. Allowing water rights sale and transfer could be of interest in other areas of Kansas. In a hypothetical example, the approach may provide an opportunity for a new producer who wants to begin irrigating crops in areas closed to new permits. In theory, under competitive free market assumptions--which may not fully exist—water use rights tend to transfer in public auction to those with greater wealth and/or productivity over time.

4. Water Banking for Saving and Leasing Groundwater Use

GMD5 is in the Arkansas River Basin of Central Kansas where priorities are different. The Kansas Geological Survey (KGS) finds that parts of GMD5 are within 1.6% of Q-Stable, meaning water recharge and flows into the aquifer is within 1.6% of water use. In GMD5, water

priorities are focused on water quality and water flow management across the district rather than aquifer decline. GMD5 facilitated development of a nonprofit water bank called the Central Kansas Water Banking Association (CKWBA). CKWBA has two programs. When a user's water use is less than an allowable portion of the historical permitted amount, the amount saved may deposited and credited in water bank user's account for future withdrawal and use. A second program allows water rights to be leased for a specified period and transferred to other users within the area or district. The state requires the water bank to have an audit every 5 years. In GMD5, the CKWBA water bank likely will assist in facilitating implementation of producer plans for resolution of the Quivira NWR impairment. California, Arizona, and Washington also authorize multiple forms of water banking that preform various water services. Similarly, CKWBA potentially could provide services viewed to be useful in other areas of Kansas. However, the concept may require additional incentives or policy rationale for adoption beyond QMD5.

5. Current Approach and Combinations of Alternatives

The current approach varies by location in Kansas. Each GMD, IGUCA, LEMA, or WCA has developed its own set goals, programs, and rules. Also, many Kansans are located outside of a GMD or WCA. Each institutional approach may differ in achievement of the intended policy outcomes and impacts. Each approach may also have unintended consequences. The policy option selected most often is a continuation of current policy. Market bidding processes and/or sale or transfer of groundwater rights potentially could be added to current policy approaches in all GMDs and external areas. Water banking potentially could be added to current policy approaches in all GMDs and external areas. However, adding complexity to existing programs may erode simplicity and understanding by users. Furthermore, transfer of groundwater user rights can be temporary, multi-annual, or more permanent. Cost-share incentives can foster innovations in aquifer conservation practices that contribute to key outcomes and impacts. Research and education demonstrations contribute to voluntary adoption of more effective approaches in generating intended outcomes and impacts over time. Mandatory monitoring and site specific measurements of aquifer sustainability levels provides evidence of impacts.

In multiple ag policy surveys on conservation programs (Lubben, et al), survey participants favored voluntary incentives over mandatory programs. Mandatory programs may sometimes be more efficient or cost effective in achieving program outcomes, however top-down, one-size fits all programs often fails to address unique local stakeholder variabilities in circumstances. Voluntary proposals result in multiple approaches and flexibility in achieving policy goals but also result in more administrative complexity and costs. In the final analysis, some producers will prefer Option 1, others will prefer Option 2 for achieving program outcomes, and still others will choose not to participate at all. An open question for citizens, leaders, and policymakers is whether measured impacts generate sufficient progress toward policy goals regarding aquifer sustainability? The predominant response may vary by GMD region and location.

Evidence that Barriers to Aquifer Conservation Still Exist

Several barriers that impede water conservation effectiveness were identified by stakeholders participating in a recent study (The Directions Group, Aug. 2024).

a. Current Farm Program subsidies incentivize production of program crops.
b. Lenders look at bottom line profit, not water conservation when making loans.
c. Crop insurance incentivizes increased yields, not water conservation.
d. No incentive programs exist that apply to my cropping situation.
e. No clear business case where my farm realizes equal or more profit.
f. If I use less water at my GMD location, my future permit allocation declines.
g. Conservation programs require my land to be taken entirely out of production.
h. To meet FSA requirements, I must irrigate a minimum amount on failed crops.
i. It costs too much to buy, operate, and maintain equipment necessary to change.
j. If I use less water, my neighbor/ competitor will use more.
k. If I become more water efficient, I will find new ways to use the water I save.
l. Economic expansion opportunities for western Kansas beef and dairy industries may create potential profit incentives for continuing crop diversification requiring less water.

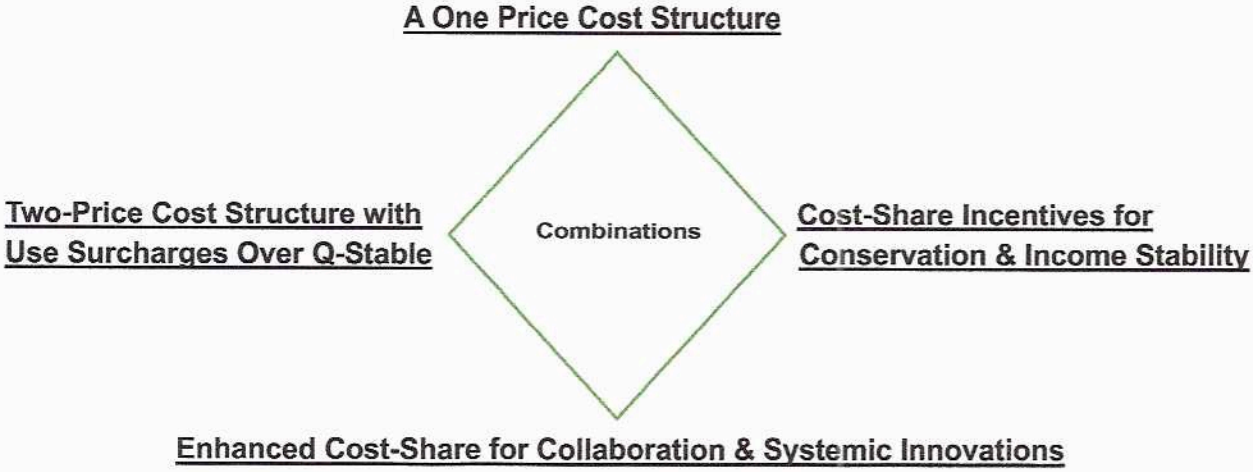
When asked if water policy institutions achieved their goals, a legislative post audit found results were mixed. Success was found in some cases, but perhaps more can be done.

Policy Choice 3: Should Market Incentives Be Enhanced for Aquifer Sustainability?

Nationally, the High Plains-Ogallala Aquifer supports an important part of the nation's agriculture and food industries. Aquifer depletion has occurred in many areas of western Kansas. Western Kansas represents a center for the nation's meat packing and an emerging dairy products manufacturing industry, which rely on regional grain and feed production and manufacturing. To date, progress in managing the aquifers in western Kansas has been achieved by (1) requiring mandatory measurement and reporting of groundwater water use, (2) supporting water conservation research and education initiatives, and (3) fostering "bottom-up" institutional development and programs for setting water conservation goals and water conservation practices for irrigated crops. Sheridan 6 LEMA demonstrated water conservation practices and aquifer sustainability levels can be achieved while maintaining net incomes. But, water use goals and procedures vary across western Kansas and so does groundwater hydrology. In addition, not everyone volunteers to implement water conservation practices.

So, some policy questions remain. Can the market incentives for groundwater conservation be created independently without altering water permit rights? Do all segments of agriculture, business, industry, communities, and populations have incentives to conserve water in a "fair and equitable" manner? Or, should more be done to sustain the aquifers for current and future benefit of Kansans? What discount rate should be used to value water use in the future relative to current water use? What economic barriers to conserving water use remain? To foster aquifer sustainability, should market incentives be enhanced for influencing crop management decisions and returns for conserving water?" Could direct market incentives have impact in overcoming the barriers to achieving a Q-Stable target level of aquifer sustainability and water conservation?" What would the incentives look like? Would addressing market barriers encourage more stakeholders and interests to join forces with irrigators who are already reducing water use with practices and accomplish even more water conservation?

As a result, the emerging policy question is: "What market incentives, if any, should be enhanced to achieve something like a Q-Stable target level of aquifer sustainability? A range of options to enhance market incentives include the following choices:



1. A One-Price Groundwater Cost Structure

Current Policy fosters locally driven bottom-up institutional approaches to encourage water conservation. In some areas, voluntary approaches may potentially be less impactful on aquifer sustainability compared to more direct market incentive structures that influence net returns and management decisions. Voluntary approaches may tend to accommodate those who are resistant to change, those who desire to maximize profit up to their maximum permit use authorized. In Kansas, fees are charged for irrigation water permits and annual use. GMDs currently assess $.05 per acre of land and up to $2 per acre-foot of permitted water to cover GMD budgeted operational and program costs. Some GMDs include cost-share incentive programs in their budgets for installing new technology innovations or more water efficient equipment. Marginal water costs tend to be assessed at a "uniform cost per unit" rate. A "one price cost structure" does not automatically provide a market signal when the irrigation manager exceeds the aquifer's Q-Stable water use level. The price of adding an additional unit of aquifer water is virtually the same as the previous unit of water regardless of whether the aquifer water added is sustainable or unsustainable or over-appropriated.

Q-Stable is a data-driven analysis that is unique to the selected analysis area, be it a GMD, county, or smaller analysis area. From the inflow and outflow relationships, the amount of water or percent reductions in pumping that may be needed to stabilize water levels for the next one or two decades. An important part of the calculation is the net inflow minus water flowing out of the aquifer, excluding pumping. Net inflows include recharge from precipitation, return flows from irrigation systems, lateral flows in the subsurface geology, and drainage from perched water level conditions caused by groundwater declines. For the Ogallala portion of the High Plains Aquifer, the consistent nature of the net inflows identified by the Q-Stable analysis are

likely to hold true for the next decade or two, but they are not sustainable and are likely to decline longer term. As pumping is reduced, so are the irrigation return flows, lateral flows and lagged drainage from perched water level conditions (Bohling, Willson & Butler, 2024).

2. Two-Price Cost Structure with Surcharges Above Q-Stable Target

An annual surcharge could be levied on water used above a target such as Q-Stable for the specific permitted use, region, or area. A regular permit fee would be assessed on water at or below the Q-Stable level, with the surcharge only applied to amounts above the Q-Stable level. To be effective, a surcharge would need to be mandatory on all users above the trigger for participants in the area. A surcharge could be graduated with higher rates on those with higher use over the target use trigger. The surcharge levels could be based on a combination of indicators such as Q-Stable measures, water scarcity and areas lacking progress on water conservation. To be effective, a surcharge must be large enough to incentivize changes in management behavior. The surcharge concept can be applied across institutional types and water uses or targeted to a single use, such as irrigation in a high-impact area. To avoid a surcharge, water users might be allowed to purchase additional water rights or lease water from a water bank with savings generated at below the Q-Stable trigger levels from within the area.

3. Cost-Share Incentives for Enhance Conservation and/or Income Stability

Cost-share incentives may take various forms including matching grants, cost reimbursement grants, tax credits, or tax rebates. Two GMDs currently budget cost-share programs for irrigators to purchase irrigation meters. Water efficiency equipment, and/or adoption of innovative conservation practices could be added. GMDs annually conduct budget development and public hearing processes to establish their annual budgets. All GMDs currently assess the $0.05 per acre of irrigated land, however the assessment for permitted water use varies from $0.22 per acre-foot to the current $2.00 per acre-foot maximum allowed. Thus, statutory flexibility exists for some GMDs to make greater use of cost-sharing programs, whereas other GMDs have fully deployed their budgets. GMDs can also access federal, state, local, and private funding to add support for various cost-share incentives.

The Irrigation Climate And Resource Evaluation (ICARE) project is an example of the Kansas Geological Survey and U.S. Bureau of Reclamation working with GMD3 to complete water use and geological mapping for 16 ICARE areas. Each ICARE area is defined by unique geological and hydrology characteristics that are similar and help to define area boundaries. The project will provide each irrigator with well specific management information on water use relative to Q-Stable aquifer impacts. In the future, Kansas cost-share funding that supports the program may potentially be augmented with federal cost-share programs such as USDA's Environmental Quality Incentives Program (EQIP) and/or Conservation Stewardship Program (CSP) available through the Natural Resource Conservation Service (NRCS).

An irrigation circle pivot corners cost-share incentive program emerged in four northwest Kansas counties from private funds during the past two years. The concept was first developed by the nonprofit Pheasants Forever in Nebraska and Colorado. Pivot Corners

attracted irrigators in Sherman, Thomas, Sheridan, and Logan Counties. Fund raisers, such as "Hunt for Habitat" and the "Governor's Ringneck Classic" generate annual support. Hayden Outdoors, a real estate firm, provides philanthropic support for the program. The local Phesants Forever chapter provided an annual $75 per acre incentive for irrigators willing to make 5-year commitment in establishing and maintaining prairie grass and wildlife habitat on their pivot corners. Reportedly, 92 pivot corners enrolled approximately 11 acres per pivot corner. So over one thousand acres were enrolled in the four counties. No water guns and irrigation is allowed on the pivot corners. Tall grass prairie grasses are established and managed to prevent trees and weeds, improve soil water retention, foster groundwater recharge, and enhance wildlife habitat. Game bird hunting is encouraged but not required by program rules.

Some Irrigators interviewed contend farming the Pivot Corners results in more end-rows and creates greater soil compaction in the corners, which leads to more evaporation, water runoff, erosion, and less groundwater retention in the soil. A meta-analysis of 89 studies found that establishing perennials and continuous roots led to the largest increases in water infiltration rates compared to conventional management and that grazing reduced infiltration rates (Basche and DeLonge, 2019). Woody encroachment tends to reduce groundwater recharge (Keen et al. 2024). Grass buffer strips contributed to maintaining soil health, soil organic matter, less residual N, and less rapid changes in soil pH during transition to dryland (Sapkota et al. 2023). Recommendations on prairie management suggest establishing prairie grass buffers enhance soil moisture and groundwater retention from annual rainfall. Recently, the four-county annual incentive was increased to $100 per acre on pivot corners for a 10-year commitment.

Pivot Corners also are potentially eligible for USDA-CRP rental payments in 10 to 15-year private bid contracts. Some Pivot Corner supporters argue current CRP regulations are too prescriptive, and bidding processes result in CRP rental rates too low to justify the commitment. They suggest aquifer sustainability is a public purpose that merits a greater incentive. One irrigator suggested savings from avoided crop insurance subsidies from not farming the corners could be applied to set a standard CRP rental incentive for Pivot Corners. Another suggested timing is good for CRP expansion with crop surpluses increasing. Program adjustments may require CRP regulation changes and supplemental funding from federal, state local and/or private sources. Additionally, the KDA Water Transition Assist Program could also be modified to provide grant incentives to retire Pivot Corners and create tall grass prairie infiltration areas.

Conservation researchers could develop a project to monitor groundwater recharge on tall grass prairie Pivot Corners under various conditions to provide more precise research-based data on groundwater and aquifer sustainability impacts. Center pivots are the dominant form of irrigation in the Central and Southern High Plains Aquifer Region (Hassani et al, 2021) where aquifer levels have declined the most. The region includes Kansas, Colorado, Oklahoma, Texas, and New Mexico. The study reported 16,210 center pivots in Kansas. The five-state total for the Central and Southern High Plains Aquifer Region was 50,116 center pivots.

Various concepts exist for stabilizing farm income during economic adjustments and transition to dryland. Ideas include income tax credits, property tax credits, and rebates to

reward conservation practices. Such concepts can add support in years with a significant loss of irrigation income or decline in property value. Crop insurance premium subsidies might also be used to encourage more buy-up coverage during dryland transition years to assist in sustaining revenues. Income stabilization or transition subsidies can be added to special farm savings account concepts to enhance the farm income safety net when severe income losses occur. Each stabilization concept may require unique adjustments and funding depending on current institutional procedures in place and/or proposed.

4. Enhanced Cost-Share for Collaborations and Systemic Innovations

Water re-use, retention, recharge, and/or new water source project initiatives are often large scale and only possible by pooling and assembling resources and knowledge. The Kansas Livestock Water Efficiency Pilot Project is part of the state's ongoing effort to encourage water conservation. In June 2024, the Kansas Department of Agriculture's Division of Conservation announced funding for cost share assistance and incentive payments to assist commercial feedlots and dairy operations with livestock water efficiency technology. In addition, Kansas State University has been demonstrating new technology innovations that could be applied to reuse of wastewater for agricultural, industrial, community and rural residential uses. Participation by multiple stakeholder groups, specialized expertise and government leaders may be required for success. Historically, farm cooperatives were organized to pool member resources and expertise to solve multi-faceted problems larger than what a single farmer could accomplish. Agricultural water users, irrigators, livestock feedlots, other industries, communities, and wastewater producers could participate in designing systems for reuse and circular use systems. Assuring health and safety standards prior to reuse requires treatment and testing processes, planning, and investment. Research could assess and estimate the potential impacts on aquifer sustainability that would contribute to policy discussions.

Cost-sharing grants can be offered for commercializing new technologies. When designing circular wastewater reuse demonstrations, it may be necessary to incentivize and engage multiple entities from different sectors and/or uses into cooperative agreements to source liquid waste and byproducts and to connect the sources with new market processing opportunities. Innovations with technical feasibility do not always assure economic feasibility or sustainability. Successful entrepreneurs must manage risks and unforeseen events. Capital adequacy is often insufficient. Like many high-tech startups, "pump priming" and cost-share incentives may be required to attract and attain investment sufficient for threshold levels of breakeven and startup sustainability. As markets are developed, incentives for reuse can also be accomplished in part by regulation of wastewater fees and prices. Higher fees can be applied to single-pass wastewater with lower fees for multiple-reuse wastewater systems. Tax credits and rebates might also be used to defray operational costs and water reuse equipment.

Opportunities for aquifer recharge and substitution by surface water sources depend on several factors for feasibility. Climatic conditions vary from west to east in Kansas. Annual average rainfall for reservoir refill, storage, and aquifer recharge opportunities increase from below 15 inches per year in western Kansas to over 30 inches in central and eastern Kansas.

Since the 1990s, an aquifer recharge project has operated near the City of Wichita in GMD2 to support the city water needs. Flood waters from the Little Arkansas River are diverted to retention areas and treated before injection into wells for aquifer recharge. In addition, Wichita shifts from a mix of drawing 60% water from well fields and 40% from Cheney Reservoir to a mix of 60% from Cheney Reservoir and 40% from well fields. Construction of aquifer recharge and retention area projects, reservoirs, and reservoir water access projects are likely to involve cost-share grants from higher levels of government. Fees are required for water use from reservoirs. More recently, a $14.25 million federal grant was added to $20 million of state funds to advance a $75 million Managed Aquifer Recharge (MAR) project designed to improve water quality and availability in Dodge City. The MAR project treats wastewater to drinking water standards and goes to replenish groundwater supplies in the aquifer for community future use.

Finally, a western Kansas precedent in procuring new water sources from a distance has been established by the Hays-Russell-K-9 Ranch project. Others have suggested more distant sources of water from eastern Kansas or Colorado. Desalination technology of salt water has progressed as ocean water levels rise from changes in climate. Costs of construction, sourcing, operation, legal costs and the art of funding procurement shape project feasibility.

5. Current Approach and Combinations of Alternatives

Current policy does not include surcharges on "over-appropriated use" but has deployed cost-sharing incentives. Combining Surcharges on "over-appropriated water use" with cost-sharing incentives for Pivot Corners and/or collaboration for water re-use by industry and communities would potentially enhance impacts and reduce "free rider" issues that may exist. Surcharges also generate revenue for potential use in enhancing market incentives for conservation and cost-share grants. A combination of surcharges plus incentives for water conservation practices represent a "carrot and stick" approach in designing a combination of market incentives for conserving aquifer water use.

Broadening revenue sources represents greater shared responsibility and tends to reduce the potential fiscal impacts on single sources of revenue. However, each source of funding brings a different policymaking process and political context. Managing multiple levels of political influence often requires alignment of values and approaches coordinated by coalitions of organizations with common interests. Adjustments in existing programs with existing funding authorizations can sometimes be more attainable than creation of new programs. New program concepts can depend on the breadth of coalition support, alignment of interests, and severity of issue impacts. Politics and policymaking represent the art of the possible and ability to compromise. There is variation in GMD programs and administrative services. Some GMDs have achieved conservation successes near Q-Stable. Results in other GMDs are more mixed perhaps due to differences in hydrology and geology as well as diversity in values and culture.

Policy Choice 4. Stakeholder Response Decisions for Public Policy Discussions

As policy decisions are finalized, stakeholders consider and adjust their responses to the policy changes or continuation in policy. A comprehensive policy change may involve a range

of responses from a range of stakeholders with an interest in the issue. Over time, the policymaking process often becomes circular and involves several stages. The impacts and outcomes from policy changes and stakeholder responses are evaluated by stakeholder interests and policymakers, which in turn may lead to subsequent rounds of policy revisions.

Some Key Response Options for Irrigation Producer Discussions

1. Consider LEMA, WCA, and Water Use Goals.
2. Consider CREP, WTAP target areas.
3. Consider above or below ground drip irrigation systems to reduce water evaporation loss
4. Consider changes in crop mix with less water intensive crops in some irrigation zones.
5. Consider deep rooted prairie grasses on pivot corners to enhance groundwater recharge
6. Consider shift in crop mix to forage, as feed grains may be shipped in at less expense.
7. Consider crop genetics and bio-stimulants for plant and soil health using less water.
8. Consider connecting with wastewater and reuse for irrigation systems
9. Consider treatment and/or reuse of lagoon water for animal water consumption.
10. Consider adjustments in farm and conservation programs, savings, and insurance product enhancements in contemplating contingency plans for transition to dryland.

Value-Added Ag Supply Chain Response Options for Discussions

1. Discuss system alternatives for water efficiency, reuse, and implementation
2. Discuss Ideas for incentives, penalties & monitoring

Non-Ag Commercial and Industry Response Options for Discussions

1. Discuss system alternatives for water efficiency, reuse and implementation
2. Discuss Ideas for incentives, penalties & monitoring

Residential and Community Response Options for Discussions

1. Discuss system alternatives for water efficiency, reuse and sourcing
2. Discuss Ideas for incentives, penalties & monitoring, and human health needs

Tradeoffs Among Values, Institutions, Market Incentives, and Policy Responses

Less than a century ago, the High Plains and Ogallala Aquifer began to provide water resources for a transformation of the western Kansas economy from dryland wheat and rangeland to an irrigated row crop based agricultural foundation leading to value-added meat and dairy processing industries and a more robust regional economy. Aquifer use peaked in the 1970s and 1980s as groundwater use began to outpace aquifer recharge. In recent decades, farmland that was once irrigated began to shift back to dryland. Rural leaders and producers are re-examining conservation practices, exploring new innovations, and developing strategies for more efficient water use, all while pursuing farm income and return on investment objectives. One longer term goal is for Kansans to sustain the High Plains Aquifer for generations to come. Another goal is to sustain and grow the regional economy. Still another goal may be to use water while it is still available. Not all water users will be impacted the same as aquifer depth and thickness varies from location to location. Water flows from higher elevations toward the east and south. In areas where over-appropriation and use continue above Q-stable, tradeoffs are likely to emerge among users, including upstream and downstream users.

Given the declining aquifer levels and the over-appropriation of water rights in some western Kansas areas, policymakers began addressing the problem in recent decades. Public policy emphasis shifted to encouraging bottom-up voluntary institutions for setting conservation goals and regional plans shaped by Groundwater Management Districts. A question remains, "Will the tapestry of voluntary local institutions and approaches that have emerged across Kansas achieve the impacts necessary for sustainable aquifer use by current and future generations?" In a couple locations, the bottom-up institutional approach to conservation appears to have stabilized aquifer levels and in one study, without loss in net income compared to standard irrigation practices. However, a recent state legislative post audit reflected some of the potential difficulties in assessing the impacts on aquifer sustainability. For example, the report stated, "Districts have limited ability to independently manage groundwater through water permitting, aggressive conservation efforts, or influencing statewide water policy."

Not all water users volunteer to participate in voluntary water conservation programs. Some water users choose to fight to keep full use of permitted water rights. In some cases, voluntary approaches resulted in greater water use efficiency, but producers may have reallocated the water savings to other uses to maintain maximum permit use. Should additional market incentives be deployed in a manner to provide a "carrot" or incentive to those who strive to achieve Q-Stable water use or a "stick" to penalize water use above Q-Stable? And, how should aquifer use goals be defined for current irrigators relative to irrigators in future years? Should there be surcharges on water use above Q-Stable for all users? Should cost-share grants be used to enhance aquifer conservation innovations and water use below Q-Stable? Should cost-share grants for wastewater reuse systems or other strategies be enhanced?

Funding is a key issue. Since 2020, annual State Water Plan Funding has more than doubled to $50 million. Annual USDA conservation program spending in Kansas is estimated to be more than $200 million. The point is that leveraging state and federal programs in addressing Kansas water issues is important (Johnson). Policy and funding solutions will be hammered out in the policy-making process at various local, regional, state, and federal levels of decision-making. The lines of compromise will be evaluated and redrawn over time after consideration of the facts, myths, and value judgements held by the policymakers, interested citizens and stakeholders involved. Producers using their permit maximums may conclude that mandatory government actions to reduce permitted maximum use as a "taking" action. That might be correct if government actions were to alter the maximum permitted water right. However, permit rights are not altered by market incentives. Instead, the costs and benefits of using certain water quantities or certain water uses are altered to address and balance private and public interests. Regulations, assessments, taxes, user fees, and surcharges are different from "takings" since they are policy tools implemented under powers of taxation and regulation. In the final analysis, the Kansas courts may be asked to decide an issue, or the Kansas legislature may be asked to clarify and define the methods used to adjust or maintain "over appropriated" water use for the benefit of current and future Kansans.

Policy Preference Survey Questionnaire **Name :**_____
September 2025 (optional)

Please describe your present status (Check yes or no)

___yes ___no A. Do you own or operate farmland with an irrigation water permit?

___yes ___no B. Do you own or operate a cattle, dairy, hog, or poultry feeding operation?

___yes ___no C. Do you work in agribusiness or a food-related industry?

Circle a response for each item to indicate your opinion about western Kansas aquifers and public policy (Strongly Agree = 1, Agree = 2, Not Sure = 3, Disagree = 4, Strongly Disagree = 5).

1 2 3 4 5 A. Declining aquifer water levels is a major problem in central & western Kansas.

1 2 3 4 5 B. Sustaining the western Kansas aquifer is necessary for economic growth.

1 2 3 4 5 C. Voluntary water conservation practices will adequately sustain aquifers levels.

1 2 3 4 5 D. Voluntary conservation may not sustain aquifers due to non-participants.

1 2 3 4 5 E. Water users should use the full amount of water that their permit allows.

1 2 3 4 5 F. Some water users participate in conservation to sustain income with less water.

1 2 3 4 5 G. Some water users don't participate in conservation efforts to earn more income.

1 2 3 4 5 H. All water users should use water at quantities that sustain aquifer water levels.

1 2 3 4 5 I. A uniform amount of acre feet of water should be allowed for all area irrigators.

1 2 3 4 5 J. Private sale of water rights should be allowed if no impacts on neighbors.

1 2 3 4 5 K. To retire groundwater rights, government should accept bids from water users.

1 2 3 4 5 L. Water banks should allow water users to save permitted water for future use.

1 2 3 4 5 M. Water banks should allow water users to lease water rights to other irrigators.

1 2 3 4 5 N. If density of household wells increase, so should safe-yield requirements.

1 2 3 4 5 O. Irrigators using more water than sustains the aquifer should pay surcharges.

1 2 3 4 5 P. Cost-share incentives should foster more efficient irrigation equipment systems.

1 2 3 4 5 Q. Cost-share incentives should encourage wastewater treatment and re-use.

1 2 3 4 5 R. Cost-share incentives should encourage prairie grass on center pivot corners.

1 2 3 4 5 S. Cost-share grants should support groundwater re-charge projects.

1 2 3 4 5 T. Regulations should be adjusted to encourage prairie grass on pivot corners.

U. Please provide your top recommendations for the policy changes in the future.

_____

_____

_____

Selected References:

1. Annual Reports 2024 for Kansas Groundwater Management Districts 1, 2, 3, 4, and 5.

2. Basche, Andrea D., & Marcia DeLonge. "Comparing Infiltration Rates in Soils Managed With Conventional & Alternative Farming Methods: Meta-analysis." PLoS One 14(9): e0215702. 2019.

3. Bottum, J. Carroll, "Land Retirement Alternatives." Farm Foundation. Increasing Understanding of Public Problems and Policies. National Policy Conference. 1962.

4. Bohling, G.C., Wilson, B.B., Liu, G., and Butler, J.J., 2024. An Overview of the O-Stable Analysis: Kansas Geological Survey Open-File Report 2024-38.

5. Butler, J., Jr., Whittemore, D. O., Wilson, B. B., and Bohling, G.C. (2016). A New Approach for Assessing the Future of Aquifers Supporting Irrigated Agriculture. Geophysical Research Letters, 43(5), 2004-2010.

6. Butler, J., Jr., Whittemore, D. O., Wilson, B. B., and Bohling, G.C. (2018). Sustainability of Aquifers Supporting Irrigated Agriculture: A Case Study of the High Plains Aquifer in Kansas. Water International, 43(6), 815-828.

7. "Dodge City Advances Managed Aquifer Recharge Project with $14.25M Federal Funding." Citizen Portal Newsletter. August 11, 2025.

8. Correspondence to permit holders in the Rattlesnake Creek Area regarding the Quivira National Wildlife Refuge Water Impairment, various dates 2024-2025.

9. The Directions Group. "Driving Change: An Action Framework for Building Local and Flexible Solutions for Profitable Agriculture on the Ogallala." Project Funded in part by Kansas Water Plan through the Kansas Water Office. 2024.

10. Edelman, Mark A. and B.L. Flinchbaugh. "How to Handle Controversial Issues: Principles of Policy Education." NCR Extension Publication 390. May 1991.

11. Edelman, Mark A., James Monke, Ron Durst. "Can Farmer Savings Accounts Help Save Farming?" Choices. (3) 2001. p 38.

12. Griggs, Burke W. "An Overview of Kansas Water Law." Testimony before the House Committee on Water, Kansas House of Representatives. January 26, 2021.

13. Golden, Bill. "Monitoring the Impacts of Sheridan County 6 Local Enhanced Management Area Final Report for 2013-2017. Department of Agricultural Economics, Kansas State University, with support from Kansas Water Office and USDA. Nov. 15, 2018.

14. Golden, B., J. Peterson, and D. O'Brien. 2008. Potential Economic Impact of Water Use Changes in Northwest Kansas. Kansas State University Agricultural Experiment Station and Cooperative Extension Service. Staff Paper No. 08-02.

15. Golden, B., and J. Leatherman. 2017. "Impact Analysis of the Walnut Creek Intensive Groundwater Use Control Area." Journal of Regional Analysis & Policy (47)2 176-187.

16. High Plains Journal. "Hunt for Habitat Set for Northwest Kansas." October 20, 2024.

17. Hassani, Kianoosh, Saleh Taghvaeian, and Hamed Gholizadeh. 2021. "A Geographical Survey of Center Pivot Irrigation Systems in the Central and Southern High Plains Aquifer Region of the United States. Applied Engineering in Agriculture 37(6):1139-1145. Jan. 2021.

18. Johnson, Paul. "Kansas Water Supply Comments." Kansas Rural Center written comments from Strategic Water Planning Meeting, Lawrence, KS. June 27, 2024.

19. Kansas Geological Survey. "2023 Status of the High Plains Aquifer in Kansas." Technical Series 25 – November 2023.

20. Kansas Department of Agriculture. "Public Notice: Wichita & Greeley Counties WTAP Sigh-up to Open." 2025.

21. Kansas Legislative Division of Post Audit. "Evaluating Groundwater Management District's Efforts to Conserve Water." Report Number R-23-001. Feb 2023.

22. Kansas Statutes Annotated. K.S.A. 82a-1030.

23. Kuester, Michelle. "Pooling Knowledge: Kansas State University Takes An Interdisciplinary Approach To Addressing Water Challenges." News: Circular Water Economy. www.wef.org/Magazine. Aug. 2025.

24. Lubben, Bradley D., Nelson L. Bills, James B. Johnson, James L. Novak. "The 2007 Farm Bill: U.S. Producer Preferences for Agricultural, Food, and Public Policy." Farm Foundation, University of Nebraska, & National Public Policy Education Committee. 2006-01. Sept 2006.

25. McGuire, V.L. (2017). Water-level and recoverable water in storage changes, High Plains aquifer, predevelopment to 2015 and 2013–15. Scientific Investigations Report 2017-5040. U.S. Geological Survey. doi:10.3133/sir20175040.

26. Media Releases: Hays and Russell Purchase of K-9 Ranch Water Rights for a Pipeline from Edwards County and subsequence court decisions, 2016-2024.

27. Media Release Listing Water Rights for Sale to Public in Stafford County on June 13, 2025.

28. Ostrom, Elinor. 1990. Governing the Commons: The Evolution of Institutions for Collective Action. New York: Cambridge University Press.

29. Sapkota, Sundar, et al. "Soil Health response of circular grass buffer strips in center-pivot irrigated agriculture." American Journal of Soil Science. 2023(87): 337-349

30. Stein, Leah. "Saving the Ogallala Aquifer: Kansas's Duty to Protect Intergenerational Water Rights." Kansas Journal of Law and Public Policy. XXXIV-1, pp 80-98.

31. Watson, Steve. "Establishing and Managing Native Prairie Plants in Small Areas." Agronomy eUpdates, K-State Research and Extension Publication MF3233, 597-3.

An Appendix to the Kansas Aquifer Policy Primer is listed on the Barry Flinchbaugh Center website and includes Excepts from Kansas Groundwater Management District Annual Reports submitted 2025 and Kansas Legislative Post Audit Excerpts. It can be accessed by internet at: https://www.flinchbaughcenter.com/issues

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Any remaining errors or omissions remain the responsibility of the author.

Finally, I wish to acknowledge and dedicate this Policy Education Primer as a tribute to the late Dr. Barry L. Flinchbaugh, who was mentor, teacher, friend and colleague over the years. Without his steadfast tutoring and story telling tales, nothing in this project or the Barry Flinchbaugh Center for Ag and Food Policy would have been thinkable.

I continue to ask, "What would Barry do or think about this or that?"

Barry would probably repeat one of his favorite Harry Truman stories…

"Just apply some good ole fashioned 'Horse Sense!' to the Kansas aquifer problems," he'd say.

Then, I'd ask, "What does Horse Sense mean?"

He'd say, "Horse sense is something a Mule doesn't have."

Mark A. Edelman