Approved March 22, 1989
Date

MINUTES OF THE Senate COMMITTEE ON Energy and Natural Resources.

The meeting was called to order by Senator Ross Doyen at
Chairperson

8:05 a.m./p~~m~~ on March 15, 1989 in room 423-S of the Capitol.

All members were present except: quorum was present.

Committee staff present:
Don Hayward, Revisor
Raney Gilliland, Research Department
Lila McClaflin, Committee Secretary

Conferees appearing before the committee:
Charlene Stinard, Kansas Natural Resources Council
Ernie Mosher, League of Kansas Municipalities
Bev Bradley, Kansas Association of Counties
Dennis Schwartz, Director, Kansas Rural Water Assn.
Terry Leatherman, Kansas Chamber of Commerce and Industry
Margaret Ahrens, Sierra Club
Joyce Wolf, Kansas Audubon Council
List of others present is on file.

The hearing continued for the proponents on H.B. 2008. A written paper from Vic Studer, The Kansas Rural Center, Inc., Whiting, Ks., was distributed (Attachment I).

Chairman Doyen called on Charlene Stinard to testify.

Ms. Stinard presented written testimony supporting H.B. 2008 (Attachment II).

Ernie Mosher presented written testimony supporting H.B. 2008, with the exception of the solid waste tipping fee (Attachment III). He responded to questions.

Bev Bradley presented written testimony opposing the tipping fees and stated her association had taken no position on the remainder of the bill (Attachment IV).

Dennis Schwartz testimony supports the implementation of the state water plan, but opposing it in its present form (Attachment V). He responded to questions.

Terry Leatherman presented testimony supporting the committee's efforts to develop a funding plan to protect the vital resource of water (Attachment VI).

Margaret Ahrens supported the bill with some amendments proposed. Her testimony is (Attachment VII). She responded to questions.

Joyce Wolf presented written testimony endorsing the concept of establishing a user-fee/general funds combination to support the funding of the State Water Plan (Attachment VIII).

The meeting adjourned at 9:00 a.m. The next meeting will be held on March 16, 1989.

1989 SENATE ENERGY AND NATURAL RESOURCES COMMITTEE

Date March 15, 1989

PLEASE PRINT GUEST LIST

NAME	REPRESENTING
Charlene Stinard	Ks Natural Resource Council
Joe Lieber	Ks Co-op Council
Vic Studer	KS Rural Center
Bud Bradley	KS Assoc of Counties
Bill Fuller	Kansas Farm Bureau
Bill Towery	K.D.H.E. - Chanute
John Strickler	Governor's Office
Terry Leatherman	KCCI
~~Ross~~ Martin	KPC
Robert Corkran	Mid Cont Oil & Gas
Glenn Hawkins	Oxy USA, Inc.
Jaye Way	Ks. Audubon Council
Keith Lebbin	Western Ks. GMD#1
Gary Baker	SW Kansas GMD #3
Almira Collior	KDHE
Dale Wenig	KDHE
Judith Humphrey	KDHE — Lawrence
Ralph E. O'Connor	KDHE — Wichita
Delbert Zerr	KDHE - Salina
Alan Steppat	Pete McGill & Associates
G. K. Hulett	KDHE
James Power	KDHE
Mary Ann Bradford	League of Women Voters

1989 SENATE ENERGY AND NATURAL RESOURCES COMMITTEE

Date 3-15-89

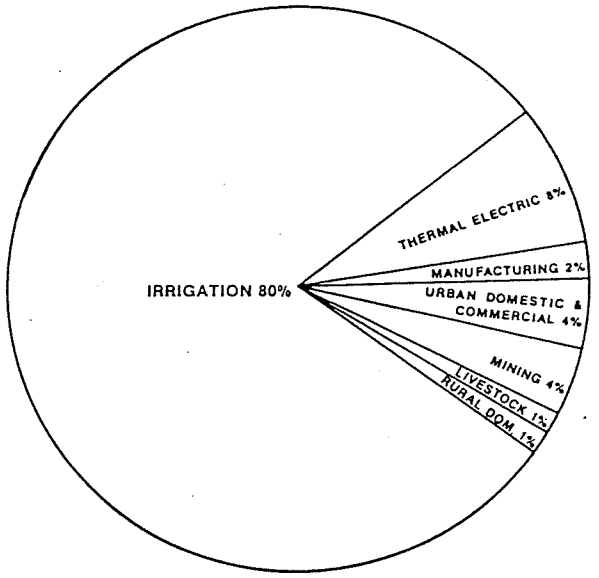
PLEASE PRINT GUEST LIST

NAME	REPRESENTING
DAVID CORLISS	LEAGUE of MUNICIPALITIES
Tom Taylor	KPL Gas Service
Al Gutierrez	Kansas Dept of Health & Environment
Richard D. Buchanan	Kans. Dept of Health & Env.
Jack Koenigsdorf	Dodge City
James Lewis	

GROUNDWATER IN KANSAS: CURRENT PERSPECTIVES NEW INITIATIVES

By Vic Studer

The Kansas Rural Center



DISTRIBUTION OF GROUNDWATER USE IN KANSAS (KWRB)

Kansans use about 6.6 billion gallons of water every day [64], but over 80% of this water is used for irrigation purposes alone. [65] Because such massive quantities of water are used to meet the water needs of crops, irrigation has the potential to seriously impact the quality and quantity of water across the state. Water quality degradation may result from irrigation practices primarily because of pumping-induced mineral intrusion, low quality irrigation return flow or leakage from chemical injection systems (chemigation). [66]

Pumping-Induced Mineral Intrusion

More than 95% of the irrigated acreage in Kansas is irrigated with groundwater. [67] Because so much water is supplied by groundwater, the danger of overpumping and contaminating fresh water aquifers is quite high. Such contamination may occur when an aquifer is overpumped and salt water in an adjacent low quality aquifer replaces the fresh water that has been withdrawn. Groundwater

contamination of this type has been observed in the Republican River area in northcentral Kansas, the Equs Beds north of Wichita, the Great Bend Prairie region southeast of Great Bend and along the Arkansas River in western Kansas. [68] Other aquifers in the central sections of the state also have the potential to develop this problem.

High levels of salinity can be induced by irrigation, this presents a significant contamination problem in western Kansas and may as a result reduce crop yields on the irrigated land. Irrigation return flow is the wastewater from irrigated fields that is drained to surface channels or disposed onto land to promote evaporation and percolation to the groundwater zone. Irrigation practices may increase the salt concentration of groundwater through the process of collection and concentration of chlorides and other substances that are naturally present in the soil or added substances such as fertilizers, pesticides and soil conditioners that may come in contact with the irrigation water.

Chemigation Practices

Chemigation is the irrigation practice that applies agricultural chemicals (pesticides and fertilizers) via irrigation water. Because the chemicals are applied with the irrigation water, there must be a direct link between the chemical supply tank and the well, consequently linking the chemical supply with the aquifer. Contamination of the aquifer may occur if chemicals leak around a defective well casing or valve, or when the irrigation pump is shut down and chemicals in the system backflow through the well to the groundwater. [69] The Kansas Chemigation Safety Law and regulations adopted in 1985 require the use of anti-pollution devices on all chemigation equipment. Farmers who use chemigation must also register with the State Board of Agriculture. Several weaknesses in the law and chemigation technology, however, have drawn criticism from environmentalists who feel the law fails to ensure that the practice of chemigation will not result in severe groundwater contamination.

Irrigation Return Flow

Irrigation return flow is water that is applied to cropland and that is not evaporated or used by plants. It must therefore eventually return to streams or to groundwater. In addition to substances originally in the water, return flow may carry sediment, nutrients, pesticides, salts and other minerals from the soils with which it comes into contact. [70] The main substances of concern include calcium, magnesium,

sodium, sulfate, bicarbonate, nitrate, orthophosphate and pesticides. These pollutants may be carried by surface runoff to streams and ponds or may seep into the soil and eventually reach groundwater.

Irrigation water that is not used or that does not soak into the soil becomes surface runoff. On the average, 10 to 30% of the water used in furrow irrigation systems will become runoff. [72] Runoff can also occur under sprinkler and other irrigation systems when the rate of application exceeds the soil's rate of intake. Some of this runoff water may be captured in tailwater recovery pits and reused. While well-managed tailwater pits can control surface irrigation runoff, they may also act as storage reservoirs or "sinks" for water pollutants. [73] Seepage from these pits can contribute dissolved solids (salts), nitrates and pesticides to underlying groundwater, especially during spring and summer when chemicals are applied and irrigation use is heaviest.

Irrigation return flow is responsible for deteriorating groundwater quality in a large portion of the Midwest. [74] High levels of nitrates, chloride, sulfate and traces of pesticides such as atrazine in Nebraska groundwater have been attributed to the effects of irrigation practices. [75] High concentrations of many of these contaminants are detected in groundwater downgradient from cultivated, irrigated fields.

Permeable soils are generally best suited to cropland irrigation. Unfortunately, these types of soils also have high leaching and nitrification rates, so that leaching of nitrates or other substances may become a serious problem. [76] One estimate suggests that 25 to 30 pounds of nitrogen per acre may be lost to groundwater under irrigated fields each year. [77] The actual amount leached is highly variable of course, depending on fertilizer and water application rates, soil conditions and other factors. More efficient water use in irrigation has been shown to significantly decrease the amount of nitrate leached.

Irrigation water is frequently applied in excess of crop needs in order to prevent the build-up of harmful salts in the root zone of crops. This excess water "flushes" salts and many other substances deep into the soil profile and often to groundwater. Subsurface return flow may thus have concentrations of salts 3 to 10 times higher than the irrigation water that was applied. Concentrations of other substances are often elevated also. Unfortunately, the problem of eliminating salts

from the root zone without "flushing" and contaminating groundwater cannot be solved with any known technology. [78]

Aquifer Overpumping

Irrigation may also indirectly affect water quality by depleting aquifers and streams. Many streams in Kansas receive baseflow from adjacent alluvial aquifers. If these aquifers are overpumped, stream flow may decrease or even stop completely. [79]

Although Kansas is blessed with the vast Ogallala aquifer, it has an extremely low natural recharge rate since it underlies western Kansas where the annual precipitation is relatively low. The amount of groundwater being withdrawn today is so huge that the aquifer is being depleted from 1 to 5 inches in some areas and at even higher rates in nearby states.

Today, water withdrawn from the Ogallala is used to irrigate one-fifth of all U.S. cropland in areas from Nebraska to Texas where cropland is too dry for natural farming.

Many water resource experts project that at the present rate of depletion much of the Ogallala could be dry by the year 2020, and much sooner in some areas where it is only a few meters deep.[80] If all farmers in the Ogallala region began using water conservation measures, depletion of the aquifer would be delayed, but not prevented in the long run.[81].

66. Balsters, Ron and Curtis Anderson, Water Quality Effects A iated with Irrigation in Kansas, Kansas Dept. Health & E nment, 1979.

67. Balsters, Ron and Curtis Anderson, Water Quality Effects Associated with Irrigation in Kansas, Kansas Dept. of Health & Environment, 1979.

68. Balsters, Ron and Curtis Anderson, Water Quality Effects Associated with Irrigation in Kansas, Kansas Dept. of Health & Environment, 1979.

69. Balsters, Ron and Curtis Anderson, Water Quality Effects Associated with Irrigation in Kansas, Kansas Dept. of Health & Environment, 1979.

70. Environmental Protection Agency, Report to Congress: Nonpoint Source Pollution in the U.S., January 1984.

71. Balsters, Ron and Curtis Anderson, Water Quality Effects Associated with Irrigation in Kansas, Kansas Dept. of Health & Environment, 1979.

72. Balsters, Ron and Curtis Anderson, Water Quality Effects Associated with Irrigation in Kansas, Kansas Dept. of Health & Environment, 1979.

73. Spalding, R.F., M.E. Exner, J.J. Sullivan and P.A. Lyon, "Chemical Seepage from a Tail Water Recovery Pit to Adjacent Ground Water ", Journal of Environmental Quality 8(3): 374-383, 1979.

74. Exner, Mary E. and Roy F. Spalding, "Evolution of Contaminated Groundwater in Holt County, Nebraska", Water Resources Research 15(1): 139-147, 1979.,

and Spalding, Roy F. and Mary E. Exner, "Areal, Vertical and Temporal Differences in Ground Water Chemistry: I. Inorganic Constituents", Journal of Environmental Quality 9(3): 466-479, 1980.

75. Exner, Mary E. and Roy F. Spalding, "Evolution of Contaminated Groundwater in Holt County, Nebraska", Water Resources Research 15(1): 139-147, 1979, Wehtje, G., L.N. Mielke, J.R.C. Leavitt and J.S. Schepers, "Leaching of Atrazine in the Root Zone of an Alluvial Soil in Nebraska", Journal of Environmental Quality 13(4): 507-513, 1984,
Spalding, Roy F. and Mary E. Exner, "Areal, Vertical and Temporal Differences in Ground Water Chemistry: I. Inorganic Constituents", Journal of Environmental Quality 9(3): 466-479, 1980,

and Junk, G.A., R.F. Spalding and J.J. Richard, "Areal, Vertical and Temporal Differences in Ground Water Chemistry: II. Organic Constituents", Journal of Environmental Quality 9(3): 479-483, 1980.

76. Madison, Robert J. and Jilann O. Brunett, "Overview of the Occurrence of Nitrate in Ground Water of the United States" in National Water Summary, 1984, U.S. Geological Survey, 1985.

77. Murphy, Larry S. and Jay W. Gosch, "Nitrate Accumulation in Kansas Ground Water", Kansas Water Resources Research Institute, Kansas State University, 1970.

78. Council for Agricultural Science and Technology, Agriculture and Groundwater Quality, May 1985.

79. Wedel, Kerry, "Surface Water Problems in Western Kansas", Journal 2(4):1, Kansas Natural Resources Council, 1983.

80. Miller, G. Tyler, Jr., 1988, Living in The Environment, 5th edition, Wadsworth, Inc.

81. Miller, G. Tyler, Jr., 1988, Living in the Environment, 5th edition, Wadsworth, Inc.

Kansas Natural Resource Council

Testimony presented before the Senate Energy and Natural Resources Committee
HB 2008: funding the State Water Plan

Charlene A. Stinard, Kansas Natural Resource Council

March 15, 1989

I am Charlene Stinard, and I represent the Kansas Natural Resource Council, a non-profit organization whose 700 members promote sustainable natural resource policies for the state of Kansas.

We commend the work of the House Energy and Natural Resources Committee in addressing a long-delayed and critical issue for Kansans -- funding to implement the State Water Plan.

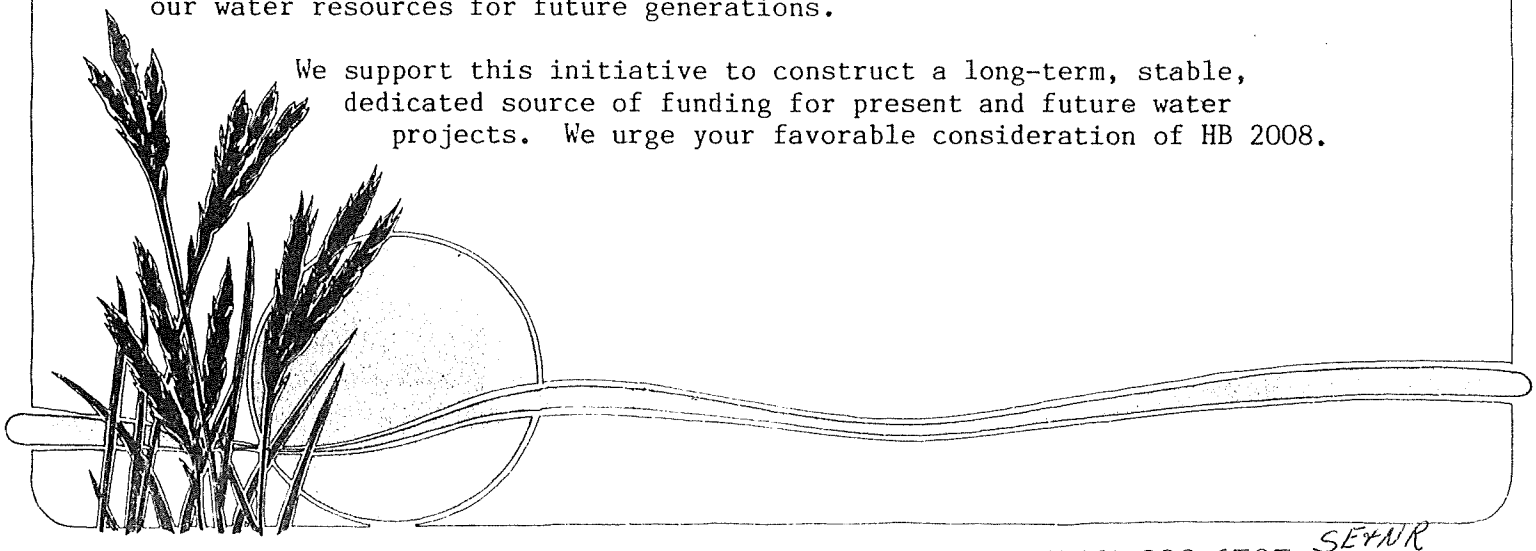
Water is the most precious resource in Kansas -- the success of agriculture, industry, municipalities, our way of life depends on adequate supplies of good quality water. Kansas is not blessed with bountiful quantities of water. And, as drought conditions continue, it is estimated that we may lose 4000 shallow wells this summer. In addition, much of our water is contaminated or threatened with contamination -- the KDHE list of identified contaminated sites grew from 332 in 1988, to 489 this year.

The need for implementation of the State Water Plan is clear. Water priorities include cleanup of identified contaminated sites, building conservation projects to protect streams and rivers from runoff, the multi-purpose small lakes program, and improvements at Cheyenne Bottoms. So far, however, the state has failed to appropriate adequate funds for meaningful implementation.

Legislatures in the past have failed to choose water funding over education; over social programs for children, families, and the elderly; over public safety; over transportation. So we are reluctant to depend on future Legislatures to fund water projects from general revenues.

We recognize that there are elements of the fee structure that impact heavily on specific users. But, we must also recognize that water is a "public good," and that we have a responsibility to preserve and protect our water resources for future generations.

We support this initiative to construct a long-term, stable, dedicated source of funding for present and future water projects. We urge your favorable consideration of HB 2008.



1516 Topeka Avenue • Topeka, Kansas 66612 • (913) 233-6707

SE+NR
3/15/89
Attachment II
A II

League
of Kansas
Municipalities

Municipal
Legislative
Testimony

An Instrumentality of its Member Kansas Cities. 112 West Seventh Street, Topeka, Kansas 66603 Area 913-354-9565

TO: Committee on Energy and Natural Resources
FROM: E. A. Mosher, Executive Director
RE: HB 2008 -- Financing of State Water Plan
DATE: March 15, 1989

By action of its Governing Body, the League of Kansas Municipalities appears as a proponent of efforts to establish a permanent funding source for the water elements of the State Water Plan, and with the exception of the solid waste tipping fee, generally supports the funding elements of HB 2008.

General Support of Concept. As noted in our convention policy statement reprinted on page 3, the League recommends legislative actions which will assure "adequate future water supply sources and protecting the quality of our water." While we are supportive of appropriations for the water components of the water plan from the state general fund, gaming fund (lottery) revenues and transfers from the severance tax proceeds, there is also general acceptance by municipal officials of the concept that the "polluters" and "users" of water should contribute to the water elements of the state water plan.

Clarifying the Intent. We are well aware that HB 2008 provides that the new revenues will be placed in the "state water plan fund", to be expended by appropriations for implementation of the "state water plan." Further, we are aware that the legislature is at liberty in the future to include whatever it wants to include within the "state water plan." However, we do have concerns that the primary emphasis of the water plan may have drifted from the long-range goals specified in K.S.A. Supp. 82a-927 of focusing on water quantity and quality toward a number of natural resource management projects and programs. As we read Section 82a-927, all of the objectives to be met in the state water plan are specifically directed toward water. We believe it was legislative intent that the water plan would deal with water -- and not constitute a natural resource development program or environmental plan, or deal with fishing or hunting or recreation, or even land conservation, except as those activities may directly affect water quality and quantity.

This definition of what really constitutes the state water plan is important to us, because municipal officials believe that sound public policy dictates a close relationship between the beneficiaries of water plan projects and programs and the contributors to the funding of those projects and programs.

On the other hand, we also think there is as much legitimacy in using state general fund revenue sources, including lottery moneys and severance tax moneys, to help finance water-related matters within the state water plan as there is in financing other elements within the state water plan.

The House Committee amendments to limit the fund moneys to "water-related projects" (lines 374:375), and the exclusion of projects that are "primarily recreational" (line 380) is helpful in defining legislative intent. We are still not too comfortable--how do you respond to questions as to where, and for what purpose, the fund moneys will be spent five years from now?

SE&NR
3/15/89
Attachment III

With this general background, the following are comments on some of the specifics of HB 2008.

Tipping Fee. The Governing Body of the League has twice taken a flat position in opposition to the proposed tax on solid waste, the so-called "tipping fee." The principal rationale of that position is that Kansas local governments face tremendous financial problems in dealing with solid waste management and disposal in the future, and if a state "tax" can be justified on solid waste operations, the money should be used directly for that purpose. We would acknowledge that disposal sites may affect water quality, but we are not clear as to how one would "drive" disposal site regulation or remediation under a water plan, as distinct from an environmental or natural resource plan. We are aware of the amendments on lines 354:368, providing for local grants from 50% of the tipping fee collections. Beyond concerns about the practical workability of this provision, we simply don't think tipping fees should even be in the bill.

Fertilizers and Pesticides. The League has no position on the proposed taxation of fertilizers and insecticides. However, we are aware that fertilizers and insecticides do affect water quality, in both urban and rural areas, and of their contributions to nonpoint source pollution. The basic policy position set by the League Governing Body is that the amount of revenue raised from the retail sale of water should not exceed the amount raised from those who contribute to the water quality problem.

General Fund; Severance Tax. The League, by convention action, is in support of allocating a portion of the general fund and a share of the severance tax, as well as moneys from lottery revenues, to finance the state water plan. (Again, this recommendation relates to the water aspects of the water plan, not its "natural resource" elements.)

Fines and Penalties. Dedicating the revenue from fines and penalties on environmental offenders seems appropriate. We are surprised that the predicted revenue of $70,000 is so low.

Water Tax. The League and municipal officials obviously have some concerns about the proposed "water protection fee", equal to a 2% tax on gross receipts from the sale of water by public water supply systems. We would also note that the total tax on non-exempt water customers, primarily industrial and commercial customers, would be as high as 8% in some cities. This total would result from the 4% state general sales tax, the proposed 2% new tax, and a maximum 1% city and 1% countywide sales tax that are in effect in some cities.

Concerns have been expressed by representatives of both rural water districts and municipal water suppliers as to the tax being based on retail sales, rather than the quantity of water used. Most public water supply systems have varying amounts of debt incurred for capital improvement purposes, and must base their retail sales prices on the cost of amortizing this debt as well as for operation and maintenance costs. Basing the protection fee on the gallonage consumed, rather than simply on the price, appears to be a fairer way to raise moneys for water-related water plan purposes.

I noted earlier the feeling of many local officials that any revenue raised from water consumers should be spent for the future benefit of water consumers, rather than for natural resources or general environmental purposes. Somewhat similar, there is a prevailing feeling that those areas or regions that contribute to the state fund should receive at least some of the benefits. I do not interpret this to mean that people are expecting a dollar for dollar return on their investment within a fixed time. I do think they want assurance that there is at least some possible future benefit.

Conclusion. In conclusion, I would suggest that the Legislature will continue to get mixed signals on financing the state water plan until the components of the plan are more definitive than they are now or have been, even with the House amendments to the bill. A clearer definition of the purposes for which the water plan fund will be used in the future would help, we think, in developing "user" and "polluter" based charges to help finance the fund. As a matter of public policy, it seems reasonable that at least half the fund total come from transfers from the general fund, including the severance tax, and allocations from the lottery fund. City residents in the state trust and depend on their municipal water utilities, in turn city officials responsible for those utilities are looking to the Water Plan to address, in part, statewide water needs impacting public water systems. The acceptance of the State Water Plan, and any dedicated source of revenue to fund it, is based on the belief that there is -- and will continue to be -- a strong tie between present contributions and future benefits. This trust in the Water Plan process, and the general willingness to accept user fees to implement beneficial projects, deserves statutory recognition. If HB 2008 is enacted this session, we would also hope that the Legislature would formally charge, by law, that the Water Authority identify those "water plan" proposals that are recommended for funding from the non-general fund elements of the water plan fund, as distinct from other sources. Annual identification of Water Plan revenues, and the tying of those revenues to specific projects of benefit to contributors, will go a long way toward maintaining trust in the Water Plan process.

Excerpt from 1988-1989 Statement of Municipal Policy, League of Kansas Municipalities:

"**State Water Plan Financing.** Assuring adequate future water supply sources and protecting the quality of our water is a high priority for the future of Kansas, meriting continued support for approved state water plan projects and programs from the state general fund and gaming fund (lottery) revenues. In addition, allocating a share of the revenue from the state severance tax on oil and gas is appropriate, as are charges on products affecting the quality of water, such as pesticides and fertilizers. The financing of the remediation of water quality problems, and the protection of water quality, should be borne largely by those who contribute to the problem. In recognition of the regional nature of water supply and quality problems, proposals to raise additional state revenue to finance new water improvements (i.e., pipelines, impoundments, etc.), including taxes on the sale and use of water, should provide for an equitable distribution of financial and other assistance in relation to the tax or other payments made by each regional area of the state. The general objective should be to apportion the benefits of revenue derived from the use of water to those who contribute the revenue. State financing of major water supply improvements by the use of bonds should be considered."

Agriculture uses the greatest amount of water each year by far, and most of the water used is groundwater. In 1986, the most recent year for which figures are available, Kansans used 1.5 trillion gallons of water for agricultural, municipal, industrial, and recreational purposes. The following table shows the State's water use that year, by type of category.

Water Use by Type of Water and Category of Use, 1986

CATEGORY OF USE	% OF TOTAL WATER USED	% OF CATEGORY THAT IS GROUNDWATER	% OF CATEGORY THAT IS SURFACE WATER
Agricultural (a)	87.1%	94.2%	5.8%
Municipal (b)	7.7	49.6	50.4
Industrial	3.5	63.4	36.6
Recreation	1.7	10.4	89.6
Percent of Total	**100.0%**	**88.3%**	**11.7%**

Source: data reported to the Board of Agriculture's Division of Water Resources
(a)"Agricultural" equals irrigation plus stockwatering; irrigation accounted for 99.4 percent of the total.
(b)"Municipal" water generally consists of public water supplies.

Reproduced from July 1988 "Performance Audit Report: State Agencies' Handling of Water Contamination and Pollution Problems in Kansas"

KANSAS WAT_ OFFICE
January 1[illegible], 1989

Item	Agency	Summary of Expenditures (All Funds) Necessary to Implement the State Water Plan and Other Water-Related Programs for FY 1990 — Total	Summary of Governor's Recommendation for Expenditures by Source of Revenue for Financing the State Water Plan and Other Water-Related Programs for FY 1990 — SGF	EDIF	Other Funds	Total	New Source
1. Aid to Local Units	KDHE						
Aid to Local Units		$2,500,000					
Tech. Assis. & Training		249,416					
Subtotal		$2,749,416	$0	$0	$0	$0	$1,575,124
2. Public Water Supply Protection	KDHE	$124,876	$0	$0	$0	$0	$124,876
3. Non-Point Source Pollution	KDHE						
Water Assessments		$60,000					
Best Management Practices		30,000					
Well Testing		1,200,000					
Pollution Control at Hillsdale		150,000					
Subtotal		$1,440,000	$0	$0	$0	$0	$1,500,000
4. Contamination Remediation	KDHE						
Pre-Nat Priority List		$169,447			$87,800	$87,800	
Contamination Cleanup		3,000,000		$1,500,000		1,500,000	
Arkansas City Superfund Match		100,000		100,000		100,000	
Leaking Underground Storage Tanks		537,000				0	
Hazardous Waste Cleanup		300,000	$300,000			300,000	
Subtotal		$4,106,447	$300,000	$1,600,000	$87,800	$1,987,800	$1,000,000
5. Targeted Cost Share	SCC	$2,056,000	$3,220,000	$0	$0	$3,220,000	$1,000,000
6. Targeted Watershed	SCC	$1,500,000	$770,000	$0	$0	$770,000	$1,000,000
7. Watershed Planning	SCC	$100,000	$0	$0	$0	$0	$0
8. Water Project Coordination (includes field staff)	BOA	$219,059	$147,482	$0	$0	$147,482	$0
9. Minimum Streamflow	KDHE	$39,078	$0	$0	$0	$0	$0
10. Fish, Wildlife & Recreation							
Mined Land Canoe Trail Evaluation	KDWP	$35,000	$36,642			$36,642	
Mined Land Canoe Trail Linking	KDHE	19,358				0	
Cheyenne Bottoms Management Project	KDWP	1,717,502	1,570,000		$70,000	1,640,000	
Recreation Facilities at Hillsdale	KDWP	1,000,000		$1,000,000		1,000,000	
Subtotal		$2,771,860	$1,606,642	$1,000,000	$70,000	$2,676,642	$0
11. Jetmore Multipurpose Small Lake	SCC	$1,301,250	$0	$451,250	$850,000	$1,301,250	$0
12. Geographic Information System	Various	$1,902,358	$0	$0	$0	$0	$0
13. Water Use Reporting	BOA	$128,448	$0	$0	$77,870	$77,870	$0
14. Education	KWO						
Public Education Program		$34,038	$32,529			$32,529	
Conservation Education Program		50,000				-	
Subtotal		$84,038	$32,529	$0	$0	$32,529	$0
15. Research							
Stream Aquifer Interaction Studies	KWO	$216,250				$0	
Interbasin Transfer Study	KWO	35,000	$35,000			35,000	
Dakota Study	KU	200,000			$200,000	200,000	
Subtotal		$451,250	$35,000	$0	$200,000	$235,000	$0
TOTAL		$18,974,080	$6,111,653	$3,051,250	$1,285,670	$10,448,573	$6,200,000

STATE AGENCIES

KDHE = Kansas Department of Health and Environment
SCC = State Conservation Commission
BOA = Board of Agriculture
KWO = Kansas Water Office
KU = University of Kansas
KDWP = Kansas Department of Wildlife and Parks

SOURCES OF REVENUE

SGF = State General Fund
EDIF = Economic Development Initiative Fund
Other = Other Funds
New Source = The Governor recommends consideration of a new source of funding to be used exclusively to implement Kansas Water Plan projects. These are not included in his budget recommendations consistent with current law, which states that he may not include funds from legislation not yet passed.

KANSAS ASSOCIATION OF COUNTIES

"Service to County Government"

212 S. W. 7th Street
Topeka, Kansas 66603
(913) 233-2271
FAX (913) 233-4830

TESTIMONY

March 14, 1989

To: Senator Ross Doyen, Chairman
Members Senate Energy and Natural Resources Committee

From: Bev Bradley, Legislative Coordinator
Kansas Association of Counties

Re: HB 2008 - financing of the state water plan

The Governing Board of the Kansas Association of Counties adopted a position in opposition to using tipping fees to fund the state water plan, at their meeting February 7, 1989. If tipping fees are to be increased in any amount the funds should be used to solve some of the problems with solid waste instead of the funding of the water plan.

There are many problems with tipping fee increases. Some counties do not have scales at their solid waste disposal sights. Some feel that the fees are currently at a maximum and any increase would cause the public to simply ignore the sight and leave their solid waste along the roadside causing even more problems.

Our association favors a water plan. We oppose funding that water plan with tipping fees. We do not have a position on the remainder of the bill.

SENR
3/15/89
Attachment IV

KRWA

TESTIMONY ON HOUSE BILL 2008
BEFORE THE SENATE ENERGY & NATURAL RESOURCES COMMITTEE
March 15, 1989

Kansas Rural Water Association supports the implementation of the state water plan, particularly those features which will help insure the quality of our precious water resources. We accept the fact that consumers of public water supply systems should contribute their fair share of the cost of implementing the plan.

We oppose House Bill No. 2008 in its present form. Given the very wide range of rates that rural water systems charge their users, a percentage tax on sales revenues would result in an unfair assessment on the users of systems with the highest rates.

If it is logical to tax industrial and feedlot use on a per thousand gallon basis, then it would seem that the same logic should be applicable to public water supply users. After all, it's the "water" which is of concern. Water rate variables such as interest rates and cost of facilities are not related to the resource.

It has been suggested that the impact of this legislative measure on rural water systems would be about $86,000 per year. However based on a 1987 survey, a 2% tax on sales of water by rural water districts would generate $470,000. KRWA would recommend a tax of 2 cents per thousand gallons which would raise $132,500 based on 1987 sales (water sales information attached).

Kansas Rural Water Association would appreciate your consideration of these suggestions.

Dennis F. Schwartz
Director, KRWA

KANSAS RURAL WATER ASSOCIATION
P.O. Box 226
Seneca, Kansas 66538
(913) 336-3760

SE&NR
3/15/89
Attachment V

INFORMATION FOR USE IN CONSIDERING HB 2008 Amendments:

*WATER SALES INFORMATION

300	Rural Water Districts in Kansas
75,000	Service connections serving
240,000	People

Total Revenues from water sales	$ 23,500,000.00
Portion collected for Debt Service	8,850,000.00
Water Charge collected	14,650,000.00
Average rate per thousand gallons	3.55

Water sold - 6,627,000,000 gallons

Projected Fee Revenues

2% tax on gross sales	$ 470,000.00
1% tax on gross sales	$ 235,000.00
7.1 cents per thousand gallons	$ 470,500.00
2 cents per thousand gallons (KRWA recommendation)	$ 132,500.00

*Information based on data collected from a 1987 KRWA survey of Kansas Rural Water Districts

Kansas Rural Water Association
P. O. Box 226
Seneca, KS 66538

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LEGISLATIVE TESTIMONY

Kansas Chamber of Commerce and Industry

500 First National Tower One Townsite Plaza Topeka, KS 66603-3460 (913) 357-6321

A consolidation of the
Kansas State Chamber
of Commerce,
Associated Industries
of Kansas,
Kansas Retail Council

HB 2008

March 15, 1989

KANSAS CHAMBER OF COMMERCE AND INDUSTRY

Testimony Before the

Senate Committee on Energy and Natural Resources

by

Terry Leatherman
Executive Director
Kansas Industrial Council

Mr. Chairman and members of the Committee, I am Terry Leatherman, with the Kansas Chamber of Commerce and Industry. I wish to thank you for the opportunity to express the Chamber's support of the legislature's resolve to fund the State Water Plan.

The Kansas Chamber of Commerce and Industry (KCCI) is a statewide organization dedicated to the promotion of economic growth and job creation within Kansas, and to the protection and support of the private competitive enterprise system.

KCCI is comprised of more than 3,000 businesses which includes 200 local and regional chambers of commerce and trade organizations which represent over 161,000 business men and women. The organization represents both large and small employers in Kansas, with 55% of KCCI's members having less than 25 employees, and 86% having less than 100 employees. KCCI receives no government funding.

The KCCI Board of Directors establishes policies through the work of hundreds of the organization's members who make up its various committees. These policies are the guiding principles of the organization and translate into views such as those expressed here.

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In November, KCCI's Energy and Natural Resources Committee adopted a policy supporting efforts to pay for the State Water Plan with funds which are continuous in nature, broadly based and equitably applied. KCCI's Board of Directors also approved that policy in December. In January, KCCI joined the list of proponents testifying for the original HB 2008.

The version of HB 2008 before you today is different from that original plan. A tax on industrial use of water has been added, increasing the burden on Kansas industry. The current version of HB 2008 also contains six million dollars from the General Fund. Certainly, there is no funding source that better meets the criteria of being broad based, equitable and continuous than general fund revenue.

Passage of HB 2008 will lead to increased fees for water use by KCCI's membership. No business person looks forward to increased costs. However, KCCI will continue to support this committee's efforts to develop a funding plan to protect this vital resource, which is broad based, continuous and equitable.

Thank you for considering our input on this matter.

SIERRA CLUB

Kansas Chapter

HB2008
Financing of the State Water Plan
Testimony Before Senate Committee on Energy and Natural Resources
Margaret Post Ahrens
March 14, 1989

I am Margaret Ahrens, representative for the 2200 members of the Kansas Chapter of the Sierra Club. We work to protect our irreplaceable natural resources from depletion and contamination. Our organization represents values that project over time: we look to preservation for the future, if need be, against the pressures of the moment.

It is our position that the use of our natural resources should reflect the TRUE costs of those resources. That means that we pay for investments in our natural resources that promote their conservation, prevent contamination and clean it up where it exists.

We see your attempt to equitably assess those investments among the citizens of Kansas as an effort to notify us all that water we have taken for granted, for "free", is not "free". This fact will not change in the future. The establishment of a stable funding source for the Water Plan is essential. It is the Sierra Club's first legislative priority in this legislative session.

With few exceptions, finished water user rate structures in Kansas do the exact opposite of what good economics would dictate: the more water we use, the lower the rate we pay to use it. In cities, this means that the rates encourage use until there is no choice but to impose emergency conservation restrictions. The marketplace sends no signals ahead of time, encouraging conservation investments and practices in our homes and businesses.

In irrigation, the only market control on water use is the price of the fuel needed to pump the limited resource from deeper depths. As the water table declines, 4000 Kansas wells may go dry. In the economic structure operating now in Kansas the well owners, not necessarily the large water users, have to pay the penalty for the lack of conservation when they pay to drill for new wells

HB 2008 reflects the kind of economic principles that send an appropriate message to all of us about water. Special groundwater protection fees included do more than collect monies; they are the first honest signals to the public about the true costs of plentiful, clean water. Use of the General Fund, by comparison, sends no message to the public about the need to conserve and protect our state's

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(Attachment VII)

water. Worse, when the budget gets tight a public previously subsidized in its water use and not familiar with the more "real" costs of that water will be hard put to choose between education or human resource and water expenditures.

HB 2008 draws severence tax monies into State Water Plan Funding. This is appropriate because of the high incidence of oil and gas related water contamination from past poor practices in Kansas. The costs to taxpayers in lieu of responsible viable parties are economic costs we have just begun to face in our state. Use of the severence tax makes right a portion of the inequities created by the public having to pick up the tab for an industry's mistakes.

The lack of reliable data does not signal that we are free from contamination from agricultural runoff as well. The U.S. Geological Survey says in a recent report* on the leaching of agricultural chemicals that "the scope of the potential problem in Kansas has remained poorly defined...The extent of the present contamination of ground water could be much worse than the data indicate."

Who will pay to clean up ground or surface water contaminated by agricultural runoff? What signal does the Kansas tax system now give to both agriculture and urban users of fertilizers and pesticides that care need be taken now to prevent immeasureable public costs later?

HB 2008 reflects the maturity of our view toward our water as the requirement for all life, in forms and economies, in Kansas for every generation. It designates particular water-related funding sources to water-related efforts. It attempts equity, protects the resource from funding feuds in the future, and makes our first stab at allowing the marketplace to reflect the true costs pf the resource. With the few modifications listed below, we urge your support of the bill.

New Section 2: We recommend deletion of this section. Solid waste management itself will require regulation and investments in Kansas. It is more appropriate that the funds raised at landfills be related to solid waste management problem solving.

New Section 10: We disagree with the restriction on the use of funds from the State Water Plan Fund for "projects that are primarily recreational". (See line 380). The Water Plan itself respects the dependence of all forms of life on water. Funding for such an international resource as Cheyenne Bottoms, which is dependent on water, should not be endangered by the future interpretation of this restriction.

* U.S. Geological Survey. Factors affecting Leaching in Agricultural Areas and an Assessment of Agricultural Chemicals in the Groundwater of Kansas. 1988.

Kansas Audubon Council

March 15, 1989
Testimony on HB 2008
SENATE ENERGY AND NATURAL RESOURCES COMMITTEE

My name is Joyce Wolf and I represent the 5000 Kansas members of the National Audubon Society, who support the wise use and protection of our natural resources. The Society supports the general concept of HB 2008 which we believe is a compromise between total funding of the state water plan from general funds or total funding from user fees.

Past history of funding prior to FY 1989, shows that spending for natural resources averaged slightly less than $4 million annually. Increasing awareness of the need to implement the water plan has placed greater demands on budget resources. Thus, the question becomes whether adequate levels of state general funds can be assured to provide the stable base that these projects require. The Kansas Audubon Council is concerned that relying solely on general funds would put many water plan projects in jeopardy, especially when pitted against education, health care, corrections, highways etc.

By initiating a set of fees for users and potential abusers of water, HB 2008 will help assure that legislative "either/or" choices will be greatly diminished. The bill establishes a dedicated funding source which keeps water-plan projects from being in contention with other state priorities, as well as lessens the competition among themselves. The Audubon Council supports the principle that users and potential abusers of water all need to contribute to the cost of protecting our water resources. Because all Kansans rely on adequate supplies of clean, safe water, we also feel it is appropriate to include general fund money in the overall formula.

The current formula of HB 2008 touches nearly every major component of water user/abuser in Kansas, thereby providing a broad base of financial support. By having such a broadly based formula, we believe that it will be able to be flexible enough to meet changing needs.

Fairness and equity are concepts which have been mentioned as being vital parts of the funding formula; we heartily agree. For that reason we believe that fees to public water supply users should be based on gallons used rather than on sales, so that local rate differences would not adversely affect some customers, and also take into consideration rural water district users who must pay for more than just their water use charges.

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In addition to the above, we would also like to add another descriptor -- reasonable. As can be seen from the accompanying charts, irrigators are the primary users of all water resources in the state. Based on the USGS data, they use 45% of the surface water and 93% of the ground water used in the state, for an overall figure of 85.5% of the total water used in the state. No one, however, would begin to suggest that they pay 85.5% of the costs of the water plan. What they contribute should be a reasonable amount that reflects both their use and their ability to pay. Clearly, all these aspects must be a part of the funding plan; it must have stable, broadly-based sources, and for the participants it must be fair, equitable and reasonable.

As a final comment on HB 2008 the Kansas Audubon Council is concerned about questions which express doubts that Cheyenne Bottoms should be included in water plan funding. Cheyenne Bottoms is first and foremost a place for wildlife. It is primarily managed to enhance and protect habitat for migratory shorebirds, waterfowl, endangered and threatened species and nesting species. Because it is primarily a place for wildlife, it is part of the Fish, Wildlife, and Recreation section of the State Water Plan.

Cheyenne Bottoms is a federally-designated critical habitat for whooping cranes, a species which once came within 14 birds of extinction. If these birds stop at the Bottoms during hunting season, all hunting is prohibited in the area. The Bottoms has been designated a "Wetland of International Importance" under the Ramsar Convention - the first non-federal resource to achieve such recognition. It is an area that is truly unique in all of the United States, and some say in all of North America. Five shorebird species send more than 90% of their entire populations through Cheyenne Bottoms during spring migrations; 45% of all North American shorebirds pass through Cheyenne Bottoms on their northward migrations. Cheyenne Bottoms, when fully restored, has the potential of being one of the state's most lucrative tourist attractions. If we are going to tap those potential dollars, then we must invest today in its restoration, protection, and enhancement.

We definitely believe that all of us have an interest in guaranteeing the availability of adequate supplies of clean water for our homes, farms, businesses, and the wildlife of the state. Because of our shared dependence on the need for clean water, the Kansas Audubon Council endorses the concept of establishing a user-fee/general funds combination of monies to finance the state water plan, and asks the committee's support of HB 2008.

Kansas Audubon Council

Position paper

CHEYENNE BOTTOMS WILDLIFE AREA

Because Cheyenne Bottoms Wildlife Area is one of the most valuable wetlands in the nation, because it belongs to all the people of Kansas, and because it faces man-made threats to its continued existence,

The Kansas Audubon Council urges Kansas legislators to:

1. Provide the Kansas Department of Wildlife and Parks with funds to prepare a planned restoration program for Cheyenne Bottoms based on recommendations from wetland experts and the "Cheyenne Bottoms Environmental Assessment," a study partially funded by Kansas taxpayers in 1985-86.

   Restoration projects may include additional dikes and water control structures; mobile pumping stations; personnel and equipment increases; construction of an on-site deep water reservoir; enclosure of the water delivery system; construction of a visitor/education center; development of self-guided auto tours with interpretive signage; construction of special nesting areas with observation blinds; peripheral land acquisition.

2. Provide the Ks Dept of Wildlife and Parks the funds to research, develop, and implement an integrated management plan for migratory shorebirds, waterfowl, endangered and threatened species and nesting species at Cheyenne Bottoms.

3. Implement the necessary steps to assure that Cheyenne Bottoms receives the entire amount of its legally protected water rights from the Arkansas River (30,000 acre-feet/year) and Wet Walnut Creek (20,000 acre-feet/year).

4. Provide the necessary financial support for Cheyenne Bottoms by:

   a) Increasing significantly expenditures of public tax money on the restoration and maintenance of Cheyenne Bottoms to supplement agency fee dollars, private donations and federal dollars.

   b) Creating a special revenue source to provide several million dollars annually to the Kansas Department of Wildlife and Parks for habitat acquisition and protection of the biological diversity of ecological systems, of which Cheyenne Bottoms is a top priority resource.

SUPPORTING INFORMATION

Cheyenne Bottoms is a federally-designated critical habitat for whooping cranes, a species that once came within 14 birds of extinction. In the fall of 1986, 28 whooping cranes visited Cheyenne Bottoms in early November.

Cheyenne Bottoms has been designated a "Wetland of International Importance" under the Ramsar Convention, an international treaty. It is the first non-federal resource to achieve such recognition.

SUPPORTING INFORMATION

Of all the wetlands in the U.S., Cheyenne Bottoms ranks #1 in importance to migratory shorebirds; 45% of all North American shorebirds pass through Cheyenne Bottoms on their northward migrations.

Five shorebird species send more than 90% of their entire populations through Cheyenne Bottoms during spring migrations: Long-billed dowitchers, White-rumped sandpipers, Stilt sandpipers, Wilson's phalaropes, and Baird's sandpipers. With the loss of nearly 500,000 wetland acres each year, Cheyenne Bottoms becomes more critical to the survival of these species every day.

High one-day counts of critical shorebird species include 210,000 Long-billed dowitchers and 101,500 White-rumped sandpipers.

Large numbers of ducks and geese species rest and rebuild fat supplies at the Bottoms; 14 species or subspecies of ducks are known to have nested at the Bottoms.

More than 320 species of birds have been seen at the Bottoms, better than 75% of all the birds seen in Kansas.

OTHER FACTS ABOUT CHEYENNE BOTTOMS

Kansas conservation organizations made restoration of Cheyenne Bottoms as a manageable wetland a top priority in 1984 and began public education/ legislative awareness campaigns.

The Kansas Audubon Council is currently in the middle of a fundraising effort for the restoration of Cheyenne Bottoms. As of November 1, more than $15,000 had been donated by Kansas Audubon members.

In 1985-86, as a result of conservation groups' efforts, the Kansas legislature authorized spending $75,000 in tax dollars, in addition to $105,000 from KDWP fee funds and Chickadee Checkoff donations for an 18-month environmental assessment of the Bottoms, which was completed in 1987.

The total area of Cheyenne Bottoms Wildlife Area is 19,840 acres, including the marsh, inlet and outlet canals. The Area is located seven miles northeast of Great Bend in a 41,000 acre natural basin. Cheyenne Bottoms WA was officially dedicated in 1957.

Floods in 1927-28 created a lake of some 25,000 acres and brought about legislation in Congress to create a Cheyenne Bottoms National Wildlife Refuge, but adequate funding was never appropriated.

Passage of the Pittman-Robertson Act in 1937 provided funding on a cost-share basis for construction of the permanent wetland. These P-R funds come from federal excise taxes on guns and ammunition.

Surface water rights from Wet Walnut Creek were secured in 1948, and from the Arkansas River in 1954. Since 1980, Cheyenne Bottoms has never received its legally protected inflows; in several years, the flows were less than 10% of the Bottoms water rights. Overappropriation of groundwater supplies has depleted streamflows in both the Arkansas River and Wet Walnut Creek. Winning the lawsuit with Colorado would have little or no effect on Cheyenne Bottoms.

KANSAS
Ground-Water Resources

Kansans rely on ground-water resources for public, rural, industrial, and irrigation water supplies. In the western two-thirds of the State, abundant ground-water resources provide most of the water supplies. Ground-water resources are limited in the eastern one-third of the State and surface-water resources provide most of the water supplies in that area.

Ground water supplies about 5.6 billion gallons per day (bgd), or 85 percent of the water used in Kansas. Public and rural systems provide ground water to almost 1.2 million people (about 49 percent of the State's population). Approximately 93 percent of the ground water withdrawn (5.2 bgd) is used for irrigation. Ground-water withdrawals during 1980 for selected uses and related statistics are given in table 1. Additional water-use data are available from the Kansas Water Office.

Table 1. Ground-water facts for Kansas

[Withdrawal data rounded to two significant figures and may not add to totals because of independent rounding. Mgal/d = million gallons per day; gal/d = gallons per day]

Population served by ground water, 1980[1]	
Number (thousands)	1,153
Percentage of total population	49
From public water-supply systems:	
Number (thousands)	903
Percentage of total population	38
From rural self-supplied systems:	
Number (thousands)	250
Percentage of total population	11
Freshwater withdrawals, 1980[2]	
Surface water and ground water, total (Mgal/d)	6,600
Ground water only (Mgal/d)	5,600
Percentage of total	85
Percentage of total excluding withdrawals for thermoelectric power	89
Category of use	
Public-supply withdrawals:	
Ground water (Mgal/d)	140
Percentage of total ground water	3
Percentage of total public supply	48
Per capita (gal/d)	155
Rural-supply withdrawals:	
Domestic:	
Ground water (Mgal/d)	25
Percentage of total ground water	0.4
Percentage of total rural domestic	86
Per capita (gal/d)	100
Livestock:	
Ground water (Mgal/d)	35
Percentage of total ground water	0.6
Percentage of total livestock	43
Industrial self-supplied withdrawals:	
Ground water (Mgal/d)	190
Percentage of total ground water	3
Percentage of total industrial self-supplied:	
Including withdrawals for thermoelectric power	35
Excluding withdrawals for thermoelectric power	77
Irrigation withdrawals:	
Ground water (Mgal/d)	5,200
Percentage of total ground water	93
Percentage of total irrigation	92

[1] Total population from Murray (1982); population served by public water-supply systems from Solley, Chase, and Mann (1983); population served by rural water-supply systems from U.S. Bureau of the Census (1983).

[2] Data from Solley, Chase, and Mann (1983). Rural domestic supplies estimated from data in U.S. Bureau of the Census (1983).

GENERAL SETTING

Ground-water conditions differ with physiography and geology. Physiographic provinces in Kansas (fig. 1) are the Osage Plains and Dissected Till Plains sections of the Central Lowlands province, the Ozark Plateaus province, and the Great Plains province (Fenneman, 1946).

The Osage and Dissected Till Plains and the Ozark Plateaus annually receive from 30 to 45 inches (in.) of precipitation. Although rain provides an abundant source of recharge, geology determines the availability of ground water. Pennsylvanian and Permian rocks (shale, limestone, and sandstone) crop out in the Osage Plains and dip toward the northwest. Glacial drift (clay, silt, sand, gravel, and boulders) of Pleistocene age mantles large areas of Pennsylvanian and Permian rocks in the Dissected Till Plains. Weathered and sandy dolomite of Cambrian and Ordovician age underlie the Ozark Plateaus at depths of 300 feet (ft) or more and dip towards the northwest.

The Great Plains receives from 15 to 30 in. of rainfall annually, and recharge is limited in the western part. Cretaceous rocks (shale, sandstone, limestone, and chalk) crop out in the northeast one-quarter of the area and dip toward the northwest. Cenozoic deposits (clay, silt, sand, and gravel) as much as 500 ft thick overlie Cretaceous rocks in the remainder of the area. Alluvial deposits (clay, silt, sand, and gravel) of Quaternary age are present in major river valleys throughout the State.

PRINCIPAL AQUIFERS

Principal aquifers in Kansas consist of two types—unconsolidated gravel, sand, silt, and clay, and consolidated sandstone, limestone, and dolomite. The principal aquifers are described below and in table 2, from youngest to oldest; their areal distribution is shown in figure 1.

ALLUVIAL AQUIFERS

The Kansas River alluvial aquifer is an important source of water along the common border of the Osage and Dissected Till Plains. The aquifer consists of unconsolidated fluvial deposits of Quaternary age and is unconfined. Wells typically yield more than 500 gallons per minute (gal/min). The water generally is a calcium bicarbonate type that is suitable for most uses. Concentrations of iron commonly exceed 0.3 milligrams per liter (mg/L), and concentrations of manganese can exceed 0.05 mg/L.

In the Great Plains, wells developed in unconfined alluvial aquifers of the Arkansas, Republican, and Pawnee River valleys generally yield more than 500 gal/min. The water generally is a calcium bicarbonate type that is suitable for most uses. Locally, concentrations of dissolved solids greater than 500 mg/L, chloride greater than 250 mg/L, and nitrate greater than 10 mg/L can result from discharge of saline water from underlying bedrock, contamination from oilfields, and agricultural practices. Naturally occurring concentrations of selenium greater than 0.01 mg/L and gross-alpha radioactivity

8-3

greater than 15 picocuries per liter (pCi/L) commonly are present in water from alluvial aquifers in the northern Great Plains.

Glacial-Drift Aquifer

The glacial-drift aquifer is a major source of water in the Dissected Till Plains. The aquifer consists of unconsolidated glacial deposits of Pleistocene age and generally is unconfined. Wells yield from 10 to about 500 gal/min. Shallow wells generally produce a calcium bicarbonate water that is suitable for most uses, but nitrate concentrations can exceed 10 mg/L. Deep wells can produce very mineralized water with concentrations of dissolved solids greater than 500 mg/L, sulfate and chloride greater than 250 mg/L, and iron exceeding 0.3 mg/L.

High Plains Aquifer

The High Plains aquifer is the most important and extensively used aquifer in Kansas. The aquifer consists of thick unconsolidated fluvial and eolian deposits of Cenozoic age and generally is unconfined. The aquifer is present in nearly three-fourths of the Great Plains. Wells yield from 500 to about 1,500 gal/min. The water generally is a calcium bicarbonate type that is suitable for most uses. Concentrations of fluoride greater than 1.4 mg/L and selenium greater than 0.01 mg/L are present in some water from northern parts of the High Plains aquifer.

Great Plains Aquifer

The Great Plains aquifer is a major source of water in the northeastern quarter of the Great Plains, where the aquifer material is exposed at the land surface, and in the southern part of the Great Plains, where it is exposed or is directly overlain by Cenozoic deposits. The aquifer consists of the Dakota and Cheyenne Sandstones of Cretaceous age and generally is unconfined. Wells yield from 10 to 100 gal/min in the northeast to more than 1,000 gal/min in the south. The water generally is a calcium bicarbonate type in areas where the aquifer is unconfined. However, sodium and chloride concentrations increase with depth, and the water is not used northwest of the area shown in figure 1. Some wells yield water with concentrations of iron exceeding 0.3 mg/L.

Chase and Council Grove Aquifer

The Chase and Council Grove aquifer is a major source of water where it is exposed in the Osage Plains. The aquifer consists of limestones of the Chase and Council Grove Groups of Permian age. Well yields range from 10 to about 200 gal/min. The water generally is a calcium bicarbonate type that is suitable for most uses, although concentrations of sulfate exceed 250 mg/L locally. The water is very mineralized (dissolved-solids and chloride concentrations exceed 500 mg/L and 250 mg/L, respectively) west of the area shown in figure 1 and is not used.

Douglas Aquifer

The Douglas aquifer is a source of water where it is exposed in the Osage and Dissected Till Plains. The aquifer consists of channel sandstone of the Douglas Group of Pennsylvanian age. In these areas, the aquifer generally is unconfined, and wells yield from 10 to about 100 gal/min. The water generally is a calcium bicarbonate type that is suitable for most uses. Some wells produce water with fluoride concentrations that exceed 1.4 mg/L. As in the case of the Chase and Council Grove aquifer, west of the area shown in figure 1, the water is not used because of its high mineral content.

Ozark Aquifer

The Ozark aquifer is the major source of ground water in the Ozark Plateaus. The aquifer consists of weathered and sandy dolomites of the Arbuckle Group of Cambrian and Ordovician age and is confined. The aquifer does not crop out in Kansas; at the shallowest point, it is 300 ft below land surface. Wells yield from 30 to about 500 gal/min. The water generally is a calcium bicarbonate type that is suitable for most uses. Water in some wells contains excessive concentrations of iron (greater than 0.3 mg/L) and naturally occurring gross-alpha radioactivity (greater than 15 pCi/L) (Spruill, 1983). In the Osage Plains, water from the Ozark aquifer becomes very mineralized with depth and toward the northwest, and hydrogen sulfide gas may be present. The water is not used west of the area shown in figure 1.

GROUND-WATER WITHDRAWALS AND WATER-LEVEL TRENDS

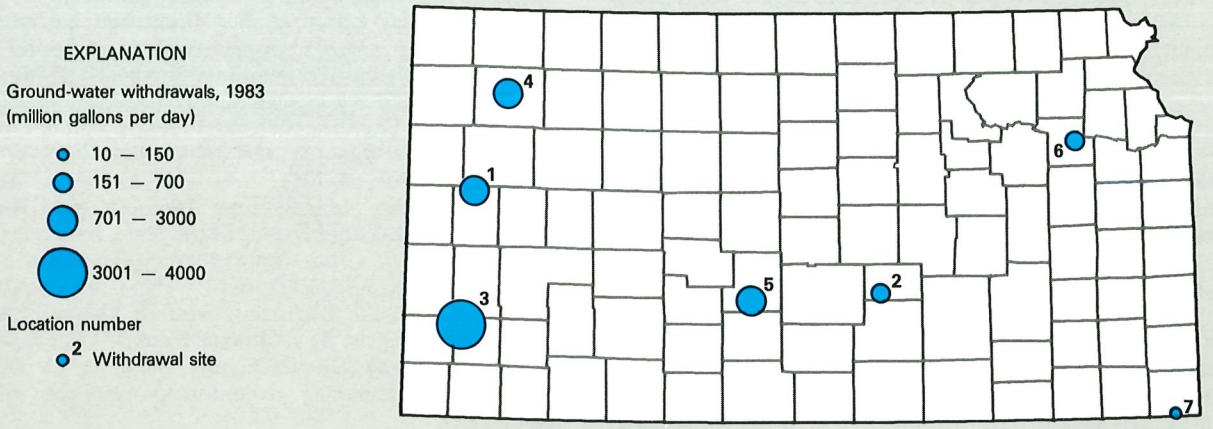
Although ground water is withdrawn throughout the State, seven major pumping centers produce most of the water. At locations 1 to 5 (fig. 2), water is withdrawn from the High Plains aquifer. These five pumping centers are Ground-water Management Districts (GMD's), which are political subdivisions of the State government locally organized to manage ground-water resources. Location 6 is the Kansas River valley in northeast Kansas. At location 7, water is withdrawn from the Ozark aquifer in southeast Kansas. Ground-water withdrawals are estimated from water rights granted by the Kansas State Board of Agriculture, Division of Water Resources. Estimates for pumping centers at locations 1 to 5 were provided by the GMD's. Estimates for pumping centers at locations 6 and 7 were obtained from unpublished data of the Kansas Division of Water Resources.

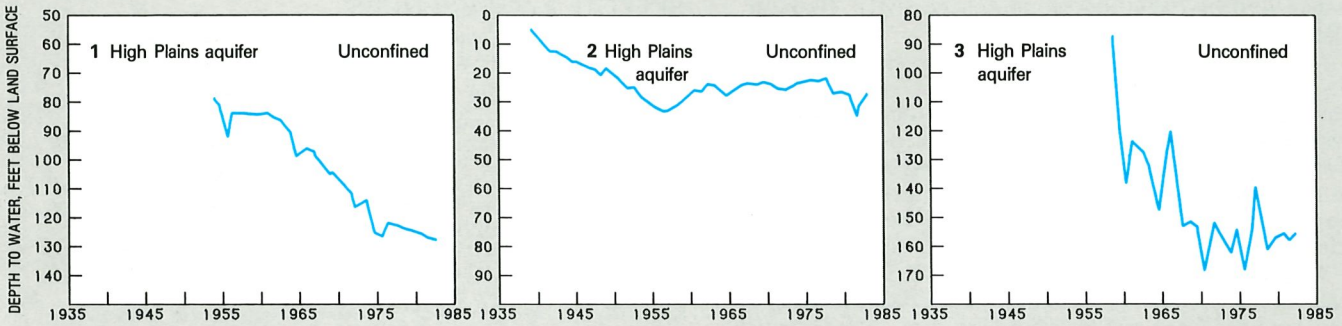
Approximately 710 million gallons per day (Mgal/d) of water is withdrawn from the High Plains aquifer at location 1 (fig. 2) which includes parts of Wallace, Greeley, Wichita, Scott, and Lane Counties. Because recharge is insufficient to replenish ground water withdrawn for irrigation, water levels had declined from 10 to 100 ft by 1980 (Luckey and others, 1981). The hydrograph shows that the greatest rate of water level decline occurred from about 1962 through 1975.

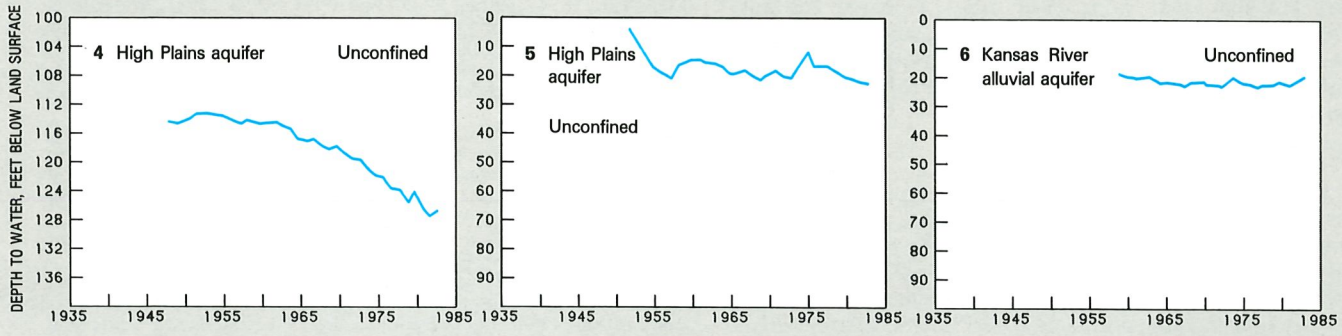
At location 2 (fig. 2), which includes parts of McPherson, Harvey, Reno, and Sedgwick Counties, approximately 190 Mgal/d of water is withdrawn from the High Plains aquifer. Although ground water is used extensively for irrigation and public supplies, recharge from precipitation generally had prevented water levels from declining more than 10 ft by 1980 (Luckey and others, 1981). The largest decline, about 30 ft, has occurred in the well field of the city of Wichita. The hydrograph from the Wichita well field (location 2, fig. 2) shows that the water level declined rather sharply from 1939 until 1957. The relative stability of water levels since about 1960 is primarily the result of decreased pumpage due to the increased use of surface water for public supplies.

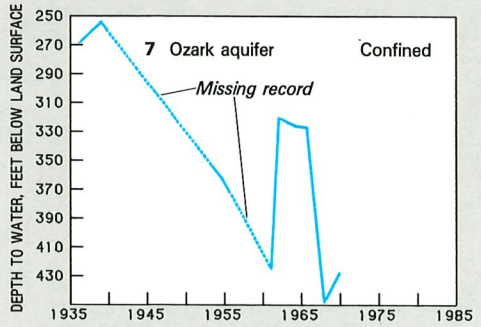
Approximately 3.3 bgd of water is withdrawn from the High Plains aquifer at location 3 (fig. 2) which includes Stanton, Morton, Grant, Stevens, Haskell, Seward, Gray, Ford, and parts of Hamilton, Kearny, Finney, Hodgeman, and Meade Counties. Because precipitation is insufficient to replenish ground water withdrawn for irrigation, water levels had declined more than 150 ft in parts of the area by 1980 (Luckey and others, 1981). The hydrograph (location 3, fig. 2) shows that the greatest rate of decline occurred from about 1955 through 1970.

Approximately 920 Mgal/d of water is withdrawn from the High Plains aquifer at location 4 (fig. 2), which includes









WITHDRAWAL SITES

No. on map	Geographic area	Aquifer	Principal uses
1	Western Kansas, Groundwater Management District 1.	High Plains. . . .	Irrigation, public supply.
2	Equus Beds, Groundwater Management District 2.	. . . .do	Do.
3	Southwest Kansas, Groundwater Management District 3.	. . . .do	Do.
4	Northwest Kansas, Groundwater Management District 4.	. . . .do	Do.
5	Big Bend, Groundwater Management District 5.	. . . .do	Do.
6	Kansas River valley, northeast Kansas.	Kansas River alluvial.	Irrigation, industrial.
7	Southeast Kansas	Ozark.	Public supply.

Figure 2. Areal distribution of major ground-water withdrawals and graphs of annual greatest depth to water in selected wells in Kansas. (Sources: Withdrawal data from Groundwater Management Districts 1–5 and Kansas State Board of Agriculture, Division of Water Resources; water-level data from U.S. Geological Survey.)

8-5

Sherman, Thomas, Sheridan, and parts of Cheyenne, Rawlins, Decatur, Graham, Wallace, Logan, and Gove Counties. Although ground water is withdrawn for irrigation in this area and precipitation provides little recharge, irrigation began later and is not developed as extensively as in other High Plains pumping centers. Ground-water levels in this area had declined generally less than 50 ft by 1980 (Luckey and others, 1981). The hydrograph (location 4, fig. 2) shows that the greatest rate of water-level decline occurred from about 1970 through 1983.

Approximately 910 Mgal/d of water is withdrawn from the High Plains aquifer at location 5 (fig. 2), which includes Stafford, Pratt, and parts of Kiowa, Edwards, Pawnee, Barton, Rice, and Reno Counties. Ground water is used extensively for irrigation, but increased recharge and decreased pumping during wet years can raise water levels significantly, as indicated by the well hydrograph (location 5, fig. 2). Ground-water levels in this area had declined generally less than 10 ft by 1980 (Luckey and others, 1981). However, declines of 25 ft have been observed locally.

Approximately 230 Mgal/d of water is withdrawn from the Kansas River alluvial aquifer at location 6 (fig. 2), which includes the Kansas River valley in Geary, Riley, Wabaunsee, Pottawatomie, Shawnee, Douglas, Jefferson, Johnson, Leavenworth, and Wyandotte Counties. Although ground water is used for irrigation and industrial supplies, increased recharge from precipitation and streamflow has kept water levels from declining significantly (location 6, fig. 2).

Approximately 14 Mgal/d of water is withdrawn from the Ozark aquifer in location 7 (fig. 2), which includes parts of Cherokee, Crawford, and Bourbon Counties. Although the quantity of ground water withdrawn from this area is considerably less than that from other areas, recharge has not increased because of confined conditions, and water levels have declined locally as much as 200 ft, based on predevelopment and 1980 potentiometric-surface maps (MacFarlane and others, 1981).

GROUND-WATER MANAGEMENT

Kansas has five State agencies and one type of local State government unit with major responsibilities for managing ground water. The Kansas Water Office is the water planning, policy, and coordination agency for the State (Kansas Statutes Annotated (K.S.A.) 74-2605 et seq.). It prepares State plans for water-resource management, conservation, and development. The Kansas Water Authority, a part of the Kansas Water Office (K.S.A. 74-2605 et seq.), is responsible for advising the Governor, Legislature, and Director of the Kansas Water Office on water-policy issues.

The Kansas State Board of Agriculture, Division of Water Resources, administers laws (K.S.A. 82a-701 et seq.) related to the conservation and use of water resources, including appropriation of ground water and assisting with the organization of Groundwater Management Districts.

The Kansas Department of Health and Environment, Division of Environment, has regulatory authority over matters dealing with water pollution (K.S.A. 65-161 et seq., K.S.A. 55-1003 et seq., K.S.A. 82a-1035 through 1038, and K.S.A. 82a-1201 et seq.). This agency is responsible for collecting, analyzing, and interpreting ground-water-quality data; developing water-quality-management plans; and responding to emergency water-pollution problems.

The Kansas Corporation Commission has a mandate (K.S.A. 55-115 et seq.) to protect fresh ground-water supplies from adverse effects of mineral-development activities.

The Kansas Geological Survey conducts ground-water research, including the collection, analysis, and interpretation of ground-water-quantity and quality data (K.S.A. 76-322, 76-2610, 82a-903, 55-128).

Groundwater Management Districts (GMD), locally managed political subdivisions of the State, have been formed as a result of the Groundwater Management District Act of 1972 (K.S.A. 82a-1020, et seq.). There are currently five GMD's in Kansas: District 1, western Kansas; District 2, Equus beds; District 3, southwest Kansas; District 4, northwest Kansas; and District 5, Big Bend. Each District is charged with managing ground-water resources within its boundaries.

SELECTED REFERENCES

Bayne, C. K., 1975, General availability of ground water and normal annual precipitation in Kansas: Kansas Geological Survey Map M-4A.

Fenneman, N. M., 1946, Physical divisions of the United States: U.S. Geological Survey special map.

Heath, R. C., 1984, Ground-water regions of the United States: U.S. Geological Survey Water-Supply Paper 2242, 78 p.

Kansas Department of Health and Environment, 1982, Ground-water quality management plan for the State of Kansas: Kansas Department of Health and Environment Bulletin No. 3-4, 77 p.

Kansas Water Office, 1984, Kansas water supply and demand estimates: Kansas Water Office, State Water Plan, Background Paper No. 15, 119 p.

Keene, K. M., and Bayne, C. K., 1977, Ground water from Lower Cretaceous rocks in Kansas: Kansas Geological Survey Chemical Quality Series 5, 18 p.

Luckey, R. R., Gutentag, E. D., and Weeks, J. B., 1981, Water-level and saturated-thickness changes, predevelopment to 1980, in the High Plains aquifer in parts of Colorado, Kansas, Nebraska, New Mexico, Oklahoma, South Dakota, Texas, and Wyoming: U.S. Geological Survey Hydrologic Investigations Atlas HA-652.

MacFarlane, P. A., Whittemore, D. O., and Hathaway, L. R., 1981, The hydrogeology and chemical quality in the lower Paleozoic aquifers in southeast Kansas and adjoining areas of Missouri and Oklahoma: Kansas Geological Survey Open-File Report 81-16, 48 p.

Merriam, D. F., 1963, The geologic history of Kansas: Kansas Geological Survey Bulletin 162, 317 p.

Murray, W. A., 1982, Kansas statistical abstract 1982-83: Lawrence, University of Kansas Center for Public Affairs, 280 p.

Raisz, Erwin, 1954, Physiographic diagram, p. 59, *in* U.S. Geological Survey, 1970, National atlas of the United States: Washington, D.C., U.S. Geological Survey, 417 p.

Solley, W. B., Chase, E. B., and Mann, W. B., IV, 1983, Estimated use of water in the United States in 1980: U.S. Geological Survey Circular 1001, 56 p.

Spruill, T. B., 1983, Statistical summaries of selected chemical constituents in Kansas ground-water supplies, 1976-81: U.S. Geological Survey Open-File Report 83-263, 29 p.

Taylor, O. J., 1978, Summary appraisals of the Nations's groundwater resources—Missouri Basin region: U.S. Geological Survey Professional Paper 813-Q, 41 p.

U.S. Bureau of the Census, 1983, 1980 Census of housing: U.S. Department of Commerce, v. 1, chapter B, part 18.

U.S. Geological Survey, 1970, The national atlas of the United States: Washington, D.C., 417 p.

Weeks, J. B., and Gutentag, E. D., 1981, Bedrock geology, altitude of base, and 1980 saturated thickness of the High Plains aquifer in parts of Colorado, Kansas, Nebraska, New Mexico, Oklahoma, South Dakota, Texas, and Wyoming: U.S. Geological Survey Hydrologic Investigations Atlas HA-648.

Prepared by Hugh E. Bevans, Timothy B. Spruill, and Joan F. Kenny

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KANSAS
Surface-Water Resources

Surface water is distributed unevenly across Kansas. With the exception of a few localities, western Kansas has little surface water most of the time; ground water is the principal source of freshwater in most of this area, although more ground water is being withdrawn than is being recharged. In contrast, ground water is not accessible in most of eastern Kansas, where surface water is the principal source of large supplies. About 37 percent of the population of Kansas is served by surface water. Surface-water withdrawals in Kansas in 1980 for various purposes and related statistics are given in table 1.

With few exceptions, the surface waters of Kansas are of suitable quality for instream uses and for irrigation. Standard treatment is adequate for offstream municipal and industrial uses. Twenty-four large reservoirs and scores of smaller ones are in use for water supply and flow regulation with a combined storage capacity of about 3.7 million acre-ft (acre-feet) or 1,210,000 Mgal (million gallons). Projected water-supply needs may require construction and operation of additional reservoirs. Flows of streams unregulated by reservoirs fluctuate between long periods of negligible flow and short periods when channels are full or flooding.

Major concerns related to surface water in Kansas are maintenance of streamflow during low-flow periods, development of drought-contingency regulations for equitable allocation during water shortages, water conservation, water quality, and the State's role in development of new reservoirs and control and management of water supplies in Federal reservoirs.

Table 1. Surface-water facts for Kansas

[Data may not add to totals because of independent rounding. Mgal/d = million gallons per day; gal/d = gallons per day. Source: Solley, Chase, and Mann, 1983]

POPULATION SERVED BY SURFACE WATER, 1980	
Number (thousands)	880
Percentage of total population	37
From public water-supply systems:	
Number (thousands)	830
Percentage of total population	35
From rural self-supplied systems:	
Number (thousands)	43
Percentage of total population	2
OFFSTREAM USE, 1980	
FRESHWATER WITHDRAWALS	
Surface water and ground water, total (Mgal/d)	6,600
Surface water only (Mgal/d)	980
Percentage of total	15
Percentage of total excluding withdrawals for thermoelectric power	10
Category of use	
Public-supply withdrawals:	
Surface water (Mgal/d)	150
Percentage of total surface water	15
Percentage of total public supply	52
Per capita (gal/d)	180
Rural-supply withdrawals:	
Domestic:	
Surface water (Mgal/d)	4.3
Percentage of total surface water	0.4
Percentage of total rural domestic	7
Per capita (gal/d)	100
Livestock:	
Surface water (Mgal/d)	46
Percentage of total surface water	5
Percentage of total livestock	57
Industrial self-supplied withdrawals:	
Surface water (Mgal/d)	340
Percentage of total surface water	35
Percentage of total industrial self-supplied:	
Including withdrawals for thermoelectric power	64
Excluding withdrawals for thermoelectric power	22
Irrigation withdrawals:	
Surface water (Mgal/d)	440
Percentage of total surface water	45
Percentage of total irrigation	8
INSTREAM USE, 1980	
Hydroelectric power (Mgal/d)	570

GENERAL SETTING

The major physiographic divisions in Kansas—the Great Plains and Central Lowlands physiographic provinces (fig. 1)—have diverse terrain including flat plains, rolling hills, sandhills, and steep slopes. Farmland, which generally consists of a mixture of cropland and pastureland, is the dominant land use in nearly all of the State. Precipitation increases fairly uniformly from an annual average of 16 inches in the western part of the State to 40 inches in the southeastern part (fig. 1). Precipitation usually is least in January and greatest in May or June, depending on location (fig. 1). Evaporation from lake surfaces ranges from 44 inches in the northeast to 68 inches in the southwest (Farnsworth and others, 1982). Average annual runoff ranges from 0.1 inch in the west to about 9 inches in the east (fig. 1). Average monthly runoff is closely related to average monthly precipitation. The period of least discharge usually occurs in December or January, and the period of greatest discharge usually occurs in May, June, or July (fig. 1).

PRINCIPAL RIVER BASINS

The northern half of Kansas is in the Missouri Region and has been divided, for the purpose of this report, into the Republican–Smoky Hill basins and Kansas–Osage–Missouri basins (fig. 2). The southern half of Kansas is in the Arkansas–Red–White Region and has been divided into the Arkansas basin and the Walnut–Verdigris–Neosho basins. These river basins are described below; their locations, and long-term variations in streamflow at representative gaging stations, are shown in figure 2. Streamflow characteristics and other pertinent information are given in table 2.

MISSOURI REGION

Republican and Smoky Hill Subregions

Republican and Smoky Hill River Basins.—Because the Republican and the Smoky Hill River basins span the western two-thirds of Kansas, the landscape is diverse, and the climate ranges from semiarid to subhumid. Less than one-third of the Republican River basin is in Kansas. The Republican River channel is sandy, wide, and shallow, and the surrounding uplands are flat to rolling. The Smoky Hill River basin is almost entirely in Kansas and comprises about one-fourth of the State's area. The Smoky Hill River is about 500 miles long and its major tributaries—the Solomon and the Saline Rivers—join it near Salina, which is the largest city (population 40,000) in the basin.

Nine of the large reservoirs constructed in the Republican and Smoky Hill River basins are in Kansas; their predominant use has been for irrigation supply and flood control. Agriculture is the basis of the economy. Surface water for irrigation is supplied by five major reservoirs in Kansas (irrigation storage capacity 414,000 acre-ft or 135,000 Mgal) and one reservoir in Nebraska (capacity 343,000 acre-ft or 112,000 Mgal). Recent chronic shortages of surface water for irrigation have decreased agricultural use of surface water and have discouraged further development.

The western part of the Republican–Smoky Hill River basins is in an area that receives little precipitation and yields very little runoff (fig. 1); streams in these basins tend to be small, except during occasional floods (table 2, site 2). The eastern parts of both basins receive more precipitation and yield much greater runoff than the western parts. The eastern parts of the basins also contain more reservoirs, which are used to decrease flood peaks and sometimes augment low flows (table 2, sites 1, 3, and 4).

The bar graph for site 2 in figure 2 shows an example of a discharge trend typical of many streams in western Kansas. The clearly defined decline in average discharge by water year illustrates the chronic shortages of inflow to irrigation-supply reservoirs during recent years. The moving average of annual discharges for the Republican River (site 1, in figure 2) shows a decrease in discharge, probably because of an increase in consumptive use during the last two decades compared to the 1920's and 1930's.

Saline ground water contributes to flow in the Smoky Hill River basin near Wilson Lake and near the mouth of the Solomon River. Surface-water issues in these basins focus on methods of managing the available water supplies for most efficient use. The immediate concerns are non-point source pollution and inadequate supplies of surface water for irrigation at several locations and for municipal use in the Hays area.

Kansas, Gasconade-Osage, and Missouri-Nishnabotna Subregions

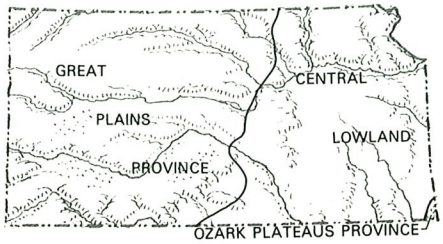
Kansas, Osage, and Missouri River Basins.—From the junction of the Republican and the Smoky Hill Rivers, the Kansas River flows about 170 miles eastward, where it joins the Missouri River at Kansas City. The Osage River basin in Kansas consists of the Marais des Cygnes River and smaller tributaries of the Osage River, which is formed downstream in Missouri. The Kansas and the Osage River basins have similar topography—rolling hills that are partly tilled and partly pastureland, interspersed with wooded and cleared valleys and some larger woodlands. The land along the Missouri River consists of flat flood plain as much as 2.9 miles wide on the Kansas side, and steep bluffs of silt and clay that are subject to the largest erosion rates in the State.

Flow of the Kansas River is affected by multipurpose reservoirs, completed from 1948 to 1977, in the Republican and the Smoky Hill River basins and on other major tributaries to the Kansas River. Three multipurpose reservoirs in the Osage River basin were completed during 1963, 1972, and 1981.

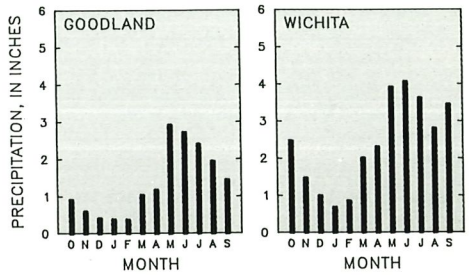
Major diversions from the Kansas, the Marais des Cygnes, and the Missouri Rivers are for the municipal supplies of Topeka, Lawrence, Leavenworth, Kansas City and its suburbs; for four fossil-fueled powerplants; and for a waterfowl refuge. Reservoirs on the Missouri River and its tributaries upstream from Kansas augment low flows, particularly during the late fall and early spring navigation seasons, and provide flood control. Low flows in the Kansas, the Big Blue (a tributary to the Kansas River), and the Missouri Rivers are sustained by ground-water inflow and by reservoir releases, but low flows of the Marais des Cygnes River are smaller and less dependable.

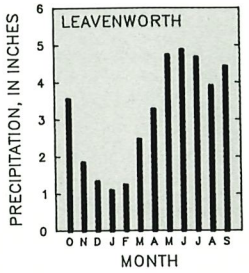
The Kansas River receives considerable flow from several large tributaries, including the Republican, the Smoky Hill, and the Big Blue Rivers. The Missouri River is so large that its low flow at St. Joseph (table 2, site 9) is more than three times the average discharge of the Marais des Cygnes River (table 2, site 8) and almost as large as the average discharge of the Kansas River at De Soto (table 2, site 7). Periodic high flows in channels and on flood plains of the Kansas and the Missouri Rivers recharge the underlying ground-water reservoirs.

Major concerns in the Kansas and the Missouri River basins are the possibility of transferring some of the relatively large average discharges of the Kansas and the Missouri Rivers to other river

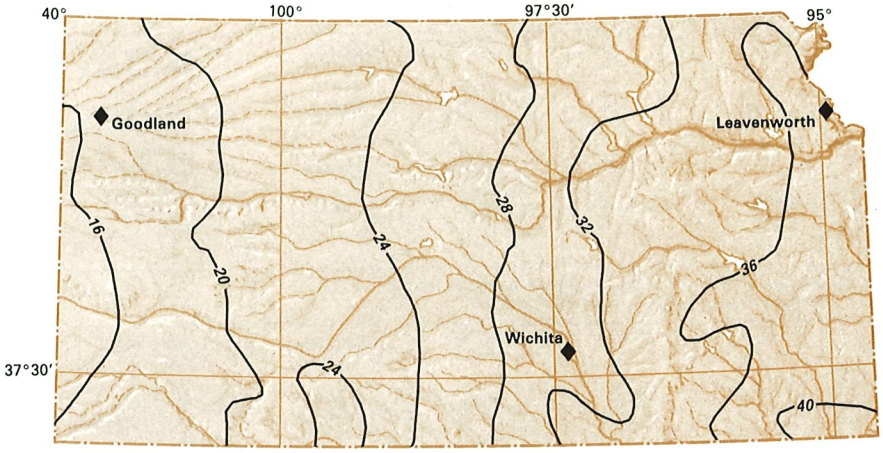


PHYSIOGRAPHIC DIVISIONS

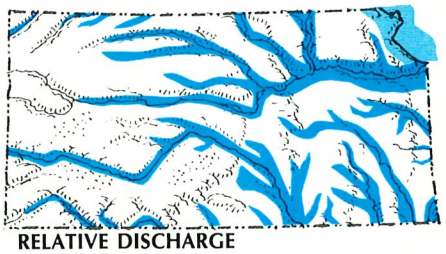




AVERAGE MONTHLY PRECIPITATION



PRECIPITATION



RELATIVE DISCHARGE

SCALE 1:6,000,000

0 50 100 MILES

0 50 100 KILOMETERS

EXPLANATION

—24— Line of equal average annual precipitation
Interval 4 inches

—2— Line of equal average annual runoff
Interval, in inches, is variable

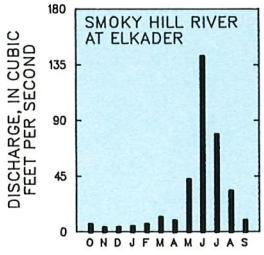
◆ National Weather Service precipitation gage—Monthly data shown in bar graphs

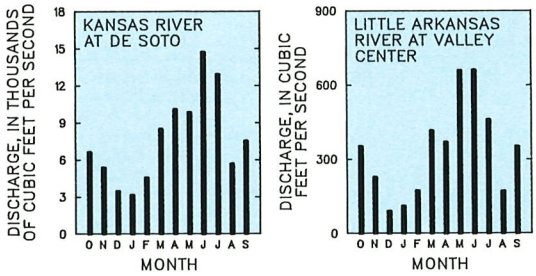
▲ USGS stream-gaging station—Monthly data shown in bar graphs

EXPLANATION

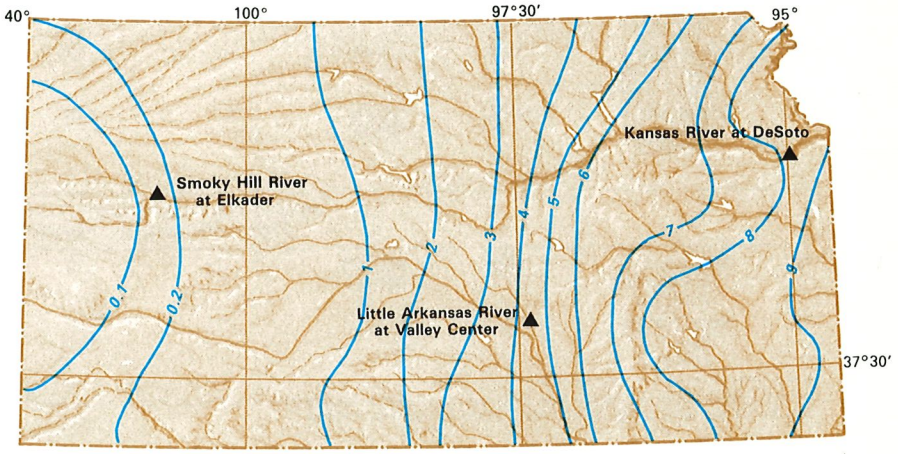
Average annual discharge
In hundreds of cubic feet per second

5
30
70
400
500





AVERAGE MONTHLY DISCHARGE



RUNOFF

Figure 1. Average annual precipitation and runoff in Kansas and average monthly data for selected sites, 1951-80.

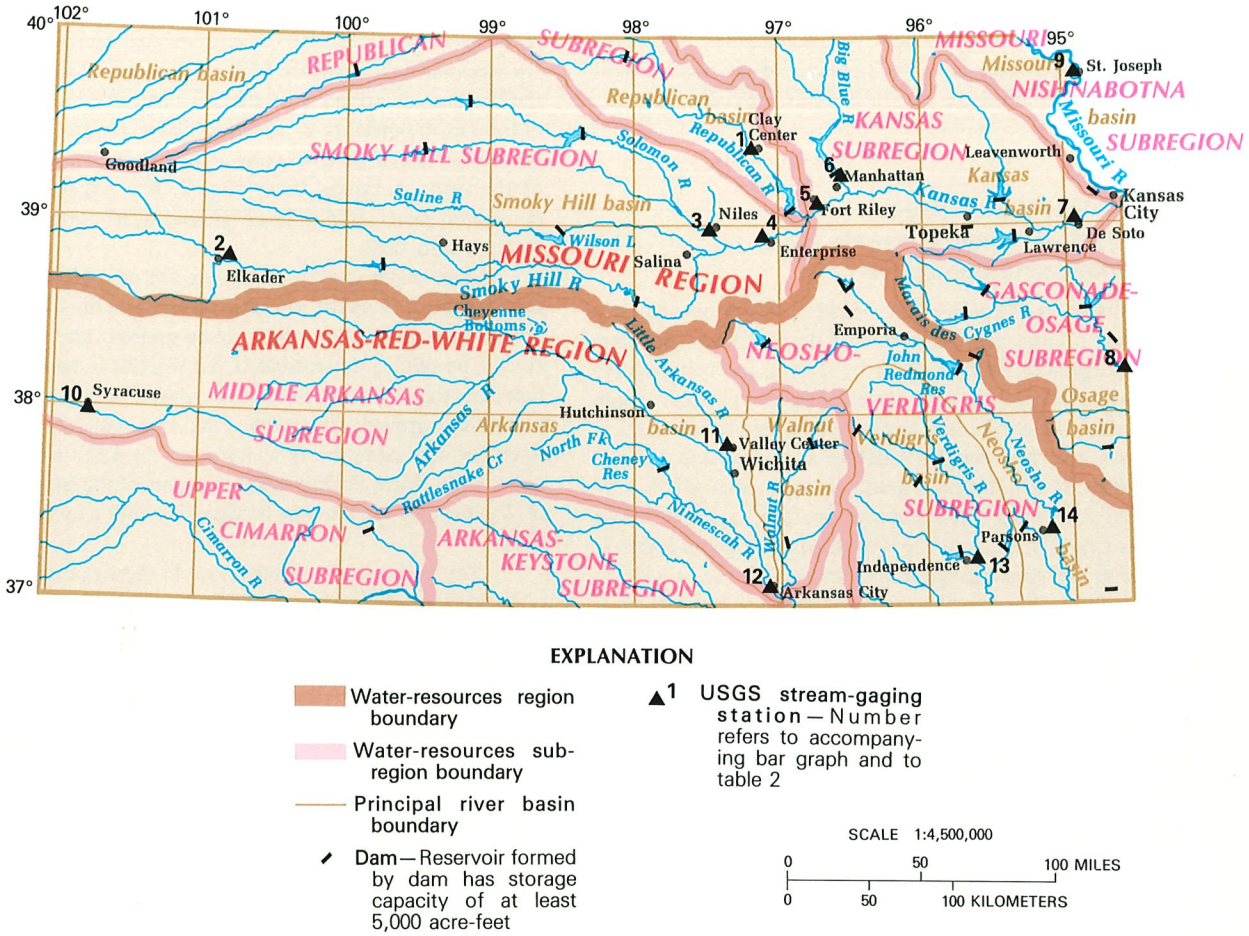
(Sources: Precipitation—annual data from unpublished map compiled by D. A. Olson, National Oceanic and Atmospheric Administration (NOAA); monthly data from NOAA files. Runoff—annual data from Gebert, Graczyk, and Krug, 1985. Discharge—monthly- and relative-discharge data from U.S. Geological Survey files. Physiographic diagram from Raisz, 1954; divisions from Fenneman, 1946.)

Table 2. Selected streamflow characteristics of principal river basins in Kansas

[Gaging station: Period of analysis is for the water years used to compute average discharge and may differ from that used to compute other streamflow characteristics. Streamflow characteristics: The 7-day, 10-year low flow is a discharge statistic; the lowest mean discharge during 7 consecutive days of a year will be equal to or less than this value, on the average, once every 10 years. The average discharge is the arithmetic average of annual average discharges during the period of analysis. The 100-year flood is that flow that has a 1-percent chance of being equaled or exceeded in a given year. Abbreviations: Do. = ditto; mi^2 = square miles; ft^3/s = cubic feet per second; . . . . = insufficient data or not applicable. Sources: Reports of the U.S. Geological Survey and Kansas State agencies]

Site no. (see fig. 2)	Gaging station: Name and USGS no.	Gaging station: Drainage area (mi^2)	Gaging station: Period of analysis	Streamflow characteristics: 7-day, 10-year low flow (ft^3/s)	Streamflow characteristics: Average discharge (ft^3/s)	Streamflow characteristics: 100-year flood (ft^3/s)	Streamflow characteristics: Degree of regulation	Remarks
	MISSOURI REGION							
	Republican And Smoky Hill Subregions							
	Republican and Smoky Hill River basins							
1.	Republican River at Clay Center (06856600).	24,542	1917–83	[1]75	990	[1]76,000	Appreciable	Major water uses are irrigation and power.
2.	Smoky Hill River at Elkader (06860000).	3,555	1940–83	0.0	30	70,000	Negligible	Water use is negligible; long periods of no flow are common.
3.	Solomon River at Niles (06876900).	6,770	1897–1903, 1917–83	[1]33	550	[2]51,000	Appreciable	Major water use is irrigation.
4.	Smoky Hill River at Enterprise (06877600).	19,260	1935–83	[1]120	1,600	[2]85,000	. . . do . . .	Major water use is irrigation.
	Kansas, Gasconade-Osage, And Missouri-Nishnabotna Subregions							
	Kansas, Osage, and Missouri River basins							
5.	Kansas River at Fort Riley (06879100).	44,870	1964–83	[1]240	2,600	[2]140,000	Appreciable	Major water use is irrigation.
6.	Big Blue River near Manhattan (06887000).	9,640	1955–83	[1]18	2,000	[2]50,000	. . . do . . .	Major water uses are irrigation and municipal supply.
7.	Kansas River at De Soto (06892350).	59,756	1917–83	[1]800	7,000	[2]230,000	. . . do . . .	Major water uses downstream from the Republican and the Smoky Hill Rivers are municipal and industrial supplies and transport of treated wastes.
8.	Marais des Cygnes River near Kansas–Missouri State line (06916600).	3,230	1959–83	[1]2.5	2,000	[1]67,000	. . . do . . .	Major water uses are municipal supply, fish and wildlife.
9.	Missouri River at St. Joseph, Mo. (06818000).	420,300	1929–83	[1]6,100	42,000	. . . .	. . . do . . .	Major water uses include irrigation, municipal and industrial supplies, barge traffic, hydroelectric power, fish and wildlife, waste transport, and recreation.
	ARKANSAS-WHITE-RED REGIONS							
	Middle Arkansas, Upper Cimarron, And Arkansas-Keystone Subregions							
	Arkansas River basin							
10.	Arkansas River at Syracuse (07138000).	25,763	1902–06, 1921–83	[1]0.3	310	[1]130,000	Appreciable	Major water use is irrigation.
11.	Little Arkansas River at Valley Center (07144200).	1,327	1922–83	10	280	43,000	Negligible	Flow may be affected by pumpage from Wichita well field.
12.	Arkansas River at Arkansas City (07146500).	43,713	1902–06, 1922–83	[1]170	1,800	[2]99,000	Moderate	Major water uses are irrigation and transportation of treated wastes.
	Middle Arkansas And Neosho-Verdigris Subregions							
	Walnut, Verdigris, and Neosho River basins							
13.	Verdigris River at Independence (07170500).	2,892	1895–1904, 1921–83	[1]9.0	1,700	[2]72,000	Appreciable	Major water uses are municipal, fish and wildlife, and recreation.
14.	Neosho River near Parsons (07183500).	4,905	1922–83	[1]7.5	2,500	[1]56,000	. . . do . . .	Major water uses are industrial, municipal, fish and wildlife.

[1]Based on period of analysis since regulation began. These values are not based on detailed analyses, are approximate estimates, and are for information purposes only.
[2]From flood-insurance hydrology study. Based on detailed analyses of regulated-flow conditions.



EXPLANATION

- Water-resources region boundary
- Water-resources sub-region boundary
- Principal river basin boundary
- Dam—Reservoir formed by dam has storage capacity of at least 5,000 acre-feet
- ▲1 USGS stream-gaging station—Number refers to accompanying bar graph and to table 2

SCALE 1:4,500,000

0 50 100 MILES

0 50 100 KILOMETERS

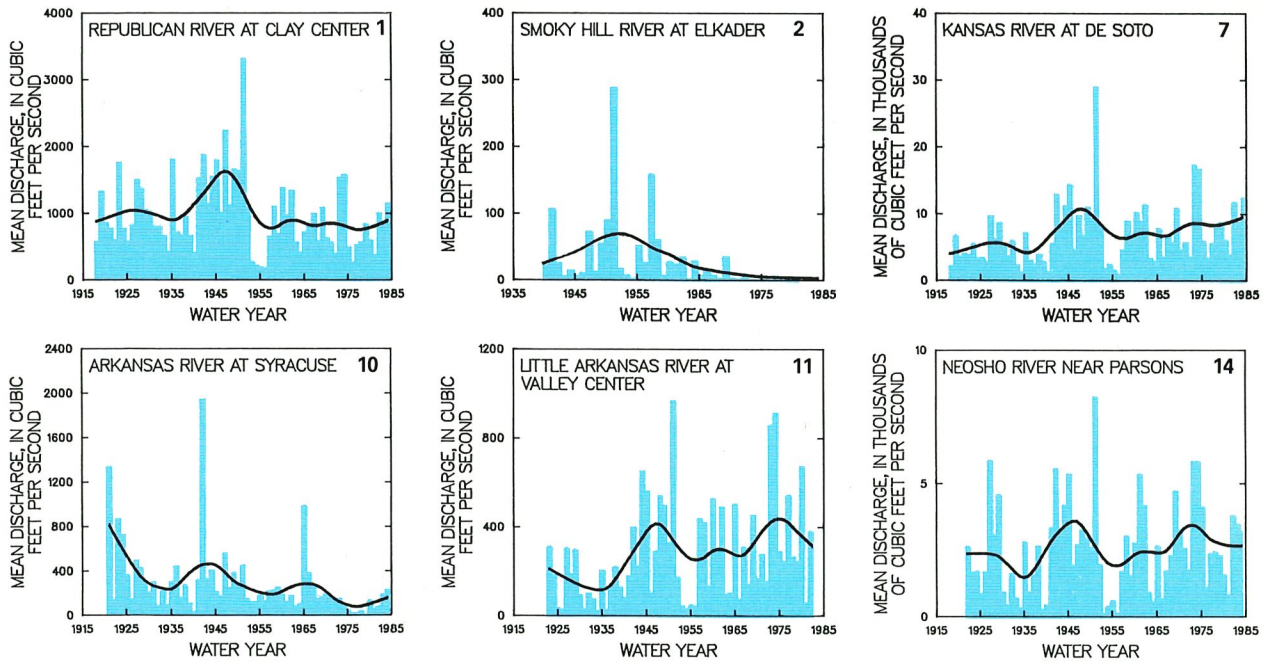


Figure 2. Principal river basins and related surface-water resources development in Kansas and average discharges for selected sites.

Bar graphs show average discharge by water year at selected stream-gaging sites; the curve is a 15-year weighted moving average of the annual values. (Sources: Water-resources regions and subregions from Seaber and others, 1984; surface-water-resources development from Hitt, 1985; discharge data from U.S. Geological Survey files.)

basins, the need to develop and ensure water supplies from smaller streams in the basins during drought, sedimentation of reservoirs, and salinity in the Kansas River at Topeka. Salinity occasionally exceeds the Federal drinking-water standards for public supplies.

ARKANSAS-WHITE-RED REGION

Middle Arkansas, Upper Cimarron, and Arkansas-Keystone Subregions

Arkansas River Basin.—The Arkansas River originates in Colorado and a large part of its flow is derived from mountain snowmelt. Regulation of streamflow by storage and consumptive use of the water in Colorado has reduced the river to a small stream where it crosses the border into Kansas. Also, as a result of water use in Kansas, the river remains small for a considerable distance within the state. It then increases gradually to Wichita where it increases rapidly. Comparison of the low, average, and flood flows at Arkansas City (table 2, site 12) with those at Syracuse (table 2, site 10) shows the great change in the Arkansas River as it flows through the State. The low flow of the Little Arkansas River is enough to support some instream uses, particularly for recreation within Wichita where low dams increase the river's surface area.

Development of the Arkansas River basin in western Kansas began with diversions, with and without offstream storage, for irrigation of corn and sugar beets. Considerable development of the river has occurred in Colorado. The John Martin Reservoir on the Arkansas River in Colorado, completed in 1943 with 702,000 acre-ft or 227,000 Mgal of storage capacity, affects flows of the Arkansas River in western Kansas. Cheyenne Bottoms—a waterfowl and fishing area enlarged from a natural shallow lake—is maintained in part by diversions from the Arkansas River and a tributary. Other developments include diversions of floodwaters around Hutchinson and Wichita, and a pipeline from Cheney Reservoir to Wichita.

The downward trend of average discharge by water year at Syracuse (fig. 2, site 10) is the result of consumptive use of water for irrigation and evaporation from reservoirs. This trend has forced the decrease of irrigation by surface water in Kansas and also has decreased the quantity of water available for the Cheyenne Bottoms waterfowl area. In contrast, average discharge by water year of the Little Arkansas River (fig. 2, site 11) has not shown a downward trend despite large ground-water withdrawals at the Wichita well field.

Poor water quality constrains use of surface water during times of low flow in the Arkansas River from the mouth of Rattlesnake Creek to Wichita where saline ground water seeps into the river. The salinity downstream from Wichita is decreased by dilution from the city's treated effluent, most of which originates from low-salinity ground water north of the river. Much of the Ninnescah River has very saline low flow; however, the water in Cheney Reservoir on the North Fork is usable for part of the municipal supply of Wichita much of the time because of dilution by less saline high flow.

The major surface-water issue in the Arkansas River basin is the need for additional sources of water to supply the fast-growing economy of the Wichita–Hutchinson area.

Middle Arkansas and Neosho-Verdigris Subregions

Walnut, Verdigris, and Neosho River Basins.—The southeastern one-seventh of Kansas consists of the Walnut River basin and the Verdigris and the Neosho River basins (in the Neosho–Verdigris Subregion). This area has the largest average precipitation and runoff in the State, yet it has periodic water-supply shortages as severe as in any other part of Kansas. One large reservoir has been constructed in the Walnut basin (capacity 301,000 acre-ft or 98,000 Mgal), four in the Verdigris basin (total capacity 1,131,000 acre-ft or 369,000 Mgal), and three in the Neosho basin

(total capacity 1,311,000 acre-ft or 427,000 Mgal), to moderate the extremes of high and low flows and to provide public-water supplies; the reservoirs also provide recreational opportunities and fish and wildlife habitats.

The largest water right in the basins will be used to cool by evaporation a nuclear powerplant near John Redmond Reservoir; the powerplant is undergoing tests in 1985 prior to full-time operation. The plant will use water transported by pipeline from John Redmond Reservoir to supplement the water in a smaller on-site impoundment. Surface water also is used by numerous small cities (the largest is Emporia, with a population of 26,000), by rural water districts, and by some farmers for supplemental irrigation. Water quality does not constrain surface-water use in most parts of these basins. Instream uses in the basins are for fish and wildlife habitats, and recreation, although the flow periodically is less than the desired minimum. The major rivers have substantial average discharges, but the 7-day low flows are very small (table 2, sites 13 and 14). The average discharge by water year at site 14 in figure 2 shows no apparent long-term trend, primarily because consumptive use of water has changed little in the basin over the years.

The major water issue in these basins is the need to assure adequate streamflow for municipal and industrial supplies during drought conditions. A related issue is substantial conveyance losses of water for public supply in river channels downstream from reservoirs.

SURFACE-WATER MANAGEMENT

Kansas has five State agencies with major responsibilities for managing surface water. In addition, Federal water projects are managed by the U.S. Army Corps of Engineers and the U.S. Bureau of Reclamation. Data used in the management include hydrologic data collected by the U.S. Geological Survey in cooperation with several Federal, State, and local agencies.

The Kansas Water Office is the water-planning, policy, and coordination agency for the State and the marketing agent for water from State-owned storage in Federal reservoirs (Kansas Statutes Annotated (KSA) 74–2605 et seq.). A new process of water planning was developed and implemented during 1983 and 1984, culminating in a new Kansas Water Plan (Kansas Water Office, 1985) that was approved by the legislature during the 1985 session. Because the planning process is continuous, the Kansas Water Plan is expected to be modified and updated frequently.

The Kansas Water Authority (KSA 74–2605 et seq.) is responsible for advising the Governor, legislature, and Director of the Kansas Water Office on water-policy issues. Twelve local River Basin Advisory Committees, created in 1985, are responsible for advising the Kansas Water Authority on needs and courses of action within the river basins.

The Kansas State Board of Agriculture, Division of Water Resources, administers laws related to water rights, conservation, and use of water resources, including appropriation of surface water and ground water. Enacted during 1945, the Kansas Water Appropriation Act (KSA 82a–701 et seq.) operates on the principle of prior appropriation. The date of application for a permit establishes the priority to continue the use of water during periods of shortage. Allocation, storage, and diversion of water in the Republican, the Big Blue, and the Arkansas River basins are affected by Interstate Compacts with Colorado, Nebraska, and Oklahoma.

The Kansas Department of Health and Environment, Division of Environment, has regulatory authority over matters dealing with pollution of surface water.

The State Conservation Commission administers the following assistance programs that affect surface water: State aid to Conservation Districts, Water Resources Cost-Share Program, State assistance in construction of watershed dams, and beginning in 1985, administration of a new Small Lakes Program.

SELECTED REFERENCES

Carswell, W. J., Jr., 1982, Storage requirements to sustain gross reservoir outflow from small basins in Kansas: Kansas Water Office Technical Report 16, 40 p.

Carswell, W. J., Jr., and Hart, R. J., 1985, Transit losses and traveltimes for reservoir releases during drought conditions along the Neosho River from Council Grove Lake to Iola, east-central Kansas: U.S. Geological Survey Water-Resources Investigations Report 85–4003, 40 p.

Farnsworth, R. K., Thompson, E. S., and Peck, E. L., 1982, Evaporation atlas for the contiguous 48 United States: National Oceanic and Atmospheric Administration Technical Report NWS 33, 26 p.

Fenneman, N. M., 1931, Physiography of the Western United States: New York, McGraw-Hill, 534 p.

_____ 1946, Physical divisions of the United States: Washington, D. C., U. S. Geological Survey special map.

Flora, S. D., 1948, Climate of Kansas: Kansas State Board of Agriculture Report, v. 67, no. 285, 320 p.

Furness, L. W., 1962, Storage requirements to sustain gross reservoir outflow: Kansas Water Resources Board Technical Report 4, 177 p.

Gebert, W. A., Graczyk, D. J., and Krug, W. R., 1985, Average annual runoff in the United States, 1951–80: U.S. Geological Survey Open-File Report 85–627, scale 1:2,000,000.

Hitt, K. J., compiler, 1985, Surface-water and related-land resources development in the United States and Puerto Rico: U.S. Geological Survey special map, scale 1:3,168,000.

Jordan, P. R., 1978, Statistical summary of streamflow data for Kansas streams in the Arkansas River basin: Kansas Water Resources Board Technical Report 14A, 206 p.

_____ 1979, Statistical summary of streamflow data for Kansas streams in the Missouri River basin: Kansas Water Resources Board Technical Report 14B, 334 p.

_____ 1982, Rainfall-runoff relations and expected streamflow in western Kansas: Kansas Water Office Bulletin 25, 42 p.

_____ 1983, Magnitude and frequency of low flows of unregulated streams in Kansas, and estimation of flow-duration curves for ungaged sites: Kansas Water Office Technical Report 17, 55 p.

_____ 1984, Magnitude and frequency of high flows of unregulated streams in Kansas: U.S. Geological Survey Open-File Report 84–453, 45 p.

Jordan, P. R., and Irza, T. J., 1975, Kansas streamflow characteristics, magnitude and frequency of floods in Kansas, unregulated streams: Kansas Water Resources Board Technical Report 11, 34 p.

Kansas Water Office, 1985, Kansas Water Plan: Topeka, Kansas Water Office publication, 220 p.

Medina, K. D., and Geiger, C. O., 1984, Evaluation of the cost effectiveness of the 1983 stream-gaging program in Kansas: U.S. Geological Survey Water-Resources Investigations Report 84–4107, 57 p.

Raisz, Erwin, 1954, Physiographic diagram, p. 59, *in* U.S. Geological Survey, 1970, National atlas of the United States of America: Washington, D.C., U.S. Geological Survey, 417 p.

Seaber, P. R., Kapinos, F. P., and Knapp, G. L., 1984, State hydrologic unit maps: U.S. Geological Survey Open-File Report 84–708, 198 p.

Solley, W. B., Chase, E. B., and Mann, W. B., IV, 1983, Estimated use of water in the United States in 1980: U.S. Geological Survey Circular 1001, 56 p.

U.S. Environmental Protection Agency, 1982a, Maximum contaminant levels (subpart B of part 141, National interim primary drinking-water regulations): U.S. Code of Federal Regulations, Title 40, Parts 100–149, revised as of July 1, 1982, p. 315–318.

_____ 1982b, Secondary maximum contaminant levels (section 143.3 of part 143, National secondary drinking-water regulations): U.S. Code of Federal Regulations, Title 40, Parts 100–149, revised as of July 1, 1982, p. 374.

U.S. Geological Survey, 1952, Kansas–Missouri floods of July 1951: U.S. Geological Survey Water-Supply Paper 1139, 239 p.

_____ 1985, National water summary 1984—Hydrologic events, selected water-quality trends, and ground-water resources: U.S. Geological Survey Water-Supply Paper 2275, 467 p.

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