On T.R.A.C.K.S.

Teaching Resource Activities and Conservation to Kansas Students

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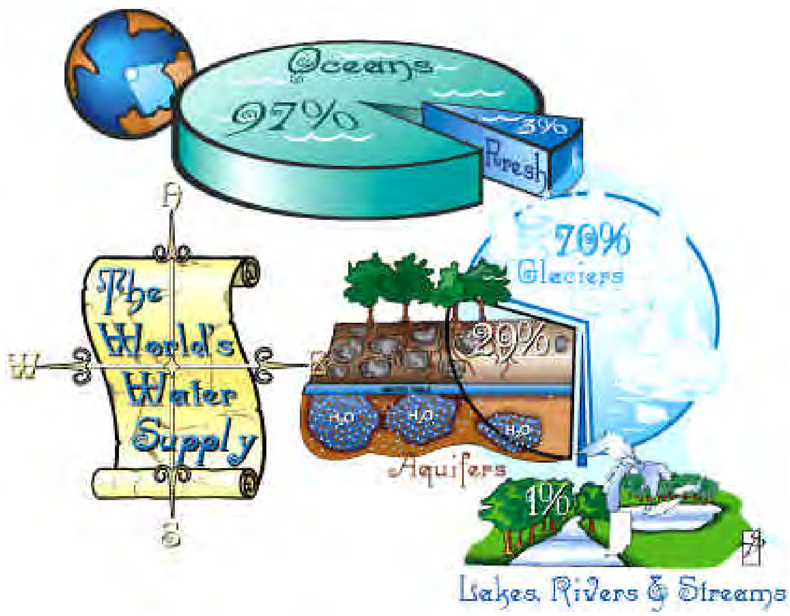


Water: Our Most Precious Resource Part I

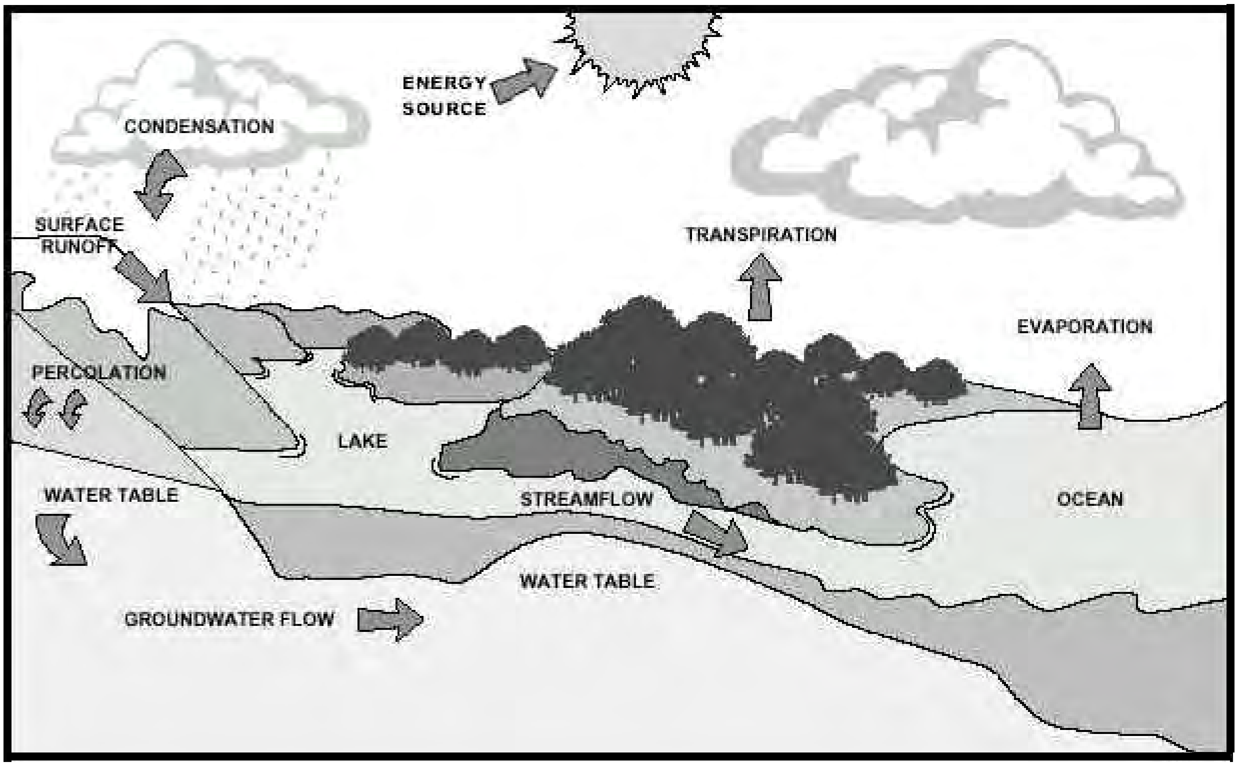
Last spring we asked subscribers for their opinion on changing the format of this newsletter from a newsprint copy to that of a CD Rom disk. The response from 128 replies indicated 60% favored a CD Rom format. With this assurance from our subscribers (and the fact we can reduce our production cost by 25% and distributing expenses by 66%), we have employed the CD Rom format to the 2001 issues of ON T.R.A.C.K.S. Each public and non-public school will receive a single CD disk containing the Fall/Winter newsletters. They may make as many copies of the newsletters or articles within as they desire. Individual subscribers will also receive a single CD rom, but we will encourage them thereafter to download the newsletter from the agency's web site.

We wish to thank all who responded to our inquiry. Many indicated the instructional value of the newsletter with their on coming classroom activities. Hopefully, the changes will allow us to provide you with many more issues of the ON T.R.A.C.K.S newsletter.

Inside...

We experienced some difficulty in obtaining state bids to reproduce the ON T.R.A.C.K.S. newsletter onto a CD rom format. Because of the delay, you will receive the Fall and Winter issues on the same disk. The first issue explores the quality, quantity, utilization, and depletion of water sources in Kansas. Our winter issue will touch upon the conservation measures needed to be employed to reduce water consumption and restore the quality of our water supplies. As a bonus, we are also including the Life in a Pond, Winter issue from 1996. Some of our older issues, produced on newsprint, may no longer be available. Therefore, we will try to include past, related issues with our current newsletter.

Where's the Water?



The Water Cycle

We all have some idea of what the water cycle is trying to represent. Words like precipitation, condensation, evaporation, ground water and so forth appear in most illustrations of the water cycle. So, just what does it all mean? There are actually several concepts being illustrated in the water cycle-- the movement of water, collection places of water, different physical states in which water can exist, and how energy is either absorbed or released by water within the cycle. Two things we must take into consideration with any discussion of the water cycle are: first, it is just a simulation. Simulations are, by definition, a simpler representation of a more complex, naturally occurring interaction. Second, the various paths of water through the water cycle are not predetermined, but will vary based on the water's collecting and resting place, energy level, and physical state.

One can begin anywhere within the water cycle since it has no real beginning or ending point. To start our discussion, lets begin with the largest collecting place for water - the oceans. Oceans contain about 97% of all the water on earth, most of which is in a liquid state. Water in a liquid state is also the middle energy level for water. To start the movement of ocean water through the water cycle we need to apply energy to it. Where will this energy come from? Our greatest source of energy on earth is the sun. The sun's energy heats up the ocean's surface causing the water molecules to increase their rate of movement. The increasing movement of these molecules will cause some of the water surface molecules to change from a liquid to a gas. As a vapor, this water can travel from the earth's surface to the atmosphere surrounding the earth's surface. This process is known as evaporation. What happens to this water vapor will depend upon its loss of energy, gravity, and the structure on the earth's surface.

Eventually the water vapor will lose its energy and turn into tiny water droplets. We call this change condensation. In clouds, these water droplets collect on tiny dust particles. The tiny water droplets collide with each other causing them to increase in size. Before too long, the droplets become so heavy that gravity pulls them from the clouds to the earth's surface. Depending on the temperature of the air in the clouds and the temperature between the clouds and earth's surface, these falling droplets will appear in the form of rain, snow, hail, or sleet. The movement of water from the atmosphere to the earth is called precipitation. Numerous things can happen to this water falling to the earth's surface. Some will actually evaporate before reaching the surface or upon striking the surface. In very cold regions they may be confined for extensive periods of time upon the earth as ice-caps or glaciers. Other droplets will fall back into the oceans or some other form of surface water. Still others will fall upon land masses and either run along the surface of the land as runoff or be absorbed into the earth to become ground water.Water collected as ground water may be held for long periods of time.

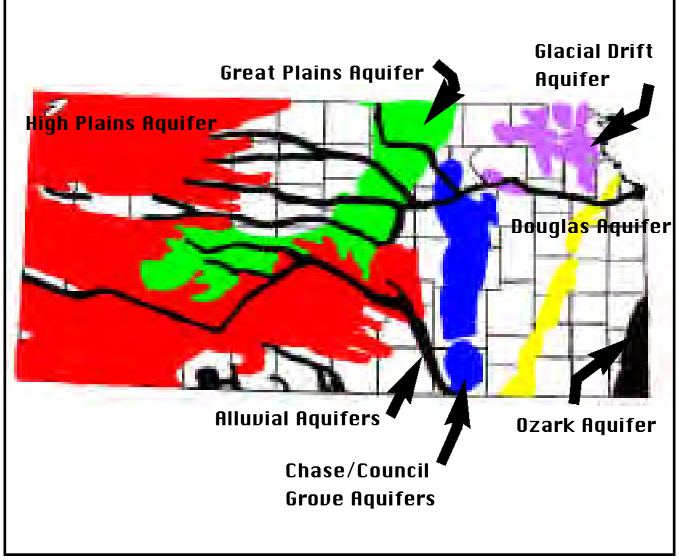
The greatest movement of water among living organisms occurs in plants. Plants absorb ground water through their roots. Some of the water remains in the plant, but the majority will travel through the plant to the leaf surface. This "leaf water" is exposed to the air and the sun's energy. Evaporation can easily take place at this interaction point. This process is called transpiration. On a hot, summer day in a forest in Minnesota, a layer of condensing water vapor may form over the tops of the trees which resembles fog.

All these processes and interactions work together to change the physical state of water and to move it from one given location to another. The sum of this interaction is called the water cycle.

GROUND WATER

The term ground water is used to identify water stored below the earth's surface. Water at the surface will slowly move through the permeable materials underneath (i.e. gravel, sand, and silt) by a process called percolation. Gravity is the principle force behind this water movement but soil particle attraction for water can also aid this process. During the water's travels it may come upon a layer of material, such as clay or nonporous bed rock, which will not allow it to pass. Water then starts to accumulate in the soil, filling up the air spaces between particles. This zone of water saturation is called the water table.

Principle Aquifers of Kansas



Areas which contain an appreciable quantity of ground water are called aquifers. Kansas sits partially atop the largest freshwater aquifer in the world known as the Ogallala. The Ogallala lies beneath eight states from South Dakota down toTexas. In Kansas, our portion of the Ogallala is known as the High Plains aquifer (colored red on the above map). It is the largest of seven aquifers located within the state. The High Plains is estimated to contain about 245 million acre-feet of stored water. To put this another way, think of an area 2,978 times the size of Kansas (or 68 times the size of the United States) covered with one foot of water and you have the amount of water stored in the High Plains aquifer. To top this off, the total amount of freshwater stored in all of Kansas' aquifers is over twice this amount. We depend heavily upon ground water for irrigation, drinking, livestock, and industrial use.

Two important terms to remember when discussing ground water is recharge and discharge. Recharge occurs when water flows into the ground water system; discharge is the water leaving the ground water system. In Kansas, precipitation is the main contributor to recharge and irrigation is the greatest cause of discharge. Because of this, the ground water level has been declining in recent years. Years with below normal precipitation result in decreasing ground water recharge which, in turn, can result in an increase in the amount of water being discharged through irrigation. Since the 1960's, ground water levels in Kansas have dropped by as much as 200 feet in some areas. The decline during the 1990's has been less than for any other decade in the last forty years. Above average rain fall and more conservative irrigation methods has contributed to this decline.

Not only must we be aware of the quantity of ground water available, we also need to protect the quality of our ground water. At one time, ground water was considered almost immune to surface pollution but no longer. Ground water contamination is all too common today, most of it emerging from point (identifiable sources of pollution) and non-point pollution (unidentifiable sources). A study in 1996-97 found excessive nitrate concentrations in 10% of the 267 wells sampled. While a nitrate problem is fairly widespread in Kansas, most ground water contamination occurs from isolated situations due to human activity involving VOC's, heavy metals, and petroleum products. In general, the larger aquifers of Kansas are in worse shape in terms of dissolved solids than shallower ones. Higher levels of ammonia, sulfate, sodium, and chloride may exist due to human activity and/or natural sources. For the most part, these contaminants do not cause any serious health-related problems. They do create problems such as scale deposits, staining, odors, and unpleasant tasting water.

Surface Water

Surface water refers to water which accummulates on the surface of the earth. No natural lakes or ponds could be found in the landscape of pre-settlement Kansas. Surface water was confined only to rivers, streams, wetlands, and springs. Settlement brought with it an increase in surface water due to the construction of ponds and lakes. The Kansas Environment 2000 Report lists 181,337 acres of public owned lakes (private owned lake and pond acres are not available). Lakes and reservoirs in Kansas drain into the Missouri River Basin or the Arkansas River Basin. Information for these basins and the lakes and reservoirs within them can be found at the U.S. Army Corps of Engineers, Kansas City District Office,700 Federal Building, Kansas City, MO, 64106, (816) 983-3949, fax (816) 983-3896 or visit the web site at www.usace.army.mil

Stream miles have also increased since settlement, but numbers are not available for comparison. Today, according to the "Kansas River and Stream Corridor Management Guide", (Kansas State Conservation Commission) Kansas has 134,338 miles of interior streams and 120 miles of border streams for a total of 134,458 stream miles.

Breakdown of Current Stream Miles

Intermittent	110,225 miles
Perennial	23,731 miles
Border Streams	120 miles
Canals & Drainage Ditches*	382 miles

*most were created from 1920 to 1970, often to drain wetlands

Today, man-made lakes and ponds have substantially increased the amount of surface water available in Kansas. Many developed areas depend on these surface waters for everyday use in times of drought. Surface water also adds recreational opportunities, aesthetic values and wildlife habitat. As many as thirty-eight new species of wildlife (the majority being fish) were found to reside in Kansas during a recent study by the Kansas State Biological Survey due to expanding water habitats. More information on wetlands and wildlife habitat will be presented in Part II of this "Water" issue of On TRACKS.

How Wet Is Our Planet *from Project Aquatic*

Objectives

Students will: 1) describe the amount and distribution of water on the earth in oceans, rivers, lakes, groundwater, icecaps and the atmosphere; and 2) make inferences about the importance of responsible water use.

Method

Students calculate water volumes using percentages.

Materials

A large display map of the world; a 12-inch diameter globe (one showing the ocean bottom is best); a five or ten-gallon aquarium, bucket, trash can, or other container; writing materials; calculators; measuring cup; one-quart (or one liter) container for every three students; one measuring tablespoon (or one ml graduated eyedropper) for every three students.

Grade Level: 5-8

Subject Areas: Math, Environmental Education, Social Studies

Duration: one 40- to 60-minute session

Group Size: any; individual and small group work

Setting: indoors

Conceptual Framework Topic Reference: AAIIA2

Key Terms: water cycle, freshwater, saltwater, groundwater, earth, planet

Appendices: Ecosystems, Metric Conversion

Background

The earth has been called the water planet. Between two-thirds and three-fourths of its surface is water. The earth's water can be seen in flowing rivers, ponds, lakes and oceans, locked in the northern and southern icecaps and drifting through the air as clouds. Water that has seeped into the earth's crust (groundwater) is more difficult to see, yet all these forms of water are part of the dynamic interrelated flow of the water cycle.

Water is continually moving around, through and above the earth as water vapor, liquid and ice. The same water is continually being recycled all around the earth.

Students tend to think of the water on the planet as being limitless and yet simple calculations demonstrate the fact that the amount of water is limited. Scientists believe that all the water that we will ever have is on the earth right now. Whatever amount is available to humans and wildlife depends largely on how its quality is maintained. Human beings have a responsibility to conserve water, use it wisely and protect its quality.

Procedure

NOTE: Refer to the table in the Variation section to adjust this activity for metric approximations.

1. Using a map of the earth, begin a discussion of the amount of water that covers the earth. Ask the students to comment on why the earth is called "the water planet." Call the students' attention to the statistic that

between two-thirds and three-fourths of the surface is covered with water. After general discussion, provide the students with the following statistics.

Water on Earth

Source	Percent
Oceans:	97.2000
All icecaps/glaciers:	2.0000
Groundwater:	0.6200
Freshwater lakes:	0.0090
Inland seas/salt lakes:	0.0080
Atmosphere:	0.0010
All rivers:	0.0001
Total:	99.8381 percent

Source: The Cousteau Almanac. New York: Doubleday/Dolphin, 1981.

2. Discuss the relative percentages. Ask the students to calculate the estimated amounts of fresh water potentially available for human use:

Source	Percent
Groundwater:	0.6200
Freshwater lakes:	0.0090
Rivers:	0.0001
	0.6291
including icecaps/glaciers:	2.0000
	2.6291

3. In discussing these figures, emphasize that pollution and contamination reduce the usable percentage of existing fresh water. Also, all the groundwater is not available and icecaps certainly are not readily available. Discuss the needs of humans for usable fresh water. Ask the students to consider which other life forms need both fresh and saline (salt) water.

4. Now show the students five gallons of water in an aquarium. Provide the students with the following quantity: 5 gal = 1,280 Tbsp.

5. Have the students assume that the five gallons represent all the water on earth. Do the calculations for them, or ask the students to calculate the volume of all the other quantities on the water percentage list. This will require the use of decimals. Remind the students that for multiplication, all the decimal places must be shifted two places to the left so that 97.2% becomes 0.972 prior to multiplication (i.e., 0.972 x 1280 Tbsp = 1244.16 Tbsp). The following values result.

5 Gallons

Source	Tablespoons
1. Oceans:	1,244.1600
2. Icecaps/glaciers:	25.6000
3. Groundwater:	7.9360
4. Freshwater lakes:	0.1152
5. Inland seas/salt lakes:	0.1024
6. Atmosphere:	0.0128
7. All rivers:	0.0012
Total:	app. 1,280.0000

6. Once the values are obtained, ask the students to calculate the volume of the water other than ocean water (approximately 34 Tbsp). Ask them to divide up in teams of three and put 34 Tbsp of water in a container and take it to their workplaces.

7. Once the students are at their workplaces, ask them to remove the amount of water represented by all freshwater lakes and rivers (it is 0.111 Tbsp, approximately one-tenth of a tablespoon or 25 drops from a standard dropper). Then ask the students to extract the amount represented by rivers (it is one-thousandth of a tablespoon). This is less than a drop. Discuss the relative proportions with the students.

8. Consider the fragile nature of the freshwaters, wetlands and oceans of our planet. Discuss how all species depend upon this minute percentage of water for their survival. Summarize the activity by using a globe to illustrate that if Earth were this size (12 inches in diameter) less than one-half cup (eight tablespoons) of water would fill all the oceans, rivers, lakes and icecaps. Close by emphasizing the importance of keeping the earth's waters clean and healthy and to use water wisely and responsibly.

Variation

Do this activity using the metric system. Using the conversion factor of 1 gal = 3.8 l, then all of the water on Earth represented earlier by 5 gal would be equivalent to 19 l or 19,000 ml.

19 Liters

Source	Millimeters
1. Oceans:	18,468.000
2. Icecaps/glaciers:	380.000
3. Groundwater:	117.860
4. Freshwater lakes:	1.710
5. Inland seas/salt lakes:	1.520
6. Atmosphere:	0.190
7. All rivers:	0.019
Total:	app. 19,000.000

Editor's Note: One way this activity has been modified is to use 100 paper squares to represent the amount of water on earth. Take away 97 squares to represent the oceans, and 2 squares to represent the glaciers/icecaps. With the remaining one square, take away one-half (cut in half) to represent what is on earth as ground - water. Now, cut the half of square in half again so that you have two quarters of a square. Discard one quarter to represent water that is in transition as water vapor, etc. The remaining one quarter of a square represents all the freshwater lakes and rivers. Now, place a small dot with the end of your pencil on the remaining one-quarter square. This dot represents the amount of freshwater in all the rivers on earth!

Extensions

1. Create a mural of the water cycle that graphically includes the statistics that represent the relative amount of water in each component of the cycle.
2. Calculate how much pollution is entering our waterways each year.
3. Calculate the size of a model of earth that would accommodate all the water in the aquarium used in the demonstration.
4. Which wildlife habitats require the most water?

Evaluation

1. Estimate the percentage of water that is distributed in each of the following areas of our planet: oceans, rivers, freshwater lakes, inland seas and saltwater lakes, groundwater, icecaps and glaciers and the atmosphere.
2. Explain why it is important that humans use water responsibly.

A Surface Water Primer

Flood control was initially the reason for much of the surface water development in Kansas. The first federal flood control legislation was passed in 1917, however, extensive development of ponds and lakes did not begin until the 1930's. Surprisingly, it was not because of flood control initiatives, but rather through the Works Progress Administration (designed to give work to capable adults during the depression times) that many new ponds and lakes were built. Wyandotte County Lake and Kingman State Fishing Lake are two examples of such projects in Kansas.

Flood control projects, initiated through the Corps of Engineers, began in the 1940's. Kanopolis Lake, located in the Missouri River Basin, was the first project completed in 1948 under the Flood Control Act of 1944. Fall River Lake, located in the Arkansas River Basin, was completed in 1949 under the Flood Control Act of 1941. Other reservoirs followed and Kansas now has a total of 25 reservoirs with Hillsdale Lake being the most recent (1984). Even with the work started in the 1930's and the flood control initiative of the 1940's, it wasn't until the 1950's that surface water became a topic of interest in Kansas.

Construction of Milford Dam, October 1963. File photo from the U.S. Army Corps of Engineers, Milford Project.

According to the Kansas Water Office, "The floods of 1951, followed by the drought of 1952 to 1957, made Kansas aware of the need to combine planning for future water supply needs with the planning for controlling floods." In 1955, the Kansas Water Resources Board (reformed as the Kansas Water Office in 1981) was created in response to this dual need. The Board was responsible for water resources planning, water policy development, and coordination of water related activities at all levels of government.

Many developments followed: the Federal Water Supply Act of 1958, which approved a constitutional amendment allowing Kansas to financially participate in the development of flood control works or works for the conservation and/or development of the state's water resources. Additionally, in response to a Council report, "A Suggested Water Development Program for Kansas", the 1963 Legislature enacted the State Water Plan Act (KSA 82a- 901).

These earlier events were followed by the first phase of the State Water Plan (KSA 82a- 927 et seq) enacted in 1965. The Board was given authority to provide assurances to the federal government regarding the need for future municipal and industrial water supply storage in any proposed or authorized water project in Kansas (KSA 82a-933P). Then in 1974, the State Water Plan Storage Act (KSA 82a-1301 et seq) was enacted by the Legislature establishing the basic framework of the current Water Marketing Program.

About two-thirds of the 24 federal reservoirs in Kansas are under the U.S.Army Corps of Engineers. The remaining seven federal reservoirs are under the Bureau of Reclamation. Lakes constructed by the Bureau of Reclamation were primarily constructed for water supply, i.e. irrigation. Lakes constructed by the Corps are considered multipurpose lakes and are only authorized by Congress when the anticipated benefits substantially outweigh the construction costs.

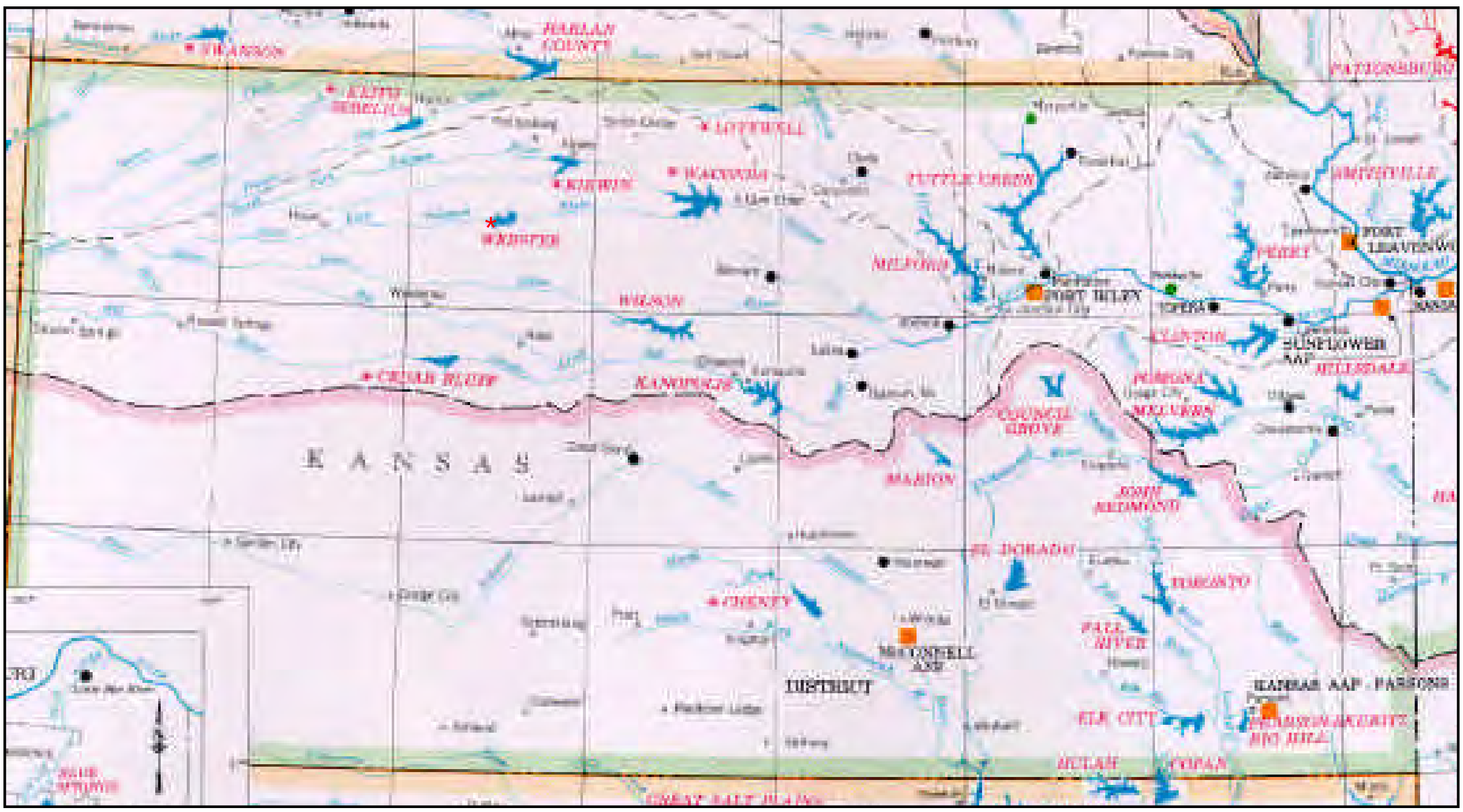
Flood control is the primary purpose followed by navigation, water supply, water quality, recreation, and fish and wildlife habitat.

The Kansas Water Office and the Corps work closely together to regulate water releases through the dams. Water above the "normal pool level" in Bureau of Reclamation lakes even falls under the Corps of Engineers control, whose authority is normally only used during flooding conditions. Water at the conservation pool or below in Bureau lakes is at the disposal of the Bureau of Reclamation, primarily for irrigation purposes.

An increase in surface water, with the resultant new habitat and recreational opportunities did not come without a price. The largest saltwater spring in Kansas, Waconda Springs, was destroyed in the construction of Glen Elder Dam and Waconda Lake in 1969. Waconda Springs was a sacred place for Native Americans. Efforts at preserving the spring were unsuccessful.

Another reservoir with opposition was Tuttle Creek. The flood of 1951 initiated the proposal for Tuttle Creek which was passed by Congress in 1952. Businesses in Topeka and Kansas City were desperate to have flood control measures but farmers in the area argued for small watershed dams to prevent floods without destroying the fertile bottomlands. The farmers promoted soil and water conservation programs over "Big Dam Foolishness." Opposition was heard all the way to Washington with a women's grassroots efforts halting the proposed Tuttle Creek Reservoir temporarily. Then, in 1955, Congress restored the funding for Tuttle Creek and it was completed in 1962. (taken from "Water and the Making of Kansas", Victoria Foth and Kansas Natural Resource Council)

It is important to note: While Kansas has increased its surface water totals in some ways, according to Resources in Need of Conservation, Kansas has lost 405,600 acres or 48% of its wet - lands. Wetlands will be discussed in part II.



*Federal Reservoirs located within Kansas. Those denoted with an * are Bureau of Reclamation Projects. All others are under the authority of the U.S. Army Corps of Engineers.*

Where Does All The Water Go?

Just how much water is required by Kansas water users? Perhaps a better question is: How much water is available for Kansas users? We have already learned available water in Kansas is either upon the surface or in the ground. Both are replenished by falling atmosphere water (precipitation). This is part of the problem. We cannot control the time, place, and amount of precipitation which falls across the state on a yearly basis. Western Kansas can expect to receive, on the average, 7-22 inches, Central Kansas 23-29 inches, and Eastern Kansas 30-40 inches of precipitation yearly (see map on opposite page). We also discovered the number one use of Kansas water is crop irrigation (over 90% in some water districts.) This is where the scenario becomes interesting.

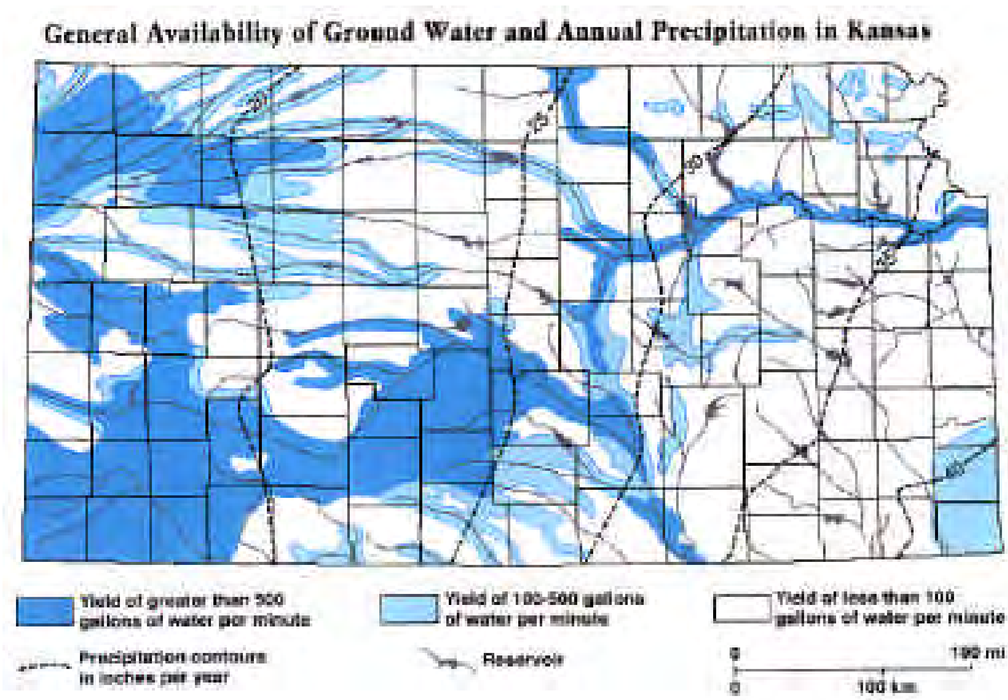
In eastern Kansas, surface water is the primary water source and, as such, can be regenerated rather quickly through precipitation. Since eastern Kansas also receives the highest amount of precipitation and uses less water than western Kansas, it is rare for the eastern section to have water shortages.

We have the opposite situation in western Kansas. Western Kansas water users depend upon groundwater. As stated previously, the replenishing of ground water through precipitation is a slow process. A study conducted by the U.S. Geological Survey revealed that every gallon of water withdrawn from the ground takes 280 years, on average, to replace. To further compound the situation, western Kansas receives half the precipitation of eastern Kansas.

A rough formula to determine whether water supplies are adequate for the water users would read something like this:

water + replenishing = available water
source rate for users

Using this over-simplified formula it appears the available water in eastern Kansas is meeting the needs of the water users. The problem area in Kansas lies in the western sector. The available water of western Kansas is having a difficult time keeping pace with the water demands.We will explore this more in the following pages.



This map is produced by the Kansas Geological Survey;

Urban Water Usage

As urban areas grow so does the demand for water. The Kansas Water Office has documented by county the projected water needs to the year 2040. The numbers for the high growth areas are astounding.

Listed below are the projected thousands of gallons of water needed for the largest water suppliers in the two most populated counties:

Johnson Co.
18,598,799 (yr 2000) 21,467,389 (yr 2010)
24,337,192 (yr 2020) 27,208,151 (yr 2030)
30,079,553(yr 2040)

Sedgwick Co.
21,746,397 (yr 2000) 23,561,241 (yr 2010)
25,376,277 (yr 2020) 27,191,122 (yr 2030)
29,006,159 (yr 2040)

Add to this all the other water suppliers, wells, and private pond sources found in the state, and you find that the gallons of water used is HUGE. (In the United States, we withdraw 450 billion gallons of water on a daily basis!) It is no surprise to find that in the eastern part of Kansas, surface water supplies the majority of the water. In the western half where surface water is limited, ground water is the major supplier. Johnson County Water District #1 obtains water from the Kansas and Missouri Rivers and underground springs near their plant. Wichita is supplied by the Arkansas River, Cheney Reservoir, and groundwater wells.

Conservation is the key to Kansas' sustaining the demands from its growing water usage. Many initiatives directed under flood control legislation (A Surface Water Primer, pg. 8) have assisted urban and industrial areas with their water demands. Programs such as the Water Marketing Program, Water Assurance Program, and the Multi-Purpose Small Lakes Program have been developed to assure water for municipalities in times of drought.

Under the Water Marketing Program, formed out of the State Water Plan Storage Act (KSA 82a-1301 et seq.)in 1974, a state-federal-local partnership was formed to help meet the future needs of Kansas. Basically, this program allows the state to pay for water storage in federal lakes. In return, local entities pay the state for water from the storage areas. The state sells water to users raw (untreated) at the reservoirs and is not responsible for the delivery or treatment of the water.

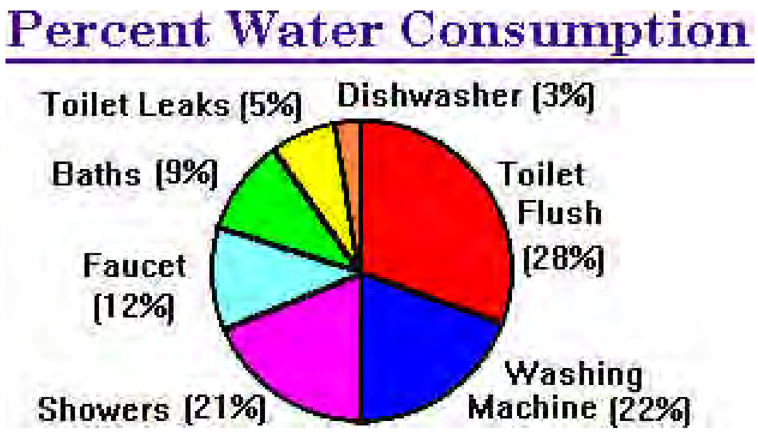
In 1986, the Legislature inacted the Water Assurance Program Act (KSA 82a-1330 et seq.) to meet the needs of municipal and industrial water users whose needs could not be economically and institutionally met by the existing Water Marketing Program. Many municipal and industrial water users who hold appropriation rights to the natural flow of a stream below large federal lakes, need water assurance only during times of drought. Often, the Water Marketing Program required these municipal and industrial water users to commit to a long term contract, up to 40 years, and placed other stipulations which were not feasible for the local entities. The Water Assurance Program gives the Kansas Water Office authority to enter into contracts with the federal government for storage space to be used for water assurance. The Act gives Kansas access to an additional 173,000 acre-feet of water supply.

Another program, the Multi-Purpose Small Lakes Program (KSA 82a-1601), was designed in 1985 to help small towns and rural water districts who are not benefitted by the general Water Marketing Program. This program was developed by the Kansas Water Office in cooperation with the State Conservation Commission, to administer watershed dam construction programs. Under this initiative, several sites that had been identified for flood control could also provide water supply for small towns and rural water districts at an affordable price. Bone Creek Reservoir in Crawford Co. is one such example of this program.

What's A Person To Do?

We know water is essential for life itself, to sustaining economical growth and stability, for farming, for communities, and wildlife. Water is also vulnerable to pollution, over-usage, and over-estimated in its obtainable quantity. We are faced with some critical issues dealing with the efficient use and protection of our water sources. The need for water conservation is quite apparent, especially in western Kansas. Where does one start? Let's start at a point with which we are all familiar and operate within on a daily basis, your home. Although home usage is the smallest general utilization of water, it is an area where we can all implement some water saving measures. For an average household, water consumption (by percentage) would look something like the following:

Showers - 21%; Bath - 9%; Toilet flushing- 28%; Toilet leaks- 5%; Washing machines - 22%; Faucets - 12%; Dishwashers - 3%.



Household Water Usage

This points out only in-house usage and does not take into consideration the lawn or garden. Most home water usage deals with cleanliness and waste disposal. Modern toilets, washing machines, showers, and dishwashers all use less water than their predecessors, but few of us can afford to replace many of these water users. Here are some more practical tips for water conservation around the house:

Use the dishwater only when full. For small amounts of dirty dishes, wash them by hand, but do not leave the water running for rinsing. Instead, if two sinks are available, fill one with soapy water and one with rinse water. When only one sink is available, gather all the washed dishes in a dish rack and rinse them with a spray device such as a plastic spray bottle.

Try to have the washing machine full to capacity or set the water level for the size of load you are washing.

Store a supply of drinking water in the refrigerator instead of running the water to cool it for drinking.

Clean vegetables or fruit in a stopped sink instead of using running water.

Repair leaks as soon as possible. A leaking toilet can waste up to 10-50 gallons a day.

Take shorter showers or install water saving headsor cut off valves to control water flow. An average bath uses less water than most showers.

Don't leave the faucet running when using your toothbrush, razor, or washing your hands. A small container of water should supply you with the necessary water for brushing your teeth or shaving. A few inches of water in the bottom of the sink should allow you to wash your hands.

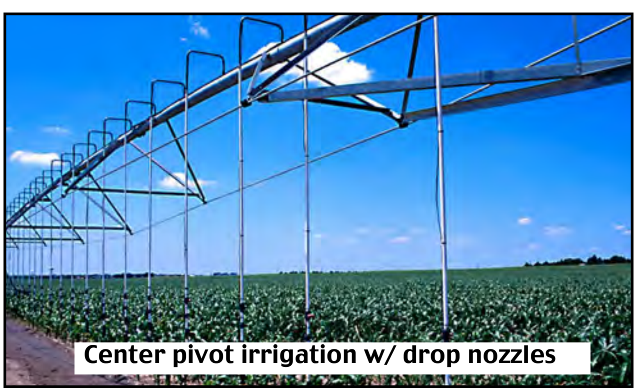
By putting these practices into use, the average household of four can save 28% to 47% on water requirements while reducing your water and energy bills. Look at the list of resources provided for other publication on water saving tips. The unnecessary flow of water has to stop somewhere; let it start with us.

Irrigation


Flooding irrigation gate

When considering water usage in Kansas, irrigation and its impact needs to be looked at very closely. We have already mentioned it briefly while introducing groundwater. Irrigation accounts for 90% of all water withdrawn from Kansas' ground water supply. Irrigation throughout the United States accounts for 64.1% of all water usage. Food production in Kansas and throughout our country has become highly dependent on irrigation. Alfalfa, corn, grain, sorghum and soybeans are crops being irrigated with ground water in Kansas. Most of the ground water available for large-scale irrigation is located in the High Plains aquifer system. Irrigation water in Kansas is presently being withdrawn from approximately 30,000 points of diversion, including wells, streams, and canals. It's estimated a center pivot irrigation system, growing corn or milo, utilizes in one growing season, the amount of water equivalent to the usage of a town with a population of 750-1,000 people. If all the diversion points were center pivot diversion systems, they would equate to the water used by a city of 22.5 to 30 million people!

There are several types of irrigation systems being employed in Kansas. The most common, based on 1998 estimations, is the center pivot sprinkler with drop nozzles (irrigating 1,049,463 areas) followed closely by center pivot sprinklers without drop nozzles (which irrigate 1,002,440 areas). A distant third is flooding, accounting for 584,169 irrigated areas. Taking all systems into account, approximately 2.75 million areas are being irrigated in Kansas.

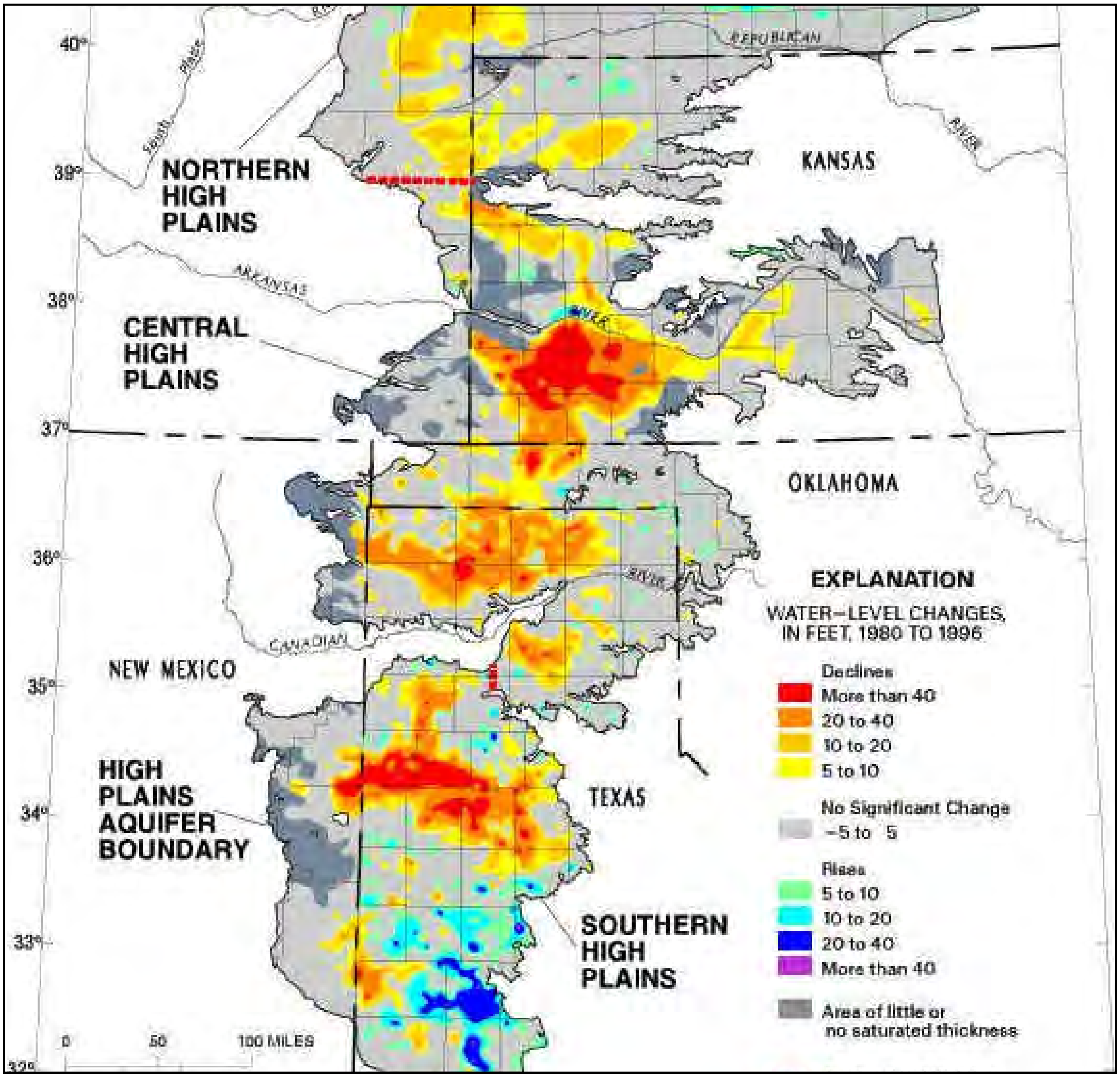

Center pivot irrigation w/ drop nozzles

Crop irrigation started in Kansas in the 1940's. Has this water utilization affected our groundwater and surface water supplies? The answser, of course, is YES! One study suggested the groundwater level in western Kansas from 1950-1995 has dropped between 5 to 40 feet and in a few situations, over a 100 feet. Only recently have substantial quantities of water for irrigation been drawn from surface water. From 1990-1995 the quantity of surface water utilized for irrigation has doubled in the major river basins. This amount is still only a fraction compared to what is being drawn from groundwater.

Though it doesn't appear direct utilization of surface water has had any measurable effect on our surface water resources, the opposite is true with groundwater irrigation. The draw of irrigation upon groundwater has had a significant impact on the aquifers of Kansas. The following information was extracted from the U.S. Geological Survey report "Water-Level Changes in the High Plains Aquifer - - 1980 to 1996."

The High Plains aquifer started experiencing water-level declines soon after extensive ground water irrigation development began in the 1940's. By 1980, the water level in parts of southwestern Kansas had declined more than 100 feet. This decline has continued from 1980 to 1996, but at a slower rate. Kansas had a yearly average decline rate 7.7 ft. from 1940 to 1980 compared to a 0.55 ft. yearly average decline rate from 1980 to 1996. Factors which contributed to this slow down in the water-level decline since 1980 are:

(1) a decrease in ground water withdrawals; this was brought about by better water management and an increase awareness that the Ogallala aquifer is a finite resource, (2) greater than normal precipitation (Kansas received an inch more rain per year during this time period), (3) a decrease in irrigated acreage in areas with large potential rates of aquifer depletion (no specific information on Kansas), (4) use of more efficient irrigation technology, such as low pressure nozzles and drop tubes on center pivots, (5) improved farm management practices, including irrigation scheduling, reuse of irrigation return flow, and the conversion to crops or varieties with less water demands, (6) greater regulation of ground water withdrawals and irrigated land development, and (7) economic conditions which have forced out the irrigation of marginal land.



The Ogallala, the world's largest underground supply of fresh water, lies beneath eight states: South Dakota, Wyoming, Nebraska, Kansas, Colorado, Oklahoma, New Mexico and Texas. It is being drained faster than nature can refill it.

The discharge and recharge rates for these irrigated lands has been very unbalanced-- discharge occurrs at a much faster rate than recharge. Surface water levels give us some indication of this phenomenon. Under normal conditions groundwater discharges or "flows" into surface water, such as rivers, streams, and ponds. But, when the groundwater level (water table) falls below the level of the surface water, the reverse takes place. Streams and ponds now act as a recharge point with water flowing from the surface to the ground. This is why the flow of many streams in areas of heavy irrigation has decreased or disappeared altogether. Maps comparing the perennial streams in Kansas in the 1960's, with those of the 1990's, show a marked decrease in miles of stream flow in the western third of the state over this period

There is little doubt the economies of western Kansas are directly dependent upon the water resources of the High Plains/Ogallala aquifer. It has been the backbone of western Kansas economy for the last 50 years. Without the aquifer's water, a farmer in western Kansas would be receiving about $28 / acre of crop land instead of the $65- $100 obtainable through irrigation. If water from this aquifer becomes unusable because of declining water levels and/or increasing operational costs, the region could loose up to $300 million in gross revenue annually.

This prosperity has a domino affect on the area economy as well. Crops are used to feed cattle which provide the basis for the area's meat packing industry. Workers at the packing plants purchase their daily needs from local merchants and the cycle continues. But, this prosperity may be running its course.

Already there are signs the water which supports this prosperity may be on its last gallon. At the current rate of usage, some areas like Greeley and Scott counties, may only have 25 years or less before the water is depleted. Some towns, such as Hays, find themselves in a continuous struggle to satisfy the water requirements of their citizenry. Water restrictions and water conservation programs are a way of life and a necessity for the people of Hays and other western communities. Dan Rogers, an agricultural economist at Kansas State University, was recently quoted in the Wichita Eagle paper as saying, "...(without irrigation) the whole economy will have to shrink."

There is a definite need to recognize the necessity for action programs and to provide technical assistance and leadership in reducing the present rate of aquifer depletion. In February of 2001, officials from the Kansas Water Office and the state Department of Agriculture will begin meeting with Congress, representatives of other states and western Kansas residents themselves on a new way to manage the Ogallala. Success of such action is vital to the well being of every individual who resides in our state, especially those in western Kansas.

Water Usage in Kansas

As stated previously, irrigation is the activity which utilizes the greatest amounts of water in Kansas; 88.53% of all ground and surface water usage is directed to irrigation. The second highest total comes from municipal usage (10.26%). Domestic usage is included in this total and represents the greatest usage within the municipal category. Industrial usage is third, representing 2.88% of water withdrawal in Kansas. The fourth highest is recreation (1.51%) followed by stock watering (0.77%). These totals do not include or reflect electrical power withdrawals in Kansas. (from the Kansas Department of Agriculture - Division of Water Resources.)

Did you know that :

One acre of irrigated corn in western Kansas uses over 400,000 gallons of water per season during a dry year.

Level basin terraces on cropland in western Kansas will hold 1 inch of runoff. This would be over 4 million gallons of water per quarter section of land.

If the efficiency of an irrigation system is increased by 5% (from 55% to 60%) on a 160 acre field of corn, the seasonal savings of water would exceed 10 million gallons.

The Ogallala: Can We Head Off A Disaster?

The Ogallala Aquifer began forming 20 million years ago. It is made up of material that was washed down from the Rockies in a wetter era. Some of this sediment is cemented into solid rock, but much of it is a porous heap of rubble in which the spaces between the pebbles probably filled with water as the gravel was deposited. Water continues to filter down into the formation at a rate of up to two inches a year but this is just a trickle compared to the rate at which water is being taken out. The amount of water withdrawn continues to exceeded the recharge rate.

Most of the depletion of the Ogallala Aquifer has occurred in the last thirty-five years. The drought of 2000 was very hard on the aquifer; 85% of the wells tested show a water level decline. Ten percent of these wells had a drop of five feet or more.

What can and has been done to control and stop the decline? The amount of water removed from the aquifer is better regulated. Irrigation equipment has been improved to conserve more water. For example, early irrigation equipment consisted mainly of overhead sprinklers where as much as 50%-60% of the water was lost to evaporation before it reached the ground, particularly on a hot, windy day. In 1996, less than half of the irrigation was done utilizing this method. More efficient irrigation technologies, such as low pressure nuzzles, drop tubes on pivots, and direct ground irrigations are being applied. Starting in the 1990's, improved farm management practices such as controlled irrigation scheduling, reuse of irrigation return flow, conversion to crop varieties with less water consumption, and regulation of ground water withdrawals has brought a reduction in the total amount of water being removed.

Even with these water saving applications, the Kansas Geological Survey estimates the heaviest water users in western Kansas would need to reduce their water withdraws by 50%-75% to keep the water level of the aquifer constant. Utilizing water from the Ogallala Aquifer has been the backbone of western Kansas' economy for close to fifty years. It just can't be turned off and have everything remain the same. The investments in water withdrawal systems are too great, the beef industry depends on the crops provided by the irrigated lands, and the water based economic wealth of western Kansas would decline between 45%-80% without irrigation.

The state of Kansas is developing plans to address the aquifer's disappearing water, but it could cost five billion dollars to implement and would require major lifestyle changes in western Kansans. Is the price to steep to pay? Could it be implemented under present Kansas water right laws? Tough questions in difficult times. People and various government agencies are very concerned about the consequences which will occur if something isn't done soon.

The Western Kansas Irrigation Research Project, a diverted group of private citizens, government agencies and industry stakeholders is one such group providing technical assistance, leadership, research, and education endeavors to reduce the rate of aquifer depletion. Their short-term goals are: 1) to maximize the economic benefits of each unit of groundwater presently being utilized; and 2) increase irrigation application efficiencies. Their long term goal is to reduce the rate of water utilization and prolong the life of the Ogallala Aquifer without loss of agricultural production. Their task, and that of any other concerned group(s), will not be an easy one to achieve, but do we have any other alternative?

DID YOU KNOW: WATER FACTS

A dairy cow must drink three gallons of water to produce one gallon of milk.

You are made up mostly of water - the average body is 70-73% water with the brain and eye having the highest water content of any organ.

Water is found naturally in three states - liquid, solid, and gas.

Water is a non-renewable resource.

Most water pollution is non-point pollution - a pollutant which can't be traced to a single source.

It takes 1,400 gallons of water to make your favorite hamburger, fries, and soft drink.

There are over 58,900 community water systems across the country producing over 34,000,000,000 gallons of drinking water each day.

A typical household uses about 300 gallons of water daily.

US Army Corps of Engineers

FEDERAL RESERVOIRS IN KANSAS

* indicates lakes under the Bureau of Reclamation. Year indicates when lake filled.

Kanopolis	1948		
Fall River	1949	Elk City	1966
Cedar Bluff*	1951	Keith Sebelius*	1967
Webster*	1957	Milford	1967
Kirwin*	1957	Perry	1970
Lovewell*	1958	Waconda (Glen Elder)*	1973
Toronto	1960	Melvern	1975
Tuttle Creek	1963	Clinton	1977
John Redmond	1964	Marion	1980
Council Grove	1964	Big Hill	1981
Cheney*	1964	El Dorado	1981
Wilson	1964	Hillsdale	1985

MONITORING THE WATER IN KANSAS IS A GROUP EFFORT. THERE ARE MANY AGENCIES AND GROUPS INVOLVED. ALL PROVIDE EXCELLENT SOURCES OF INFORMATION.

One of the best resources is the United States Geological Survey.The Kansas office is located in Lawrence and their web site is ks.water.usgs.gov

"The U.S. Geological Survey (USGS) is the Nation's largest earth-sciences agency and has the principal responsibility within the Federal government for providing hydrologic information and for appraising the Nation's water resources. The USGS collects streamflow, groundwater level, water quality, and water-use data at numerous locations throughout Kansas."

This hydrologic data is used in research and hydrologic studies to describe the quantity, and location of the State's water resources. It is also used to provide flood warnings and forecasts; operate reservoirs; design bridges, dams, levees, and floodways; develop and protect water-supply sources; evaluate the effects of various actions on water quantity and quality; provide information for water-rights and many other uses.

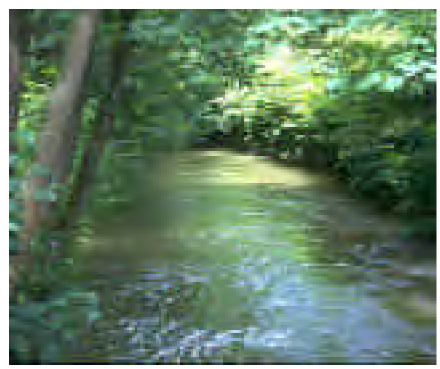
The collection, analysis, and interpretation of this data is done in cooperation with other Federal, State, and local agencies, universities, and research centers. The USGS works with more than 20 local, State, and Federal government COOPERATORS to collect and interpret water-resources information in Kansas. More information regarding USGS programs in Kansas can be found in: "USGS Programs in Kansas" on their web page. The data can change daily so it is not listed here. Excellent maps and data can be viewed on the site.

Kansas Department of Health and Environment is also very involved in water usage in Kansas.

"KDHE's mission is to optimize the promotion and protection of the health of Kansans through preservation, protection, and remediation of natural resources of the environment."

They can be contacted at:

Kansas Department of Health and Environment
Clyde D. Graeber, Secretary
Capitol Tower Building
400 SW 8th, Suite 200
Topeka, KS 66603-3930
Phone: 785-296-0461
Fax: 785-368-6368
web site: www.kdhe.ks.us



The Kansas Water Office works to acheive proactive solutions for resource issues of the state and to ensure good quality water to meet the needs of the people and the environment of Kansas. The Office evaluates and develops public policies, coordinating the water resource operations of agencies at all levels of government. For more information concerning the mentioned programs within On TRACKS and other programs related to water use in Kansas contact:

The Kansas Water Office
901 South Kansas Avenue
Topeka, KS 66612-1249
toll free 1-888-KAN-WATER
direct 785-296-3185
TTY785-296-6604
fax 785-296-0878
web site http://www.kwo.org

Aquatic Resources

Reference Center Catalog: Check out the "Aquatics" section of the reference center catalog. There are numerous resources which would expand and enrich the water topics in this newsletter. Here are a few:

Aquatics

12-3.1 WOW! The Wonder of Wetlands

14-24 How Safe is Your Water?

14-17 Field Manual for Water Quality Monitoring

CD-25 Eco-adventure in the Oceans

CD-29 Water Pollution

CD-12 Clean Water Detective

GK-9 The Dead River

VLK-7 What's It Like Where You Live- Ponds and Lakes

VLK-8 What's It Like Where You Live- River and Streams

VT-297 The Wetland and Riparian Areas of Kansas

VT-199 It's Found Underground: Ground Water

VT-1823-2-1- CONTACT- Down The Drain

VT-139 Save Our Streams

PP-77 America's Pearly Mussels

PP-132 TheWater Cycle

Nature's Notebook has a short section on "Water" (pp B-1 to B-6) which illustrates the major river systems and annual rainfall in Kansas. It also has an activity to match water related words to their definitions and a section dealing with the importance of wetlands for wildlife and people.

Don't over look the excellent activities in **Project WILD,** such as "I'm Thirsty", "Pond Succession", "Riparian Zone", "Water's Going On?" Also consider the activities in **Project Aquatic** :"Aqua Words", "Deadly Waters", "How Wet is our Plant", "To Dam or Not to Dam", "Watershed", and "Where Does Water Run Off After School?" And, of course, look at the activities in **Project Learning Tree** : "Every Drop Counts", "Field, Forest, and Streams", "Pollution Search", "Renewable or Not", "Watch On Wetlands", and "Water Wonders."

Here are just a few of the many activities in **Project WET:** "A-maze-ing Water", "Aqua Notes", "Back to the Future", "Color Me a Watershed", "Get the Ground Water Picture", "The Incredible Journey", "Money Down the Drain", "Thirsty Plants", "Water Court", and "Whose Problem Is It?"

Use the above resources and let your imagination go wild.