Unit 8) Ponds & Lakes

It is hard to imagine the Kansas landscape without any ponds or lakes, even though almost all of these bodies of water are the result of human efforts. In Kansas, lakes and ponds have been built to meet a variety of human needs, including the needs for drinking water, water to irrigate agricultural crops, and water for recreational activities, as well as to reduce flood damages and the impact on human lives due to flooding. At the same time, ponds and lakes provide wildlife habitat and enhance the natural environment.

There is a story behind each pond or lake in Kansas–why it was built, who built it, and when it was built. Those stories bring understanding to the history of the state, and assist in addressing present concerns and planning for future needs.

Building Dam for Erosion Control Franklin County, 1936

Source: Library of Congress; Arthur Rothstein, photographer

"A lake is the landscape's most beautiful and expressive feature. It is earth's eye; looking into which the beholder measures the depth of his own nature."

Henry David Thoreau, American author and naturalist

Ponds, lakes, and reservoirs play an important role in the ecology of Kansas. They serve as wildlife habitat, municipal water supplies, recreational areas, and are used for irrigation, power generation, and flood control. From the smallest farm ponds to the largest reservoirs, these bodies of standing water vary in size, purpose, history, and their role in the environment. Bodies of water, no matter what the size, can have a significant impact on the homes, communities, and natural areas that surround them.

Kansas by the Numbers

Lakes	40 state fishing lakes more than 200 community lakes
Reservoirs	24 federal reservoirs 2 built for power generation
Ponds	over 150,000 (privately owned)

Defining Characteristics

What is the difference between a pond, a lake, and a reservoir? There are many definitions of each body of water, from scientific and geologic definitions to cultural and societal definitions. What one person may call a lake may fit the technical definition of a pond. While there is no clear-cut way to identify beyond debate what the difference is, there are some general guiding factors.

First, a lake is larger and deeper than a pond. Lakes are usually over ten acres in size, while ponds are smaller than ten acres. Lakes are too deep for plants to grow to the surface except around the shore, while ponds are shallow enough to allow sunlight to reach the bottom so rooted plants may grow even in the deepest sections. There are also differences in water temperatures between lakes and ponds. Ponds generally have a uniform water temperature from top to bottom that may change with the air temperature. Lakes, on the other hand, have more stable water temperatures but develop distinct layers with different water temperatures. In addition, ponds experience very little wave action while lakes have enough surface water exposed to the wind to develop waves.

Comparing Characteristics

Ponds
- usually smaller than 10 acres in size
- shallow enough that plants may root in the bottom
- uniform temperature that changes with air temperature
- little or no wave action

Lakes
- usually over 10 acres in size
- deeper than a pond
- too deep for plants to grow to the surface, except around the shore
- stable temperature (does not change with air temperature)
- distinct layers with different water temperatures
- develop waves

Reservoirs
- usually formed by building a dam on a river or stream
- built for collection and storage of water for multiple purposes
- generally refers to large lakes built by the U.S. Bureau of Reclamation or the U.S. Army Corps of Engineers

A reservoir is a man-made body of water, typically formed by building a dam on a river or stream and used for the collection and storage of water. By definition, then, a small man-made farm pond can be called a reservoir, but generally the term "reservoir" is used to describe the large lakes built for multiple purposes: flood control, drinking water, irrigation, and recreational activities. The actual names attached to most of these large lakes were a result of legislation passed by the U.S. Congress.

Lakes, Ponds and Reservoirs

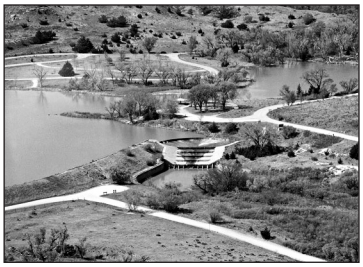
"Earth and sky, woods and fields, lakes and rivers, the mountain and the sea, are excellent schoolmasters, and teach some of us more than we can ever learn from books."

John Lubbock, British statesman

Lakes

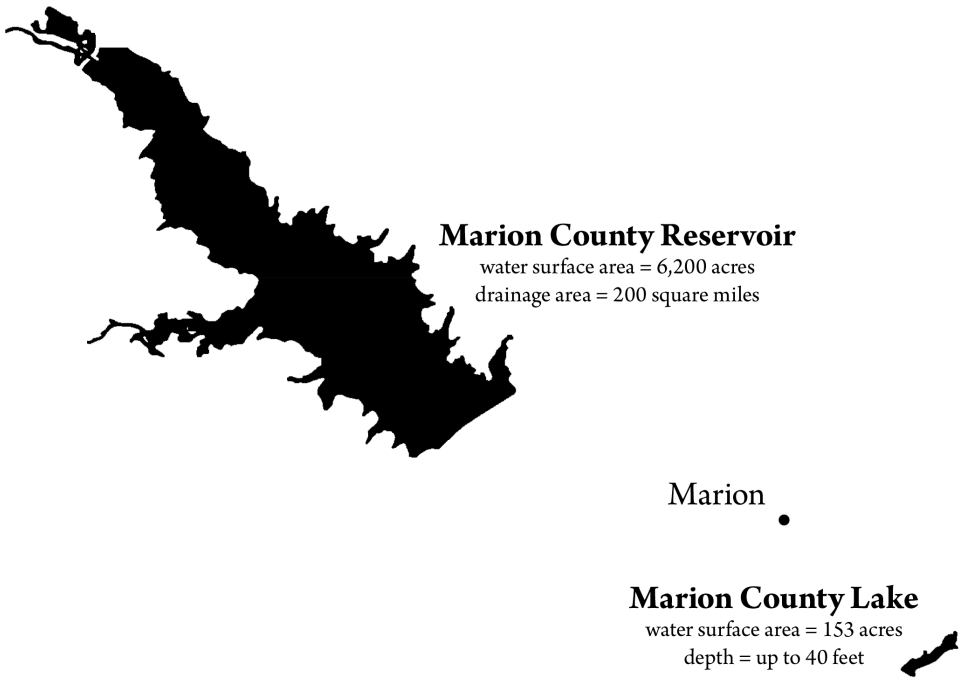
Kansas has hundreds of public and private lakes within its borders, including 26 large reservoirs, 40 state fishing lakes, and more than 200 community lakes owned by local governments. Another way to define a lake, based on the cultural definition of a lake, is that lakes generally have names. In Kansas, other than the large lakes referred to as reservoirs, the primary purpose of lakes is for flood control, recreational activities such as boating and fishing, and wildlife habitat.

In Kansas, lakes are generally filled by surface runoff. Therefore, lake size is directly related to both the size of the watershed and regional precipitation. The watershed is the area of land that water flows across or under on its way to a stream, river, lake, or pond. A lake's watershed consists of all the land that drains to that particular lake. There are more lakes in southeastern Kansas because of the greater precipitation and surface runoff in this region. With more lakes, each lake has a smaller watershed area. In western Kansas, on the other hand, there are fewer lakes so each lake tends to have a larger watershed area, which somewhat compensates for the smaller amount of precipitation.



Scott State Fishing Lake
Credit: Barbara A. Shelton, KGS

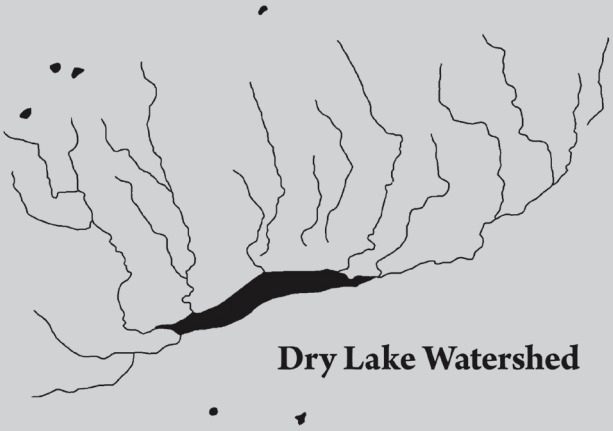
Size Comparison – Marion Reservoir and Marion County Lake



Source: USFWS, Wetlands Mapper

Dry Lake

Dry Lake, a privately owned lake in southeastern Scott County, is dry most of the time. When the lake is full, water covers about 200 acres.



Source: USFWS, Wetlands Mapper

Ponds

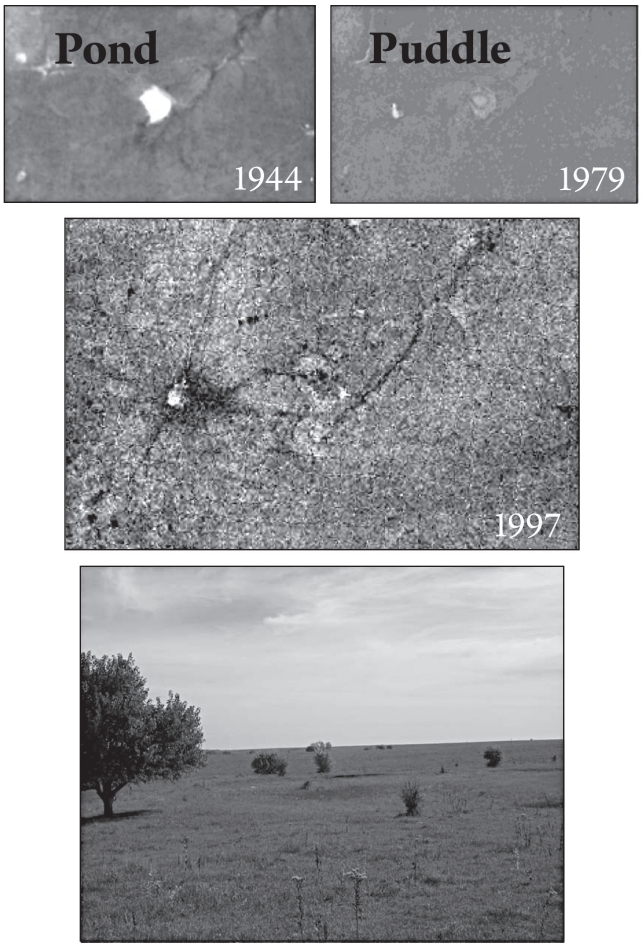
Many bodies of water referred to as lakes are actually ponds. Ponds cover less than 10 acres and are not as deep as lakes. Rooted plants may grow across many shallow ponds. The shallower depths of most ponds also means that seasonal changes affect ponds much more than deeper bodies of water like lakes and reservoirs. A pond may dry up during dry weather and can freeze over (or freeze solid) in the winter.

There are many kinds of ponds. They can be natural depressions or created by humans to hold water for agricultural or other purposes. Farmers build ponds to control flooding, to supply water for livestock and wildlife, and to supply water for irrigation. Some animals, like beavers, even build dams to form ponds. According to the Kansas Department of Wildlife and Parks, there are over 150,000 privately owned farm ponds in the state of Kansas.

One of the unique characteristics of a pond is its temporary nature if it is not maintained to hold water. Left untouched, a pond can slowly change over time, going through several stages in a process called succession. In the first stage, the young stage, a pond has open water with a clear bottom. Small plants begin to grow on the bottom and line the shore. In stage two, small animals such as fish, snails, and dragonflies discover enough food to live in the pond. Plants become abundant and emergent plants grow out further into the pond. The pond starts to fill in with organic debris as plants and animals die and sink to the bottom. A pond reaches stage three when the emergent vegetation grows all the way across the pond's surface. It becomes a marsh (wetland) at this point. In stage four, dead and decaying material completely fills in the pond so that it now becomes either a grassy prairie or a forest. At this stage, the pond has completed its cycle of succession, a process that may take hundred of years.

Credit: Richard Sleezer

Pond Succession



Credit: Richard Sleezer

Reservoirs

According to the technical definition of a reservoir—a man-made body of water that stores water for future use—most lakes and ponds in Kansas could be called reservoirs. However, when most people refer to the reservoirs in Kansas, they mean one of the 26 large lakes created by dams built on major rivers and streams. Most of these reservoirs were built in the 1960s for flood control, water supplies for cities and rural areas, irrigation, and recreational activities. The reservoirs range in size from 1,200 to 16,000 surface acres. In Kansas, two federal agencies, the U.S. Army Corps of Engineers and the U.S. Bureau of Reclamation, control the water resources of the federal reservoirs. The land resources of the federal reservoirs are usually managed in cooperation with state and local organizations. Over 90 percent of the state parks and wildlife management areas operated by the Kansas Department of Wildlife and Parks are managed in conjunction with the federal reservoirs. Coffey County Lake and

Wilson Lake Dam
Source: U.S.Army Corps of Engineers

Kanopolis Lake, 1960s
Credit: Edward A. Almquist

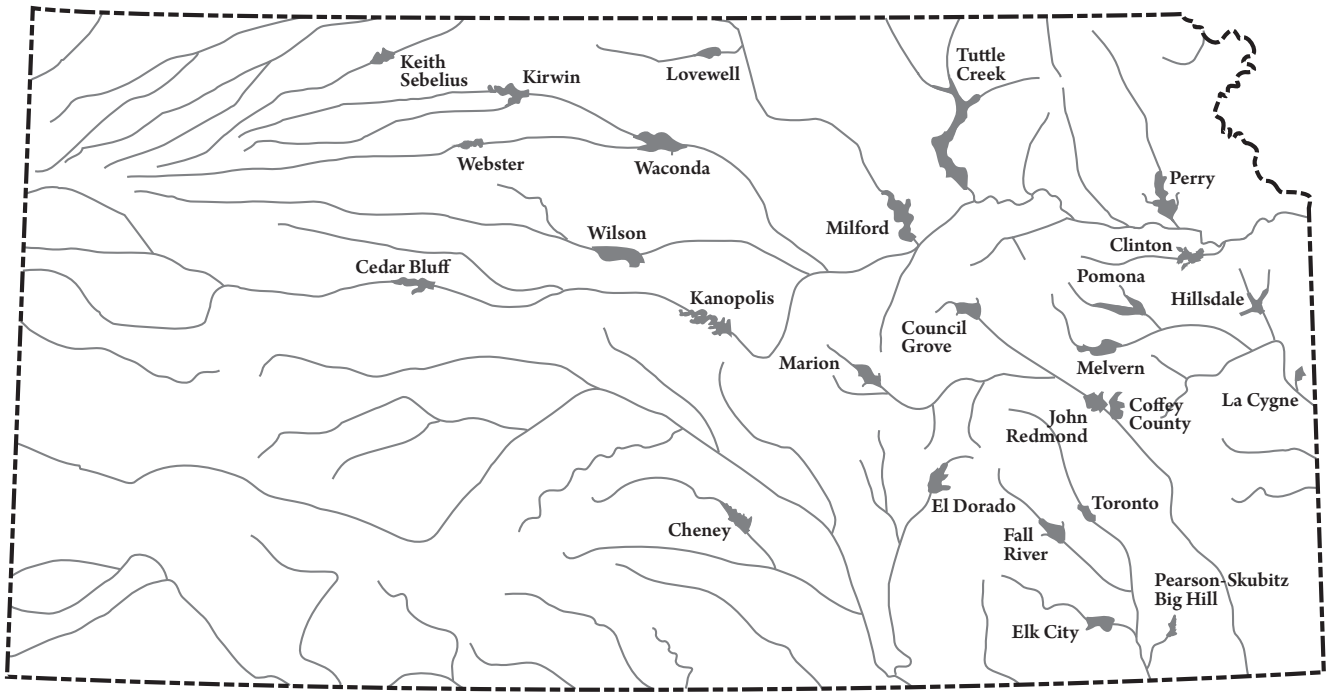
La Cygne Reservoir, two of the large lakes usually identified as Kansas reservoirs, were built to provide cooling water for power generation plants and are not federal reservoirs.

Building Reservoirs

Most of the reservoirs in Kansas are only about 50 years old. The creation of these large lakes changed the natural and human landscape of Kansas in significant ways. Thousands of acres of land, most of which was used for agricultural purposes, was replaced with standing water, thus removing habitat for land-dwelling animals and adding habitat for birds, fish, and other aquatic life. The river valleys below the reservoirs were protected from floods like those of 1951, which destroyed public and private property and caused millions of dollars in damages in Kansas.

There were human costs for the changes to the natural landscape of Kansas made by the development of the reservoirs. Many of the dams and reservoirs built in Kansas were controversial, pitting the need for flood protection of downstream cities and property owners against the rights of area landowners and the costs to small towns and close-knit communities. After all, the lakes displaced land inhabited by more than just wildlife. Thousands of people were forced to relocate their homes. Entire towns, such as Alida and Broughton, disappeared under lake waters. In other places, part or all of entire towns moved to higher ground. Railroads, highways, electric lines, cemeteries, churches, schools, and businesses were relocated. Families who had farmed the same land for generations lost their homes and their land. Though not everyone agrees that the dams–and, thus, the reservoirs–were the best solution for flood control, most people acknowledge the positive impacts of these man-made bodies of water. Engineers report that the savings from reduced flooding over the past 50 years exceed the costs of building and developing the dams and reservoirs. In addition, many of the communities near the reservoirs

Kansas Reservoirs



Source: KGS

Kansas Reservoirs

U.S. Bureau of Reclamation
- Cedar Bluff Reservoir
- Cheney Reservoir
- Keith Sebelius Reservoir
- Kirwin Reservoir
- Lovewell Reservoir
- Waconda Reservoir
- Webster Reservoir

U.S. Army Corps of Engineers – Kansas City District
- Clinton Lake
- Hillsdale Lake
- Kanopolis Lake
- Melvern Lake
- Milford Lake
- Perry Lake
- Pomona Lake
- Tuttle Creek Lake
- Wilson Lake

U.S. Army Corps of Engineers – Tulsa District
- Council Grove Lake
- El Dorado Lake
- Elk City Lake
- Fall River Lake
- John Redmond Reservoir
- Marion Reservoir
- Pearson-Skubitz Big Hill Lake
- Toronto Lake

Kansas City Power & Light Company and Kansas Gas & Electric
- Coffey County Lake
- La Cygne Reservoir

have benefited by having additional sources of water and from the recreational activities that take place on the public lands surrounding the reservoirs.

Pond and Lake Ecosystems

"Birds have wings; they're free;
they can fly where they want when they want.
They have the kind of mobility many people envy."
Roger Tory Peterson, American naturalist and ornithologist

Limnology is the study of inland waters, such as ponds, lakes, and streams. It deals with the ways plants and animals in inland waters interact with their environment and all the environmental factors that influence those ecosystems.

Limnology–the scientific study of lakes and other bodies of fresh water.

Vegetation

Pond Ecosystem
Credit: Tom Kelley, USFWS

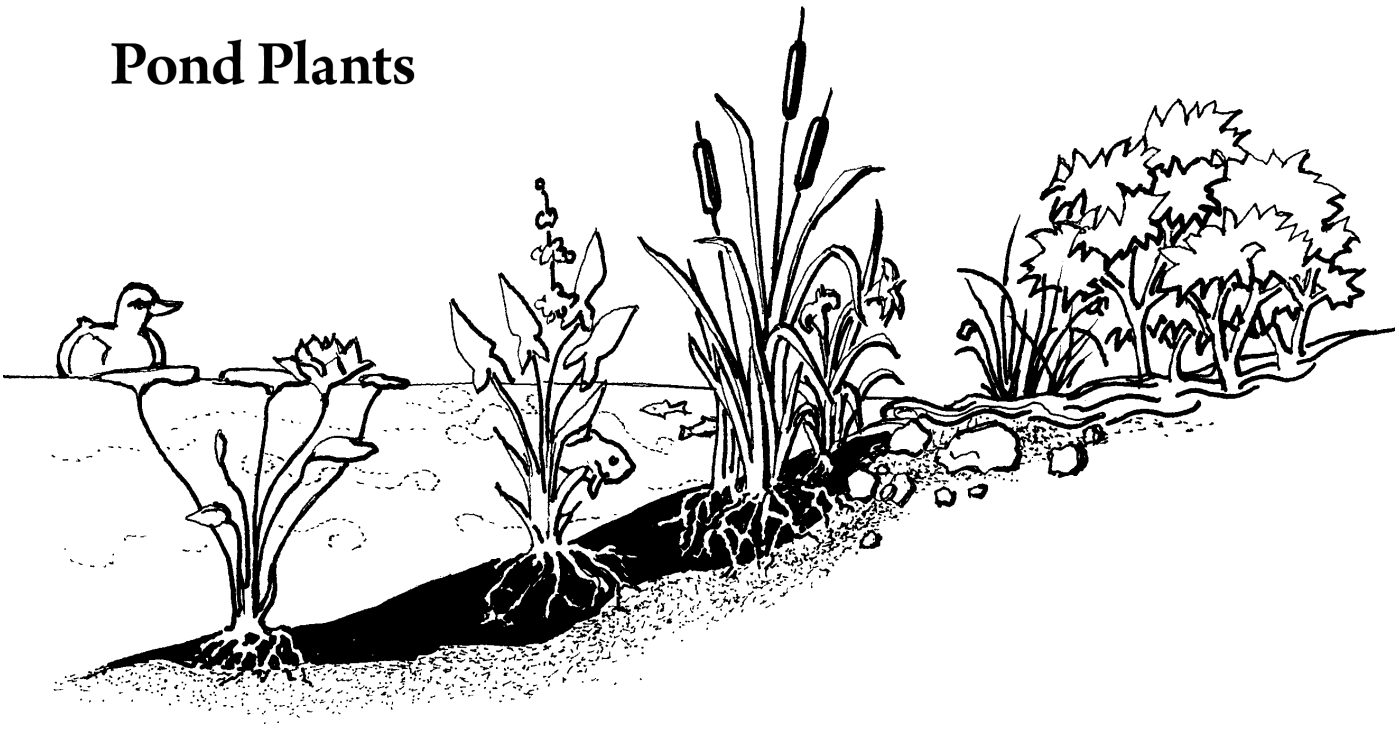
Aquatic plants are beneficial to ponds and lakes and provide the basic foundation for all life on the water. They offer shelter for fish, birds, frogs, and other animals, as well as places for insects to live. Algae, worms, insects, snails, and small fish living among aquatic plants become food sources. Plants produce oxygen and filter runoff by absorbing nutrients, such as nitrogen and phosphorus. The many different species of plants that live in ponds and lakes can be divided into four classes: emergent, submerged, floating-leaf or free-floating, and algae. Emergent plants are rooted in soil that is underwater most of the time. These plants grow up through the water, so that stems, leaves, and flowers emerge in the air above the water level. Emergent plants, such as cattails and bulrush, provide cover for fish, nesting places for birds and other animals, and protect the shorelines by stabilizing sediments. Submerged plants are largely underwater plants with only a few floating or visible leaves. These include pondweeds, elodea, watermilfoil, and coontail. Floating-leaf and free-floating plants may or may not be rooted in the bottom of the lake or pond. They have leaves, and often flowers, that float on the surface of the water while most of the plant remains underwater. The most common floating-leaf plant is the water lily. Duckweeds and lotus are also floating-leaf plants. The fourth class of plant life is algae. Algae are the smallest and most important food producers in the aquatic environment, forming the base of the food web in a pond or lake. During photosynthesis, algae release

American Lotus
Credit: Cindy Baldwin

Thermal Stratification

Due to the heat-absorbing properties of water, the lakes and reservoirs in Kansas and other Midwestern states can form distinct temperature zones–strata–from the surface down to the sediment at the bottom of the lake. The heat comes from direct sunlight on the water. The degree of thermal stratification (number of distinct parallel layers) within a lake or reservoir will vary based on the amount of sunlight available, the level of water mixing due to wind and wave action, and the speed of water flowing through the lake. Strong differences in water temperature at various depths will occur when lakes and reservoirs are subject to intense solar heating in the spring and there is little or no mixing of water due to wind, wave action, or runoff. Strata with large differences in temperature will not mix easily. Once a warm layer forms in a standing body of water in the spring or summer, it will not mix with a lower, cooler layer until fall, when water temperatures in the upper layers drop. In a strongly stratified lake or reservoir, this may mean that the bottom layers of water will be cut off from any sources of oxygen. With no access to new sources of oxygen, oxygen in the lower layers of a lake is rapidly depleted through decomposition of organic matter at the bottom of the lake or reservoir. Fish and other aquatic life are limited to the strata where there is adequate oxygen for their survival. In the fall, when the temperature of the upper layers drops to near the temperature of lower layers, the water layers are able to mix again. Often, this process is called the "turning over" of a lake, reservoir, or deep pond.

Pond Plants



Floating-leaf **Submerged** **Emergent**

Source: USDA NRCS

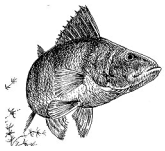
oxygen–increasing the amount of dissolved oxygen in the body of the water. Even though these plants are usually single-celled and microscopic, they can occur in such abundance that they change the color of the water and give it a distinctive odor. Algae contain chlorophyll and other pigments, giving "pond scum" (another name for algae) a distinctive appearance.

Excessive vegetation can become a problem in impounded waters like ponds, lakes, and reservoirs. Abundant vegetation can affect the fish population because small fish can hide in the vegetation, which can lead to the overpopulation of certain species. Too much vegetation can also interfere with fishing, swimming, and boating. Dead and decaying vegetation can produce offensive odors. A more serious problem results from the oxygen deficiency caused by decaying vegetation. This can occur at almost any time of year but is most common in mid-summer or in mid-winter. Summer problems occur after periods of hot, calm, cloudy weather. During these times, photosynthesis is greatly reduced, often resulting in aquatic plants dying and decomposing. Winter problems occur when a lake or pond freezes over and a layer of snow covers the ice, blocking out sunlight and preventing the production of oxygen through photosynthesis.

Algae
Credit: Mary Anne Stoskopf

Types of Aquatic Plants
Algae– smallest aquatic plants; usually single-celled and microscopic.
Emergent– rooted in soil that is underwater most of the time; plant parts such as leaves, flowers, and stems grow above water.
Floating-leaf or free-floating–may or may not be rooted in soil; most of the plant is underwater with only floating leaves or flowers visible on the surface of the water.
Submerged–underwater plants rooted in soil with only a few floating or visible leaves.

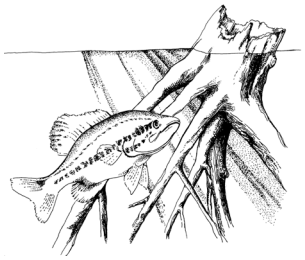
Fish



Walleye
Credit: Bob Savannah, USFWS

Kansas ponds and lakes provide habit for many vertebrates, including fish. There are 135 species of fish in Kansas, including largemouth and smallmouth bass, crappie, channel and flathead catfish, white and striped bass, bluegill, Kentucky (spotted) bass, rainbow trout, and walleye. Fishing is a popular sport across the state and brings revenue to many communities near favorite fishing spots. To keep up with the demand, four state fish hatcheries produce millions of fish each year to stock private and public lakes and ponds. The pond facilities of the Kansas Department of Wildlife and Parks are among the largest in the United States. This agency developed the methods used in producing channel catfish, which now lead all other species in commercial aquaculture in the United States. Several other species of fish are also raised in private commercial fish farms in Kansas.

All fish need food, water, shelter, and a spawning area. In a pond or lake's food web, the green plants manufacture food for plant-eating animals (herbivores). These small animals are eaten by small carnivores (flesh-eating animals), such as smaller fish and dragonflies. Medium-sized fish eat the smallest carnivores and then are consumed by larger fish. Shelter is provided for fish by structures in the water. Old wood and trees located in the water may shelter fish or provide spawning areas. Each species of fish has different requirements for spawning areas and materials. The spawning areas are essential for fish reproduction.



Source: USDA NRCS

Birds

Many of the 468 bird species found in Kansas can be seen around lakes and ponds. Kansas is in the Central Flyway of the North American continent. Many migratory birds visit Kansas during the spring and fall migrations. In the spring, there is usually an abundance of water in small ponds and lakes, providing food and resting areas for migrating species. Following a hot, dry Kansas summer, many of those bodies of water may be low on water in the fall so many bird species stop at the larger lakes and reservoirs during the fall migration. Long-legged wading birds, such as herons, sandpipers, killdeer, and other shorebirds, feed on small aquatic animals, frogs, and fish in shallow areas and along the shorelines. Waterfowl (ducks and geese) feed on aquatic plants, insects, and crustaceans, swim on ponds and lakes, and build nests nearby. Hawks and owls hunt near ponds and lakes while other raptors, such as eagles, dive for fish in lake waters and build nests in trees near or over the water. Songbirds, blackbirds, swallows, and other bird species come to ponds and lakes to drink or hunt insects, such as mosquitoes.

Great Blue Heron
Credit: Jonas N. Jordan, U.S. Army Corps of Engineers

Western Grebe
Credit: Tim McCabe, USDA

Swainson's Hawk
Credit: Paul Kerris, USFWS

Swallow
Credit: Wayne Stoskopf

Other Animals

Lakes and ponds provide habitat for many different animals, large and small. Reptiles and amphibians, such as turtles, snakes, frogs, and salamanders, are common in aquatic environments. Amphibians live mainly in water or damp places and usually lay their eggs in water. The typical life cycle of an amphibian includes a stage in which the larvae or tadpoles live exclusively in the water. Reptiles, such as snakes and turtles, find protection from weather extremes in aquatic environments, including ponds and lakes. Aquatic environments provide both water and food for mammals. Common mammals found near Kansas ponds and lakes include deer, coyotes, raccoons, beavers, and muskrats. Private lakes and ponds also provide critical water supplies for domestic animals, such as cattle and horses.

Snapping Turtle
Credit: Bob Savannah, USFWS

Wildlife populations are dependent upon the quality of their habitat. The carrying capacity of an area is defined as the greatest number of organisms that can be supported by the area without damaging that area. Some habitats have a higher carrying capacity than others because of a more abundant food supply, more space, greater accessibility to water, or a more diverse vegetative growth suitable for shelter or protection. Wildlife species are interdependent with one another as well as with their environment. If one species is removed, the balance of the ecosystem is disturbed. All plants and animals living in an area derive their energy and nourishment from the soil, the air, the water, and the sun. Lakes and ponds provide unique habitats for wildlife. Many organisms and animals have adapted to the continually changing aquatic environments provided by lakes and ponds and to the broad changes in temperature that may occur in such waters.

Coyote
Credit: Bob Savannah, USFWS

Watershed Management

"In nature there are neither rewards nor punishments; there are consequences."

Robert Green Ingersoll, American orator

All of the animals and plants which live near the ponds, lakes, and reservoirs of Kansas are dependent upon the quality of the land and the water, and they all affect the quality of the land and the water as well. People who live, work, and play in the watershed heavily impact the quality of the environment. Water runoff flows downhill to the lowest point, which usually means it ends up in a stream, lake, or pond. Pollution resulting from natural and human activity finds its way into the water resources of that region, threatening the quality of the habitat for all living creatures.

Management of the area within the watershed of a lake can provide water protection for the entire life of a pond or lake. Any activity that reduces the amounts of sediment, nutrients, or other potential pollutants carried by surface runoff into a body of water protects the water quality of that pond or lake. Many people are working to protect water quality in the state of Kansas, including agencies such as the State Conservation Commission (SCC). The SCC works with 85 watershed districts within the state to administer programs that improve water quality, reduce soil erosion, conserve water, and reduce flood potential.

Agricultural Practices

Farmers and ranchers work to protect the water downstream from agricultural areas in many ways. They use soil and water conservation practices designed to reduce soil erosion and the loss of nutrients from cropland. Some conservation practices are designed to reduce surface water runoff, which may reduce the amount of water available to fill ponds and lakes. Farmers and ranchers also maintain ponds and dams by planting grasses around the areas to trap sediment and nutrients, filtering the water and delaying the succession process.

During dry periods, sediment that has accumulated in shallow ponds may be removed to prepare critical livestock watering ponds to hold water when the rains do come. Dams are inspected and repaired when necessary to extend the life of the ponds.

No-till Corn
Credit: Gene Alexander, USDA

The Impact of Development

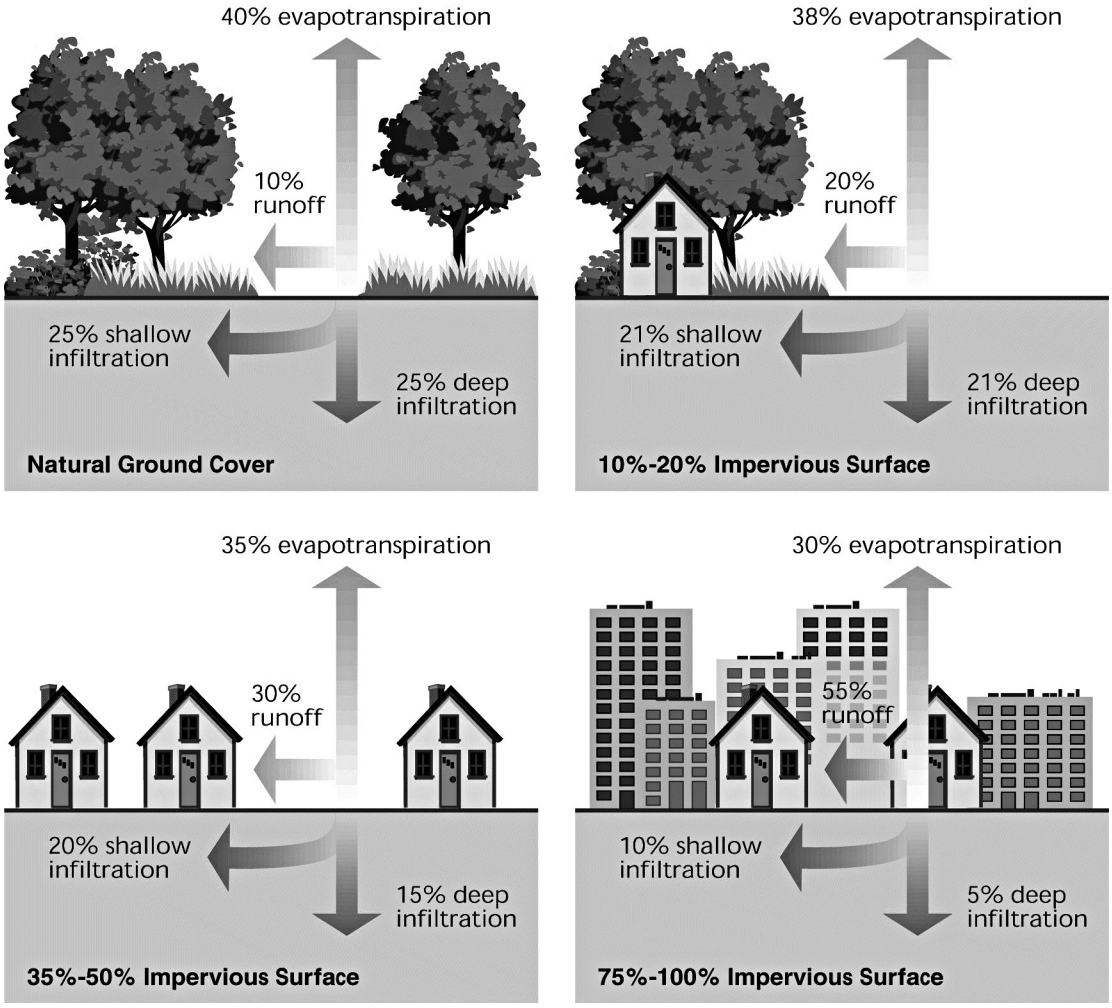
The areas around lakes and reservoirs are popular sites for homes and businesses. However, development near lakes can be detrimental to the lakes for a variety of reasons. During the construction phase of development, soil erosion can cause sediment and nutrient levels to rise when there is runoff. Once an area is developed, the increase in impervious surfaces (paved or hard-packed gravel areas) also increases the amount of surface runoff. In addition, the activities occurring around houses, shops, and parking areas in developed areas can result in pollution of lake waters. Potential pollutants from urban and developed regions include nutrients from septic systems that are not working properly and lawn and garden fertilizers; metals, oils, and other chemicals from machinery and cars; pesticides from lawns and gardens; and salt used to clear roads and parking areas during the winter. These sources of pollution are referred to as nonpoint source pollution, because they originate from various sources over a wide land area and enter bodies of water through surface water runoff. Point sources of pollution can be traced back to discharges through specific pipes, channels, ditches, etc. Point sources of pollution include improperly treated municipal and industrial wastewater discharges. The point of discharge may be into a river or stream that flows into a lake or reservoir.

Multipurpose Water

"We make the world we live in and shape our own environment."
Orison Swett Marden, American writer

Even though most of them are man-made, the ponds, lakes, and reservoirs of Kansas are important natural resources. Farmers and ranchers use ponds to provide drinking water for their livestock or to irrigate their crops. Birds and animals depend on ponds and lakes for their food, water, and shelter. Communities rely upon reservoirs for drinking water, flood protection, and recreation. Through a commitment to conservation, the citizens of Kansas can ensure future generations enjoy these vital water resources.

Impact on Surface Water Runoff



Source: FISRWG

Endnotes

1. "2001 Environmental Quality Incentives," U.S. Department of Agriculture Natural Resources Conservation Service, <http://www.nrcs.usda.gov/programs/eqip/2001summaries/KSEQIP%20doc.pdf>.

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The Cheney Reservoir Watershed Project. 2006. U.S. Geological Survey Kansas Water Science Center. < http://ks.water.usgs.gov/Kansas/studies/qw/cheney/>.

Reid, George K. *Pond Life: A Guide to Common Plants and Animals of North American Ponds and Lakes*. New York: Western Publishing Co., 1967.

Sleezer, Richard, Ph.D., In Pursuit of Artificial Ponds, Puddles, and Transiently Damp Patches. Emporia State University. 2004. <http://www.kgs.ku.edu/Hydro/Ponds/products/InPursuit.pdf>

Teacher Resources

Books:

AR - *Accelerated Reading Level*

101 Facts about Lakes
Barnes, Julia. 2003 (AR - 5.5)

Animals of Rivers, Lakes, and Ponds
Donovan, Sandra. 2003 (AR - 4.6)

Butternut Hollow Pond
Heinz, Brian J. 2006 (AR - 3.9)

Dams
Oxlade, Chris. 2005 (AR - 6.9)

Food Chains in a Pond Habitat
Nadeau, Isaac. 2002 (AR - 4.9)

Journey into a Lake
Johnson, Rebecca L. 2004

Lakes: Timeless Reservoirs
Frahm, Randy. 2002 (AR - 6.4)

Life in a Freshwater Lake
Jackson, Kay. 2005 (AR - 5.8)

The Magic School Bus at the Waterworks
Cole, Joanna. 1999 (AR - 3.7)

Pond & River
Parker, Steve. 2005 (AR - 7.6)

Pond Seasons
Alderson, Sue Ann. 1997 (AR - 4.4)

Pond Watching with Ann Morgan
Ross, Michael Elsohn. 2000 (AR - 7.5)

Rivers, Lakes, Streams, and Ponds
Beatty, Richard. 2003 (AR - 8.7)

Career Profile:

Alice McClain

Owner, McClain Excavating

Alice McClain lives a big life.

And she has literally and figuratively cleared a path across Kansas, working as one of the few female heavy equipment operators.

A resident of Goff, McClain grew up on a farm with four sisters and no brothers. "I was the fourth girl out of five, so I learned early how to run the farm equipment," she says.

The skills she acquired on the family farm serve her well: McClain now owns and operates McClain Excavating, a business enterprise that she married into. Her workforce specializes in running heavy construction equipment–like bulldozers and track excavators–to do jobs like digging ponds, building terraces, and clearing trees.

As a business owner, there is more office time than if she were just running a track excavator, but everything contributes to knowing how best to improve the land. "I spend time on paperwork for payment to government offices and billing individuals. I learned on the job how to stake out waterways and terraces, how to tell grade."

McClain Excavating works closely with the Natural Resources Conservation Service on improvement projects, following their recommendations and guidelines. "Their projects are meant to help the land," she says. "I have learned through running the equipment and everything that goes with it how to help whatever field we are in."

There aren't many females driving heavy equipment, she admits, but stresses the importance of finding what you like to do when you choose a path–never mind what society defines as the norm. "Whatever a person ends up doing in their life for a career has to be something that you really enjoy," she says. "Myself, I gain a lot of personal satisfaction from doing a job well done, and I'm not sure I could do that if I didn't like what I do."

Courtesy: McClain Excavating

Career Profile:

Gary Keehn

Director, Banner Creek Reservoir

Credit: Roberta Spencer

In May 2007, Gary Keehn became the director of Banner Creek Reservoir, a lake constructed west of Holton in the mid-1990s. Keehn supervises daily operations of the lake and conducts field inspections to ensure compliance with county, state, and federal regulations and laws. He coordinates recreational activities, such as horseshoe, volleyball, and disc golf tournaments, along with recreation programs for cities, schools, and other organizations.

Before he became the director of the Jackson County lake, Keehn taught science at Jackson Heights High School north of Holton. Insects and reptiles filled his "living" science classroom. In addition to his unique indoor classroom, Keehn used hands-on teaching methods that made for memorable, lifelong lessons about the environment. While teaching, he designed and developed a 15-mile hiking and biking trail around Banner Creek Reservoir as well as four nature trails. Today, Keehn's classroom is outdoors at Banner Creek Reservoir and his students are campers, scout troops, and other lake visitors.

Keehn grew up in Soldier, Kansas, and graduated from Jackson Heights High School. He received his bachelor of science degree at Baker University, with an emphasis in wildlife management and environmental education. However, Keehn says, he didn't really think he would become a high school science teacher. "When I left Baker, I thought I was going to do research on my own and work for some state or federal agency," Keehn says. "Then I was offered a job by the YMCA Storer Camps in Michigan to teach environmental education and run two nature centers. My time there really made me realize how environmental and outdoor education can open the eyes of students and adults to their own lives."

While teaching, Keehn used field trips to streams, rivers, and ponds to teach students about those ecosystems. "I have been able to take what is normal to most people–the enjoyment of being outdoors–and have it become an empowering thing for students," Keehn says. "The knowledge of these outdoor habitats can empower them to have control of what happens around them in our natural waterways."

Prior to teaching at Jackson Heights, Keehn taught at Highland High School where he developed a wildlife management class that traveled throughout northeast Kansas counting fish and wildlife populations. Under his leadership, students participated in projects that included biological monitoring and water quality sampling of the Delaware River and sampling of the Missouri River for zebra mussels, listed as an aquatic nuisance species in the United States.

Keehn and his students won numerous awards. Twice, the Kansas Association of Conservation Districts named Keehn Teacher of the Year. He was named the 1995 Wildlife Conservationist of the Year by the Kansas and National Wildlife Federation. Keehn coached several Envirothon teams that competed well on the state level. (The Envirothon is an outdoors science quiz bowl competition for high school students.) In addition, many of Keehn's students took their science class activities and expanded those, winning FFA and 4-H awards.

It is obvious that Keehn loves the outdoors and passes on that passion. Keehn says that every student can have an effect on his or her surroundings. "They may not all think they are environmentalists, but they can have enough knowledge to keep them interested in protecting our natural areas in many other ways."

Teacher's Resources (continued)

Salamander Rain: A Lake & Pond Journal
Pratt-Serafini, Kristin. 2001

Song of the Water Boatman and Other Pond Poems
Sidman, Joyce. 2005 (AR - 5.0)

Web at Dragonfly Pond
Ellis, Brian Fox. 2006 (AR - 4.3)

What is a Fish?
Kalman, Bobbie. 1998 (AR - 4.9)

Websites:

Kansas Department of Wildlife & Parks
www.kdwp.state.ks.us
(Public waters in Kansas: Fishing>Where to Fish)

Ponds
Research website – Kansas Geological Survey
http://www.kgs.ku.edu/Hydro/Ponds/index.htm

U.S. Army Corps of Engineers
Kansas City District: ***www.nwk.usace.army.mil/***
Tulsa District: ***www.swt.usace.army.mil/***

U.S. Bureau of Reclamation – Great Plains Region
http://www.usbr.gov/gp/lakes_reservoirs/kansas_lakes.htm

Ponds and Lakes Showcase:

Cheney Reservoir

Cheney Reservoir is located in south-central Kansas within the north fork of the Ninnescah River valley. When it was constructed by the U.S. Bureau of Reclamation in the 1960s, the primary purpose of the reservoir was to provide a water supply for the city of Wichita. Today, Cheney Reservoir provides between 60 and 70 percent of the total municipal and residential water use in Wichita. Other uses of the reservoir complex include habitat for fish and wildlife, recreational uses, and flood control. The reservoir complex consists of over 9,500 acres of surface water, over 5,000 acres of wildlife area, and a state park with nearly 2,000 acres. Cheney State Park includes a marina and boat ramps, camping facilities, areas for fishing and hunting, and hiking trails. The Ninnescah Sailing Association sponsors regattas and races at Cheney Reservoir, which is nationally recognized as a sailing lake.

Credit: Lisa French, Cheney Lake Watershed, Inc.

water supply for the City of Wichita

In the early 1960s, with a population of around 250,000 people, it was becoming apparent that Wichita needed to supplement its main source of water, the Equus Beds aquifer. For more than 50 years, Wichita's primary source of supply had been groundwater pumped from the city's well field in the Equus Beds aquifer, a part of the regional High Plains aquifer. After pumping began in the well field on September 1, 1940, water levels and storage volumes in the aquifer began declining. By supplementing Wichita's public water supply with surface water from Cheney Reservoir, the longevity of the natural aquifer increased.

Wichita and area residents, now numbering over 350,000 in the city alone, want to ensure the longevity and quality of both the aquifer and the reservoir. The U.S. Geological Survey conducted studies monitoring Cheney Reservoir's water quality, particularly when Wichita residents noticed taste and odor problems. In 1994, the Citizens Management Committee and the City of Wichita instituted improvements in the Cheney Reservoir watershed, including incentive payments to farmers and landowners who implement and maintain specific management practices. These voluntary management practices include nutrient and pest management plans as well as waste utilization plans for animal and household waste systems. Actions to reduce the transportation of sediments into the reservoir include the installation of terraces and waterways, grass plantings, and implementation of no-till or reduced tillage cropping practices. These actions have resulted in reducing the sediments entering the reservoir by more than 20,000 tons per year and have prevented an estimated 98,000 tons of waste from entering the watershed annually. [1]

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