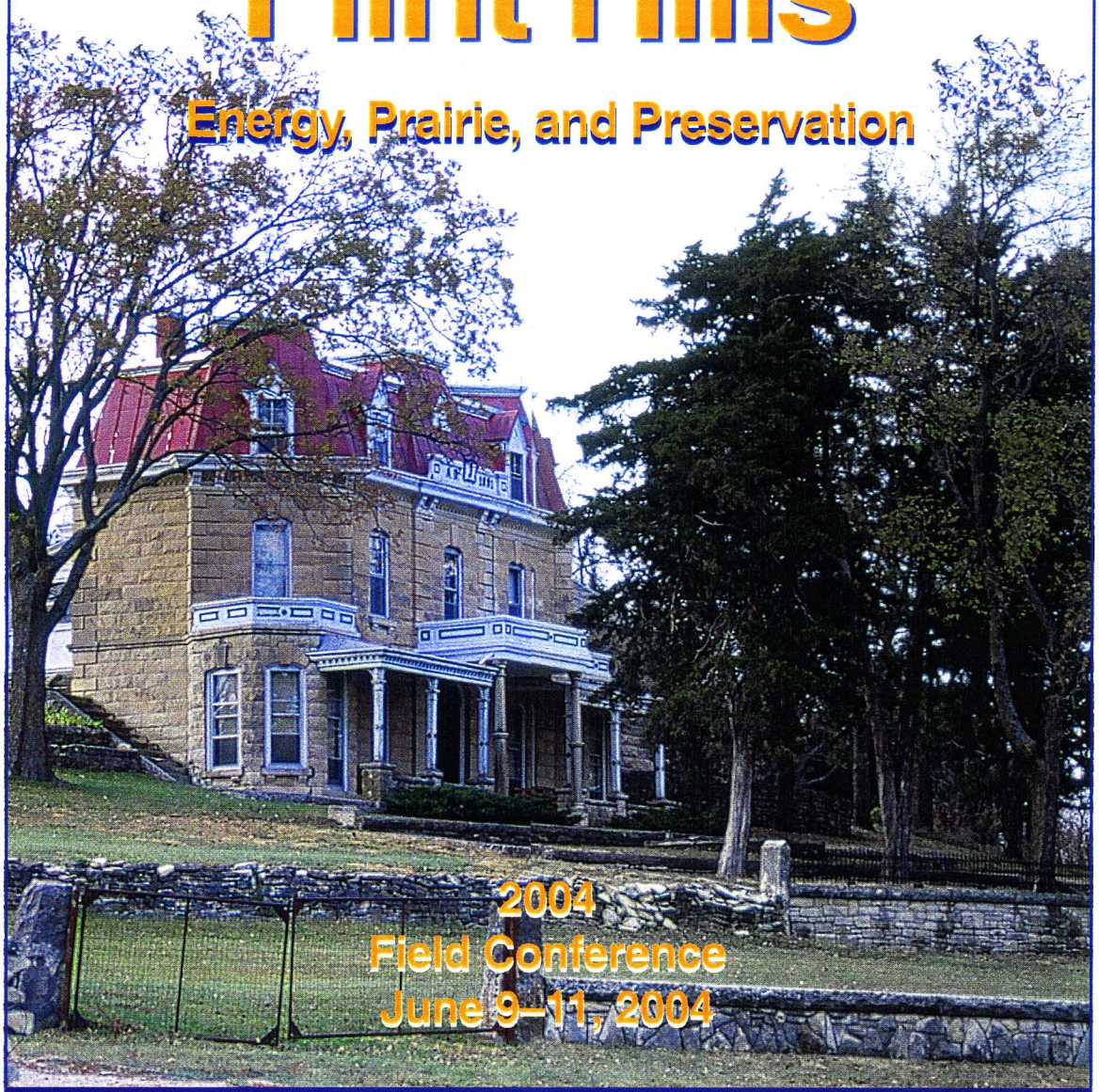
Kansas Field Conference

The Kansas Flint Hills

Energy, Prairie, and Preservation



2004
Field Conference
June 9–11, 2004

Sponsored by
Kansas Geological Survey
Kansas Biological Survey
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Kansas Department of Wildlife and Parks

KANSAS FIELD CONFERENCE

FIELD GUIDE

2004 FIELD CONFERENCE

The Kansas Flint Hills

Energy, Prairie, and Preservation

June 9-11, 2004

Edited by

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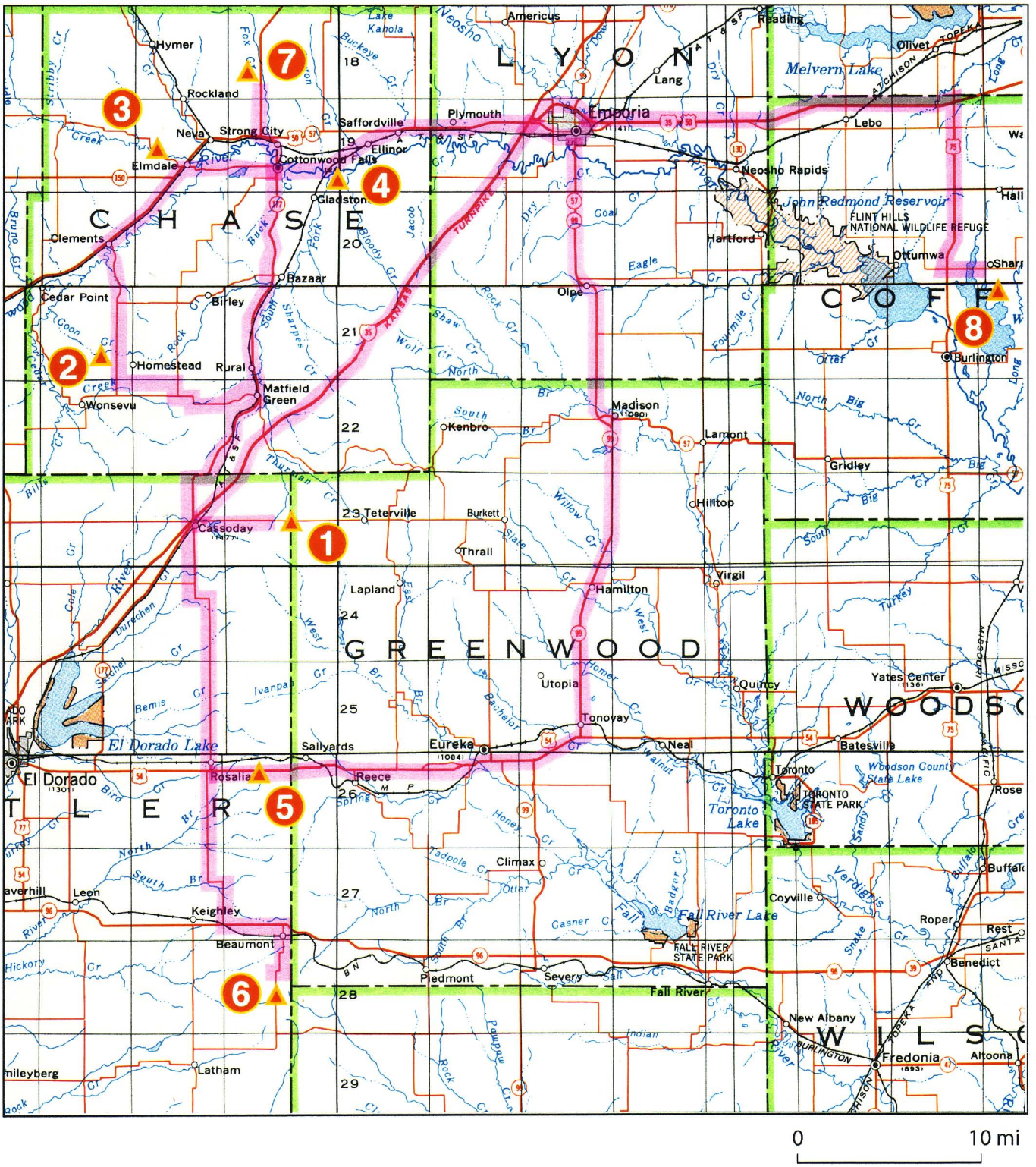
The Kansas Flint Hills

Energy, Prairie, and Preservation

2004 FIELD CONFERENCE



The Kansas Flint Hills
Energy, Prairie, and Preservation

2004 FIELD CONFERENCE
June 9–11, 2004

TABLE OF CONTENTS

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The Kansas Flint Hills

Energy, Prairie, and Preservation

2004 FIELD CONFERENCE

June 9–11, 2004

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Administer statewide forestry programs including Forest Stewardship, Forest Product Utilization & Marketing, Urban & Community Foresty, Rural Fire Protection, and Conservation Tree Planting
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Area Extension Forester, Kansas Forest Service (KFS), 1975–1987; Fire Control Specialist, KFS, 1987–1988; State Forester, KFS, 1988–present
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Education
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University of Kansas, 1958-1960
Colorado State University – BS, 1962

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Education
Fort Hays State University – BS, 1958
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Kansas Legislature, 7 years; Administrative Assistant to Kathleen Sebelius, 4 years; retail sales; special education paraprofessional, Topeka High School
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Education
Colorado School of Mines – Geol. Eng., 1949
Colorado School of Mines – Petrol. Geol., 1951
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Education
Highland Community College – AA, 1983
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Experience
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Education
University of Missouri – BS, 1957
Kansas State University – MS, 1968

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Experience
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Kansas Senate

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Current Responsibilities
Chairman, Natural Resources Committee; Member, Agriculture and Utilities Committee

Experience
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Education
Ottawa University - BA, 1963

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Current Responsibilities
Member of Utilities, Corrections and Juvenile Justice, and Judiciary Committees; attorney

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Current Responsibilities
Geology Extension, Kansas Field Conference, geologic mapping
Experience
Kansas Geological Survey, 12 years; Petroleum Geology, 15 years; Engineering Geology, 6 years
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Kansas State University – BS, 1972
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The Kansas Flint Hills

Energy, Prairie, and Preservation

2004 FIELD CONFERENCE

June 9–11, 2004

Welcome to the 2004 Field Conference, co-sponsored by the Kansas Geological Survey, the Kansas Biological Survey (both divisions of the University of Kansas), the Kansas Corporation Commission, and the Kansas Department of Wildlife and Parks. Previous field conferences have focused on specific natural-resource issues, such as water or energy, or different regions of the state, such as southwestern or northeastern Kansas. This year the Field Conference will, for the first time, focus on a specific physiographic region. The Flint Hills are an ideal area to see and talk about a range of natural-resource issues.

A Preview

One way of dividing up the state of Kansas is by physiography, or according to the physical characteristics of the land. Kansas has been divided into 11 physiographic regions that have a similar appearance. In some respects, Kansans are accustomed to thinking about their state in terms of areas where the landscape is similar, such as the High Plains of the west or the Smoky Hills in north-central Kansas.

The Flint Hills is one of the state's best-known physiographic regions. The bedrock here is Permian in age, deposited in shallow seas about 280 million years ago. It is an area of rolling hills and deeply incised river valleys. Many of the limestone layers here contain masses or layers of chert, or flint, that give the hills their name. These cherty limestones are largely the reason that this area is uncultivated today and that, combined with the higher rates of precipitation in this part of the state, are much of the reason that this area remains in native tallgrass prairie and supports an extensive ranching culture.

In many respects, the Kansas Flint Hills remain unchanged over the past century, especially when compared to other parts of the state. This is a largely rural area, with several counties that are home to more cattle than people. But that does not preclude this region from confronting various natural-resource issues. In fact, the very lack of change in the natural landscape has made natural-resource issues even more contentious here than in other parts of Kansas. Though this part of the state is home to only a small proportion of the Kansas population, nearly every Kansan feels a connection to the Flint Hills.

Many of the issues in the Flint Hills are biological. We will visit two expanses of tallgrass prairie, one owned by The Nature Conservancy and one owned by the National Park Service and the National Park Trust, to see the types of habitat and wildlife that they are trying to preserve, and learn their response to threats such as invasive plants and habitat fragmentation. We will learn about the early Native inhabitants of this prairie and talk about the way that ranchers are using it today. Although this area is largely rural, urban development (or, more accurately, suburban development) has encroached in some places. We will see and discuss efforts by various organizations to come up with methods, such as conservation easements, to control development in this landscape.

The prairie grasses, which are grazed to fatten cattle, are probably the area's most obvious natural resource. But other natural resources are also utilized here. Coalbed methane, a natural gas produced from coal seams, is being developed in some areas, along with shallow deposits of low-Btu natural gas. Building stone, such as that used in construction of parts of the state capitol in Topeka, continues to be quarried and used today. We will see locations where coalbed methane, low-Btu natural gas, and building stone are produced. Wind is a natural resource here that has most recently been the subject of possible use, resulting in bitter controversy about wind farms and their impact on habitat and the landscape. We will see prospective wind farm locations and hear from both sides about this contentious issue.

Kansas Geological Survey

Since 1889, the Kansas Geological Survey has studied and reported on the state's geology. Today the KGS's mission is to study and provide information about the state's geologic resources and hazards, particularly ground water, oil, natural gas, and other minerals. In many cases, the KGS's work coincides with the state's most pressing natural-resource issues.

By statutory charge, the KGS's role is strictly one of research and reporting. The KGS has no regulatory function. It is a division of the University of Kansas. The KGS employs about 70 full-time staff members and about 80 students and grant-funded staff. It is administratively divided into research and research-support sections. Programs can be divided by subject into water, energy, geology, and information dissemination.

Water—Water issues directly affect the life of every Kansan. Water supplies are crucial for domestic and municipal use, and in much of the state's economic activity. Western Kansas agriculture and industry rely heavily on ground water; in eastern Kansas, growing populations and industry generally use surface water. The KGS's water research and service includes an annual water-level measurement program (in cooperation with the Kansas Department of Agriculture), studies of mineral intrusion in the Big Bend and Equus beds areas, water quality in the Arkansas River, depletion of the Ogallala aquifer, the interaction between streams and aquifers, and a variety of other topics.

Energy—Kansas produces more than $2 billion worth of oil and natural gas each year. Because much of the state has long been explored for oil and gas, maintaining that production takes research and information. The KGS studies the state's coal resources and one newly developed source of energy, coalbed methane. The Survey does research on the state's petroleum reservoirs, new methods of providing information (such as a digital petroleum atlas), and new methods of producing oil (such as the use of carbon dioxide flooding, a technique that was discussed during the 2001 Field Conference). The KGS is completing a multi-year study of the resources of the Hugoton Natural Gas Area and issues related to carbon dioxide sequestration. The KGS also has a branch office in Wichita, the Wichita Well Sample Library, that stores and loans rock samples collected during the drilling of oil and gas wells in the state. In 2004, the KGS played a lead role in the State's Energy Resources Coordinating Council (SERCC).

Geology—Much of the KGS's work is aimed at producing basic information about the state's geology, information that can be applied to a variety of resource and environmental issues. The KGS develops and applies methods to study the subsurface, such as high-resolution seismic reflection, undertakes mapping of the surficial geology of the state's counties, and studies specific resources, such as road and highway materials. The KGS reports on non-fuel minerals (such as salt, gypsum, aggregates, etc.) and is charged with studying geologic hazards, such as subsidence, earthquakes, and landslides.

Geologic Information—To be useful, geologic information must be disseminated in a form that is most appropriate to the people who need it. The KGS provides information to the general public, policy-makers, oil and gas explorationists, water specialists, other governmental agencies, and academic specialists. Information is disseminated through a publication sales office, automated mapping, the state's Data Access and Support Center (located at the KGS), a data library, electronic publication, and Geology Extension.

Kansas Geological Survey Staff participating in the 2003 Field Conference:

M. Lee Allison, Director and State Geologist
Bill Harrison, Deputy Director
Rex C. Buchanan, Associate Director, Public Outreach
James R. McCauley, Assistant Scientist, Geologic Investigations Section
Tim Carr, Chief, Energy Resources Section
Robert S. Sawin, Research Associate, Geology Extension

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Kansas Corporation Commission

The mission of the Kansas Corporation Commission (KCC) is to protect the public interest through impartial and efficient resolution of all jurisdictional issues. The agency regulates rates, service, and safety of public utilities, common carriers, and motor carriers, and regulates oil and gas production by protecting correlative rights and environmental resources. The KCC's responsibility is to ensure that the public interest is served by customers receiving adequate, reliable service at fair and reasonable rates that will allow the utilities' investors to earn an adequate return.

The KCC consists of three Commissioners appointed by the Governor with the consent of the Senate. By law, no more than two commissioners can be of the same political party. The Chairman of the Commission is elected by the Commission. The current commissioners are Brian Moline (chair), John Wine, and Robert Krehbiel. The KCC is made up of an Energy Division, Transportation Division, Oil and Gas Conservation Division (which is headquartered in Wichita), and Utilities Division. The current executive director is Susan Duffy.

The KCC's Conservation Division has responsibility for the regulation of oil and gas, including responsibility for water and environmental protection. The Division's rules and regulations are geared toward protection of fresh and usable water and soil; protection of correlative rights; and prevention of waste of oil and gas resources. The goal of the division is to set practical and effective standards that protect the environment without unduly restricting drilling and production of oil and gas. The Division has district offices in Dodge City, Wichita, Chanute, and Hays.

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Kansas Department of Wildlife and Parks

The Kansas Department of Wildlife and Parks is responsible for management of the state's living natural resources. Its mission is to conserve and enhance Kansas' natural heritage, its wildlife, and its habitats. The Department works to assure future generations the benefits of the state's diverse living resources; provide the public with opportunities for the use and appreciation of the natural resources of Kansas, consistent with the conservation of those resources; and inform the public of the status of the natural resources of Kansas to promote understanding and gain assistance in achieving this mission.

The Department's responsibility includes protecting and conserving fish and wildlife and their associated habitats while providing for the wise use of these resources, and providing associated recreational opportunities. The Department is also responsible for providing public outdoor recreation opportunities through the system of state parks, state fishing lakes, wildlife management areas, and recreational boating on all public waters of the state.

In 1987, two state agencies, the Kansas Fish and Game Commission and the Kansas Park and Resources Authority, were combined into a single, cabinet-level agency operated under separate comprehensive planning systems. The Department operates from offices in Pratt, Topeka, five regional offices, and a number of state park and wildlife area offices.

As a cabinet-level agency, the Department of Wildlife and Parks is administered by a Secretary of Wildlife and Parks and is advised by a seven-member Wildlife and Parks Commission. All positions are appointed by the Governor with the Commissioners serving staggered four-year terms. Serving as a regulatory body for the Department, the Commission is a non-partisan board, made up of no more than four members of any one political party, advising the Secretary on planning and policy issues regarding administration of the Department. Regulations approved by the Commission are adopted and administered by the Secretary.

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Kansas Biological Survey

Established in 1911, the Kansas Biological Survey (KBS) is a non-regulatory, non-degree-granting research and service unit of the University of Kansas (KU) and the State of Kansas. The KBS is one of a dozen state-supported biological surveys in the United States. The KBS mission is to gather information on the kinds, distribution, and abundance of plants and animals across the state, and to compile, analyze, interpret, and distribute this information. Annually, KBS scientists bring hundreds of thousands of grant dollars to KU, review hundreds of development proposals for environmental impacts, and educate thousands of people through exhibits, field forays, public lectures, seminars, and informal talks. KBS scientists also routinely consult with Federal and State agencies, private industry, nonprofit organizations, and the general public on a range of environmental and biological issues.

KBS activities are organized into three divisions: Water Resources, Land and Wildlife Resources, and Information Technologies. Several permanent research units support the efforts of division staff. These research units also provide training and education opportunities for master's and doctorate-level graduate students at KU. The KBS research units include the following:

The *Central Plains Center for Bioassessment* (CPCB) was established in 1998 to focus on regional water-quality issues, specifically within EPA Region VII. The program places particular emphasis on monitoring Region VII streams. CPCB's mission is to provide biological expertise for the Central Plains Region by facilitating the exchange of information between scientists, government officials, and the public on issues of water quality; providing scientific expertise on such issues as taxonomy, aquatic ecology, data storage, data analysis, and study design; collaborating on scientific studies of nutrients, bio-criteria, and bioassessments of regional water bodies; and maintaining open communications within the region via a web page.

The *Kansas Applied Remote Sensing Program* (KARS) was established in 1972 to apply remote sensing technologies, with particular emphasis on satellite remote sensing. Projects undertaken by the KARS program are designed to identify and enhance the manner in which remote sensing technologies and geographic information systems can aid in decision-making, policy formulation, planning, and meeting other needs and responsibilities. Of particular emphasis are applied projects in the areas of grasslands, agricultural resources, forests, water resources, and land-use mapping and monitoring.

The *Kansas Field Station and Ecological Reserves* (KSR) program was established in 1947 to support interdisciplinary field research. It focuses on population biology, conservation and restoration, and community and landscape ecology in terrestrial and aquatic ecosystems. The environmental field station consists of approximately 1,800 acres of rolling woodland, native prairies, and managed grassland tracts, as well as experimental facilities and associated research, teaching, and support facilities.

The *Kansas Natural Heritage Inventory* (KSNHI) was established in 1986 to study the conservation of the state's rare, threatened, and endangered flora and fauna. The program conducts directed surveys for rare species and their habitats, habitat assessments, and surveys for a variety of natural community types. The mission of KSNHI is to collect, manage, and disseminate information about the biological diversity of the state. Program staff work closely with public and private decision-makers to provide early notification of potential resource conflicts, to guide land-use decisions, and to develop conservation priorities. KSNHI also maintains a core data base of biodiversity (plants, animals, and communities) for the state of Kansas.

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Flint Hills Tallgrass Prairie Preserve
Wednesday, June 9

8:45 am	Bus Arrives
	Welcome - Alan (5 min) on bus
9:00 am	Stream and Prairie Groups Depart (1hr 15 min)
10:15 am	Groups Switch (1hr 15 min)
11:30 am	Return To Bus
	Discussion (30 min)
	Flint Hills Initiative - Brian and Alan (5-10 min) Federal Conservation Programs Watershed Issues Misc
12:00 pm	Lunch
12:45 pm	Bus Departs

Prairie
- Craig Freeman
- Kelly Kindscher
- Brian Obermeyer

Stream
- Jim Hays
- Kristin Hase
- Scott Campbell
- Jerry de Noyelles
- Bill Busby

SCHEDULE & ITINERARY

Wednesday June 9, 2004

7:00 am	Breakfast at the Holiday Inn Express, Emporia
7:20 am	Conference Overview *Lee Allison*, Director, Kansas Geological Survey
8:00 am	**Bus Leaves Holiday Inn Express for Site 1**
8:45 am	**SITE 1**—The Nature Conservancy's Flint Hills Tallgrass Prairie Preserve *Alan Pollom* and *Brian Obermeyer*, The Nature Conservancy *Ed Martinko*, Kansas Biological Survey *Mike Hayden*, Kansas Department of Wildlife and Parks
12:00 pm	Chuckwagon Lunch
12:45 pm	Bus to Site 2
1:30 pm	**SITE 2**—Coalbed Methane Exploration, Chase County (Penn Virginia Oil and Gas Corp.) *Tim Carr*, Kansas Geological Survey *Morris Korphage*, Kansas Corporation Commission
2:15 pm	Bus to Site 3
2:45 pm	**SITE 3**—Low-Btu Shallow Gas, Chase County (American Energies Corp.) *Alan DeGood* and *Steve Moore*, American Energies Corp. *Tim Carr*, Kansas Geological Survey *Morris Korphage*, Kansas Corporation Commission
3:30 pm	Bus to Site 4
4:00 pm	**SITE 4**—Bayer Stone Cottonwood Quarry *Steve Bayer*, Bayer Stone, Inc.
4:45 pm	Bus to motel
5:15 pm	Arrive Holliday Inn Express, Emporia
6:15 pm	Bus to dinner
6:30 pm	Refreshments and Dinner at the Fourth Avenue Dining Company, Emporia
8:00 pm	Bus to motel

Flint Hills Region

The Flint Hills cover a north/south strip through about the eastern third of Kansas (and extend south into Oklahoma, where they are called the Osage Hills). The geology here is generally interbedded limestones and shales, deposited in shallow seas during the Permian Period of geologic history about 280 million years ago. These alternating beds of limestone and shale produce hillsides with a steplike appearance. The limestones form benches on the hillsides; the shales form the steep slopes between the benches. Many of these limestones also contain invertebrate fossils, such as corals, clams, snails, crinoids (a distant relative of the starfish), and fusulinids, a single-celled animal that resembles a grain of wheat.

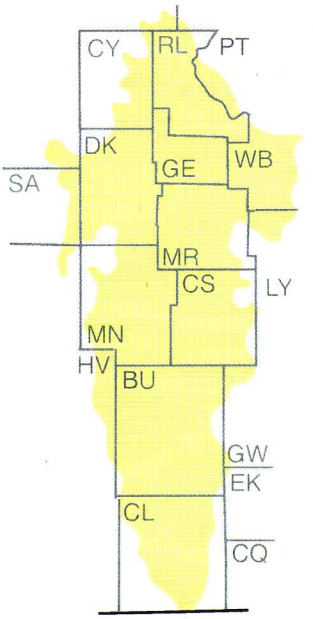
What differentiates the geology in the Flint Hills from much of the rest of eastern Kansas, however, are layers or nodules of chert (or flint) that are found in some of these limestones. These cherts are hard and erosion-resistant. Chert is composed of silica, and there are various theories about its origin. Some scientists believe that the silica precipitated out of the ocean water in the Permian seas. Others believe that volcanic ash, which drifted to the ocean floor, is the source of chert. Because of the chert, and the shallow soils and rocky surfaces, much of this region has been left in native grass. For the most part, cultivation is restricted to river bottoms and some of the higher, less rocky upland areas.

Plants

Because so much of this area remains uncultivated, it is today one of the largest expanses of tallgrass prairie remaining in North America (the word "prairie" comes from a French word for meadow). The predominant grasses here are big bluestem, little bluestem, Indian grass, and switchgrass. A number of wildflowers are also typically found here, such as lead plant, blue false indigo, wild alfalfa, butterfly milkweed, and pitcher sage. In the fall, bright yellow broom snakeweed typically occurs in areas where soils are especially thin, in pastures that have been overgrazed, or in places where the soil has been disturbed.

Fire

Fire plays an extremely important role in the ecology here. Historically, lightning set fires that burned patches of the prairie every few years. Native Americans set fires in the spring to encourage the grass to green up more quickly (the black surface created by the fire helps warm the earth, thus speeding up growth). Today ranchers burn their



pastures every spring (or, in some cases, every second or third year) for many of those same reasons, and to control the brushy growth and trees. In general, burning starts in late March or early April, depending on the weather.

Birds

Today's tallgrass prairie has evolved over thousands of years, and because the Kansas Flint Hills retain much of their native character, they continue to provide a fairly unique ecological role. In addition to the prairie plants and grasses mentioned above, the Flint Hills are home to birds that have adapted to the lack of trees. Some of the most notable are upland sandpipers and nighthawks, which lay their eggs directly on the ground, have a distinct call, and may pretend to be wounded to try to attract predators away from their nests or babies. One of the most famous denizens of the prairie is the greater prairie chicken. The males typically congregate on patches of prairie called leks or booming grounds, where they fight among themselves, display to females, and make a loud booming call to attract mates. Prairie chicken numbers in the Flint Hills have declined in past years, perhaps as a result of annual burning and its impact on nesting, though numbers seem to have stabilized recently.

Vertebrates

Other animals are commonly found in the Flint Hills. Bright green collared lizards, which can grow up to a foot in length, are often seen sunning themselves on rocky outcrops. A range of fish species inhabit Flint Hills streams, especially the relatively clear, gravel-bottomed creeks that are found here. A variety of minnows are found here, including the Topeka shiner, a now-endangered fish that prefers the large, open pools of water near the headwaters of small streams.

Deer, rodents, possums, coyotes, foxes, raccoons, badgers, skunks, and bobcats also still inhabit the prairie. Elk and pronghorn are now gone, except for a small antelope herd that has been re-established. And the prairie's most famous mammal, the bison, is gone except for small herds in places such as the Konza Prairie near Manhattan. Bison regularly grazed these hills until their extirpation in the 1800's. In some ways, today's cattle herds have now taken on the ecological role that bison historically fulfilled, though studies at the Konza Prairie show that prairies had a somewhat greater diversity of plant species when grazed by bison as compared to cattle (though species diversity is greater in areas grazed by cattle than those areas that are not grazed at all).

People

The human history of the Flint Hills is as varied and complex as its ecology. The hills were home to various tribes of Native Americans (the Kansa Indians, for whom the state is named, were placed on a reservation in Morris County in the 1800's). Native hunting trails cut through various parts of the hills, and some of those trails, such as the Santa Fe Trail, which cuts through Morris and Marion counties, became major routes for European travel. White settlement here began in the 1850's, once Kansas became a territory. In the 1860's, the Flint Hills played an important part in the state's commerce, as Texas drovers moved cattle north through the hills on their way to railheads such as Abilene. In some cases, Texas ranchers even bought ground in the Flint Hills for pasturing cattle toward the end of the drive.

Much of the Flint Hills retains characteristics from the early days of cattle ranching. Many of the ranches are large spreads that can accommodate big herds of cattle. According to a 1997 study of the 12 Flint Hills counties, 102 tracts of land covered more than three square miles (or 1,920 acres). The average size of those parcels was 5,675 acres. While there are a number of well-known Flint Hills ranching families of long-standing, such as the Roniger family in Chase County, this study found that about two-thirds of the landowners of these large parcels were absentee landowners.

Ranching

Today's Flint Hills pastures provide an efficient method for putting weight on cattle. Historically ranchers put cattle onto their pastures in early May, then took them off in October. Typical stocking rates are one calf per every 3–5 acres, and weight gains can average anywhere from 1 to nearly 2 pounds per calf per day. Today, many ranchers use a method

called early intensive grazing in which they double the typical stocking rate, put the cattle on pastures in early May but begin to take them off in July so that their pastures are empty by August.

One of the most recent and most thorough accounts of the Flint Hills is William Least Heat–Moon's 1991 account of Chase County, *PrairyErth: A Deep Map*. William Trogdon, whose pen name is William Least Heat–Moon, is a native of Kansas City, Missouri, and his first book, *Blue Highways*, was a best-seller and a New York Times notable book of 1983.

Sources

Owensby, C., Cochran, Robert, Anderson, Kling, Smith, Ed, and Vanzant, Eric, 1995, 50 years of range research revisited: Department of Agronomy, Department of Animal Sciences and Industry, Kansas State Cooperative Extension Service, Kansas State University, 57 p.

Reichman, O. J., 1987, Konza Prairie—A tallgrass nautral history: University Press of Kansas, 226 p.

Chapman, Shannen S., Omernik, James M. Freeouf, Jerry A., Huggins, Donald G., McCauley, James R., Freeman, Craig C., Steinauer, Gerry, Angelo, Robert T., and Schlepp, Richard L., 2001, Ecoregions of Nebraska and Kansas (color poster with map, descriptive text, summary tables, and photographs): U.S. Geological Survey, scale 1:1,950,000.

Kindscher, K., and Scott, N., 1997, Land ownership and tenure of the largest land parcels in the Flint Hills of Kansas: Natural Areas Journal, v. 17: 131–35.

Defining the Flint Hills as an Ecoregion

Many Kansans consider the Flint Hills to be the most scenic region in the state. Although most Kansans lack formal training in the natural sciences, they seem to know when they are in the Flint Hills. Defining and delineating the Flint Hills is more problematic. What factors and processes have produced the Flint Hills? Where do the Flint Hills begin and end? Natural scientists from different disciplines might give differing answers to these questions.

The name "Flint Hills" suggests a lithology or rock type and a landform as possible means of definition. The flint in the region's name is a local term for chert, a hard silicious rock similar to quartz that occurs in some of the limestones that crop out. However, only three of the many limestone beds in the Flint Hills have abundant chert. The "Generalized Physiographic Map of Kansas" distributed by the Kansas Geological Survey uses the outcrop of the easternmost of these chert-bearing limestones as the eastern boundary of the Flint Hills. This excludes a large swath to the east that would appear to most people to be part of the Flint Hills. Using this definition, only the northwest corner and an even smaller area in the southwest corner of Greenwood County would be included in the Flint Hills. But as we will see, much of Greenwood County has the look of the Flint Hills. Areas of the Flint Hills formed on rocks lying above the chert-bearing beds are largely free of chert or flint.

The Flint "Hills" are formed by the erosion of cuestas. Cuestas, derived from the Spanish word meaning slope, are formed in areas of gently dipping strata composed of alternating hard and soft rocks. In the Flint Hills, alternating beds of limestone and shale dip very gently to the west. The limestones, being more resistant to erosion, cap the hills and ridges and form "benches" on many hillsides. The eastern faces of the westward sloping cuestas tend to be steeper and more prominent than the gentle western backslopes. The shales, being more easily erodable, form the concave slopes between the benches on the hillsides. However, cuestas and the alternating limestone and shale beds that form them are found across all of eastern Kansas and into western Missouri and are in no way restricted to the Flint Hills. We thus need another characteristic to help define the Flint Hills more precisely.

Vegetation, or more precisely, tallgrass prairie is certainly a defining aspect of the Flint Hills. In fact, the "Bluestem Hills" is another name that the Flint Hills go by. However, tallgrass prairies once stretched along the east edge of the Great Plains from Texas to North Dakota, and eastward across what is now the Corn Belt to Indiana and even parts of Ohio (fig. 3-1). One must ask why this last major remnant of the tallgrass prairie is preserved in the Flint Hills. The common answer is that the Flint Hills are too rugged and the soils are too thin and rocky for the raising of crops. Thus, the region has historically been used as grazing land. This is certainly true in the highly dissected areas on the steep east-facing slopes of the cuestas formed on the limestones that crop out. However, the westward slopes of the Flint Hills are much gentler and lack rugged relief. These slopes are developed on the thicker shales that lie above the chert-bearing limestones. Soils that form in this area are likewise deeper and less rocky than those formed in the hilly areas to the east. Significant areas in the uplands of the western parts of the Flint Hills could be plowed and planted to crops. But these areas remain in tallgrass pasture and rangeland. This seems to be because of the strong ranching tradition that is rooted in the Flint Hills. But this ranching tradition is also found in the Smoky Hills, Red Hills, Chautauqua Hills, and the High Plains of Kansas.

Using a single element of the landscape, whether it be geology, landform, natural vegetation, soils, or land use does not allow us to adequately define what we know to be the "Flint Hills." But the combination of these landscape elements enables us to more precisely describe and delimit this as a region of unifying environmental characteristics. This is the idea behind the mapping of ecoregions. A map entitled "Ecoregions of Nebraska and Kansas" is included with this Field Guide. This mapping was coordinated by the U.S. Environmental Protection Agency with assistance from other federal agencies. Significant input to the Kansas map was provided by the Kansas Biological Survey, the Kansas Geological Survey, the Kansas Department of Health and

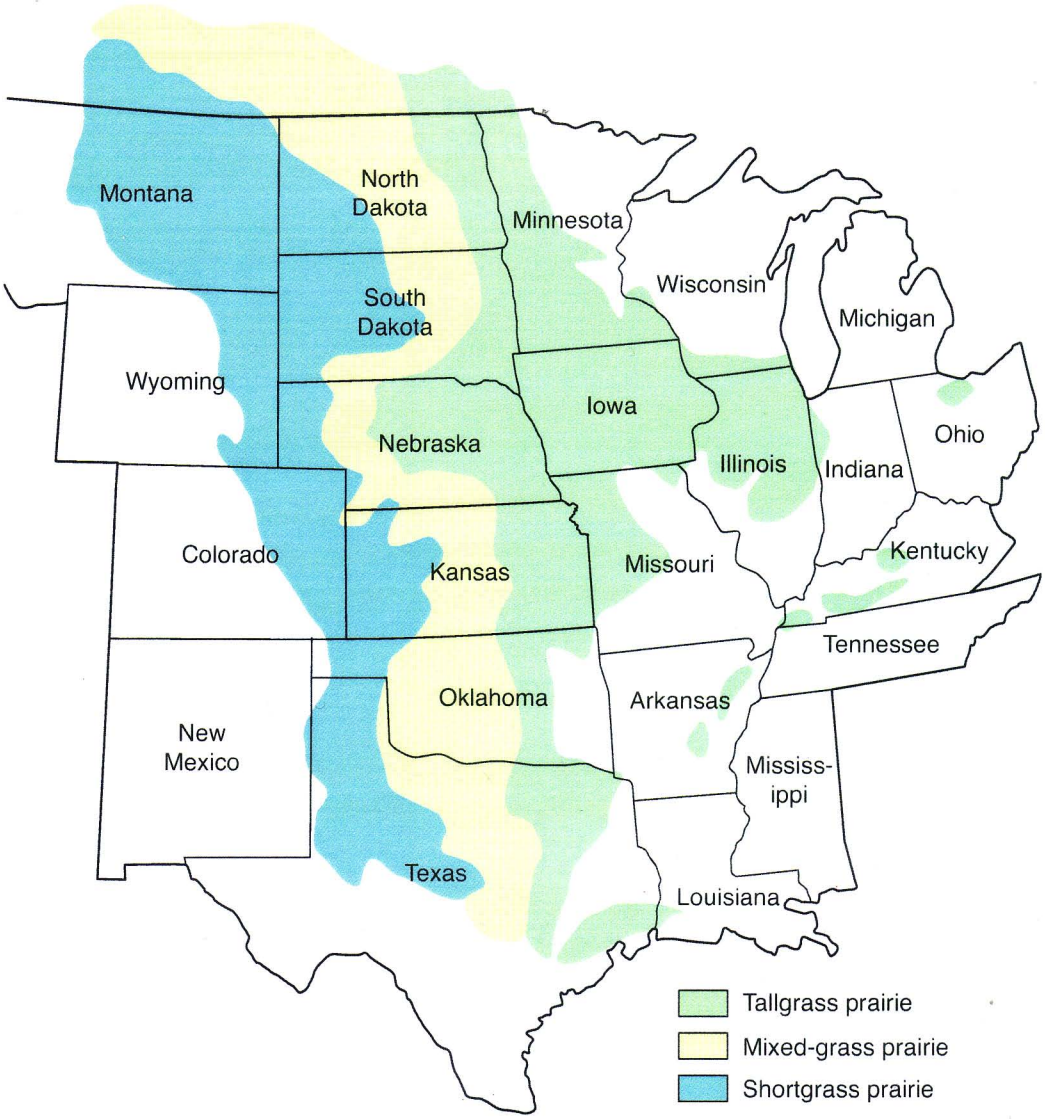


Fig. 3-1—Historic extent of the tallgrass prairie of North America.

Environment, and the Kansas Department of Wildlife and Parks.

"A region is simply a more or less homogeneous area that differs from other areas. To use more contemporary jargon, within-region variance is less than between-region variance. The 'best' regions are those that are based on the greatest amount of interrelatedness" (Hart, 1982).

As stated under the title of "The Ecoregions of Nebraska and Kansas," (Chapman, et al., 2001) "Ecoregions denote areas of general similarity in ecosystems and in the type, quality, and quantity of environmental resources; they are designed to serve as a spatial framework for the research, assessment, management, and monitoring of ecosystems and ecosystem components. Ecoregions are directly applicable to the immediate needs of State agencies, including the development of biological criteria and water-quality standards, and the establishment of management goals for nonpoint-source pollution. They are also relevant to integrated ecosystem management, an ultimate goal of most Federal and State resource-management agencies."

The "approach for defining ecoregions was based on the hypothesis that ecosystems and their components display regional patterns that are reflected in a combination of causal and integrating factors. These factors include climate, mineral availability (soils and geology), vegetation, and land use. The relative importance of each of these factors in giving ecoregions their identity varies from place

to place at all hierarchical levels of regional definition. A variety of maps thus was used to delineate the ecoregions; those most helpful were land use, landsurface form, potential natural vegetation, and soils." (Omernik, 1987).

The concept of ecoregions of the conterminous United States has been tested and applied in a number of states to:

1. assess existing and attainable surface-water quality;
2. compare ecological similarities and differences;
3. establish meaningful and reasonable chemical, physical, and biological criteria and goals;
4. determine the number and location of monitoring and demonstration sites;
5. extrapolate results from site-specific studies;
6. identify areas that should receive additional resource protection; and
7. predict the effects of management practices on resource quality (Gallant et al., 1989).

The "Ecoregions of Nebraska and Kansas" map's definition of the Flint Hills ecoregion of Kansas states:

> The Flint Hills ecoregion is the largest remaining intact tallgrass prairie in the Great Plains. This region is characterized by rolling hills composed of shale and cherty limestone, rocky soils, and humid, wet summers. Average annual precipitation ranges from 28 to 35 inches. The Flint Hills marks the western edge of the tallgrass prairie. Erosion of the softer Permian limestone has left the more resistant chert (or flint) deposits, producing the hilly topography and coarse soils of the area. This rocky surface is difficult to plow; consequently, the region has historically supported very little cropland agriculture. The natural tallgrass prairie still exists in most areas and is used for range and pasture land. However, some cropland agriculture has been implemented in river valleys and along the periphery of the Flint Hills, especially in the northwest corner where the topography is more level. This northwest edge is transitional between the cherty, rocky soils of the Flint Hills ([ecoregion] 28) and the silty, loamy, loess-formed soils of the Smoky Hills ([ecoregion] 27a).

Sources

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The Nature Conservancy's Flint Hills Tallgrass Prairie Preserve

The Flint Hills Tallgrass Prairie Preserve is a 2,188-acre tallgrass prairie conservation area and cattle ranch located east of Cassoday in eastern Butler and western Greenwood counties. A portion of the preserve is situated on the headwaters of the South Fork of the Cottonwood River, which is designated as critical habitat for the federally endangered Topeka shiner. The preserve was purchased in 1972 and 1973 through funding from Katharine Ordway, a philanthropist who helped establish a system of prairie preserves. The preserve has served as summer pasture for cattle since the 1870's.

The historical tallgrass prairie was one of North America's major ecosystems, covering over 142 million acres in 16 states (see fig. 3-1). It was a complex landscape, harboring a rich diversity of plants and animals that was shaped by the natural forces of climate, fire, and grazing. Today, less than 3 percent of the original tallgrass prairie remains. The Flint Hills region of Kansas and Oklahoma, spanning almost 5 million acres, contains the best remaining expanse of tallgrass prairie based on quality of flora and fauna and contiguous nature and size of the tracts (fig. 3-2).

Management/Restoration Plan

To create a heterogeneous prairie landscape that more closely reflects its pre-settlement condition, The Nature Conservancy's Kansas Chapter has engaged in a grazing and burning plan for the preserve. The plan excludes fire and cattle from about one-third of the preserve for a period of 4 years. Following the fourth year, another section is rested and left unburned. The rotational grazing and burning plan creates a shifting mosaic of grassland successional stages that provides habitat for a much broader range of native grassland species.

The dams around two stock ponds have been fenced to protect them from cattle traffic, thus reducing the amount of silt entering headwater streams situated on the preserve. Removal of non-native trees also is necessary. Historically few trees, if any, grew on the preserve.

Targeted Species at the Preserve

The greater prairie-chicken and short-eared owl require large areas, but tolerate or require a variety of habitats within their home ranges. The Henslow's sparrow is one of a suite of birds that require open grasslands. All of these bird species have experienced significant population declines due to the loss of suitable habitat.

The endangered Topeka shiner is a small minnow that lives in calmer runs and pools in the headwaters of certain small streams in Kansas, including the South Fork of the Cottonwood River that occurs on the preserve. The Topeka shiner builds its nest in association with sunfish. Although it appears that the shiner can coexist with cattle-grazing operations, grazing that regularly produces excessive silt loads can adversely affect the reproduction of the Topeka shiner.

Natural Attractions

Sweeping vistas of the open prairie landscape are just one of the many natural attractions at the Flint Hills Tallgrass Prairie Preserve. Although wildflowers bloom throughout the growing season, there are two peak periods: one in the spring (mid-May to mid-June) and another in late summer (August and September). Hundreds of plant species can be found on the preserve. The namesake tall grasses—big bluestem, Indian grass, and switchgrass—can grow as tall as 8 feet in moist, deep soil sites. The grasses reach maximum height in August and September.

Visitor Information

There are no facilities at the preserve and access for visitors must be prearranged by contacting The Nature Conservancy Kansas Chapter office in Topeka. The Conservancy encourages compatible use of its preserves by members, researchers, students, and the public. Removal of any natural features, including plants, animals, and rocks, is not permitted. Pets are not allowed on the property.

The Kansas Chapter

The Kansas Chapter was formally founded in 1989; however, the Conservancy has been preserving natural diversity in Kansas for nearly three decades. Along with the Flint Hills Tallgrass Prairie Preserve, the Conservancy has successfully protected more than 43,000 acres in Kansas at Cheyenne Bottoms, Konza Prairie, Smoky Valley Ranch (Logan County), and Welda Prairie (Anderson County). The Conservancy pays taxes on property it owns.

The Kansas Chapter works to safeguard native plant and animal life in the state by first identifying lands that provide especially important habitat, and then by using several methods to protect those lands. Because Kansas still retains much of its original character, a great opportunity exists to protect the very best remaining examples of wildlife habitat that create the essence of Kansas.

Source

The Nature Conservancy Kansas Chapter, 2004, Flint Hills Tallgrass Prairie Preserve website: http://nature.org/wherewework/northamerica/states/kansas/preserves/art62.html

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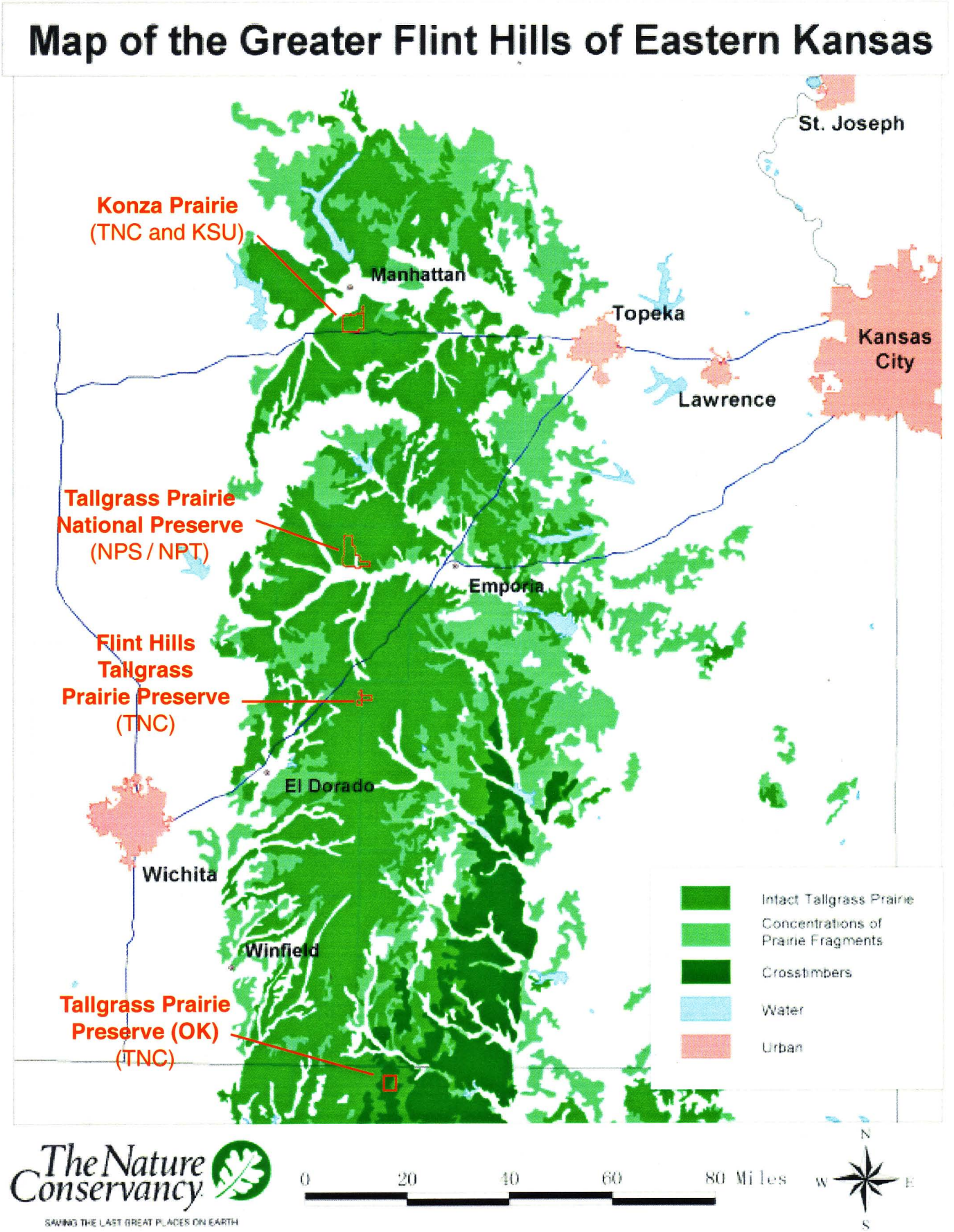

Fig. 3-2—Greater Flint Hills of eastern Kansas with locations of preserves.

The Flint Hills Initiative

As part of The Nature Conservancy's ongoing efforts to preserve the Flint Hills landscape, the Kansas Chapter initiated a community-based conservation program called the Flint Hills Initiative, which involves multiple strategies to abate critical threats in the greater Flint Hills of Kansas and Oklahoma. One of the main strategies is to promote conservation easements, which allow landowners to retain private ownership and the right to continue ranching, while legally restricting in perpetuity the type and amount of development that may take place on their property.

Need for Protection

While ranching continues as the main land use and economic activity in the Flint Hills, less compatible uses of the land are gradually establishing footholds. Fragmentation of native rangeland by ranchettes and other low-density housing developments are increasingly common, and proposals for land uses considered incompatible with a functioning tallgrass prairie ecosystem, such as communications towers, utility transmissions lines, wind farms, and landfills, are regularly put forth. Invasive species, particularly sericea lespedeza, pose a serious threat to the biological and economic integrity of the Flint Hills. Fire management, herbicide use, and grazing practices also are issues that affect important conservation elements within the Flint Hills.

Flint Hills Initiative

Since the mid-1970's, The Nature Conservancy has established a major presence in the Flint Hills, with the acquisition of the 8,616-acre Konza Prairie located in the northern Flint Hills, the 2,188-acre Flint Hills Tallgrass Prairie Preserve located centrally, and the 38,700-acre Tallgrass Prairie Preserve that anchors the southern end in Oklahoma.

The Flint Hills Initiative, through voluntary, cooperative efforts, works with landowners and public and private entities to help preserve the biological integrity of the region by protecting additional areas between the major preserves. The program's major goal is to maintain the unfragmented nature of the region and keep ranchers on their lands by protecting them from encroaching development. In this way, the Conservancy safeguards important wildlife habitats as well as the region's ranching heritage. Conservation easements are entirely voluntary and individually crafted to meet the wants and needs of the landowner and the easement holder.

Conservation Easements

One of the most practical and socially acceptable ways to protect this extensive prairie landscape from development is through the use of conservation easements. A conservation easement is a legal agreement between a landowner and the easement holder (such as a land trust or a government agency) that restricts the use of the land in order to protect its conservation value. This method of conservation is in line with the goal of many who want to maintain the unfragmented nature of the Flint Hills while preserving its ranching heritage and economic base.

A conservation easement, one of the most powerful tools available for the permanent preservation of private lands, is a voluntary contract between a landowner and the holder of the easement to preserve the land in perpetuity from incompatible development. Because the land remains in private ownership, with the remainder of the rights intact, a property protected by a conservation easement continues to provide jobs, property taxes, and other economic benefits to the area. The landowner retains full control of the agricultural use of the land for traditional purposes such as ranching. In addition, a conservation easement is legally binding, whether the property is sold in the future or passed down to heirs.

Conservation easements must be held by a recognized land trust or non-profit organization, which monitors the property to ensure the mutually agreed-upon terms of the easement are upheld. Usually, conservation easements are donated, although some are sold. The Nature Conservancy has primarily used conservation easements in high-priority sites that protect the value of land as habitat for native plant and animal species.

In addition to The Nature Conservancy, other organizations that can provide information to landowners about conservation easements in Kansas include:

Kansas Department of Wildlife and Parks
Contact: Jim Hays, Land Acquisition Coordinator 620/672–5911, ext. 157

Kansas Land Trust
Contact: RoxAnne Miller, Executive Director 785/749–3297

Kansas Livestock Association Ranchland Trust
Contact: Mike Beam, Senior Vice President 785/273–5115

Natural Resources Conservation Service
Contact: Rod Egbarts, Soil Conservationist 785/823–4548

Sunflower Land Trust
Contact: Jim Michael, Chief Executive Officer 316/775–1554

United States Fish and Wildlife Service
Contact: Damien Miller, Program Coordinator 785/539–3474, ext. 107

Sources

Hayden, M., 2004, The Conservation Easement Alternative: Kansas Wildlife and Parks Magazine, January/February issue

The Nature Conservancy, 2004, Conservation Easements in the Flint Hills brochure.

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Federal Conservation Programs

The 2002 Farm Bill provides for several Federal programs in Kansas that involve conservation easements. The Farm and Ranch Lands Protection Program (FRPP) provides matching funds to entities purchasing conservation easements. The Grassland Reserve Program (GRP) and the Wetlands Reserve Program (WRP) hold permanent conservation easements to protect and restore range, pasture, and wetlands, respectively. These programs are administered through the Department of Agriculture's Natural Resources Conservation Service (NRCS).

Farm and Ranch Lands Protection Program

The Farm and Ranch Land Protection Program provides matching funds to help purchase development rights to keep productive farm and ranchland in agricultural uses. Working through existing programs, the U.S. Department of Agriculture (USDA) partners with State, tribal, or local governments and non-governmental organizations to acquire conservation easements or other interests in land from landowners. USDA provides up to 50 percent of the fair-market easement value.

To qualify, farmland must: be part of a pending offer from a State, tribe, or local farmland protection program; be privately owned; have a conservation plan for highly erodible land; be large enough to sustain agricultural production; be accessible to markets for what the land produces; have adequate infrastructure and agricultural support services; and have surrounding parcels of land that can support long-term agricultural production. *See attached USDA/NRCS Fact Sheet.*

Grassland Reserve Program

The Grassland Reserve Program is a voluntary program offering landowners the opportunity to protect, restore, and enhance grasslands on their property. The Natural Resources Conservation Service, Farm Service Agency, and Forest Service are coordinating implementation of GRP, which helps landowners restore and protect grassland, rangeland, pastureland, shrubland, and certain other lands and provides assistance for rehabilitating grasslands. The program will conserve vulnerable grasslands from conversion to cropland or other uses and conserve valuable grasslands by helping maintain viable ranching operations.
See attached USDA/NRCS Fact Sheet.

Wetlands Reserve Program

The Wetlands Reserve Program is a voluntary program offering landowners the opportunity to protect, restore, and enhance wetlands on their property. The USDA Natural Resources Conservation Service provides technical and financial support to help landowners with their wetland-restoration efforts. The NRCS goal is to achieve the greatest wetland functions and values, along with optimum wildlife habitat, on every acre enrolled in the program. This program offers landowners an opportunity to establish long-term conservation and wildlife practices and protection.
See attached USDA/NRCS Fact Sheet.

Sources

Farm and Ranch Lands Protection Program, 2003, Farm and Ranch Lands Protection Program Fact Sheet: U.S. Department of Agriculture, Natural Resources Conservation Series, Farm Bill 2002, http://www.nrcs.usda.gov/programs/farmbill/2002/pdf/FRPPFct.pdf

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Wetlands Reserve Program, 2003, Wetlands Reserve Program Fact Sheet:U.S. Department of Agriculture, Natural Resources Conservation Series, Farm Bill 2002, http://www.nrcs.usda.gov/programs/farmbill/2002/pdf/WRPFct.pdf

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NRCS
Natural Resources Conservation Service
United States Department of Agriculture

Farm Bill 2002

Fact Sheet

April 2003

Farm and Ranch Lands Protection Program

Overview

The Farm and Ranch Lands Protection Program (FRPP) is a voluntary program that helps farmers and ranchers keep their land in agriculture. The program provides matching funds to State, Tribal, or local governments and non-governmental organizations with existing farm and ranch land protection programs to purchase conservation easements. FRPP is reauthorized in the Farm Security and Rural Investment Act of 2002 (Farm Bill). The U.S. Department of Agriculture s (USDA) Natural Resources Conservation Service (NRCS) manages the program.

Benefits/Accomplishments

Through 2002, more than 170,000 acres have been protected in 35 states.

How FRPP Works

USDA works through State, Tribal, and local governments and non-governmental organizations to conduct the FRPP. These entities acquire conservation easements from landowners. Participating landowners agree not to convert their land to non-agricultural uses and to develop and implement a conservation plan for any highly erodible land. All highly erodible lands enrolled must have a conservation plan developed based on the standards in the NRCS Field Office Technical Guide and approved by the local conservation district. Landowners retain all rights to use the property for agriculture.

To participate, a landowner submits an application to an entity a State, Tribal, or local government or a non-governmental organization that has an existing farm or ranch land protection program. The NRCS State conservationist, with advice from the State Technical Committee, awards funds to qualified entities to purchase perpetual conservation easements.

Eligibility

To qualify for FRPP, the land offered must be part or all of a farm or ranch and must:

- Contain prime, unique, or other productive soil or historical or archaeological resources;
- Be included in a pending offer from a State, Tribal, or local government or non-governmental organization s farmland protection program;
- Be privately owned;
- Be covered by a conservation plan for any highly erodible land;
- Be large enough to sustain agricultural production;
- Be accessible to markets for what the land produces;
- Be surrounded by parcels of land that can support long-term agricultural production; and
- Be owned by an individual or entity that does not exceed the Adjusted Gross Income (AGI) limitation.

The AGI provision of the 2002 Farm Bill impacts eligibility for FRPP and several other 2002 Farm Bill programs. Individuals or entities that have an average AGI exceeding $2.5 million for the three tax years immediately preceding the year the contract is approved are not eligible to receive program benefits or payments. However, an exemption is provided in cases where 75 percent of the

AGI is derived from farming, ranching, or forestry operations. The final rule for this provision has not yet been published.

If the land cannot be converted to non-agricultural uses because of existing deed restrictions or other legal constraints, it is ineligible for FRPP.

Funding

FRPP is funded through the Commodity Credit Corporation. The FRPP share of the easement cost must not exceed 50 percent of the appraised fair market value of the conservation easement. As part of its share of the cost of purchasing a conservation easement, a State, Tribal, or local government or non-governmental organization may include a charitable donation by the landowner of up to 25 percent of the appraised fair market value of the conservation easement. A cooperating entity must provide, in cash, 25 percent of the appraised fair market value of the conservation easement or 50 percent of the purchase price.

For More Information

If you need more information about FRPP, please contact your local USDA Service Center, listed in the telephone book under U.S. Department of Agriculture, or your local conservation district. Information also is available on the World Wide Web at: http://www.nrcs.usda.gov/programs/farmbill/2002/

Visit USDA on the Web at:
http://www.usda.gov/farmbill

Note: This is not intended to be a definitive interpretation of farm legislation. Rather, it is preliminary and may change as USDA develops implementing policies and procedures. Please check back for updates.

NRCS Natural Resources Conservation Service

Farm Service Agency

Farm Bill 2002

Fact Sheet

August 2003

Grassland Reserve Program

Overview

The Grassland Reserve Program (GRP) is a voluntary program that helps landowners and operators restore and protect grassland, including rangeland, and pastureland, and certain other lands, while maintaining the areas as grazing lands. The program emphasizes support for grazing operations, plant and animal biodiversity, and grassland and land containing shrubs and forbs under the greatest threat of conversion.

GRP is authorized by the Food Security Act of 1985, as amended by the Farm Security and Rural Investment Act of 2002. The USDA Natural Resources Conservation Service (NRCS) and USDA Farm Service Agency (FSA) administer the program, in cooperation with the USDA Forest Service. Funding for the GRP comes from the Commodity Credit Corporation (CCC).

Benefits

Restoring and protecting grasslands contributes positively to the economy of many regions, provides biodiversity of plant and animal populations, and improves environmental quality.

How GRP Works

Applications may be filed for an easement or rental agreement with NRCS or FSA at any time. Participants voluntarily limit future use of the land while retaining the right to conduct common grazing practices; produce hay, mow, or harvest for seed production (subject to certain restrictions during the nesting season of bird species that are in significant decline or those that are protected under Federal or State law); conduct fire rehabilitation; and construct firebreaks and fences.

The program offers several enrollment options:

Permanent Easement. This is a conservation easement in perpetuity. Easement payments for this option equal the fair market value, less the grazing value of the land encumbered by the easement. These values will be determined using an appraisal.

Thirty-year Easement. USDA will provide an easement payment equal to 30 percent of the fair market value of the land, less the grazing value of the land for the period during which the land is encumbered by the easement.

For both easement options, USDA will provide ALL administrative costs associated with recording the easement, including appraisal fees, survey costs, title insurance, and recording fees. Easement payments may be provided, at the participant's request, in lump sum or annual payments (equal or unequal amounts) for up to 10 years.

Rental Agreement. Participants may choose a 10-year, 15-year, 20-year, or 30-year contract. USDA will provide annual payments in an amount that is not more than 75 percent of the grazing value of the land covered by the agreement for the life of the agreement. Payments will be disbursed on the agreement anniversary date each year.

Restoration agreement. If restoration is determined necessary by NRCS, a restoration agreement will be incorporated within the rental agreement or easement. CCC will provide up to 90 percent of the restoration costs on lands that have never been cultivated,

and up to 75 percent of the cost on restored grasslands. Participants will be paid upon certification of the completion of the approved practice(s) by NRCS or an approved third party. Participants may contribute to the application of a cost-share practice through in-kind contributions.

Eligibility

Landowners who can provide clear title are eligible to participate for either easement option. Landowners and others who have general control of the acreage may submit an application for a rental agreement.

There is no national maximum limitation on the amount of land that may be offered for the program. However, there is a minimum requirement established in law. Offers for enrollment must contain at least 40 contiguous acres, unless special circumstances exist to accept a lesser amount. These special circumstances are determined by the NRCS State Conservationist.

The Adjusted Gross Income provision of the 2002 Farm Bill impacts eligibility for GRP and several other 2002 Farm Bill programs. Individuals or entities that have an average adjusted gross income exceeding $2.5 million for the three tax years immediately preceding the year the contract is approved are not eligible to receive program benefits or payments. However, an exemption is provided in cases where 75 percent of the adjusted gross income is derived from farming, ranching, or forestry operations.

Eligible land includes grassland or land that contains forbs or shrubs (including improved rangeland and pastureland); and grassland or land that is located in an area that historically has been dominated by grassland, forbs, and shrubs and has potential to provide habitat for animal or plant populations of significant ecological value if the land is retained in its current use or restored to a natural condition. Incidental lands may be included to allow for the efficient administration of an agreement or easement.

For More Information

If you need more information about GRP, please contact your local USDA Service Center, listed in the telephone book under U.S. Department of Agriculture, or your local conservation district. Information also is available on the World Wide Web at: http://www.nrcs.usda.gov/programs/farmbill/2002/ and http://www.fsa.usda.gov/dafp/GRP/default1.htm

Visit USDA on the Web at:
http://www.usda.gov/farmbill

Note: This is not intended to be a definitive interpretation of farm legislation. Rather, it is preliminary and may change as USDA develops implementing policies and procedures. Please check back for updates.

NRCS
Natural Resources Conservation Service
United States Department of Agriculture

Farm Bill 2002

Fact Sheet

March 2003

Wetlands Reserve Program

Overview

The Wetlands Reserve Program (WRP) is a voluntary program that provides technical and financial assistance to eligible landowners to address wetland, wildlife habitat, soil, water, and related natural resource concerns on private lands in an environmentally beneficial and cost-effective manner. The program provides an opportunity for landowners to receive financial incentives to enhance wetlands in exchange for retiring marginal land from agriculture. WRP is reauthorized in the Farm Security and Rural Investment Act of 2002 (Farm Bill). The Natural Resources Conservation Service (NRCS) administers the program. Funding for WRP comes from the Commodity Credit Corporation.

Benefits

WRP participants benefit by:

- Receiving financial and technical assistance in return for restoring and protecting wetland functions and values;
- Seeing a reduction in problems associated with farming potentially difficult areas; and
- Having incentives to develop wildlife recreational opportunities on their land.

Wetlands benefit the Nation by providing fish and wildlife habitat; improving water quality by filtering sediments and chemicals; reducing flooding; recharging groundwater; protecting biological diversity; as well as providing opportunities for educational, scientific, and recreational activities.

How WRP Works

Landowners and Tribes may file an application for a conservation easement or a cost-share restoration agreement with the U.S. Department of Agriculture (USDA) to restore and protect wetlands. Participants voluntarily limit future use of the land, but retain private ownership.

The program offers three enrollment options:

Permanent Easement. This is a conservation easement in perpetuity. Easement payments for this option equal the lowest of three amounts: the agricultural value of the land, an established payment cap, or an amount offered by the landowner. In addition to paying for the easement, USDA pays 100 percent of the costs of restoring the wetland.

30-Year Easement. Easement payments through this option are 75 percent of what would be paid for a permanent easement. USDA also pays 75 percent of restoration costs.

For both permanent and 30-year easements, USDA pays all costs associated with recording the easement in the local land records office, including recording fees, charges for abstracts, survey and appraisal fees, and title insurance.

Restoration Cost-Share Agreement. This is an agreement (generally for a minimum of 10 years) to re-establish degraded or lost wetland habitat. USDA pays 75 percent of the cost of the restoration activity. This enrollment option does not place an easement on the property. Other agencies, conservation districts, and private conservation organizations may provide additional assistance for easement payments and wetland restoration costs as a way to reduce the landowner s share of the

costs. Such special partnership efforts are encouraged.

NRCS and its partners, including conservation districts, continue to provide assistance to landowners after completion of restoration activities. This assistance may be in the form of reviewing restoration measures, clarifying technical and administrative aspects of the easement and project management needs, and providing basic biological and engineering advice on how to achieve optimum results for wetland dependent species.

Applications are accepted through a continuous sign-up process. Applications may be obtained and filed at any time with your local USDA Service Center or conservation district office. Applications also may be obtained through USDA s e-gov Internet site at: www.sc.egov.usda.gov. Enter Natural Resources Conservation Service in the Agency field, Wetlands Reserve Program in the Program Name field, and CCC-1250 in the Form Number field.

Eligibility

To offer a conservation easement, the landowner must have owned the land for at least 12 months prior to enrolling it in the program, unless the land was inherited, the landowner exercised the landowner s right of redemption after foreclosure, or the landowner can prove the land was not obtained for the purpose of enrolling it in the program. To participate in a restoration cost-share agreement, the landowner must show evidence of ownership.

To be eligible for WRP, land must be restorable and be suitable for wildlife benefits. This includes:

- Wetlands farmed under natural conditions;
- Farmed wetlands;
- Prior converted cropland;
- Farmed wetland pasture;
- Farmland that has become a wetland as a result of flooding;
- Range land, pasture, or production forest land where the hydrology has been significantly degraded and can be restored;
- Riparian areas which link protected wetlands;
- Lands adjacent to protected wetlands that contribute significantly to wetland functions and values; and
- Previously restored wetlands that need long-term protection.

Ineligible Land. Ineligible land includes wetlands converted after December 23, 1985; lands with timber stands established under a Conservation Reserve Program contract; Federal lands; and lands where conditions make restoration impossible.

The Adjusted Gross Income provision of the 2002 Farm Bill impacts eligibility for WRP and several other 2002 Farm Bill programs. Individuals or entities that have an average adjusted gross income exceeding $2.5 million for the three tax years immediately preceding the year the contract is approved are not eligible to receive program benefits or payments. However, an exemption is provided in cases where 75 percent of the adjusted gross income is derived from farming, ranching, or forestry operations. The final rule for this provision has not yet been published.

Uses of WRP Land

On acreage subject to a WRP easement, participants control access to the land and may lease the land for hunting, fishing, and other undeveloped recreational activities. At any time, a participant may request that additional activities be evaluated to determine if they are compatible uses for the site. This request may include such items as permission to cut hay, graze livestock, or harvest wood products. Compatible uses are allowed if they are fully consistent with the protection and enhancement of the wetland.

For More Information

If you need more information about WRP, please contact your local USDA Service Center, listed in the telephone book under U.S. Department of Agriculture, or your local conservation district. Information also is available on the World Wide Web at: http://www.nrcs.usda.gov/programs/farmbill/2002/

Visit USDA on the Web at:
http://www.usda.gov/farmbill

Note: This is not intended to be a definitive interpretation of farm legislation. Rather, it is preliminary and may change as USDA develops implementing policies and procedures. Please check back for updates.

Coalbed Methane In Kansas

In 2002, natural gas produced from coal beds totaled 1,614 billion cubic feet (Bcf), representing 8.3 percent of total U.S. dry gas production (19,353 Bcf). In 2002, proved reserves of coalbed methane (CBM) increased to 18,491 Bcf, a 5 percent increase from the 2001 level (17,531 Bcf). Coalbed methane accounts for 10 percent of all 2002 dry natural gas reserves. The Energy Information Agency estimates the 2002 proved gas reserves of fields identified as having coalbed methane are now more than quadruple the volume reported in 1989. Coalbed methane is a growing and significant worldwide energy source that is expected to increase for the next several decades. This additional source of methane is a significant component that addresses our present natural gas supply challenges. If we are to move from a 20 trillion cubic feet to a 28 trillion cubic feet natural gas economy within a decade (forecast by the Energy Information Agency), we will require significant new unconventional gas sources.

While coalbed-methane production in Kansas extends back to wells drilled for Federal tax credits during the late 1980's and 1990's, and even to the "shale gas" wells of the early part of the twentieth century, more than one-half of the more than 1,300 coalbed-methane wells in eastern Kansas have been drilled during the last three years. This is a remarkable drilling boom that ranges throughout eastern Kansas from Oklahoma to Nebraska. While a small component of total gas production, CBM production in Kansas has doubled from 2002 to 2003, and will increase significantly in 2004.

The four-county area of Labette, Montgomery, Neosho, and Wilson in southeast Kansas is the center of coalbed-methane exploration and production. While CBM production extends as far north as Miami and Johnson counties, and to the west in Chautauqua County, the bulk of current CBM production is from the four counties mentioned above. Conventional gas production in this area was relatively insignificant, so the effects of new CBM gas production are easily recognized. In the four-county area, gas production has doubled from 2002 to 2003 (4.2 billion cubic feet to 9.08 billion cubic feet). This increase is the result of new CBM production which should continue to increase in the next few years. In 2003, the value at the wellhead of the CBM gas produced in the four counties increased to almost $45 million from approximately $12.5 million in 2002.

What will be the impact of this increased revenue to the four-county area? First, a one-eighth royalty to the mineral owner (usually the surface owner in agricultural areas) will be $2.25 million. In addition, the employment impact can be estimated using final demand multipliers as reported in "Regional Multipliers: A User Handbook for the Regional Input-Output Modeling System (RIMS II): US Department of Commerce's Bureau of Economic Analysis, 1992". The increase in revenue from 2002

Table 3-1a—Estimated indirect effects on the local economy of increased coalbed-methane production in the four-county area of southeast Kansas (Labette, Montgomery, Neosho, and Wilson).

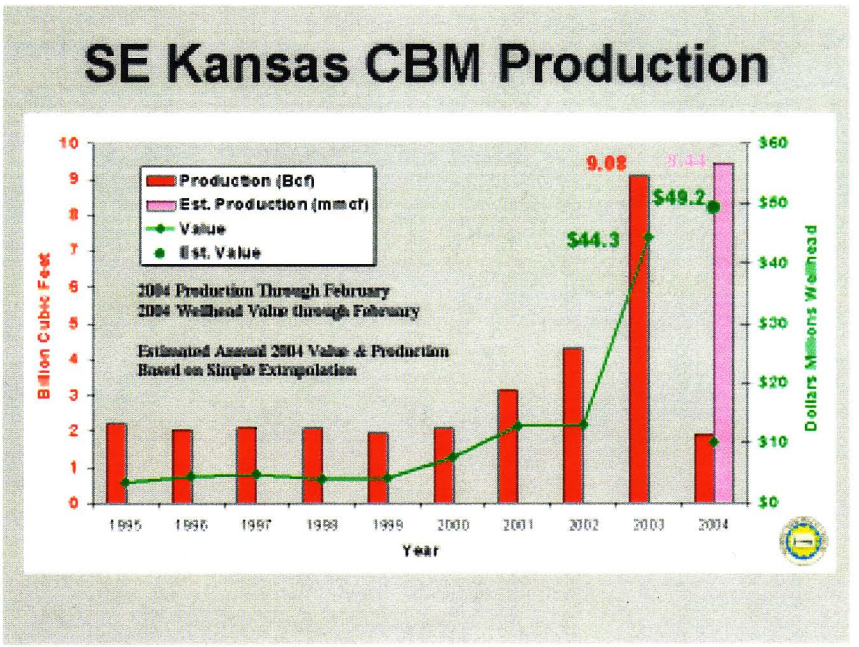
Change in Value at Wellhead (Million$)	Final Demand Multiplier Output	Final Demand Multiplier Earnings	Final Demand Multiplier Employment	Change in Output (Million$)	Change in Earnings (Million$)	Change in Employment
$30	1.4982	0.1925	14.2	$45	$5.8	426

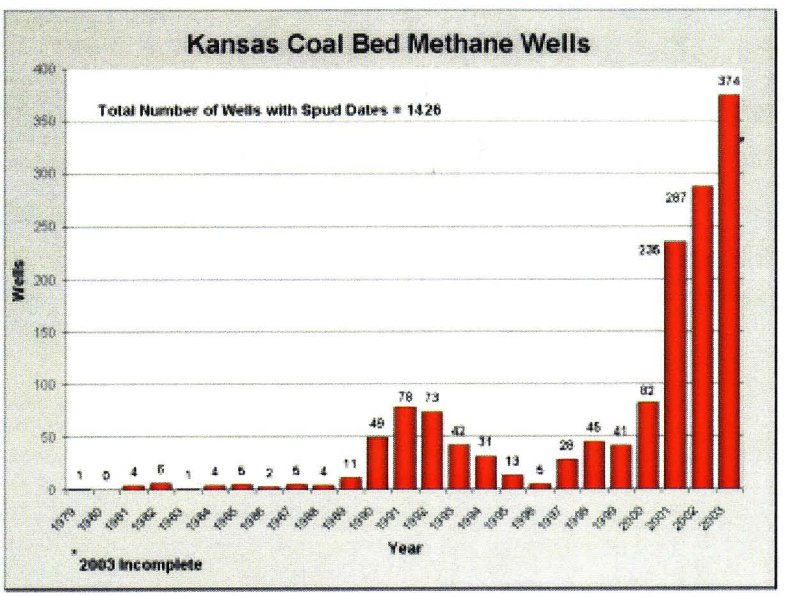
Table 3-1b—Estimated direct effects on the Kansas oil and gas industry of increased coalbed-methane production in the four-county area of southeast Kansas (Labette, Montgomery, Neosho, and Wilson).

Direct EffectMultiplier Earnings	Direct EffectMultiplier Employment	Change in Earnings(Million $)	Change inEmployment
0.0984	9.1014	$2.95	273

Table 3-2—Assessed value and tax dollars in 2001 and 2002 from mineral leasehold in Labette, Montgomery, Neosho, and Wilson counties.

Southeast Kansas Mineral Leasehold Property Taxes				
	2001		2002	
County	Assessed Value	Tax Dollars	Assessed Value	Tax Dollars
Labette	$118,879	$12,931	$354,821	$38,692
Montgomery	$1,086,517	$137,963	$1,447,388	$189,594
Neosho	$255,075	$34,174	$878,596	$123,342
Wilson	$932,101	$105,450	$1,381,048	$159,449
Total	$2,392,572	$290,517	$4,061,853	$511,077





Figs. 3-3 and 3-4—Completion activity by year for wells listed as coalbed methane. A total of 1,783 wells are listed with a coalbed-methane status. However, only 1,338 have completion dates. Wells without completion dates may be permitted but not drilled locations or wells for which completion reports have not been filed. Earlier drilling activity in 1980–1992 can be attributed to Federal tax credits. Drilling during the last four years can be attributed to the price of natural gas and the success of coalbed-methane production in southeast Kansas.

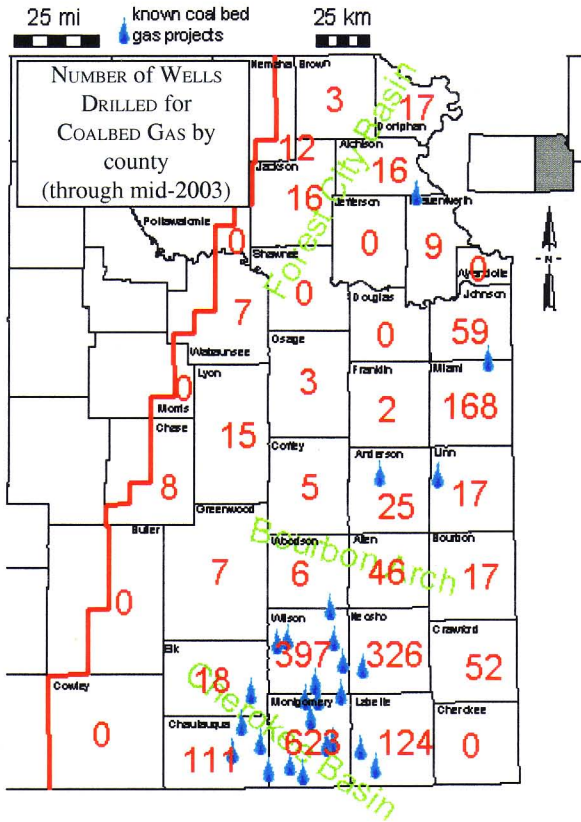


Fig. 3-5—Coalbed-methane drilling activity and producing or pilot projects in Kansas by county. Note the concentration of wells in southeast Kansas.

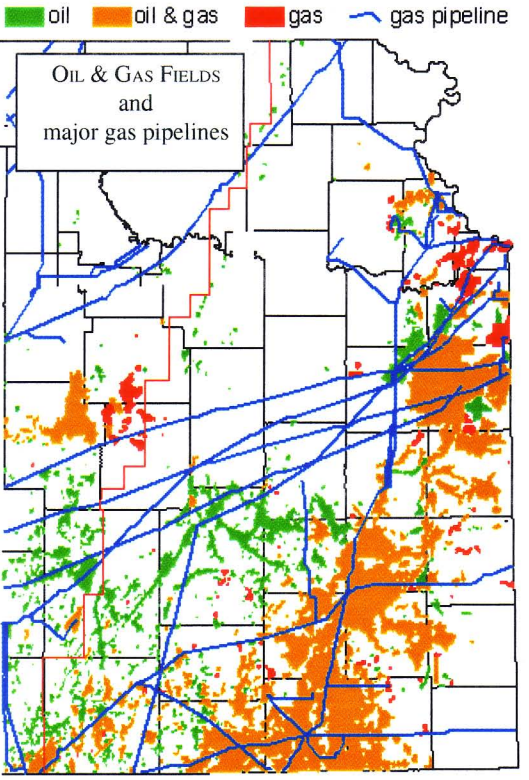


Fig. 3-6—Interstate pipeline infrastructure in eastern Kansas and major oil and gas fields.

to 2003 for gas production is approximately $30 million. The increased economic activity to the economy of the four-county area is estimated at $45 million with increased earnings of $5.8 million (Table 3-1a). The increased employment in the four-county area is estimated at 426 new jobs (Table 3-1a). Direct-effect multipliers can be used to estimate the impact of increased revenue from coalbed-methane production on the local petroleum industry (Table 3-1b). The local petroleum industry is estimated to have increased almost $3 million in earnings and a potential increase of 273 employees. In this four-county area, these indirect and direct effects are very significant.

The four-county area of southeast Kansas has seen a significant increase from 2001 to 2002 in property tax evaluations attributed to coalbed-methane activity (Table 3-2). In 2001, mineral leasehold was assessed at $2.4 million. In 2002, mineral leasehold was assessed at $4.1 million and actual tax dollars from mineral leasehold taxes increased 76%. These increased assessments and tax dollars do not include the impact of surface facilities and pipelines (e.g. compression stations). Valuations are not available for 2003, but based on the doubling of production and more than tripling of wellhead value, a significant increase in tax assessments and revenue is expected.

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Coalbed Methane Exploration—Chase County

In 2003, Penn Virginia Oil and Gas Corporation, out of Kingsport, Tennessee, drilled two coalbed methane pilot projects in the Flint Hills region. Because both of these projects are several miles from established coalbed methane production, they are considered exploratory, or wildcat, projects. The first project was drilled in northern Greenwood County about 15 miles east of Cassoday. The Chase County project is located about 15 miles southwest of Cottonwood Falls.

Six wells were drilled at each pilot project and both projects target Pennsylvanian-age coals; the same coal seams that have been mined at or near the surface in extreme southeast Kansas. Here these coal beds are about 3,300 feet below the surface.

The coals at this site are about 2,000 feet deeper, and much thicker, than the coals at established coalbed methane fields in southeast Kansas. It is also probably the most westerly extension of coalbed methane production in Kansas. The targeted coal interval here is more than 30 feet thick, compared to less than 8 feet thick, in southeast Kansas. This unusual thickness of coal is associated with faults that were probably active while the coals were being deposited. The fault blocks that moved downward created low, swampy areas that allowed extra thicknesses of coal to accumulate.

The six-well pattern consists of five methane producing wells and one saltwater disposal well. Initially, coalbed methane wells produce only water. As the water is drawn off (called dewatering), the methane is released from the coals. The produced water, which is salty at this location, is disposed of through the saltwater-injection well that is drilled to the deeper Arbuckle Group, a formation that is commonly used for saltwater disposal in Kansas. The five coalbed methane wells at this site are currently still producing only water.

Source

Southeast Kansas Coal Bed Methane Project—Penn Virginia Oil & Gas Corporation montage.

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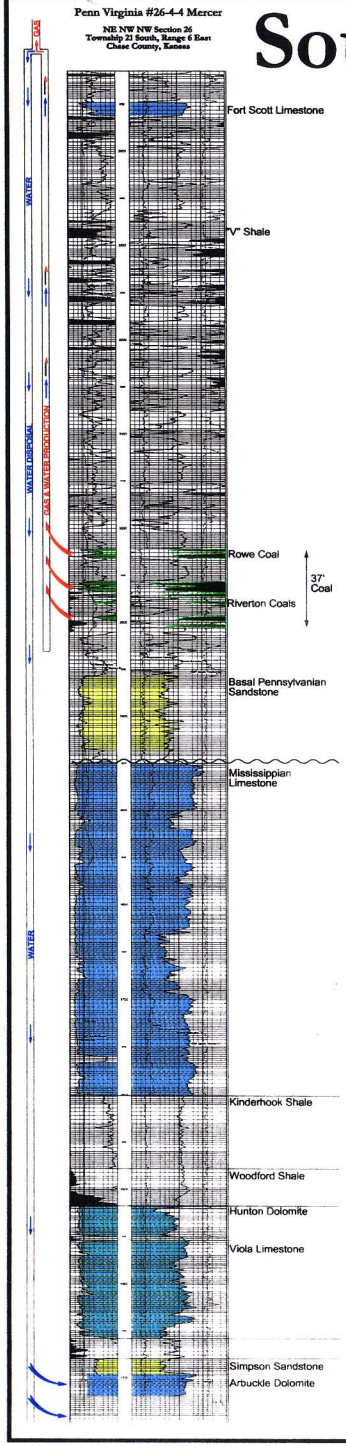
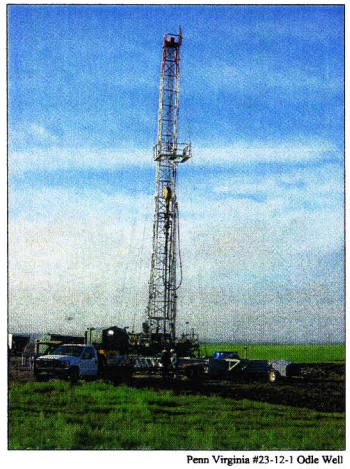
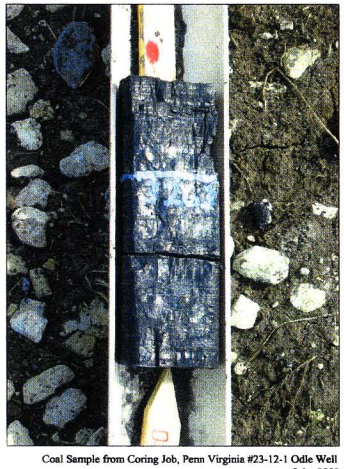
Southeast Kansas Coal Bed Methane Project

Penn Virginia Oil & Gas Corporation

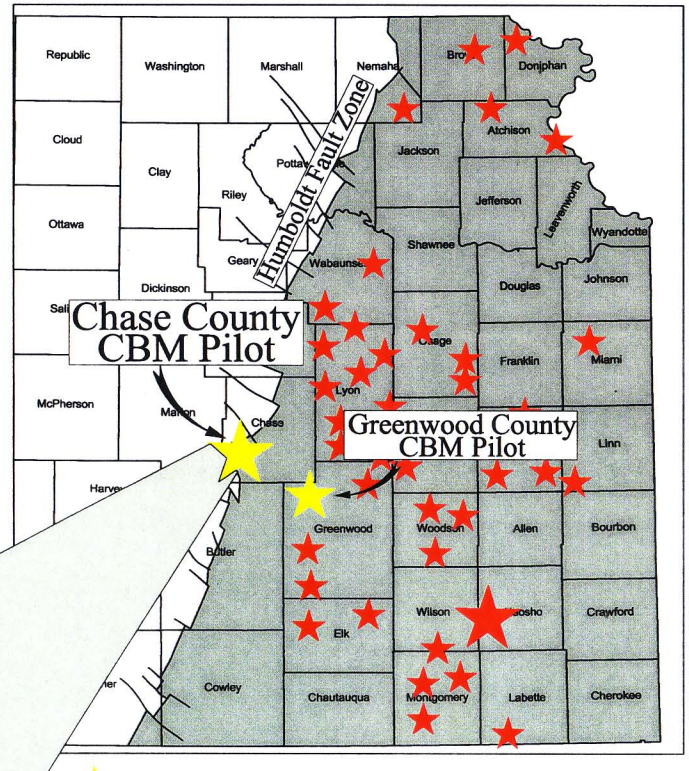


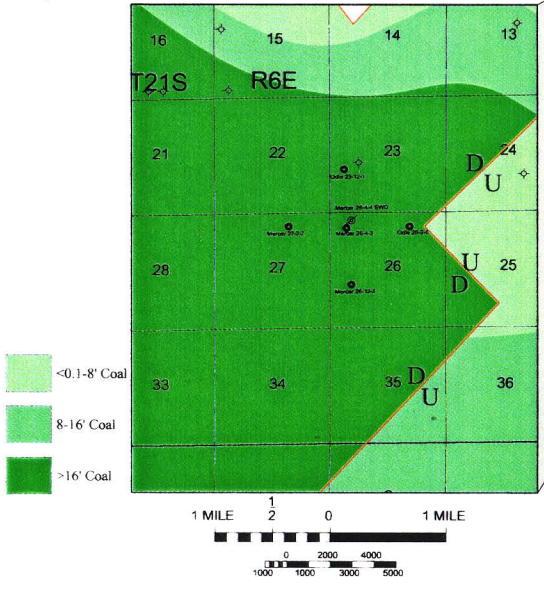


Penn Virginia #23-12-1 Odle Well
July, 2003



Coal Sample from Coring Job, Penn Virginia #23-12-1 Odle Well
July, 2003





Penn Virginia CBM Activity

Other Companies CBM Activity

In 2003, Penn Virginia Oil & Gas Corporation drilled two coalbed methane pilot projects in an attempt to establish commercial natural gas production from Pennsylvanian coals in the Cherokee Basin area of southeastern Kansas. Our initial pattern of six wells was drilled in northern Greenwood County, Kansas, and was soon followed by another six-well pattern in Chase County. Our Chase County pilot is unusual for Kansas coal bed methane develoment in two regards. The first regard is that it is 2000 feet deeper than most of the existing CBM production in Kansas. The other is that we have targeted unusually thick coals in comparison to the established CBM area in Kansas. We found more than thirty (30') feet of coal in the same geological formation that usually contains less than eight (8') feet of coal further to the southeast. This unusual thickness of coal owes its existence to the fact that many faults along the Humboldt Fault Zone were actively moving while the coals were being deposited. The fault blocks that moved downward were low, swampy areas that accumulated an extra thick section of coal.

We believe that we will soon begin producing methane from the thick coal seams we have encountered here in Chase County. Currently our five CBM wells here are producing only water, which is a normal part of the process of "dewatering" the coal seams prior to producing methane gas. All of the water we produce is reinjected via the Penn Virginia #26-6-4 Mercer water disposal well into the deeper Arbuckle Dolomite, a formation that has long been used for salt water disposal in Kansas.

Kansas Geological Survey
Public Information Circular 19
December 2001

Natural Gas from Coal in Eastern Kansas

Robert S. Sawin
Public Outreach, Kansas Geological Survey

Lawrence L. Brady
Geologic Investigations, Kansas Geological Survey

Coalbed methane now accounts for about 7 percent of the total annual gas production in the United States

Introduction

Methane, the main component of natural gas, has been a product of the petroleum industry for years. Many of us use natural gas in our homes—in our furnaces, water heaters, and stoves. Now, a relatively new and unconventional source of natural gas—methane from coal beds—has generated interest in eastern Kansas.

Coalbed methane is natural gas that occurs in coal beds. The geological process that turns plant material into coal generates methane gas. This gas was a deadly nuisance that produced explosions in underground coal mines, so the mines had to be ventilated to remove the gas. In the early 1980's, the mining industry began to capture and sell this gas rather than release it to the atmosphere. Thus, a new industry was created—the commercial production of methane from subsurface coal beds.

Coalbed methane now accounts for about 7 percent of the total annual gas production in the United States. In areas of the San Juan basin in New Mexico and Colorado, parts of the Black Warrior basin in Alabama, and basins in the central Appalachians, large quantities of methane are being developed from coal beds. This gas is now being exploited in other areas of thick, coal-bearing rocks such as the Powder River basin in Wyoming and Montana.

In Kansas, most of the activity has been in the southeastern part of the state, primarily Montgomery, Wilson, western Labette, and eastern Chautauqua counties; however, other parts of eastern Kansas that are underlain by coal beds also have potential for coalbed methane production (fig. 1). Coal beds that have potential to produce methane occur in eastern Kansas east of the Nemaha uplift, a subsurface geologic structure that runs from Oklahoma City, Oklahoma, north through El Dorado, Kansas, and just east of Manhattan, Kansas.

This circular describes coal and coalbed methane, gas production from coal, leasing and landowner mineral rights, and the potential for coalbed methane production in Kansas.

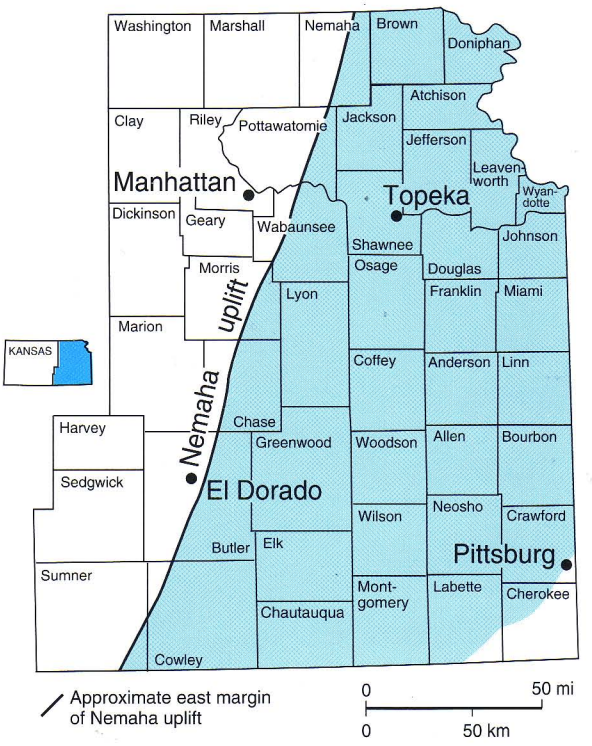


Figure 1—*Portion of Kansas with potential for coalbed methane development.*

Coal and Coal Gas

Coal is the most abundant energy source in the world. Coal deposits have been mined in Kansas for nearly 150 years, mostly in southeastern Kansas, where surface and subsurface mines have produced over 300 million tons of coal. Bituminous (soft grade) coal resources of Pennsylvanian age, deposited about 300 million years ago, are widespread in eastern Kansas and constitute nearly all the coal resources in the state. Coal production in Kansas peaked during World Wars I and II. Today, however, only one small mine operates in Kansas, near Prescott, in Linn County.

An increasing level of interest in coalbed methane has spurred activity in eastern Kansas

Coal forms from plant material that was accumulated in ancient swamps and bogs at rates fast enough to prevent decay. Upon burial, the material is first converted to peat. Through time, as temperature and pressure increase with further burial, peat is converted to coal (it takes about 10 feet of peat to make 1 foot of coal). During this process, large quantities of methane-rich gas are generated and stored within the coal. Coal can store surprisingly large volumes of gas, up to six or seven times as much gas as a conventional gas reservoir (typically sandstone or limestone) of equal rock volume. The amount of gas in coal depends on the degree of alteration the coal has undergone in the burial process, the depth below the surface, and the pressure of the reservoir.

Coalbed gas is mainly composed of methane (CH_4), the principal constituent of natural gas. Coalbed methane is what geologists call a sweet gas because it typically contains very few impurities such as hydrogen sulfide, nitrogen, or carbon dioxide, all normally found in natural gas. Coalbed methane, when burned, generates as much heat as petroleum-based natural gas.

Producing Gas from Coal

Coal contains gas and large amounts of water. Once the confining pressure on the coal is relieved (for example, by drilling and pumping), the gas is slowly released from the coal. Naturally occurring fractures, called cleats, provide the plumbing system within the coal that allows water and gas to travel through the coal to the well. For gas to be released from the coal, the pressure must be reduced by removing water from the coalbed, a process called dewatering. Dewatering brings large quantities of water (usually saltwater in Kansas) to the surface, which is reinjected deep underground.

Initial development of coalbed methane wells can take several months because of the large quantities of water that need to be pumped from the coal bed. In general, coalbed methane wells go through three stages during their production history (fig. 2). During the dewatering stage, water production initially exceeds that of methane, but as production continues, the volume of water decreases as the volume of methane increases. A stable production stage is reached when methane production reaches its maximum and water production levels off. During the decline stage, water production remains low and the amount of methane declines until methane becomes uneconomical to produce.

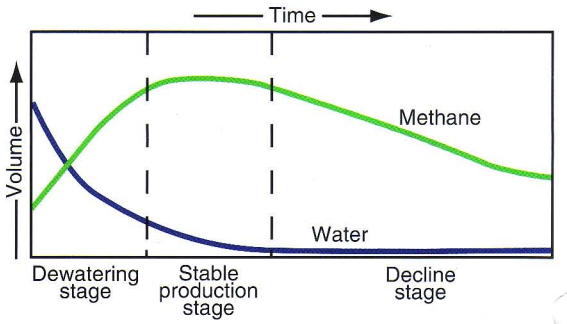


Figure 2—*Production stages of a coalbed methane well (adapted from Rice, 1997).*

Mineral Rights and Leases

An increasing level of interest in coalbed methane has spurred activity in eastern Kansas. Local landowners may benefit economically if they own the mineral rights beneath their property. Mineral rights are defined as the right of ownership of the mineral resources that underlie a tract of land.

Both the land surface and the resources below the surface can be owned and are considered property. The mineral rights can be owned in total or can be owned by the specific mineral commodity; for example, one company can own the mineral rights to the coal, while another company owns the oil and gas rights. Coalbed methane is natural gas and is considered part of the oil and gas minerals.

The owner of the mineral rights can be different than the surface owner. In Kansas, the landowner usually owns the subsurface rights, but sometimes these rights have been severed, or separated from the surface ownership. Severance of mineral rights occurs when the owner of both the surface and mineral rights sells or grants by deed the mineral rights underlying their property. The landowner may also reserve, or retain, all or a portion of the mineral rights upon sale of the property. Mineral deeds and mineral reservations are recorded with the county register of deeds and are included in any abstract of title to the land involved.

Mineral owners have the right to access and develop their minerals. Landowner rights are preserved, whether or not they participate in development of the mineral rights. Regulations are in place to stop operators if their activities are irresponsible or damaging to the surface. Landowners are entitled to compensation for loss of use or damage to their land. Most operators are willing to work with the landowner to reach a fair settlement for damages, but if this fails, state and federal regulations protect the landowner.

Before companies can begin an exploration and development program, they must obtain a lease to the mineral rights (in the case of coalbed methane, an oil and gas lease). An oil and gas lease is a legal agreement between the mineral-rights owner (the lessor) and the oil and gas operator (the lessee) that grants the operator the right to explore and develop the oil and gas resources which may underlie the area described in the lease. Some general stipulations that are usually part of a lease agreement are lisited below:

- A legal description of the area and the number of acres.
- The primary term of the lease. This can be for any period of time, but is usually five or ten years.
- A provision for lease rental payments (usually annual) by the operator to the mineral-rights owner. Rental payments maintain the lease in effect throughout the primary term. If oil or gas is found, the lease will remain in effect as long as production continues, even beyond the primary term of the lease.
- A royalty clause that stipulates the mineral-rights owner's share of the oil or gas production. The royalty may be any amount mutually agreed to by the operator and the mineral rights owner, but is usually one-eighth (12.5 percent) of the oil or gas produced from the lease. Usually the operator sells the oil or gas to a refiner and the mineral-rights owners receive payment for their share from the operator.

The bituminous coals of eastern Kansas have great potential for large quantities of methane

Coalbed Methane Potential in Kansas

The bituminous coals of eastern Kansas have great potential for large quantities of methane. In areas where the coals are deeper than 500 feet, and the gas has been trapped in the coals by thick overlying shales, economic quantities of methane gas may exist. Many other factors, such as the market price for natural gas, also determine the economic feasibility of exploring for coalbed methane in eastern Kansas.

Although the coal beds in eastern Kansas tend to be widely distributed, and several beds (up to 14) could be encountered in a well, the primary concern is the thinness of most of the coal beds and the correspondingly smaller volumes of gas. Evaluation of approximately 600 geophysical logs in eastern Kansas indicates that about 96 percent of the coal occurs in beds 14 to 42 inches thick (fig. 3) and only about 4 percent occurs in beds greater than 42 inches. The main strategy for exploring for coalbed methane in eastern Kansas will be to locate thicker coals or multiple coal beds to warrant viable economic development (fig. 4).

Most of the coals in eastern Kansas are less than 2,500 feet deep, so drilling costs should be relatively low. Many gas pipeline networks already exist, and Kansas has recognized disposal zones for the water that is produced with the methane. All these factors suggest that eastern Kansas is an important area for potential development of coalbed methane.

Photo: Robert S. Sawin

Figure 3—*Outcrop of a thin coal bed in Cherokee County.*

Agencies to Contact About Coalbed Methane

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Photo: Robert S. Sawin

Figure 4—*Coalbed methane well in Montgomery County, Kansas.*

The mission of the Kansas Geological Survey, operated by the University of Kansas in connection with its research and service program, is to conduct geological studies and research and to collect, correlate, preserve, and disseminate information leading to a better understanding of the geology of Kansas, with special emphasis on natural resources of economic value, water quality and quantity, and geologic hazards.

The Geology Extension program furthers the mission of the KGS by developing materials, projects, and services that communicate information about the geology of Kansas, the state's earth resources, and the products of the Kansas Geological Survey to the people of the state.

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December 2001

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Low-Btu Shallow Gas Development

Low-Btu Natural Gas in Kansas (by David Newell, KGS)

A significant untapped source of natural gas in the midcontinent (nominally comprising Oklahoma, Kansas, and parts of adjacent states) is low-Btu gas, which may eventually account for as much as 13 trillion cubic feet of reserves in this region. Gas is considered low-Btu gas if it has a heating value of less than 950 Btu's. The Btu content of a gas is directly related to the volume of major non-hydrocarbon components (i.e., nitrogen, helium). Some natural gases can have as little as 5% non-hydrocarbon components to qualify it as low-Btu gas. Much of this low-Btu gas has either been shut-in behind pipe or simply abandoned after discovery if it could not be blended with any readily available higher-Btu gas. Utilization of this low-Btu resource may now be possible with new technologies developed over the last decade. Combining these technologies and adapting them to a scale that makes them economical for the hundreds of small gas fields operated by independent producers in the midcontinent remains the challenge.

Gas from many midcontinent formations differs from gas found elsewhere in the world in that it can contain significant quantities of nitrogen (N_2) and subsidiary amounts of helium (He). Non-hydrocarbon gases in natural gas reduce the amount of energy per unit volume (i.e., expressed as its heating value, in Btu's). Because noncombustible gases reduce the energy-carrying capability of the existing pipeline infrastructure, pipeline companies typically limit the amount of nitrogen and other non-combustible inerts to 4%, or set a minimum Btu content for gathering systems feeding into the pipeline.

Helium, like nitrogen, is a noncombustible gas. However, helium can be recovered as a salable gas, with recent prices ranging from $25 to $50 per thousand cubic feet (mcf). In most cases, nitrogen and helium make up less than 20% of the total gas. However, in as many as one-third of the fields in Kansas, the quantity of nitrogen and helium significantly reduce Btu content.

Geographically, low-Btu gases appear to be widespread and along established oil and gas production trends (fig. 3-7), but generally low-Btu gases are more likely in the central part of the state, whereas higher-Btu gases are more common toward southern Kansas. Pay zones in central Kansas are 2,000 to 3,500 feet deep, whereas in southern Kansas

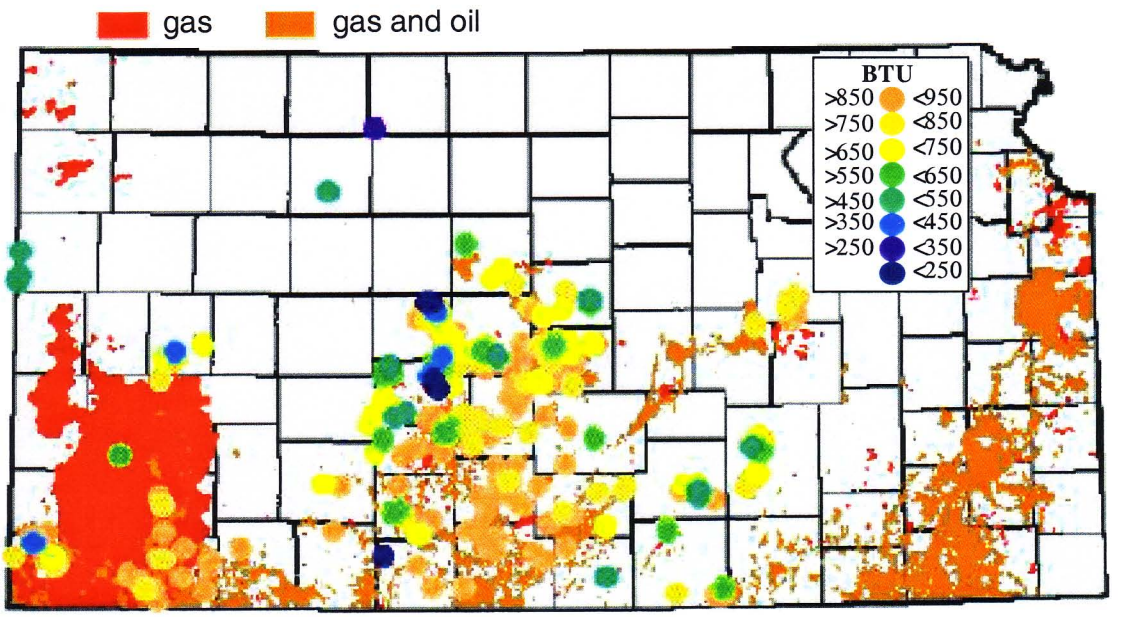

Fig. 3-7—Btu content of natural gas in Kansas. Color coding of Btu content in natural gas indicates the Btu content generally increases southward, but low Btu gases are common in and around higher Btu gas areas.

they generally are deeper—approximately 3,000 to 6,000 feet below the surface.

Elmdale Field—Chase County

The first production in Chase County was reported from the Elmdale gas field. The Elmdale field was discovered sometime in the early 1920's. Drilling was probably based on surface mapping of the Elmdale dome, an area where the surface and subsurface rocks are warped upward.

The shallowest producing interval in Chase County is the Permian-age Admire Group. Gas is produced in shallow (200 to 400 feet) wells from several sandstones (most notably the Indian Cave sandstone) in fields such as Elmdale and Davis fields in northwest Chase County.

The Lansing and Kansas City Groups (Pennsylvanian-age) are a sequence of alternating limestones, shales, and sandstones commonly combined in the subsurface and referred to as Lansing–Kansas City. Wells drilled recently by American Energies Corporation in the Elmdale field have been completed in the Lansing–Kansas City interval at a depth of about 1,300 feet.

The Davis gas field, located about 8 miles northeast of Elmdale field, extends over the Tallgrass Prairie National Preserve, which we'll visit on Thursday. The first producing well in the Davis field was drilled in 1929 with an initial reported production of 681 thousand cubic feet of gas per day. However, the majority of wells in and immediately surrounding the preserve were not drilled until the 1940's when petroleum was in short supply during World War II. Most of the wells were completed with an open hole across the producing formation at depths from 260 to 450 feet. Initial production appears to be in the range of 30 to 50 thousand cubic feet per day, but rates up to 1 million cubic feet per day were reported. The gas was piped for local use through a 6-inch line to Strong City and Cottonwood Falls. These wells have not produced for several years.

American Energies Corporation

Wichita-based American Energies Corporation operates solely in Kansas and operates or has interest in over 400 oil, gas, injection, and saltwater disposal wells. The company, with 20 employees, is involved in exploration, drilling, and production, and will participate in over 40 wells in 2004. Plans include a gas storage field and a nitrogen extraction plant to process low Btu gas in the Elmdale area.

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Bayer Stone Cottonwood Quarry

Bayer Stone, Inc., is headquartered in St. Marys, Kansas. This family-owned company, founded in 1937, quarries and finishes stone for the outside of commercial and residential buildings, as well as for countertops, floor tile, windowsills, and other uses inside homes and buildings. The company operates quarries in Pottawatomie and Chase counties, then hauls stone from the quarries to its St. Marys facility for finishing. In addition to working with Kansas limestone, the company also finishes limestone from Indiana.

Bayer (pronounced Buyer) has quarried limestone in Chase County since 1962. This quarry, opened in 1983, produces blocks of Cottonwood limestone (Cottonwood Limestone Member), which has been a source of building stone in Kansas for almost 150 years. The Cottonwood was used in the construction of parts of the Kansas Capitol, in the Chase County courthouse in Cottonwood Falls, in the house that serves as the headquarters of the Spring Hill Ranch at the Tallgrass Prairie National Preserve, and in many other buildings across Kansas.

The Cottonwood limestone is named after the nearby town of Cottonwood Falls (though it is unclear when or how the word 'Falls' was dropped from the limestone's name). The town, in turn, was named for the Cottonwood River. The Cottonwood limestone is Permian in age and generally about six feet thick. The Cottonwood contains abundant fossils of fusulinids, a single-celled animal that floated on the surface of the Permian seas; the fossils resemble grains of wheat.

Quarrying operations here begin by stripping away the soil and other materials from above the limestone. Then a belt saw, which moves at the rate of about 5.5 inches per minute or about 250 feet per day, cuts the stone into blocks that are 3 to 6 feet wide. The stone is then loaded onto trucks and sent to St. Marys (or to other companies that buy the stone and finish it themselves). The quarry sends out an average of 6 to 10 truckloads of stone per day. Each truck carries about 330 cubic feet or 46,500 pounds of stone. Once the limestone is removed, soil is placed back over the quarry and re-seeded.

Source

Bayer Stone, Inc. web site: http://www.bayerstone.com

Resource Contact

Steve Bayer
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SCHEDULE & ITINERARY

Thursday ,June 10, 2004

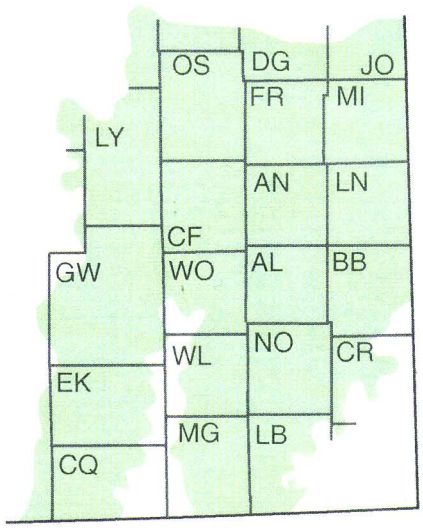
7:00 am	Breakfast at the Holiday Inn Express, Emporia
8:00 am	**Bus Leaves Holiday Inn Express for Site 5**
9:15 am	**SITE 5**—Rosalia Wind Project, Butler County Jim Roberts ~~*Wayne Walker*~~, Zilkha Renewable Energy —Transmission Issues Associated with Wind Energy Development *Jim Ludwig*, Westar Energy
10:15 am	Bus to Site 6
10:45 am	**SITE 6**—Elk River Wind Project, Butler County *Matt Hantzmon*, Greenlight Energy, Inc. *Pete Ferrell*, Ferrell Ranch
11:45 am	Bus to Lunch
12:00 pm	Lunch at the Beaumont Hotel, Beaumont
12:45 pm	Bus to Site 7
2:00 pm	**SITE 7**—Tallgrass Prairie National Preserve *Steve Miller*, National Park Service
5:15 pm	Bus to Dinner
5:30 pm	Refreshments and Dinner at the Grand Central Hotel, Cottonwood Falls
7:30 pm	Bus to motel
8:00 pm	Arrive Holiday Inn Express, Emporia

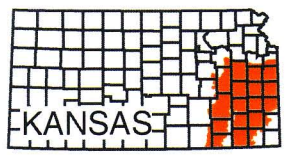
Osage Cuestas Region

The Osage Cuestas are the physiographic region immediately east of the Flint Hills. The rocks here are older than the Flint Hills, deposited in the Pennsylvanian Period of geologic history, about 295 million years ago, but in many respects the geology of this region is similar to the geology of the Flint Hills. The Osage Cuestas are composed of interbedded limestones and shales that were deposited in shallow seas, much as the rocks in the Flint Hills. In fact, the geology of Pennsylvanian-age rocks and Permian-age rocks in Kansas is so similar, and the boundary between the two ages of rocks so subtle, that geologists have difficulty establishing exactly where you move from one region into the other. One notable difference, however, is that some of the limestones in the Flint Hills contain abundant chert, whereas the rocks in the Osage Cuestas typically do not.

Cuesta is a Spanish word for hill or cliff, and it is the term that geologists use to describe ridges that have a steep, clifflike face on one side and a gentle slope on the other. This type of landform characterizes the Osage Cuestas. While many rock formations in eastern Kansas may look as if they lie layer-cake flat, most of them dip very gently to the west and northwest. That is, rocks that are at the surface in one location are very slightly tilted so that they then plunge underground as you move to the west. Thus, the Osage Cuestas are formed by a series of east-facing ridges (or escarpments), where these rock formations crop out at the surface; between the ridges are a series of gently rolling plains. For the most part, each escarpment is capped by an erosion-resistant limestone, while the gentle slopes are formed on thick layers of shale.

While the geology of the Osage Cuestas and the Flint Hills is somewhat different, the landscape in the two areas generally looks dramatically different. That is, in part, because much of the land in the Osage Cuestas is somewhat flatter and less rocky, so that much of it has been cultivated. If the ground in the Cuestas had not been cultivated, it would likely today support a tallgrass prairie that is very similar to the tallgrass prairie that dominates the Flint Hills. The eastern edge of the Cuestas borders the oak/hickory woodlands that cover the areas of extreme eastern Kansas and western Missouri. In some respects, the Osage Cuestas are a zone of transition from that oak/hickory forest in the east to the tallgrass prairie to the west.





Wind Energy and the Flint Hills

Kansas has been widely recognized as one the leading states in terms of its potential for producing electricity from the wind. During the 2002 Field Conference, we visited the Gray County Wind Farm, the first commercial wind farm in the state. Located near Montezuma, in southwestern Kansas, this facility, operated by Florida Power and Light Energy, consists of 170 wind generators spread over about 12,000 acres. These turbines have the capacity to generate 107 megawatts of electricity, enough to power about 33,000 households. Landowners receive an annual payment for each of the turbines that is located on their land.

In the time since our visit to Montezuma, additional wind farms have been proposed for various places in the state. In particular, developers have looked at the Kansas Flint Hills, in part because wind potential here is high and in part because the existing infrastructure in the form of transmission lines is already in place. Various proposals for wind farms have been floated, including locations in Butler, Morris, Pottawatomie, Riley, and Waubaunsee counties. Developers have argued that the farms would not only take advantage of the state's wind potential, but would provide a clean, renewable alternative to coal-fired power plants.

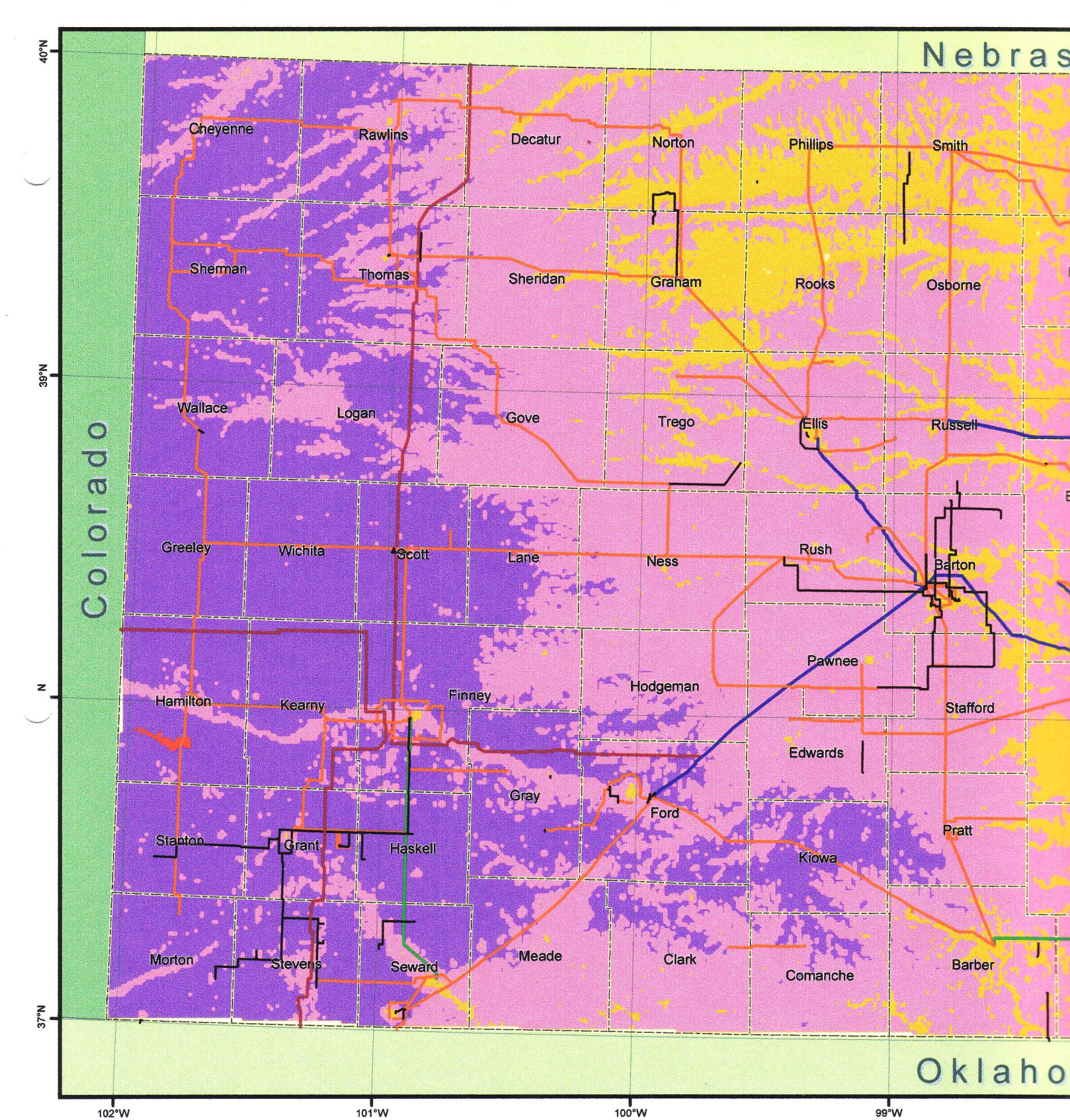
The proposals for Flint Hills wind farms created a strong reaction from opponents. They argue that wind farms would affect the scenic vistas in the hills, that the building of roads to the wind farms and the construction of towers for the generators would disrupt wildlife (particularly the greater prairie chickens, whose numbers have declined and which are especially sensitive to tall structures). They have also argued that any economic benefit would accrue to only a small group of landowners and that wind power is economic only because of tax exemptions that are available to producers of alternative energy.

Opponents to Flint Hills wind farms have generally carried their arguments to county commissions, which have the legal authority to allow or disallow wind farms in the counties that are zoned. At least two of these counties have no zoning, however, and there opponents have also taken their case to the Legislature. The 2004 Legislature held hearings on bills that would place a moratorium on the construction of wind farms in any of the 12 counties that are defined as including the Flint Hills, though those bills did not pass.

In response to these concerns, Governor Kathleen Sebelius created the Wind and Prairie Task Force, operating under the auspices of the State Energy Resources Coordination Council. The Task Force was charged with carrying out the Governor's goal of assisting local communities in their decision-making processes relating to siting of wind-energy projects in the Flint Hills and helping resolve potential conflicts between economic development and preservation in the tallgrass prairie. The Task Force's co-chairs were Jerry Karr, Emporia, and Jerry Lonergan, Topeka. The 24-member Task Force reported to the Governor in early June.

Source

Wind and Prairie Task Force web site: http://www.kansasenergy.org/sercc_wptf.htm



Electric Transmission Lines

- 345 - KV
- 230 - KV
- 161 - KV
- 138 - KV
- 115 - KV
- 69 - KV

Wind Speed at 50 meters	(m/s)	(mph)	Wind Power Density at 50m W/m²
Class 1:	0.00 - 5.60	0.00 - 12.5	0 - 200
Class 2:	5.60 - 6.40	12.5 - 14.3	200 - 300
Class 3:	6.40 - 7.00	14.3 - 15.7	300 - 400
Class 4:	7.00 - 7.50	15.7 - 16.8	400 - 500
Class 5:	7.50 - 8.00	16.8 - 17.9	500 - 600
Class 6:	8.00 - 8.80	17.9 - 19.7	600 - 700
Class 7:	> 8.80	> 19.7	> 700

Kansas Wind Resource Map

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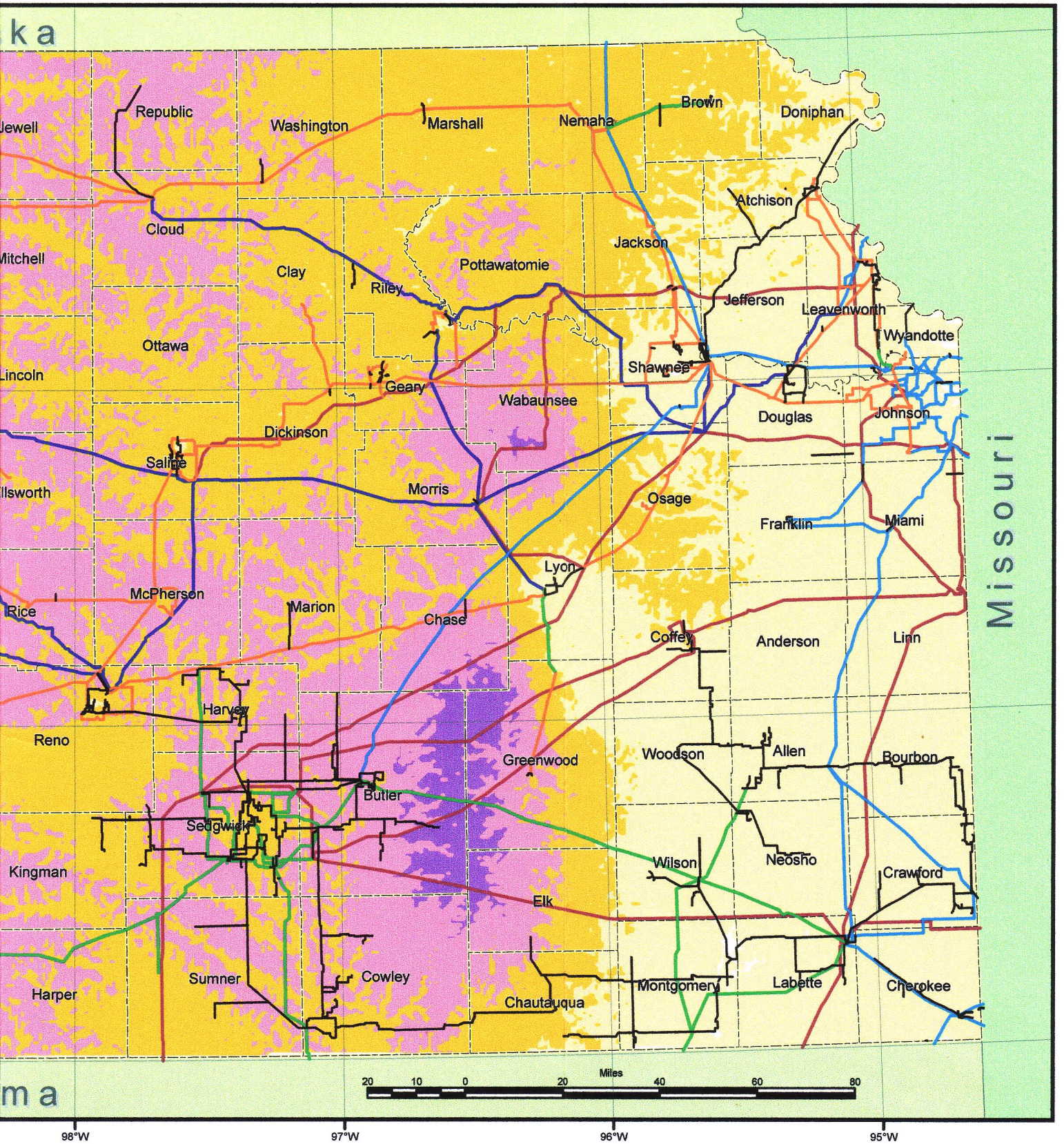
Kansas Corporation Commission
Energy Programs



The wind resource estimates presented on this map were developed by Coriolis-AE using WindMap TM, a program developed by BrowerCo. WindMap TM is a mass conserving model based on NOABL, a program developed in the 1970s by the U. S. Department of Energy. The spatial grid resolution is of 1000 (app) meters.

The resource estimates have NOT been validated by the National Renewable Energy Laboratory (NREL) or independent meteorologist. All wind energy development projects should confirm wind resources by direct measurements in accordance with wind energy industry standards.

Development of this map was performed under contract with the Kansas Corporation Commission Energy Program with funding from the U. S. Department of Energy's Wind Power America Program.

This map may be viewed on the web at: http://www.kcc.state.ks.us/energy/wind.htm

Kansas Corporation Commission
26 March 2004

How Westar Energy Evaluates Wind Power

James Ludwig, Vice President, Public Affairs

Since wind power developers have recently been expressing interest in building wind turbines in Kansas, Westar Energy is often asked whether we plan to become involved. We consider many factors, but a few stand out.

Owner/Operator Versus Power Purchaser

Westar currently is not interested in building, owning, and operating its own wind power facility.[1] We have plenty of experience in owning and operating coal, natural gas, oil, and even nuclear plants, but not wind turbines. Since early 2003, Westar has embarked on a plan to return to its roots as a pure electric utility and to reduce financial and business risks. We believe investing in a wind turbine facility without having the prerequisite staff and experience would be excessively risky.

We are, however, exploring the possibility of purchasing renewable resource power, including wind power, from a developer. Earlier this year, Westar issued a "request for proposal" for renewable resource power. All but one of the respondents proposed wind-turbine facilities.

Capacity

At this time Westar has about a 20 percent capacity margin. This means we have the ability to produce about 20 percent more power than we need to serve all our retail and firm wholesale customers at a period of peak demand.[2] We run our plants or purchase power according to "economic dispatch" or the costs of operation, starting with the cheapest and moving up to the most expensive. Nuclear power is the least expensive because the cost of uranium is, by several orders of magnitude, cheaper than coal. Coal, in turn is several orders of magnitude cheaper than fuel oil or natural gas; therefore, coal plants are next in the dispatch chain. The last plants to be brought on line are our oil and natural gas plants.[3] We try to purchase power from other generators whenever it is less expensive than generating from our own plants.

At this time, Westar does not need additional capacity. But having a 20 percent capacity margin does not necessarily mean that purchasing electricity from a wind-power owner is uneconomic for us.

Cost

If, on average over a long-term contract, buying electricity from the owner of a wind power facility yields us a lower cost per kilowatt hour than running our own plants or buying power from other sources, then Westar – and our customers – would be better off if a wind-power agreement was part of our power portfolio.

By the request for proposal process, we are using the best data to ascertain whether purchasing wind power makes economic sense for us. Wind-power developers who want to do business with us will have to make their best offer along with others. We can then compare their offers with one another's and with the cost of our alternatives.

Our regulators (the Kansas Corporation Commission) determine whether we are allowed to recover power-purchase costs from our customers generally based on two criteria. First, the commis-

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[1] Since the mid 1990's, Westar has owned and operated two small wind turbines at our Jeffrey Energy Center coal plants, but we do not claim that these count as a wind-power facility. From the outset, Westar has always treated these two turbines as an experiment. They are smaller than the typical wind turbines installed today. We located them at Jeffrey because we owned the land, had ready access to transmission lines, and had evaluated the potential for environmental impact to be very small. The wind at that site is adequate, not ideal.

[2] As a member of our area-reliability council, we must maintain a minimum of a 12 percent capacity margin. Electric utilities cannot add capacity megawatt by megawatt because it would be a prohibitively expensive way to plan for future load growth. Generating plants are built, and then load "grows" into the additional capacity.

[3] Some industry critics observe that some of the costs associated with uranium and fossil fuels are not accounted for because the costs of environmental degradation and health-care costs associated with breathing emissions from combusting fossil fuels are not incorporated in rates. Although the argument may be explored from an environmental perspective, the point is not considered in the rates customers currently pay their electric utility.

sioners determine whether the power-purchase agreement is fitting for the reliability needs and characteristics of our entire power-resource profile. Second, the commissioners rule whether we have purchased power at the most reasonable least cost possible given the information we were aware of at the time of the purchase.

Location

Wind developers try to locate their wind-power facilities as close to transmission lines as possible. By Federal regulation, an electric utility such as Westar is required to connect developers' wind facilities to the power grid. Wind-power facility owners, however, are required to pay for the connection and for the studies that determine whether sufficient transmission capacity to transmit their electricity exists on the grid.

From the perspective of an electric utility, transmission-service expenses are lessened, and the electricity from a wind-power facility is easier to manage, if the wind facility is located in the utility's control area. The largest electric utility in any given area usually has responsibility for providing transmission service, voltage support, load following, reliability assurance, and other ancillary services within its general geographic area; this is referred to as its control area.

The environmental interests in Kansas have been divided over siting wind turbines in the Flint Hills and some other ecologically sensitive regions. In our request for proposals, Westar asked respondents to tell us to what extent they have considered environmental standards and concerns in their proposed sites.

Benefits and Challenges of Wind Power

Any source of electric power has advantages and disadvantages. Coal-fired plants, for example, are known for being reliable and available if properly maintained; emissions from coal-fired plants, however, cause environmental pollution. Likewise, wind power offers benefits and causes challenges.

On the plus side: wind power does not cause any emissions; fuel is free; and many parts of Kansas have excellent wind characteristics. Wind developers can, and appropriately do, extol other advantages.

On the downside: wind developers have struggled to price their electricity competitively, but have made strides as wind-turbine technology improves; wind turbines have little "capacity" value, because they cannot be relied on hour by hour, day by day, to the extent a nuclear plant can be. Critics of wind power can, and appropriately do, list other disadvantages.

For an electric utility, wind power poses challenges in integrating its output into the utility's resource mix. Wind power either is variable or intermittent – variable when the wind gusts *within* the velocity range at which a turbine can generate power or intermittent when wind is *outside* that range, in which case no electricity is generated. When variable, an electric utility must balance fluctuations in wind output with other sources of generation. The best generation for balancing wind power is a natural gas plant, because natural gas plants are built to ramp up and down providing a flexible amount of power.[4] Unfortunately, natural gas prices are high, and it appears they will stay high. This phenomenon affects a utility's cost analysis of wind power.

When?

Has the time come for Westar to buy wind power from a developer? Our decision hinges on the factors mentioned above (and to a lesser extent on other factors). We are still analyzing respondents' answers to our request for proposals. We have not yet made a final decision.

Resource Contact

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[4] Nuclear and coal plants are base-load plants, which means they run best at constant levels and are not engineered to ramp up and down.

Rosalia Wind Project

Houston-based Zilkha Renewable Energy had proposed a wind project 3 miles east of Rosalia on either side of U.S. Highway 54. Rosalia is about 12 miles east of El Dorado in Butler County. The project proposal was withdrawn in October 2002, and is currently on hold.

The 73-turbine wind project would be arranged on about 9,000 acres of private land. Each turbine at the proposed project would be 230 feet tall with 200-foot-long rotors, and about half the towers would have lights on them. The Rosalia project would produce enough energy to power about 30,000 homes a year. The power could go to cities in Kansas or regional utilities in Missouri or Oklahoma.

Zilkha Renewable Energy has operating wind farms in Oklahoma, Pennsylvania, Iowa, California, and Costa Rica. The Zilkha family sold Zilkha Energy Company, an oil and gas exploration business, in 1998, and soon after became involved in renewable energy.

Sources

O'Toole Buselt, Lori, 2002, Wind Farms Polarize Butler County: The Wichita Eagle, September 30, 2002.
Zilkha Renewable Energy web site: http://www.zilkha.com

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Elk River Wind Project

The Elk River Wind Project is being developed by Elk River Windfarm, LLC, a Kansas limited liability company wholly owned by Greenlight Energy, Inc. of Charlottesville, Virginia. Greenlight Energy and HMH Energy Resources of Larkspur, California, are co-developers of the project. The project is located in Butler County about 4 miles south of Beaumont, Kansas. Elk River Windfarm, a 67-turbine, 150-megawatt project is permitted and ready for the start of construction and procurement activities, with project completion scheduled for the third quarter of 2005.

Elk River Windfarm holds long-term leases for approximately 8,000 acres of land, of which less than 2–3 percent will be disturbed by the project's construction and operation. The project is designed to be compatible with the existing cattle ranching and farming operations on the properties.

Three meteorological towers installed on the project site have gathered wind data since 1995. Seven years of data demonstrate average wind speeds that exceed 8.5 meters per second at a height of 65 meters. The estimated output of a 150-megawatt project such as Elk River is 560 gigawatt-hours annually.

The site is close to midwestern load centers and transmission capacity. Wichita, Topeka, Kansas City, Tulsa, and Oklahoma City are all within 150 miles of the project site. A 345-kilovolt transmission line, owned by Westar Energy, is within 4 miles of the site.

The project is in a remote and sparsely populated area. The total estimated population within 1,000 feet of the property lines is zero. Elk River commissioned several environmental studies to identify potentially sensitive environmental areas or species on the site. All studies were conducted by nationally recognized environmental experts who concluded that the project would create no significant adverse impacts.

Greenlight Energy, Inc., is a national developer of large-scale wind energy. Greenlight's projects span 15 states and will support over 1,000 megawatts of wind-energy capacity, representing a potential investment of over $1 billion in wind-energy facilities. When completed, these projects have the potential to generate enough energy to power 350,000 households. Elk River Windfarm is one of two projects nationwide that have been publicly announced by Greenlight.

HMH Energy Resources, Inc., provides services both to consumers who want to reduce energy use and costs, improve reliability, or install on-site generation; and to developers of energy-generation projects. HMH has extensive experience and expertise in economic analysis, energy procurement, project structuring and financing, risk analysis and mitigation, contract negotiations, and policy formation.

Sources

Elk River Windfarm, LLC Fact Sheet.
Greenlight Energy web site: http://www.glnrg.com/
HMH Resources web site: http://www.hmhresources.com/

Resource Contacts

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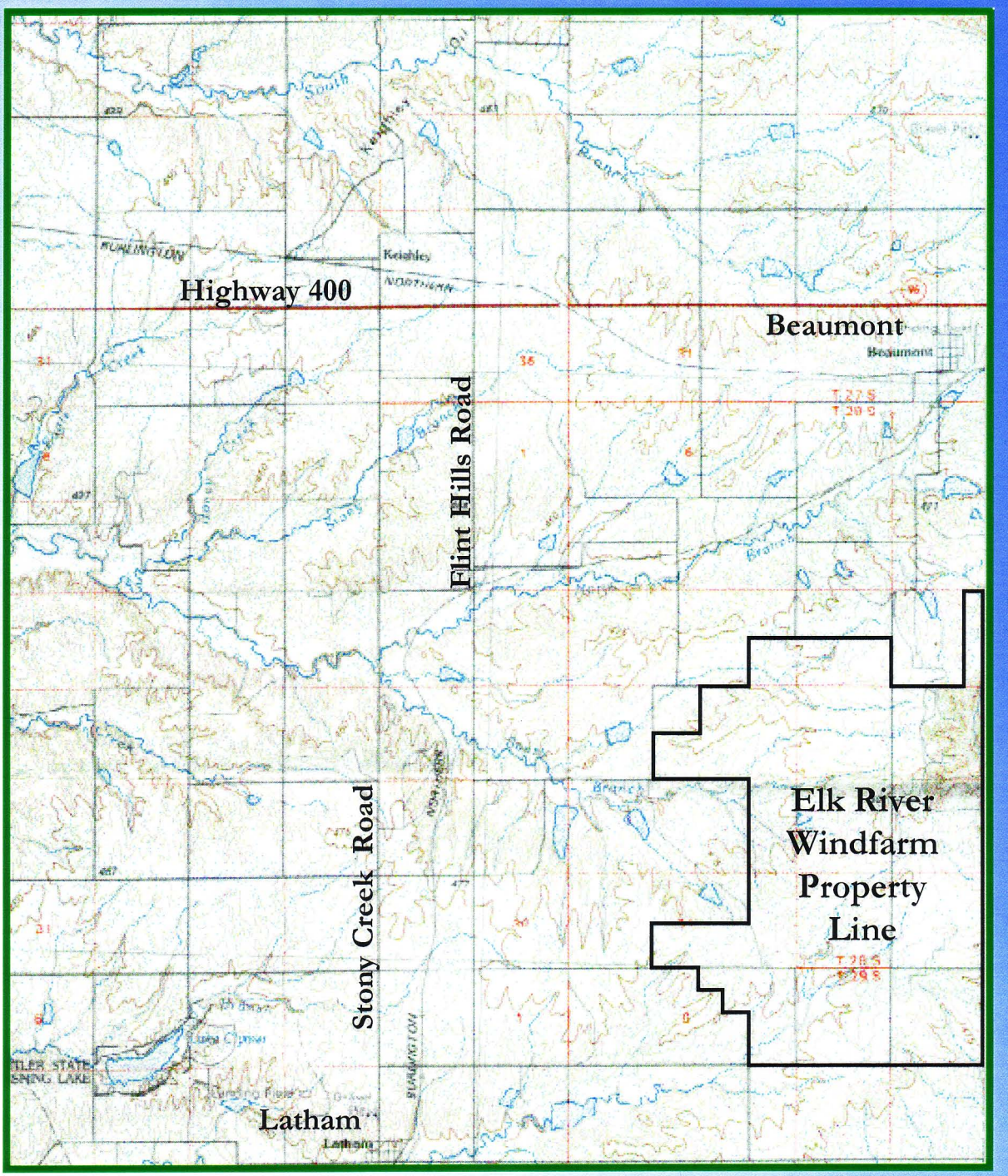
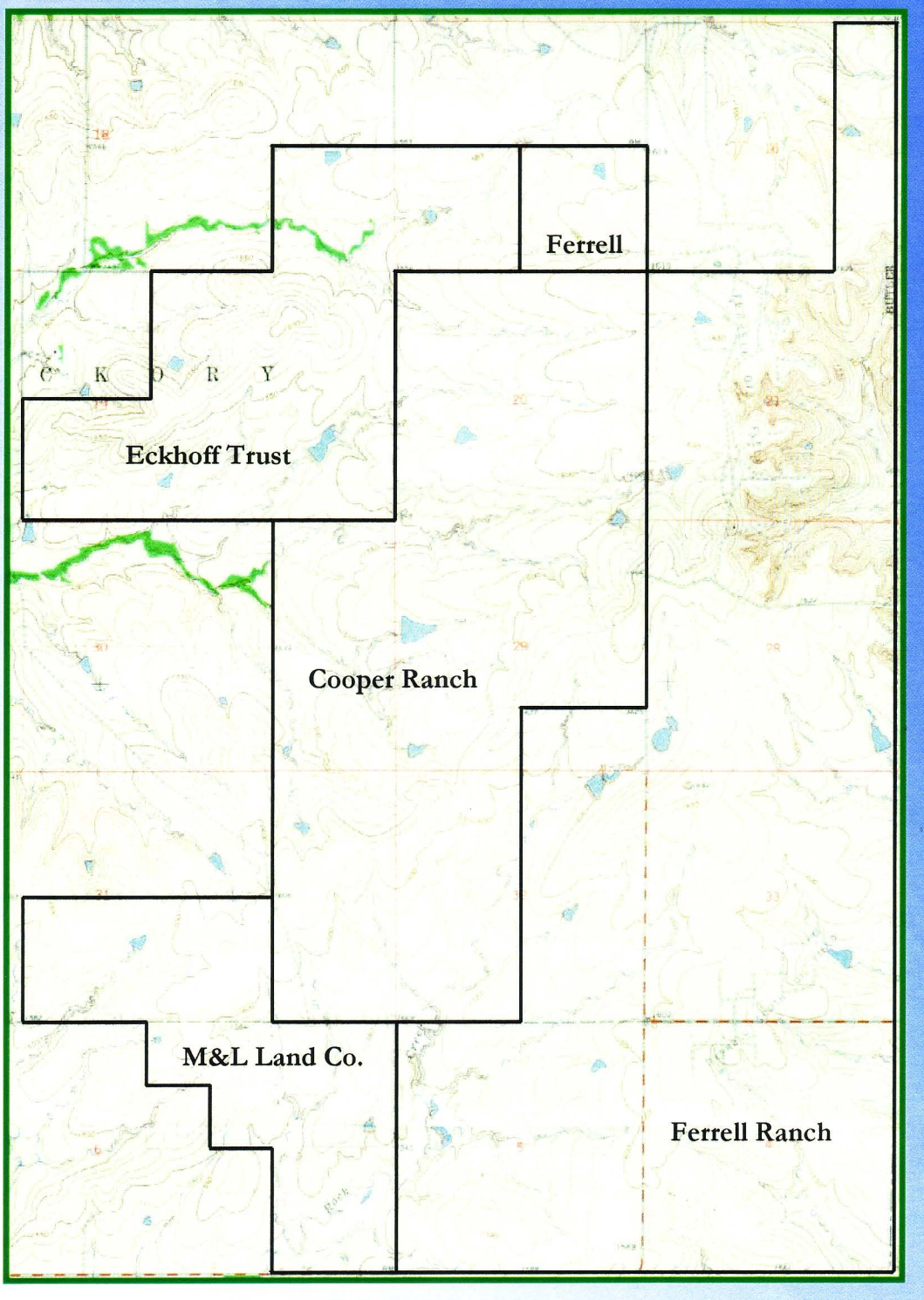
Elk River Windfarm, LLC



-- Project Site Location --

Elk River Windfarm, LLC



-- Full Project Site Delineated--

Tallgrass Prairie National Preserve

The Tallgrass Prairie National Preserve, established in 1996, consists of 10,894 acres in Chase County (fig. 4-1). The preserve is operated jointly by the National Park Service and the National Park Trust. The preserve consists of pastures on both the east and west side of U.S. Highway 177 and a ranch headquarters and barn. Fox Creek drains a portion of the preserve east of the highway, while Palmer Creek cuts through the ranch's extreme north end. A small amount of the bottom ground along Fox Creek has been cultivated (today it is primarily in brome grass, though there are plans to restore some of the area to tallgrass prairie and some will be planted to historic crops and orchards), and the remainder of the ranch is in native prairie.

Native American trails cut through the preserve and some evidence of prehistoric activity has been found here, though archeological investigations are not complete. The oldest homestead here was established just east of today's ranch headquarters in 1860. In the 1870's, Stephen F. Jones moved to Chase County and established a large-scale livestock ranch in the area now covered by the preserve. Jones named his property the Spring Hill Ranch, for springs that issued in the hill just west of the headquarters, and in 1881 built a three-story mansion in the 'Second Empire' style of nineteenth-century architecture. He then added the massive barn and other outbuildings. Jones also donated the land for the Fox Creek School, about one-half mile north of the headquarters.

Jones eventually moved to Kansas City and sold the ranch to Barney Lantry, a Strong City rancher. In 1906, Lantry sold it to a ranching outfit headquartered in the Red Hills of southwestern Kansas whose brand was Z–, and the ranch is often referred to as the Z Bar to this day.

Efforts began as early as the 1960's to establish a national park of some sort in the Flint Hills as a way to preserve, and establish public access to, a part of the tallgrass prairie. However, local opposition to the federal government, and the possible removal of the land from production and the tax roles, thwarted any action until 1989, when the Audubon Society bought an option on the Z Bar. In 1994, the land was purchased by the National Park Trust, a private land-conservancy organization dedicated to saving parklands and resources.

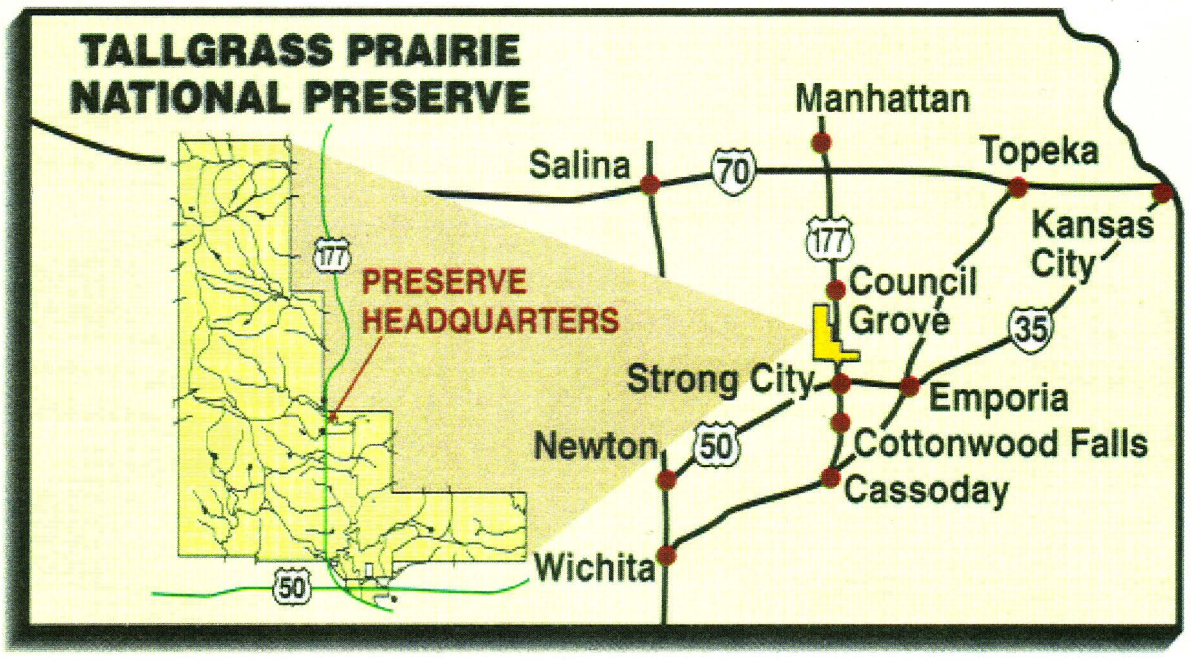


Fig. 4-1—Map showing the location of the Tallgrass Prairie National Preserve.

On November 12, 1996, Congress passed legislation creating the Tallgrass Prairie National Preserve. The preserve is the only unit in the national park system that is dedicated to the tallgrass prairie ecosystem. Because of concern about the level of federal involvement, the legislation restricted National Park Service ownership of land to no more than 180 acres. The Park Service was to work cooperatively with the private National Park Trust in operating the ranch, an arrangement that Senator Nancy Kassebaum Baker (who was active in the preserve's creation) described as "a model for the nation." In 2002, the Trust donated 32 acres to the Park Service; that area includes the ranch headquarters, barn, schoolhouse, and other outbuildings. Within the past year, Governor Kathleen Sebelius has announced the formation of a Kansas trust that would take over for the National Park Trust.

Though the preserve is owned and operated jointly by the National Park Service and the National Park Trust, the land is still leased privately for cattle grazing and the preserve is still very much a working ranch. The Park Service and the Park Trust offer tours of the preserve, however. For a small fee, visitors can tour the ranch house and the barn and take a bus ride out onto the prairie, where rangers describe the land and its flora and fauna. A short hiking trail runs from the headquarters to the Fox Creek school house. The Trust also operates a bookstore in the headquarters. The National Park Service has worked extensively with local input to develop long-term plans for the preserve, including the possibility of more extensive hiking trails, overnight camping, the introduction of bison, and a new visitors center. The preserve's superintendent is Steve Miller. Annual visitation is 18,000 to 20,000 visitors per year, with the peak seasons coming in the spring and fall.

The preserve is also the focus of fairly extensive scientific study. An ongoing plant survey has identified hundreds of plant species found on the preserve. Scientists from the U.S. Geological Survey's biological division have studied a prairie chicken booming ground on the ranch. Park Service archeologists are continuing to study archeological sites on the preserve, including not only evidence of Native Americans, but structures and other artifacts left behind by the early days of white settlement. The Kansas Geological Survey conducted a survey of springs on the property, identifying 237 springs, though many of these are 'wet-weather' springs that dry up during the summer. The Survey is also developing a geologic map of the area around the headquarters and of the entire preserve.

Sources

National Park Service, Tallgrass Prairie National Preserve web site: www.nps.gov/tapr

National Park Trust web site: www.parktrust.org/zbar.html

U.S. Department of the Interior, National Park Service, 2000, Final General Management Plan/ Environmental Impact Statement, Tallgrass Prairie National Preserve, Kansas, September 2000, 195 p.

Resource Contacts

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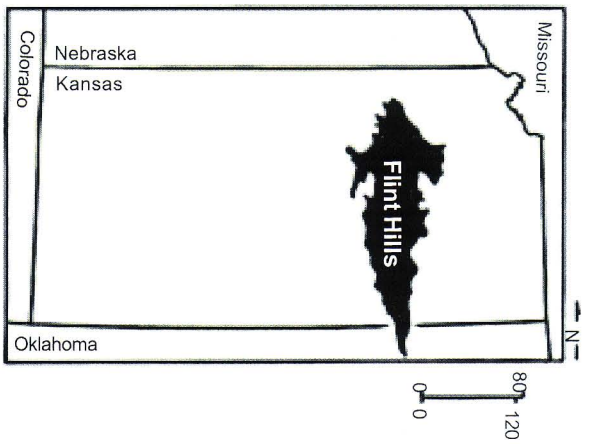
Geology and the Prairie

National Park Service
U.S. Department of the Interior

Tallgrass Prairie National Preserve
Strong City, Kansas

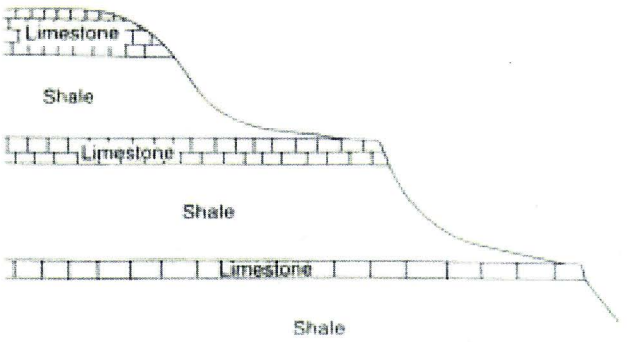
Flint Hills



Few places in this country demonstrate the connection between landscape and people better than the tallgrass prairie in the Flint Hills. The Flint Hills and the surrounding area are shaped by the rocks that lie directly beneath the vegetation and soil—the same rocks which made cultivation difficult and led to the use of native prairie grasses for ranching. This rocky terrain is closely tied to today's ranching culture. The Flint Hills region is characterized by thin soils, limestone outcrops, vegetation-covered shale intervals between the limestones, deeply incised valleys, and dissected topography. The Flint Hills cross east central Kansas from the north near the Nebraska border and extend into Oklahoma to the south. Many of the limestones contain nodules and layers of flint (also called chert)—a hard, dense rock that resists erosion. As the limestones erode, angular fragments of flint accumulate at the surface, giving the Flint Hills their name.

The thin, rocky soils and steep slopes of the Flint Hills have precluded cultivation, effectively preserving the native grasslands. Historically, only deep ravines and the flood plains of streams were forested. Most cultivation is limited to river and stream bottoms, such as along Fox Creek, just east of the ranch headquarters area; there, the bedrock is covered by a layer of river-deposited sediments that have developed thick soils that are especially valuable for cultivation.

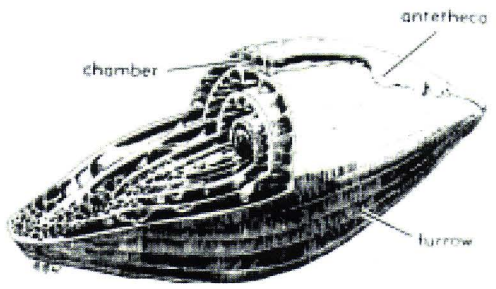
Layers of Ocean Floor



Limestone ranges in color from nearly white to brown. It is hard, and more resistant to erosion than the softer shales, which are usually gray or tan. The alternating beds of limestone and shale produce hillsides with a terraced appearance. Many of the limestone layers create notable benches on the hillsides; the shales form the steep slopes between the benches. The hills themselves are created by a process called differential erosion. Tougher, more resistant limestones and flint cap the tops of hills, while the land between them has been worn away and slowly removed.

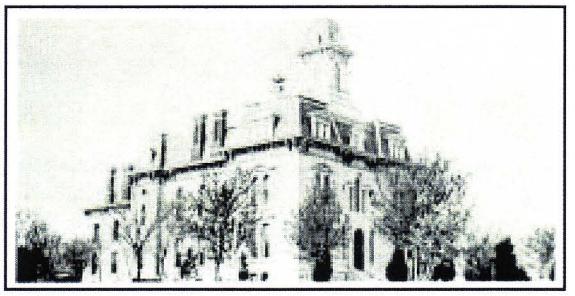
The rocks of this area—alternating beds of limestone and shale—were deposited during the Permian Period of geologic history, about 280 million years ago. At that time, the climate here was hot, and the surface was covered by ocean water most of the time. The limestones represent periods when the region's surface was covered by shallow, tropical oceans which teemed with life; shales represent times when mud was deposited on the ocean floor. Each of these sedimentary rock layers has been named after towns, creeks, or other nearby landmarks; the names are based on the locations where each rock layer was first found and described by geologists.

Abundant Fossils



A closer look at the rock reveals many fossils. Most of these marine fossils are invertebrates—animals without backbones—such as corals, clams, snails, bryozoans (colonies of animals resembling sea fans), sea urchins, crinoids (a stalked animal that is distantly related to the starfish and sea urchin), and clam-like animals called brachiopods. All of these organisms at one time lived in a shallow, warm, tropical ocean. Particularly abundant in some limestones are fusilinids—fossils shaped like wheat grains; these were one-celled animals that floated in the water. When they died, their skeletons drifted to the bottom of the ocean and were preserved in the lime mud of the ocean floor. These lime muds eventually became limestone. Fusilinids can be seen in many of the limestone blocks used for building on the preserve.

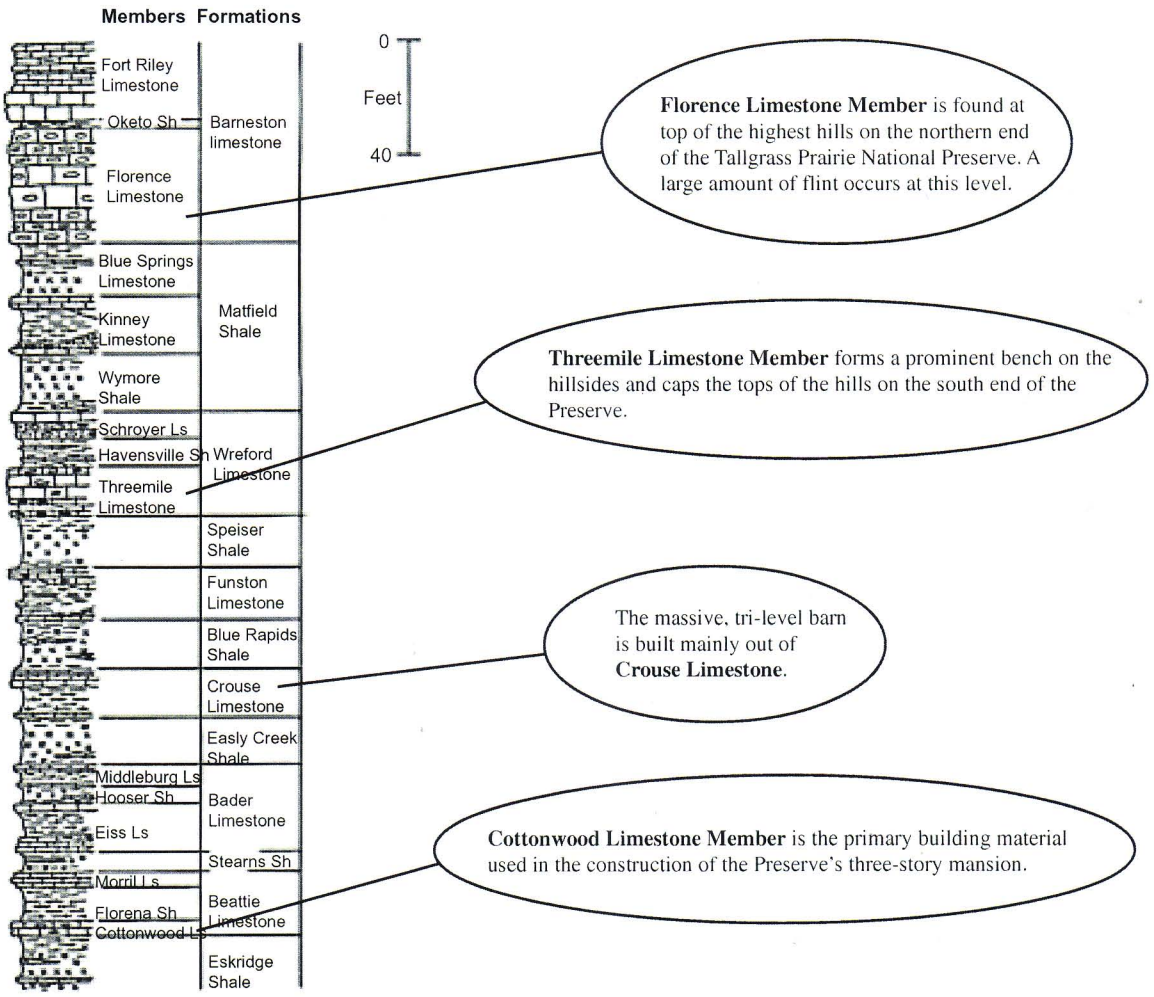
Building With Limestone



Wood was scarce when the prairie was settled primarily by Anglo-American emigrants in the mid-1800s, so the abundant limestone became important for constructing buildings, bridges, and fences. The Cottonwood limestone, a rock layer that occurs on the preserve near the base of the hills in the Fox Creek Valley, is a common building stone in Kansas. The Cottonwood is thick, nearly white in color, even-textured, durable, and contains numerous fusilinids. Blocks of stone three or more feet thick, and several feet in length and width, can be taken from a single ledge. The ranch house, portions of the schoolhouse and barn, and many other structures on the preserve were built with Cottonwood limestone. Numerous buildings in the state, including the Chase County Courthouse in Cottonwood Falls, and most of the State Capitol building in Topeka, were constructed with Cottonwood limestone.

Classification of Rocks at the Tallgrass Prairie National Preserve

Permian Period



For additional reading:

- Kansas Geology: An Introduction to Landscapes, Rocks, Minerals, and Fossils Edited by Rex Buchanan, University Press of Kansas, 1984.
- Ancient Life Found in Kansas Rocks: An Introduction to Common Kansas Fossils by Roger B. Williams, Kansas Geological Survey, Educational Series I, 1975.
- Konza Prairie: A Tallgrass Natural History by O.J. Reichman, University Press of Kansas, 1991.

This publication was developed through cooperation with the **Kansas Geological Survey**.

SCHEDULE & ITINERARY

Friday June 11, 2004

7:00 am	Breakfast at the Holiday Inn Express, Emporia
8:00 am	**Bus Leaves Holiday Inn Express for Site 8**
8:45 am	**SITE 8**—Wolf Creek Generating Station *Susan Maycock*, Wolf Creek Nuclear Operating Corp.
12:00 pm	Bus to Motel
12:45 pm	**Arrive Holiday Inn Express, Emporia**

Wolf Creek Generating Station

Wolf Creek Generating Station provides electrical power for about 800,000 customers in Kansas and Missouri. Wolf Creek Generating Station is owned by Westar Energy, Kansas City Power & Light, and Kansas Electric Power Cooperative, Inc. Wolf Creek Nuclear Operating Corporation, a wholly owned subsidiary of the three utilities, operates the plant and employs approximately 1,300 people.

Uranium used in nuclear fuel is plentiful in the United States and the world. Cost of uranium fuel is about half the cost of coal, and about a fourth as expensive as oil and gas. Use of nuclear fuel does not contribute to "acid rain" or the "greenhouse" effect. By choosing to build a uranium-fueled plant, as well as coal-fired plants, Wolf Creek's owners have a diversity of fuel sources to help assure an adequate, reliable supply of electricity.

Generating Electricity from Uranium

Wolf Creek generates electricity by heating water to produce steam. Steam turns turbines, which spin a magnet inside an electrical generator, thus producing electricity. Wolf Creek Generating Station has the largest electrical generator in Kansas.

Instead of burning gas, oil, or coal as a heat source, Wolf Creek produces heat by splitting, or "fissioning" atoms of uranium fuel. Fission begins when a neutron strikes a uranium atom, causing the atom to split. Heat is released and still more neutrons are produced, which strike more atoms, producing more heat. This process is called a controlled nuclear reaction and takes place inside a reactor.

Nuclear fuel in the reactor is in the form of half-inch ceramic pellets that are stacked into metal alloy fuel rods that are 12 feet long. A fuel bundle contains 264 rods, and there are 193 fuel bundles in the Wolf Creek reactor. The fuel core weighs about 110 tons and can produce the energy equivalency of approximately 19 million tons of coal. About one-third of the fuel is replaced every 18 months.

Water surrounding these fuel bundles in the reactor is heated to more than 600 degrees Fahrenheit by the fissioning of uranium. This water system is kept under high pressure to prevent boiling. As this "super-heated" water circulates in pipes through four steam generators, heat is transferred to a second water system, which is completely separate from the first. Water in this second system boils, creating steam that is used to spin the turbine and produce electricity.

The steam then enters a condenser, where water from a third system, Wolf Creek's 5,090-acre cooling lake, circulates through tubes. Steam passing over the tubes is condensed back into water and then returned to the generators to repeat the cycle. Lake water does not physically mix with the second water system, but does absorb about 40 degrees of heat from the steam. The lake water is discharged back into the lake where it eventually cools to ambient temperatures.

Safety

Because the concentration of fissionable uranium in a nuclear power plant's fuel core is only a fraction of that necessary for an explosion, nuclear power plants cannot explode like an atom bomb.

A nuclear plant does contain radioactive material, which must remain isolated from the environment. Because of this, nuclear plant design includes numerous safety systems and physical barriers to prevent the release of radioactive materials.

The ceramic oxide pellets that contain the enriched uranium are designed to confine radioactive material at greater than normal operating temperatures. Fuel rods that contain the uranium fuel pellets are sealed at the fuel-processing facility and are not opened at the plant. A second barrier, the "reactor pressure boundary," involves the reactor vessel, piping, and the water used to cool the fuel and transfer heat. This system is a closed loop that can stand strains much higher than experienced during normal operation. A third measure of protection is the domed containment building inside which the reactor and steam generators are housed. Constructed of reinforced concrete 3 to 4 feet thick, with a leak-tight steel inner wall, this structure is designed to contain radioactive materials even if all other barriers fail.

To ensure the plant is operated properly, control-room operators are trained extensively and licensed by the Nuclear Regulatory Commission. The extensive training program includes hands-on operations in a state-of-the-art control-room simulator to teach operators how to handle the plant under normal conditions, as well as emergency situations.

In addition to safety measures that are designed into the plant, an elaborate emergency action plan is in place, as required by Federal regulatory agencies. This plan is designed to protect public health and safety. It involves about 1,400 people from Wolf Creek Nuclear Operating Corporation, the State of Kansas, and Coffey County who are trained to respond in the event of a plant emergency.

Environmental Work

The Wolf Creek site includes about 10,500 acres. Roughly 300 acres of the land is used for the power plant and associated buildings. About one-half of the land is leased to area farmers and ranchers for crops and cattle grazing. Crop ground leases require conservation practices such as contour farming and construction and maintenance of grass waterways and terraces which help ensure topsoil conservation. When farmers harvest crops, they leave about one-third of the crops in the fields for wildlife. Grazing restrictions, pasture rotation, and controlled burning ensure continued rangeland health. Another 1,500 acres of company land are managed solely for area wildlife. As a part of this, a tallgrass-restoration program was implemented prior to operation of the plant.

Environmental studies began in the area before plant construction started in 1977. Weather conditions, wildlife, and archeological studies were conducted. The cooling lake, which was formed by damming Wolf Creek and is supplemented when necessary with water from John Redmond Reservoir, has become home to many species of fish, birds, and wildlife.

Wolf Creek cooling lake's fish population is a functional part of the powerplant. Predator fish (bass, crappie, walleye, catfish) were stocked in the lake to control gizzard shad which, if present in large numbers, can clog intakes where water is pumped from the lake to the plant's cooling system. If this occurs, the plant must shut down and may require expensive repairs. The lake, now called Coffey County Lake, was opened to public fishing in 1996.

Fig. 5-1—Wolf Creek Generating Station.

The Wolf Creek Environmental Education Area, located on the upper reaches of Coffey County Lake, has been established with the support of several public and private organizations. This 160-acre area, which opened in 1994, contains three self-guided trails, a bird viewing blind, restrooms, and a picnic area. Two of the trails are accessible to all visitors, including those in wheelchairs or with limited mobility. The Wolf Creek Environmental Education Area is an official Outdoor Wildlife Learning Site (OWLS) partially funded by a grant from the Kansas Department of Wildlife and Parks through the Chickadee Checkoff program.

Wolf Creek Generating Station Facts

Cost	$3 billion
Capacity	1,200,000 kilowatts
Construction Start	May 1977
Commercial Operation	September 1985
Fuel	Ceramic pellets with 4.5% uranium-235
Reactor:	
Manufacturer	Westinghouse
Type	Four-loop Pressurized Water Reactor
Dimension	44 feet high, 14 feet wide
Containment Building:	
Dimension	208 feet high, 140 feet wide
Materials	Concrete (3–4 feet thick) lined with a leak-tight steel barrier
Coffey County Lake	5,090 acres

Sources

Wolf Creek Generating Station pamphlet.
Wolf Creek Environmental Education Area brochure.
Wolf Creek Nuclear Operating Corporation website: http://www.wcnoc.com/

Resource Contact

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