http://www.uky.edu/KGS/water/library/gwatlas/Oldham/Oldham.htm

Kentucky Geological Survey
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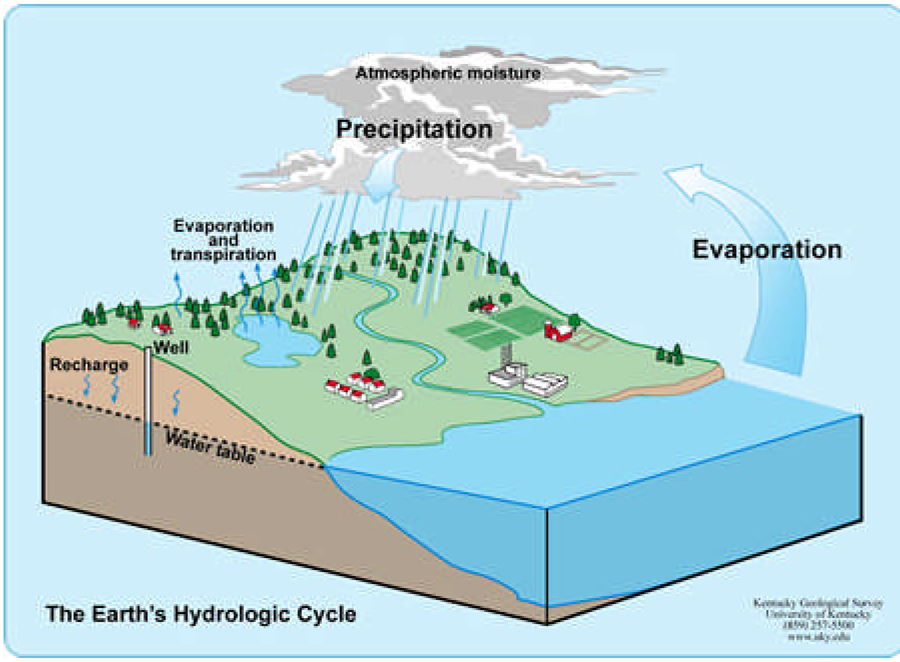
Groundwater Resources of Oldham County, Kentucky



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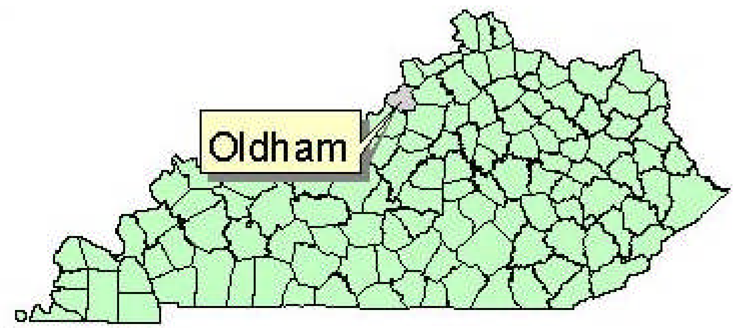
County Report 93, Series XII **ISSN 0075-5567** **2004**

Foreword

This report on the groundwater resources of Oldham County was prepared for the Water Resource Development Commission by the Kentucky Geological Survey. Reports were prepared for each of Kentucky's 120 counties. These reports complement other county planning reports of the commission, including strategic water development plans and strategic wastewater treatment plans, and the Kentucky Division of Water's county water-supply plans.



Each groundwater resource report is a compilation of information on hydrology, geology, topography, water supply, and water quality taken from maps, reports, and data collected from 1940 to 2000. The primary way of accessing the information is via the Internet--for example, by linking to the Water Research Library on the Kentucky Geological Survey's Web site. The digital form of this report, and its ability to link to data anywhere on the Internet, makes it a dynamic tool for gathering information.

The current compilation is by no means exhaustive; no doubt valuable data have been overlooked. As new or more-detailed information becomes available, it can be easily linked to this report.

Although this report may be of value to planners and geologists for strategic planning and feasibility studies, it cannot replace field investigation for the development or assessment of site-specific groundwater resources.

Disclaimer Statement: The Kentucky Geological Survey (KGS) is continually gathering data from multiple sources, interpreting the data it gathers, and reflecting its interpretations on maps such as those in this report. Reasonable efforts have been made by KGS to verify that these maps and the digital data provided thereon accurately interpret the source data used in their preparation; however, these maps may contain omissions and errors in scale, resolution, rectification, positional accuracy, development methodology, interpretations of source data, and other circumstances. As additional data become available to KGS, and as verification of source data continues, these maps may be reinterpreted or updated by KGS. These maps are designed at a designated scale and should not be enlarged. Furthermore, these maps should not be used for navigation, engineering, legal, or any other site-specific use. Nothing contained herein shall be deemed an expressed or implied waiver of the sovereign immunity of the Commonwealth or its duly authorized representatives, agents, or employees.

Introduction

This report is intended to provide both a basic understanding of groundwater resources in Oldham County and links to more in-depth sources of information, maps, and data. Links are highlighted in blue and underlined. Most of the links are to documents or maps in Adobe PDF files. PDF files may be viewed with the free Acrobat Reader. Some of the files are large and, depending on your system, you may prefer to download the files to your system overnight. A few maps may be in MrSid file format. These files are viewable with the free MrSid Viewer, with ESRI geographic information system software, and with any other MrSid-compatible software.

Acknowledgments

Many individuals and several agencies provided information and assistance in the preparation of this atlas. The GIS students at the Federal Prison Camp, Lexington, Ky., prepared index maps and created spatial data from historical well maps. Staff members of the Kentucky Natural Resources Information System provided technical and programming assistance. Reports from the Kentucky Division of Water, the U.S. Geological Survey, the Kentucky Geological Survey, the Water Resource Development Commission, the U.S. Census Bureau, and other agencies were used. And finally, the atlas would not have been completed at this time if the Water Resource Development Commission had not promoted the project and provided both financial and technical support.

Overview

About 2,900 residents of Oldham County rely on private domestic water supplies: 1,400 use wells and 1,500 use other sources. The Ohio River alluvium is the best source of groundwater in the county. Many properly constructed drilled wells will produce several hundred gallons per minute from the alluvium, with most wells able to produce enough for a domestic supply at depths of less than 100 feet. Water is hard or very hard, but otherwise of good quality. In the main sections of the larger creek valleys, in some of the Ohio River bottoms, and on broad ridges in a limited area south of the towns of Skylight and Crestwood, most drilled wells will produce enough water for a domestic supply at depths of less than 100 feet. Some wells located in the smaller creek valleys and in some broad ridges in western and central Oldham County will produce enough water for a domestic supply, except during dry weather. In upland areas of the rest of Oldham County, about half the county, most drilled wells will not produce enough water for a dependable domestic supply, unless they are drilled along drainage lines, in which case they may produce enough water except during dry weather. Groundwater in these areas is hard or very hard, and may contain salt or hydrogen sulfide, especially at depths greater than 100 feet.

Water Use

Oldham County had an estimated population of 41,143 (14,209 households) in 1999; projected population is 52,612 (18,453 households) in 2020. Public water is provided to about 93 percent of the residents. In areas not served by public water, slightly fewer than half the households use wells and the remainder use other sources. About 30 households will be added to public water service through new line extensions from 2000 to 2020. If all the proposed water-line extensions are made, about 7 percent of the county will still rely on private water supplies in the year 2020.

The Water Resource Development Commission has prepared a report on water-supply infrastructure in Oldham County.

It is estimated that there are over 200,000 water wells in Kentucky. The Kentucky Groundwater Data Repository, maintained by the Kentucky Geological Survey, has information on over 50,000 of these wells. The locations of wells and springs in the county for which data are available is shown on the map of wells and springs in Oldham County. A map of certified well drillers in Kentucky has been prepared by the Kentucky Division of Water.

Topography

Discussion from McGrain and Currens (1978)

Oldham County is in the Outer Bluegrass Region of north-central Kentucky. The Ohio River marks the northwestern border, and the normal pool elevation of the Ohio River, 420 feet, is the lowest elevation in the county. Adjacent bluffs rise abruptly 200 to 350 feet above the river or narrow floodplain and mark the sites of the greatest local relief.

The terrain is gently rolling to hilly, with upland elevations ranging from 650 feet on the west to 900 feet on the east. The highest elevation in the county is 920 feet, a flat-topped ridge east of Kentucky 53 about 2 miles southeast of LaGrange.

The eastern edge of the county is more highly dissected by normal stream erosion and is noticeably hilly. A few ridges are flat topped. The width of the ridges increases to the west. In the vicinity of the western edge of the county, wide expanses of gently rolling to nearly flat land are present. Here, local relief is slight, except near Floyds Fork and Harrods Creek, which have carved valleys 150 to 200 feet below the surrounding upland.

The elevation of LaGrange, the county seat, is 867 feet. Other elevations include Ballardsville, 860 feet; Brownsboro, 721 feet; Buckner, 831 feet; Crestwood, 798 feet; Skylight, 730 feet; and Westport, 486 feet. The elevation of Crystal Lake, southeast of LaGrange, is 777 feet.

The 7.5-minute topographic quadrangle maps that cover Oldham County are shown, by name and by index code (Kentucky Natural Resources and Environmental Protection Cabinet) on the index map.

Geology of the County

In Oldham County, water is obtained from consolidated sedimentary rocks of Ordovician, Silurian, and Devonian ages, and from unconsolidated sediments of Quaternary age. The oldest rocks found on the surface in Oldham County, the Drakes Formation, were deposited in shallow seas 490 million years ago during the Ordovician Period. In the Late Ordovician, the seas became relatively shallow, as indicated by the amounts of mud (shale) in the sediments. When the waters were clear and warm, a profusion of animal life developed, particularly brachiopods and bryozoa. Lying on top of the Ordovician rocks are the Silurian rocks, which were also deposited in warm seas, 430 million years ago. In Kentucky, the Silurian seas were commonly warm and clear, although the presence of some shale beds suggests that muddy conditions prevailed at times. Locally, numerous corals and brachiopods can be found in the Silurian limestones and dolomites. The Devonian New Albany Shale lies above the Silurian rocks. This shale, also called the black shale, was formed when the deep sea floor became covered with an organic black muck 400 million years ago. The muck is now hard black shale (an oil shale) and is one of the most distinctive of all geologic formations in Kentucky. Over the last million years, unconsolidated Quaternary sediments have been deposited along the larger streams and rivers.

Geologic Formations in the County
Unconsolidated deposits
Alluvium (Qa) and glacial sediments (Qg)

Limestones
Devonian limestones (Sellersburg Limestone, Jeffersonville Limestone) (Dsj)

Interbedded limestones and shales
Louisville Limestone (Slw)
Waldron Shale (Slw)
Laurel Dolomite (Slb)
Osgood Formation (Slb)
Brassfield Formation (Slb)
Drakes Formation (Saluda Dolomite, Bardstown, Rowland Members) (Od) and Bull Fork Formation (Ob)

For more information, see the definitions of geologic terms and rock descriptions, a geologic map of Oldham County, a summary of the geology of Kentucky, and a discussion of fossils and prehistoric life in Kentucky.

Groundwater Availability

Alluvium (Qa) and Glacial Sediments (Qg)
Topography
The alluvium forms floodplains and terraces, as much as 6 miles wide, in the Ohio River Valley; it forms broad flat areas in the valleys of the Salt and Kentucky Rivers and large tributaries. Some Ohio River terraces are as much as 80 feet above normal pool stage. Flats are dissected by short, steep-sided gullies near tributaries.

Hydrology
The alluvium yields 200 to 500 gallons per minute to most wells that penetrate the full thickness of sediment in the Ohio Valley; it yields more than 1,000 gallons per minute to large-diameter wells. The alluvium yields 100 to 500 gallons per day to wells in tributary-stream valleys, and may yield more than 500 gallons per day where gravel is present. Water is hard, and the iron content may be high near the Ohio River Valley walls.

Devonian Limestones (Sellersburg Limestone, Jeffersonville Limestone) (Dsj)
Topography
These limestones form broad ridges in western Oldham County.

Hydrology
These limestones yield more than 500 gallons per day to drilled wells in broad, flat valleys or along streams on broad uplands, and yield water to springs. Water is hard.

Louisville Limestone (Slw)
Topography
The Louisville lies in broad ridges in south-central Oldham County. It forms cliffs and ledges in valley sides.

Hydrology
The Louisville yields more than 500 gallons per day to wells drilled in valley bottoms or along streams on broad uplands. It yields as much as 50 gallons per minute in places. It also yields water to springs at the contact with the underlying Waldron Shale. Water is hard, and may contain salt or hydrogen sulfide below stream level.

Waldron Shale (Slw)
Topography
The shale forms slopes between limestone ledges on hillsides; the erosion of shale undermines the overlying Louisville Limestone.

Hydrology
The Waldron yields almost no water to wells or springs. It holds up water in the overlying Louisville Limestone and prevents recharge to the underlying Laurel Dolomite.

Laurel Dolomite (Slb)
Topography
The Laurel forms ledges and cliffs along streams.

Hydrology
The Laurel yields 100 to 500 gallons per day to wells on broad ridges and along streams. It yields water to small springs at the contact with the underlying Osgood Formation. Water is hard.

Osgood Formation (Slb)
Topography
The Osgood forms slopes between ledges above and below.

Hydrology
The Osgood yields almost no water from shale; it yields water to seeps from limestone, and impedes recharge to underlying rocks. Water is hard.

Brassfield Formation (Slb)
Topography
The Brassfield forms ledges on slopes and tops of small cliffs of the underlying Saluda Dolomite.

Hydrology
The Brassfield yields almost no water to wells. It does yield water to seeps and small springs. Water is hard.

Drakes Formation (Saluda Dolomite, Bardstown, Rowland Members) (Od) and Bull Fork Formation (Ob)
Topography
These formations lie in moderately dissected upland areas, with moderately steep slopes where shale predominates and less steep slopes where limestone predominates. The Drakes and Bull Fork form steep slopes along large streams and cliffs; many slopes are dotted with weathered limestone slabs. Solutional features are evident where thick limestone beds underlie streams.

Hydrology
These formations yield 100 to 500 gallons per day to wells in large stream valleys, and more where thick limestone is present. They yield almost no water to wells on hillsides and ridges, except in broad ridges in the upper part of the formation. They do yield water to small springs. Water is hard, and may contain salt in valley bottoms, but generally is of good quality.

The U.S. Geological Survey's Hydrologic Atlas Series, published cooperatively with the Kentucky Geological Survey, provides hydrologic information for the entire state. Atlases covering the county are: HA-22, HA-97, and HA-97_1.

Exploration for Groundwater

Groundwater is precipitation that has drained through the soil into the gravels and bedrock fractures and faults below. It is found nearly everywhere, but useable, reliable quantities can only be tapped in sand, gravel, and rock formations that have sufficient void space to hold and conduct water. These formations are known as aquifers. Most groundwater used for domestic supply comes from relatively shallow wells (less than 150 feet in depth) in fractured bedrock or unconsolidated materials. The bedrock may be shale, sandstone, siltstone, limestone, or coal. Water can be stored in all these rocks, but rapid movement of water is primarily controlled by secondary fractures--joints or faults that penetrate the rock near the land surface (Wyrick and Borchers, 1981; Kipp and Dinger, 1991).

Joints and faults in the earth's crust may extend for tens of feet up to several miles in length. The more lengthy of these features, called linear terrain features, fracture traces, or lineaments, can be seen on different types of aerial photographs and satellite imagery. These features may collect, store, and transport large amountts of groundwater that can provide sufficient water to communities and industry.

Little effort has been made in the past to determine the groundwater resource potential as it relates to high-yield wells. Recent efforts in the upper Kentucky River Basin, in which satellite imagery was used to locate wells, resulted in three out of four resulting wells producing more water than 90 percent of all the recorded wells in the area, and having enough water to supply from 50 to 250 homes per well.

Exploiting geologic features such as fracture traces and lineaments is a common technique used for the exploration of subsurface fluids, including groundwater (Siddiqui and Parizek, 1971; Mabee and others, 1994) and petroleum (Driscoll, 1986). Fracture traces are linear expressions on the earth's surface that are less than 1 mile in length; those greater than a mile are termed lineaments. Linear features that are not readily apparent on the ground can often be distinguished at high altitudes. Currently, private vendors as well as foreign agencies have made high-resolution satellite photos and radar images available. These data can be used in detailed surficial analysis for linear features that can be related to high-production groundwater zones.

Karst

By James C. Currens, Kentucky Geological Survey

A karst landscape has sinkholes, sinking streams, caves, and springs. Kentucky is one of the most famous karst areas of the world. Much of the state's beautiful scenery, particularly the horse farms of the Inner Bluegrass, results from the development of karst landscape. Karst underlies regions of major economic importance to the state. Many of Kentucky's cities, including Frankfort, Louisville, Lexington, Bowling Green, Elizabethtown, Munfordville, Hopkinsville, Russellville, Princeton, Lawrenceburg, Georgetown, Winchester, Paris, Somerset, Versailles, and Nicholasville, are partly or entirely underlain by karst. Springs and wells in karst areas supply water to thousands of homes. Much of Kentucky's prime farmland is underlain by karst. A substantial portion of the Daniel Boone National Forest, with its important recreational and timber resources, is underlain by karst. Caves also provide recreational opportunities and contain unique ecosystems. Mammoth Cave, with over 350 miles of passages, is the longest surveyed cave in the world. Two other caves in the state are over 30 miles long, and 10 Kentucky caves are among the 50 longest in the United States.

Although maps that show in detail where the karst terrain of Kentucky occurs have never been made, the areas underlain by rocks on which karst can develop have been mapped. The 1:500,000-scale geologic map (Noger, 1988) can be used to estimate the percentage of karst terrain in the state. Ninety-two of Kentucky's 120 counties contain at least some areas of karst. About 40 percent of the state is underlain by rocks with the potential for at least some karst development (recognizable on topographic maps), and 20 percent of the state has well-developed karst features.

Karst Regions

The karst of Kentucky occurs in five principal regions, but also in many scattered locations.

- The largest area is the Western Pennyroyal, arching from the Ohio River north of Elizabethtown southward, then westward through Bowling Green and Hopkinsville, then northward again back to the Ohio River. Many of the state's longest caves, and terrain most densely pocketed with sinkholes, are in this region.
- The next largest expanse is the Inner Bluegrass, surrounding Lexington and including Georgetown, Versailles, Winchester, and several other cities.
- The Eastern Pennyroyal lies east of the Inner Bluegrass and reaches from the Ohio River south-southwest to the Tennessee border. The Eastern Pennyroyal includes the communities of Mount Vernon, Somerset, and Monticello.
- The Carter Caves region, east-northeast of Winchester, is the fourth region, but it is sometimes considered part of the Eastern Pennyroyal. Although no large communities are located on this karst, Carter Caves State Park, an important tourist attraction, is located here.

The last major karst area lies along the crest of Pine Mountain in southeastern Kentucky, where geologic forces have thrust the limestone from deep beneath the coal field to the surface. No communities occupy this karst area, but it is a significant recreational and ecological resource, and springs draining from it are important water supplies.

Karst terrain affects the lives of many Kentuckians every day. Most people don't realize they are affected because the costs are hidden in the form of higher taxes and increased cost of living. Often enough, the consequences of living in a karst terrain directly affect people's lives. Of vital concern is protection of groundwater resources. For example, many communities in Kentucky were established near karst springs to take advantage of the reliable water supply. Because of pollution, most of these town springs have long since been abandoned as water supplies. Factories and homes built over filled sinkholes may be damaged as the fill is transported out of the sinkhole and the soil cover collapses. Also, structures built in sinkholes are often vulnerable to flood damage.

Flooding in a karst area.

Features of a Karst Landscape

The term "karst" is derived from a Slavic word that means barren, stony ground. It is also the name of a region in modern Slovenia near the border with Italy that is well known for its sinkholes and springs. The name has been adopted by geologists as the term for all such terrain.

A karst landscape most commonly develops on limestone but can develop on several types of rocks, such as dolomite, gypsum, and salt. The karst terrains of Kentucky are mostly on limestone and formed over hundreds of thousands of years. As water moves underground, from hilltops toward a stream through tiny fractures in the limestone bedrock, the rock is slowly dissolved away by weak acids found naturally in rain and soil water.

An aquifer is any body of rock from which important quantities of drinkable water may be produced. Springs are sites where groundwater emerges from an aquifer to become surface water. Springs occur along creeks and rivers where the water table meets the land surface. They also occur where rocks that do not allow water to flow easily, such as shale, underlie or have been faulted against permeable rock. The impermeable rock blocks the flow of the groundwater, forcing it to the surface. Karst springs occur where the groundwater flow has concentrated to dissolve a conduit or cave in soluble rock. The groundwater basin of a karst spring collects drainage from all the sinkholes and sinking streams in its drainage area. The water flowing from each sinkhole joins together underground to form ever-increasing flow in successively larger passages, which discharge at the spring. Karst springs (also known as "cave springs") can have large openings and discharge very large volumes of water. The soil cover, narrow fractures, small conduits, and larger cave passages collectively form a karst aquifer.

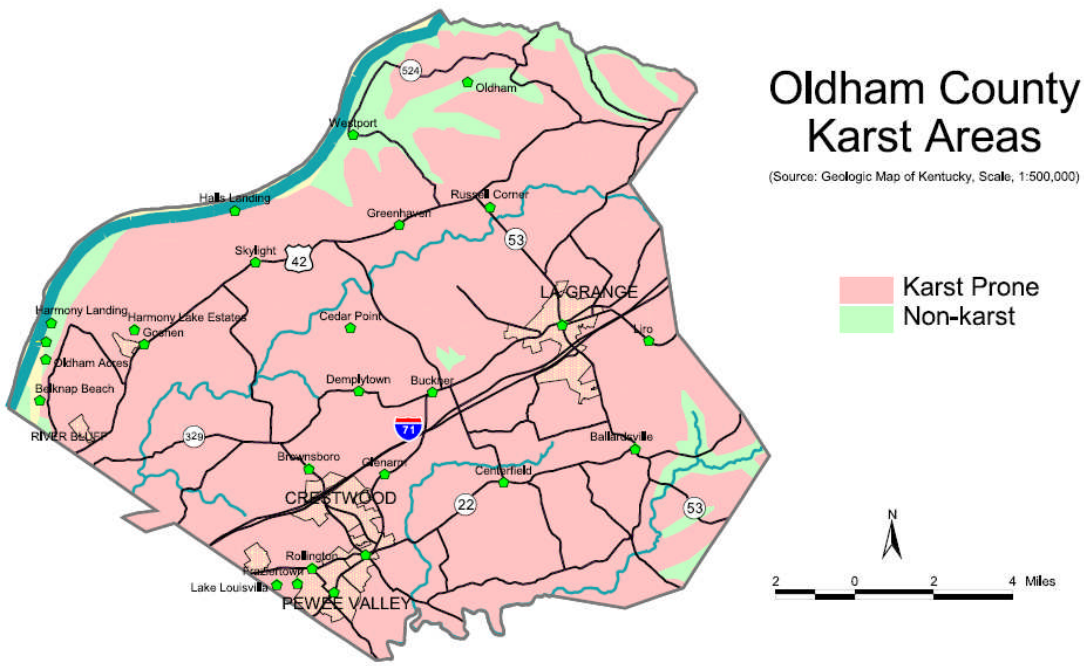
A sinkhole is any depression in the surface of the ground into which rainfall is drained. Karst sinkholes form when a fracture in the limestone bedrock is preferentially enlarged. Sinkholes form in two ways. In the first way, the bedrock roof of a cave becomes too thin to support the weight of the bedrock and the soil material above it. The cave roof then collapses, forming a collapse sinkhole. Bedrock collapse is rare, and the least likely way a sinkhole can form, although it is commonly assumed to form all sinkholes. The second way sinkholes form is much more common and much less dramatic. As the rock is dissolved and carried away underground, the soil gently slumps or erodes into a dissolution sinkhole. Once the underlying conduits become large enough, insoluble soil and rock particles are carried away too. Dissolution sinkholes form over long periods of time, with occasional episodes of soil or cover collapse.

All of the dissolved limestone and soil particles eroded from the bedrock to form a sinkhole pass through the sinkhole's "throat" or outlet. The throat of a sinkhole is sometimes visible, but is commonly roofed by soil and broken rock and can be partly or completely filled with rubble. This opening can vary from a few inches in diameter to many feet. Normally, water flows out of the sinkhole throat to a conduit that drains to a spring. When sinkhole throats are totally blocked and little water can flow out, a "sinkhole pond" may form, a common sight in the Pennyroyal. Sinkhole ponds are temporary features and last only as long as the throat is tightly plugged.

Swallow holes are points along streams and in sinkholes where surface flow is lost to underground conduits. Swallow holes range in diameter from a few inches to tens of feet, and some are also cave entrances. Swallow holes are often large enough to allow large objects such as tree limbs and cobble-size stones to be transported underground. This means that waste dumped into sinkholes can easily reach underground streams. It is not uncommon for discarded automobile tires and home appliances to be found deep within caves with flowing streams. Likewise, sewage, paint, motor oil, pesticides, and other pollutants are not filtered from water entering a karst aquifer.

A karst window is a special type of sinkhole that gives us a view, or window, into the karst aquifer. A karst window has a spring on one end, a surface-flowing stream across its bottom, and a swallow hole at the other end. The stream is typically at the top of the water table. Karst windows develop by both dissolution and collapse of the bedrock. Many karst windows originated as collapse sinkholes.

[Karst locations are shown on a map of karst in Oldham County](#).



[More information on karst](#) is available on the KGS Web site.

Water Quality

According to the Groundwater Branch of the Kentucky Division of Water, "Groundwater is a vital, renewable natural resource that is widely used throughout Kentucky. Wells and springs provide approximately one-third of public domestic water supplies in the state. Surface streams, the major source of Kentucky's water supply, are primarily sustained during base flow by groundwater discharge from adjacent aquifers. This resource is susceptible to contamination from a variety of activities at the land surface. Once contaminated, groundwater can be difficult or impossible to remediate."

Quality of Groundwater in the County

The quality of groundwater in the Bluegrass Region varies considerably from place to place and is determined by its geologic source. In Oldham County, groundwater is hard to very hard and may contain salt or hydrogen sulfide, except water from the Ohio River alluvium, which is generally of good quality. The two most common natural constituents that make water in the Bluegrass Region objectionable for domestic use are common salt and hydrogen sulfide. The hydrogen sulfide-bearing water is usually satisfactory for domestic use since the hydrogen sulfide escapes as a gas upon exposure of the water to the air.

At a time when surprisingly little information is available on groundwater quality, groundwater contamination has become a major environmental issue. Reliable information about water quality is necessary in order to develop plans for protecting groundwater. The absence of accurate and broad perspectives on groundwater quality may lead to inappropriate and ineffective regulatory policies. Because groundwater supplies a large percentage of rural drinking water and water for agricultural use, rural landowners have become increasingly concerned about the quality of groundwater. The Kentucky Farm Bureau, Kentucky Division of Conservation, University of Kentucky Cooperative Extension Service, and the Kentucky Geological Survey conducted a water-quality survey of nearly 5,000 rural domestic wells. The results are discussed in "Quality of Private Ground-Water Supplies in Kentucky." Additional references are contained in the Water Research Library on the Kentucky Geological Survey's Web site.

Salt Water

Salt water (saline water) is found below fresh groundwater at variable depths throughout the entire state of Kentucky. Depths to the saline groundwater range from 50 feet or less down to 2,000 feet below land surface in Kentucky. "Salinity" is defined as a measure of the quantity of dissolved mineral matter or total dissolved solids (TDS) in water, reported in parts per million (parts per million) or milligrams per liter (mg/L); the two forms of measurement are usually equivalent. The term "salt" or "table salt" as used by most people is pure sodium chloride. Sodium and chloride are generally the major component of saline waters in Kentucky, but are not the only constituents. Water having a TDS concentration of less than 1,000 parts per million is classified as fresh and water having a TDS concentration of 1,000 parts per million or more is classified as saline. Recommendations by the U.S. Public Health Service for drinking water suggest that total dissolved solids should not exceed 500 parts per million, but less than 1,000 parts per million may be used. In agriculture, the recommended TDS levels vary with uses, as shown in the following table, which was taken in part from "Fresh-Saline Water Interface Map of Kentucky" (Hopkins, 1966).

Upper limits of total dissolved-solids concentration in water to be consumed by livestock or used for crops.

Crop	parts per million
All crops, including forage	525
Most fruit and vegetable crops	1,400
Poultry	2,860
Pigs	4,290
Horses	6,435
Cattle (dairy)	7,150
Cattle (beef)	10,000
Adult sheep	12,900

Being aware of the depth to saline groundwater is valuable when planning a water-supply well. Drilling a well too deep through the freshwater interval may cause a good well to be unsuitable for various uses. Care must be taken to prevent contamination of the freshwater zones by the deeper saline waters. Properly constructed water wells will screen the production zone in the targeted aquifer and isolate all other zones by casing and properly grouting and cementing of the space outside the casings in the boreholes.

In Oldham County, the fresh-saline interface ranges from elevations of less than 300 feet mean sea level near the Ohio River to 800 feet in the high areas of the county. Generally, salt water is found at depths greater than 100 feet below the level of the principal valley bottoms.

Sensitivity of Groundwater to Pollution

According to the Kentucky Division of Water, Groundwater Branch, Oldham County has areas of moderate to high sensitivity to groundwater pollution (see "Groundwater Sensitivity Regions of Kentucky"). The hydrogeologic sensitivity of an area is defined as the ease and speed with which a contaminant can move into and within a groundwater system. The sensitivity assessment addressed only the naturally occurring hydrogeologic characteristics of an area. Possible impacts of human activity upon groundwater, such as mining, logging, industry, and the use of pesticides, injection wells, and landfills, were not considered in the production of this map. Because of its small scale and generalized nature, this map is not intended for site-specific use, such as detailed land-use planning for city, county, or State agencies. The map should prove useful as a broad-scale management, educational, and planning tool, however.

Maps and Data

More information may be found at the following Web sites:

Index to 7.5-minute topographic and geologic quadrangle maps

Digital aerial photography, geologic quadrangle, topographic quadrangle, and other maps

Digital elevation data

GIS data

Internet map services and databases

Additional Reading

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Definitions of Geologic Terms

Alluvial deposits: Stream-sediment deposits of comparatively recent age.

Aquifer: Stratum or zone below the surface of the earth capable of producing water, as from a well.

Bedding plane: The division planes that separate the individual layers, beds, or strata of rock.

Bedrock: Solid rock underlying soils and unconsolidated materials.

Faults: Fractures in the earth's crust along which displacement has occurred. The presence of faults may be very important in the success of large-capacity wells. In general, faulting enhances the permeability of bedrock aquifers because the bedrock is broken and pulverized along the zone bordering the fault plane. This is especially true in limestone areas, where fracturing is enhanced by subsequent solution. High-capacity wells are commonly located in fault zones.

Joints: Widely spaced vertical cracks in the bedrock.

Limestone: Layered rock composed of grains of calcite cemented together; may contain fossils.

Sandstone: Layered rock composed of grains of sand cemented together.

Shale: Thin-layered rock composed of clay minerals.

Soil: Loose materials occurring between the ground surface and underlying bedrock.

Rock Descriptions

From Noger (1988) and Carey and others (1994)

Limestone: Limestones are characterized by solution-enlarged joints and bedding planes that channel water into conduits. The majority of groundwater flows through the conduits and discharges at springs along major, permanent streams. Wells drilled in these areas may produce only a little water, or hundreds of gallons per minute, depending on the chance intersection of an enlarged joint or other opening. Little water moves through the unaltered bedrock. Groundwater flowing through fractures and solution openings is easily contaminated. These rocks are generally very hard, requiring blasting or heavy equipment for excavation, and the depth of soil coverage is highly variable. In some areas of Kentucky underlain by limestones, soils more than 30 feet thick have been reported.

Sandstone: These rocks are generally very hard, requiring blasting or heavy equipment for exavation. Sandstones tend to form thin soils and steep slopes. Groundwater flows through openings between sand grains and along fractures (widely spaced cracks).

Unconsolidated deposits: These deposits consist of noncemented clay, sand, and gravel and are found primarily in stream valleys. West of Lake Cumberland, these deposits occur both in stream valleys and upland areas. They are easily eroded during rainstorms. West of Lake Barkley, these deposits include loess, a fine-grained material deposited by wind. These deposits yield large volumes of water where aquifers are extensive. Areas of terrace deposits and alluvium in upper stream reaches may be too small to sustain high rates of production.

Fractured shales: Fresh exposures of fractured shale are hard and require heavy machinery for excavation. Although jointing and bedding planes in these brittle shales allow groundwater movement, there is little storage in the unfractured material. Wells in these rocks typically produce little water.

Clay shales: These shales are easily excavated and restrict groundwater movement. The high clay content can produce slippage and workability problems. Joints and bedding planes tend to heal or become clogged, and although clay minerals have large intergranular storage of water, there is little or no permeability to allow its movement. Wells in these rocks are generally dry.

Interbedded shales and limestones: This is bedrock composed of 80 percent or more shale and 20 percent or less limestone. Limestone layers are usually 2 inches or less thick. These rocks are easily excavated and generally restrict groundwater movement. Oversteepened banks and artificial cuts are subject to slippage. These formations have some limited potential as aquifers, but the high clay content generally blocks small conduits in the limestone. Wells in these rocks are generally dry.

Interbedded clay shales and sandstones: Where clay shales are dominant, successful water wells are difficult to drill. In areas where the unit is sandy, wells more commonly yield sufficient water for a domestic supply.

Interbedded limestones and shales: These rocks contain more than 20 percent limestone. Where limestone content exceeds 60 percent, wells may yield adequate water for a domestic supply.

Interbedded limestones, sandstones, and shales: These rocks consist of a vertical sequence of alternating limestones, sandstones, and shales.

Coals, sandstones, and shales: This unit consists of a vertical sequence of coals, sandstones, and shales that is generally horizontally discontinuous. Wells that penetrate a section composed of more than 50 percent sandstone have better than average yields, and almost all wells will produce enough water for domestic supplies. Many wells will produce sufficient supplies for small industries. Wells completed in coals, or obtaining flow from coals, are highly productive, but water quality may be marginal or poor. Wells completed in shales are commonly adequate for domestic supplies, depending upon the occurrence of weathered fractures in the shale.