INTRODUCTION

With the exception of the St. Louis area, south-central Missouri is primarily an agricultural and recreational area. The more productive farms, which produce chiefly livestock products and feed crops, are located on the broad, rolling uplands and along the narrow stream valleys of the region. The many large springs, clear streams, scenic caves, and rugged uplands offer numerous opportunities for outdoor activities such as camping, floating, fishing, hunting, and hiking. Public access to the area is provided by Clark National Forest (800,000 acres or 324,000 hm^2), Mark Twain National Forest (600,000 acres or 243,000 hm^2), Ozark National Scenic Riverways (99,000 acres or 40,100 hm^2), four U.S. Army Corps of Engineers reservoirs, and several State parks. In addition, the eastern part of the area has developed into a leading producer of lead, zinc, and iron ore.

Although the populations of several rural counties in the area have declined in recent years, significant population increases have occurred in the vicinity of the two principal population centers, St. Louis in the northeast and Springfield in the southwest. Population increases have also occurred along the interstate highway connecting these two urban areas, in the vicinity of the Corps of Engineers reservoirs, and in the mining area. During 1960–70, for example, the population of Jefferson, St. Louis, and Taney Counties increased by 59.2, 35.2, and 27.2 percent, respectively. Future population increases are expected to occur as a result of continued urban expansion, increased recreational use of land and water resources, and additional development of the mining industry.

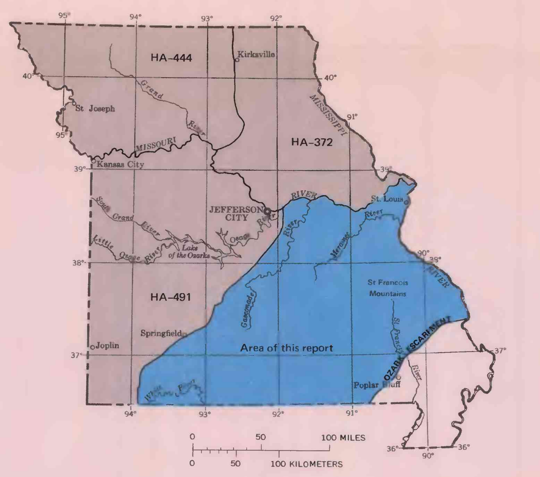
Knowledge of the water resources of south-central Missouri is necessary in planning the use, development, and preservation of the area's resources. The purpose of this atlas is to present a general summary of information concerning the occurrence, availability, use, and quality of water in the area and to offer alternatives, considerations, and information sources for use in developing the area's water resources.

This atlas describes an area of approximately 23,000 mi^2 (59,600 km^2) and includes all or parts of 38 counties. The area is bounded on the north by the southern edge of the Missouri River flood plain, on the east by the Mississippi River and the Plateaus-Lowlands boundary (Ozark Escarpment), on the south by the Missouri-Arkansas State line, and on the west by the western drainage divides of the Gasconade and White River basins. The alluvial valley of the Missouri River is excluded from the present study. Water resources of the Missouri River valley are described in Emmett and Jeffery (1969) and Gann and others (1971).

This investigation was made in cooperation with the Missouri Geological Survey Department of Natural Resources, (formerly, Missouri Geological Survey and Water Resources). Special appreciation is expressed to the many individuals, public utilities, private industries, and representatives of other State and Federal agencies who furnished information and assistance for the study.

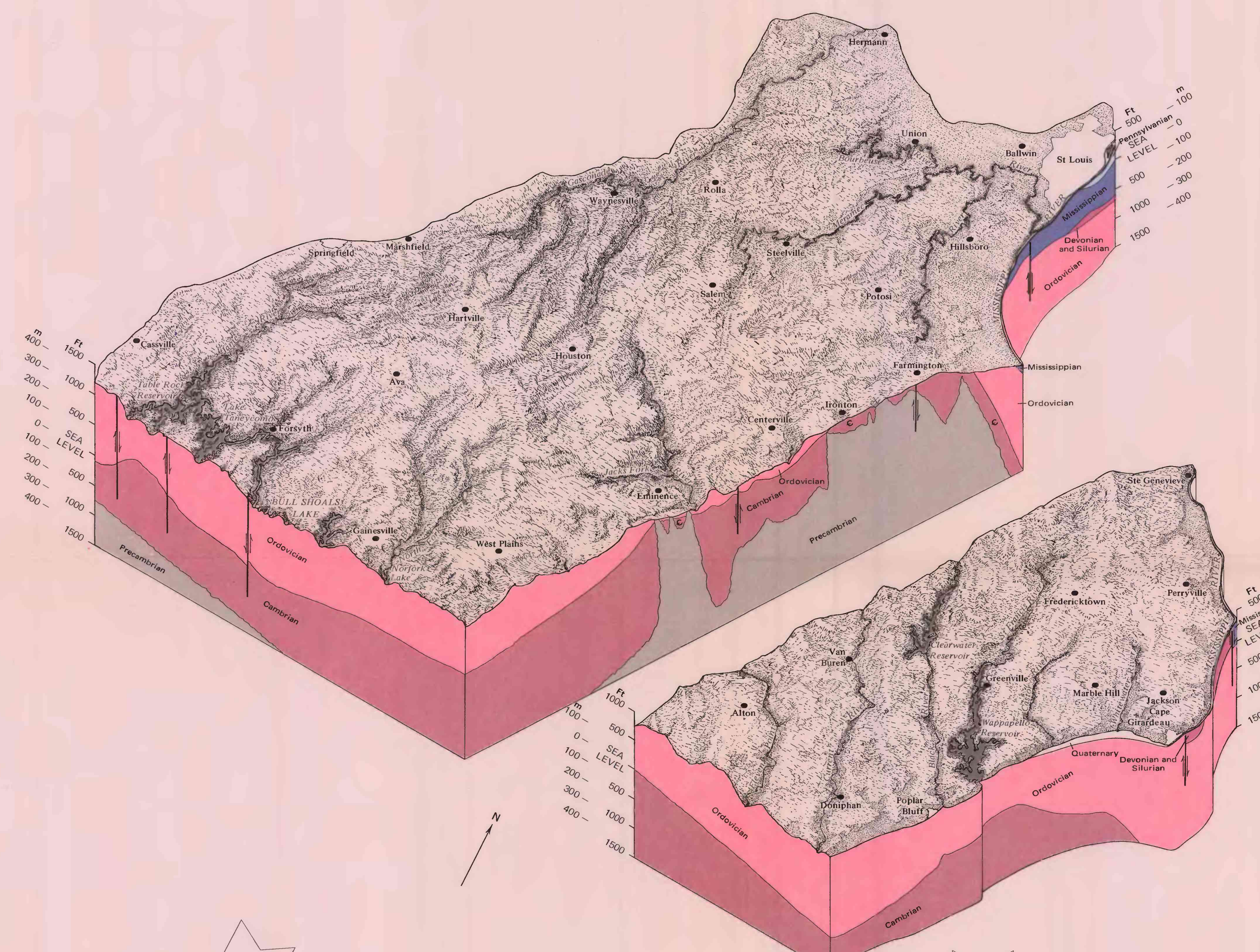
The stratigraphic nomenclature used in this atlas follows that of the U.S. Geological Survey and varies from the current usage of the Missouri Geological Survey.

A table of conversion factors is included on this sheet for the benefit of those users desiring to convert the English units published herein to metric units.



INDEX MAP OF MISSOURI SHOWING AREA OF THIS REPORT AND PUBLISHED REPORTS

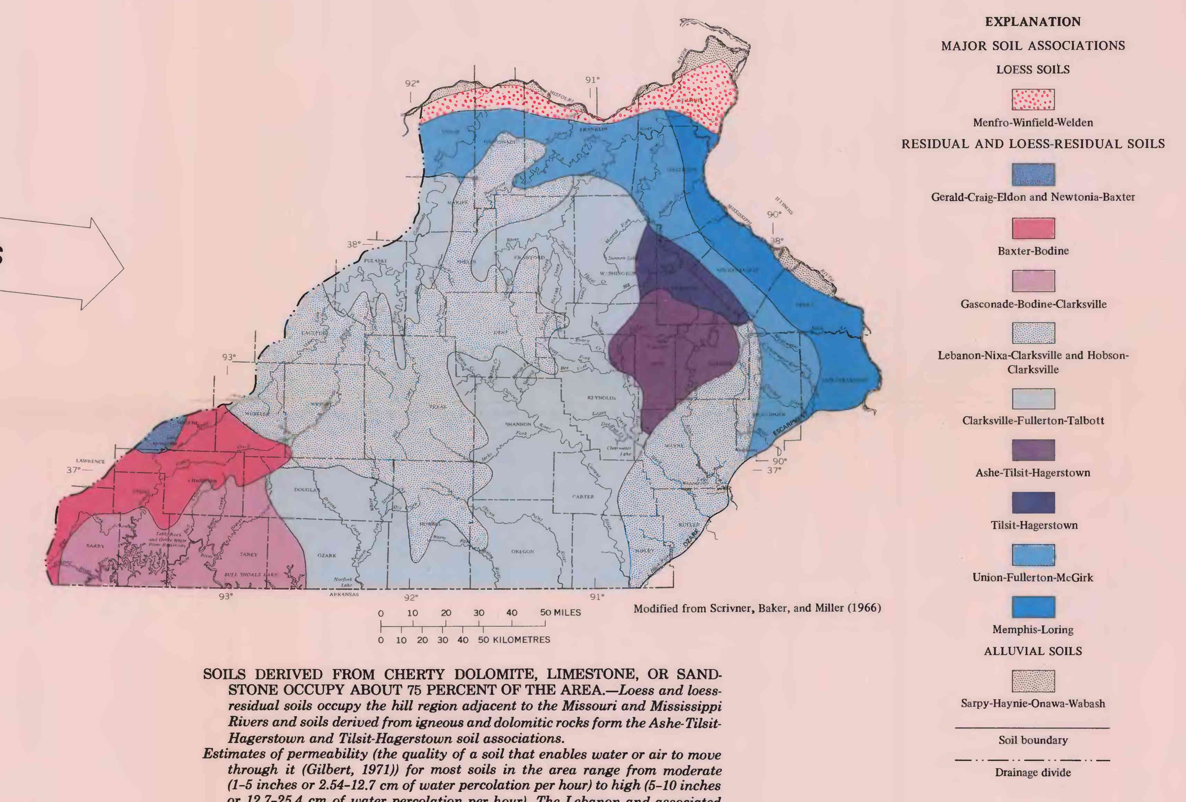
PHYSICAL SETTING



TOPOGRAPHICALLY, SOUTH-CENTRAL MISSOURI IS A MATURELY DISSECTED PLATEAU.—*The broad, rolling uplands are separated by entrenched, meandering streams in deep, narrow valleys. Land-surface altitudes range from 1,770 feet (539 m) in the St. Francois Mountains to 300 feet (91.4 m) on the flood plain of the Current River near the Missouri-Arkansas line.*

Principal streams in the northern part of the area flow northeast into the Missouri and Mississippi Rivers. Streams in the southern part flow south and southeast into the White and St. Francis Rivers. Four large reservoirs have been constructed in the area (Wappapello, Clearwater, Table Rock, and Taneycomo) and two reservoirs in Arkansas extend into Missouri (Bull Shoals and Norfork). An additional reservoir (Meramec Park) is currently (1974) under construction.

SOILS



Modified from Scrivner, Baker, and Miller (1966)

SOILS DERIVED FROM CHERTY DOLOMITE, LIMESTONE, OR SANDSTONE OCCUPY ABOUT 75 PERCENT OF THE AREA.—*Loess and loess-residual soils occupy the hill region adjacent to the Missouri and Mississippi Rivers and soils derived from igneous and dolomitic rocks form the Ashe-Tilsit-Hagerstown and Tilsit-Hagerstown soil associations.*

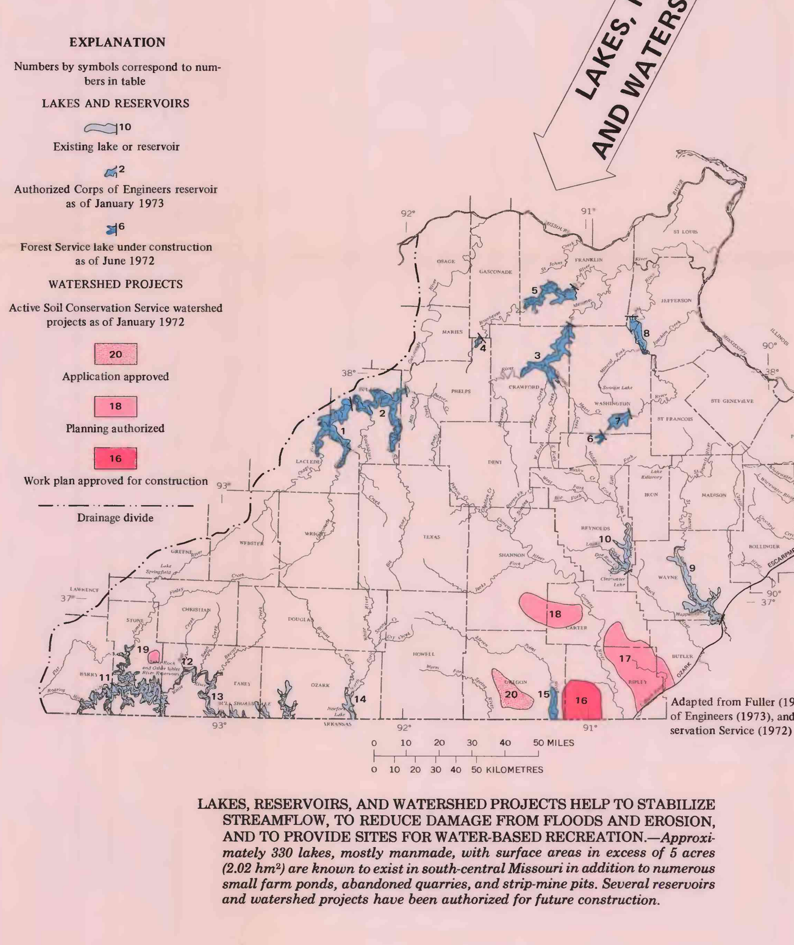
Estimates of permeability (the quality of a soil that enables water or air to move through it (Gilbert, 1971)) for most soils in the area range from moderate (1–5 inches or 2.54–12.7 cm of water percolation per hour) to high (5–10 inches or 12.7–25.4 cm of water percolation per hour). The Lebanon and associated soils, however, usually contain a dense subsoil, fragipan, 2 to 3 feet (0.61–0.91 m) below the surface which has low permeability (<1 inch or 2.54 cm of water percolation per hour).

LAKES, RESERVOIRS, AND WATERSHED PROJECTS

Map number	Lakes and reservoirs	Storage capacity (acre-feet)
1	Richland[1]	1,400,000
2	Arlington[1]	769,000
3	Meramec Park	1,000,000
4	I-38	39,000
5	Union	477,300
6	Council Bluff	13,200
7	Irondale	161,000
8	Pine Ford	285,000
9	Wappapello	613,000
10	Clearwater	413,000
11	Table Rock	3,462,000[2]
12	Taneycomo	30,900
13	Bull Shoals	5,408,000[2]
14	Norfork	1,983,000[2]
15	Water Valley	....

Map number	Active watershed projects	Drainage area (mi^2)
16	Fourche Creek	156
17	Little Black	375
18	Pike Creek	145
19	Reeds Spring	5.5
20	Frederick Creek	71

[1]Recommended for deauthorization by Corps of Engineers in 1975.
[2]Includes storage in Arkansas.



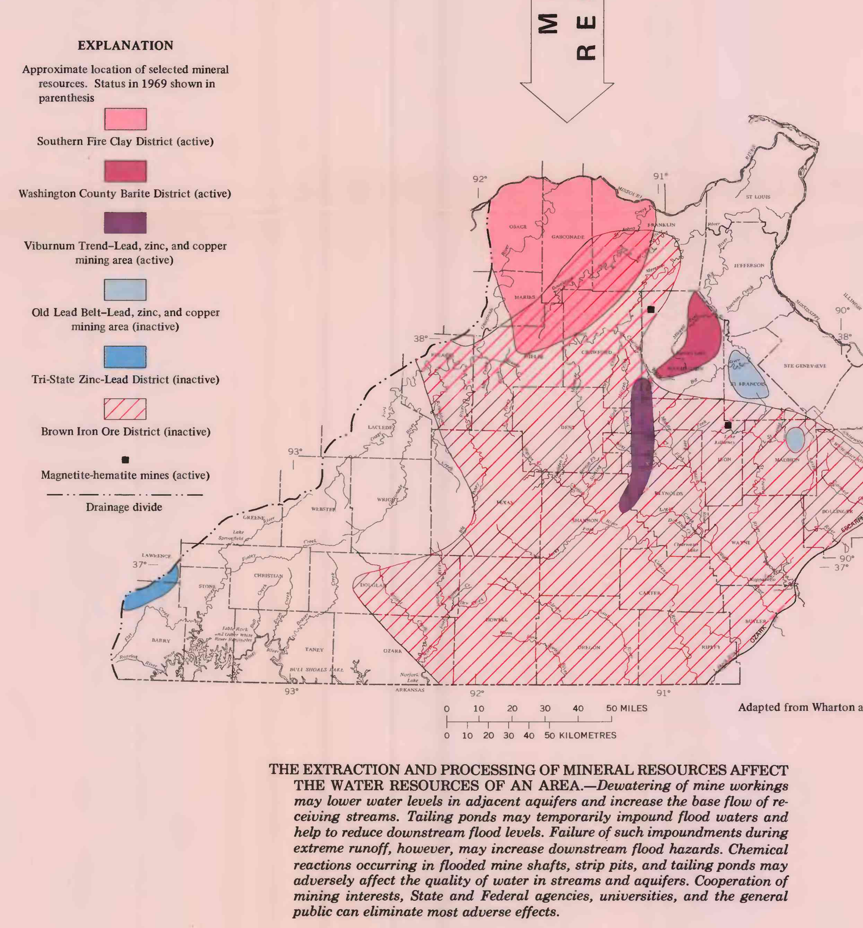
Adapted from Fuller (1966), U.S. Corps of Engineers (1973), and U.S. Soil Conservation Service (1972)

LAKES, RESERVOIRS, AND WATERSHED PROJECTS HELP TO STABILIZE STREAMFLOW, TO REDUCE DAMAGE FROM FLOODS AND EROSION, AND TO PROVIDE SITES FOR WATER-BASED RECREATION.—*Approximately 330 lakes, mostly manmade, with surface areas in excess of 5 acres (2.02 hm^2) are known to exist in south-central Missouri in addition to numerous small farm ponds, abandoned quarries, and strip-mine pits. Several reservoirs and watershed projects have been authorized for future construction.*

FACTORS FOR CONVERTING ENGLISH UNITS TO METRIC UNITS

Multiply English units	By	To obtain metric units
	Length	
Inches (in.)	2.54	centimetres (cm)
Feet (ft)	.3048	metres (m)
Miles (mi)	1.609	kilometres (km)
	Area	
Acres	.4047	square hectometres (hm^2)
	.004047	square kilometres (km^2)
Square miles (mi^2)	2.590	square kilometres (km^2)
	Volume	
Gallons (gal)	3.785	litres (l)
	3.785×10^{-3}	cubic metres (m^3)
Million gallons (10^6 gal)	3785	cubic metres (m^3)
Acre-feet (acre-ft)	1233	cubic metres (m^3)
	1.233×10^{-3}	cubic hectometres (hm^3)
	Flow	
Cubic feet per second (ft^3/s)	28.32	litres per second (l/s)
	.02832	cubic metres per second (m^3/s)
Gallons per minute (gal/min)	.06309	litres per second (l/s)
	6.309×10^{-5}	cubic metres per second (m^3/s)
Million gallons per day (Mgal/d)	.04381	cubic metres per second (m^3/s)
	Mass	
Tons per square mile (tons/mi^2)	.3503	tonnes per square kilometre (t/km^2)

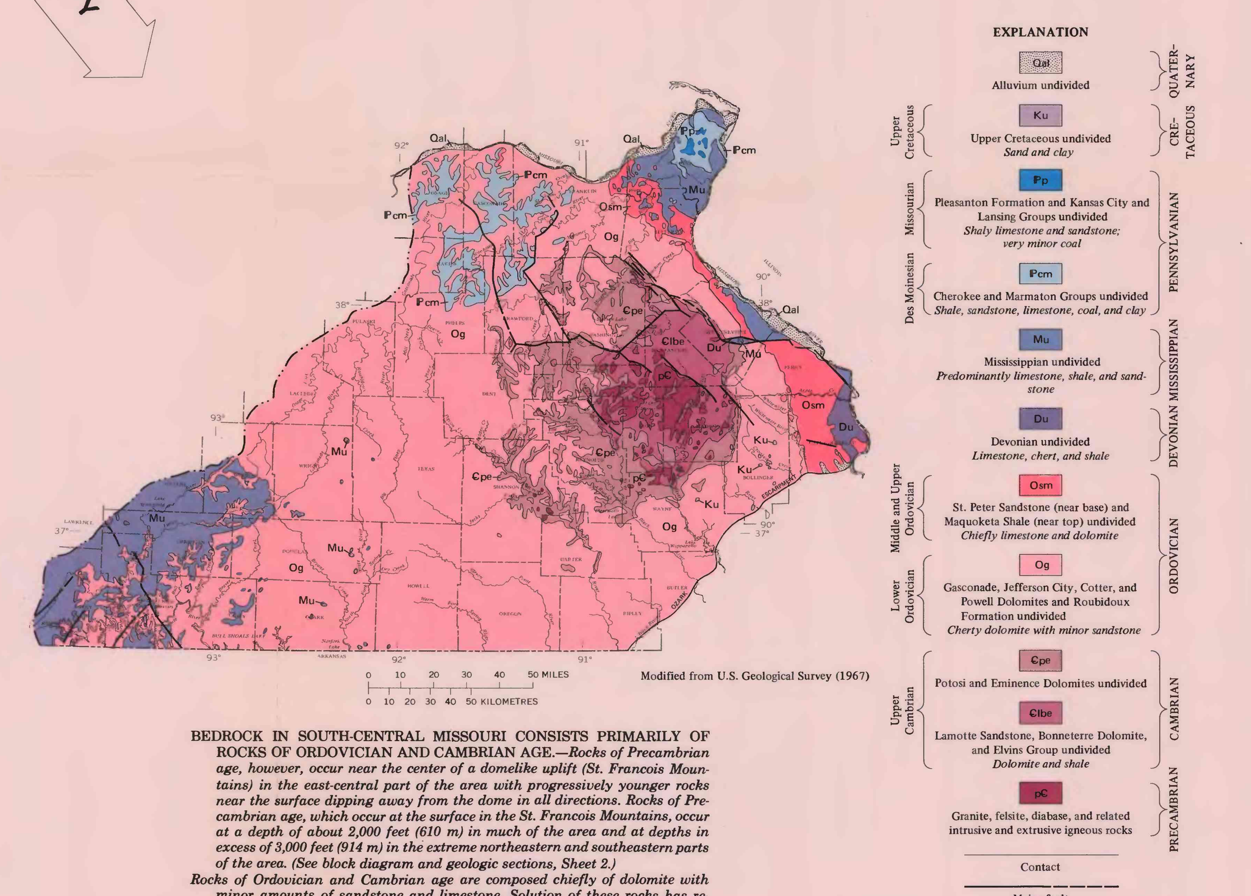
MINERAL RESOURCES



Adapted from Wharton and others (1969)

THE EXTRACTION AND PROCESSING OF MINERAL RESOURCES AFFECT THE WATER RESOURCES OF AN AREA.—*Dewatering of mine workings may lower water levels in adjacent aquifers and increase the base flow of receiving streams. Tailing ponds may temporarily impound flood waters and help to reduce downstream flood levels. Failure of such impoundments during extreme runoff, however, may increase downstream flood hazards. Chemical reactions occurring in flooded mine shafts, strip pits, and tailing ponds may adversely affect the quality of water in streams and aquifers. Cooperation of mining interests, State and Federal agencies, universities, and the general public can eliminate most adverse effects.*

GEOLOGY

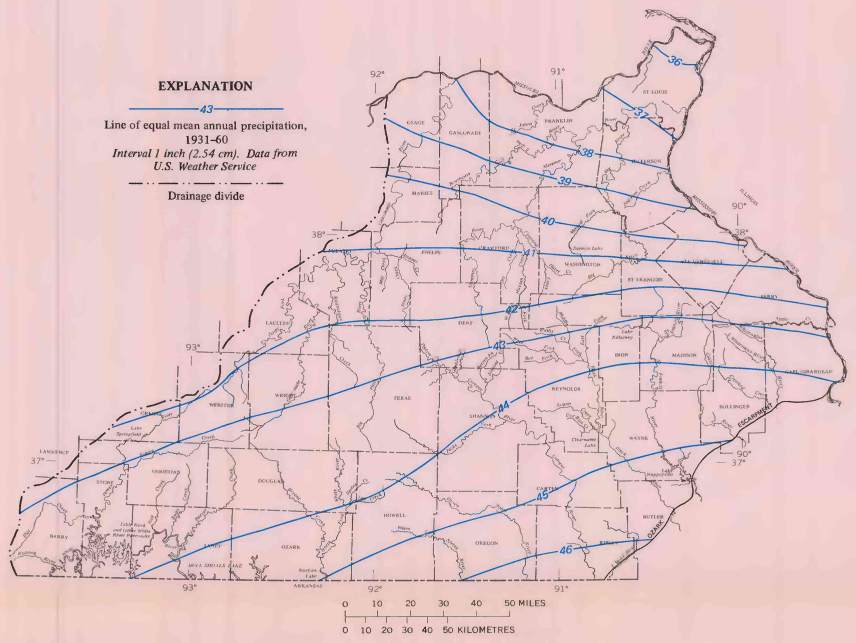


Modified from U.S. Geological Survey (1961)

BEDROCK IN SOUTH-CENTRAL MISSOURI CONSISTS PRIMARILY OF ROCKS OF ORDOVICIAN AND CAMBRIAN AGE.—*Rocks of Precambrian age, however, occur near the center of a domelike uplift (St. Francois Mountains) in the east-central part of the area with progressively younger rocks near the surface dipping away from the dome in all directions. Rocks of Precambrian age, which occur at the surface in the St. Francois Mountains, occur at a depth of about 2,000 feet (610 m) in much of the area and at depths in excess of 3,000 feet (914 m) in the extreme northeastern and southeastern parts of the area. (See block diagram and geologic sections, Sheet 2.)*

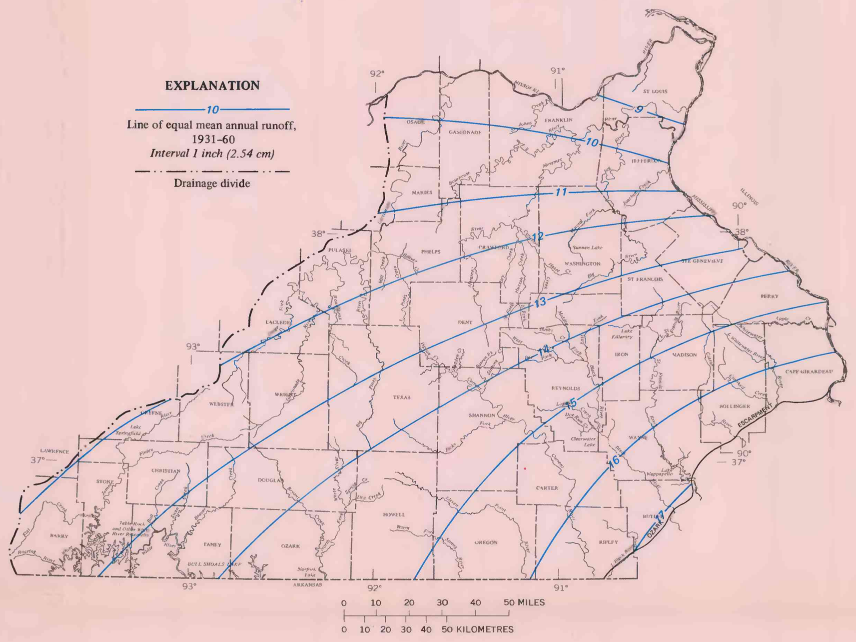
Rocks of Ordovician and Cambrian age are composed chiefly of dolomite with minor amounts of sandstone and limestone. Solution of these rocks has resulted in the occurrence of numerous sinkholes, losing streams, and large springs in much of the area. The presence of these features usually indicates relatively free exchange of flow between land surface and aquifers.

APPROXIMATE WATER BUDGET



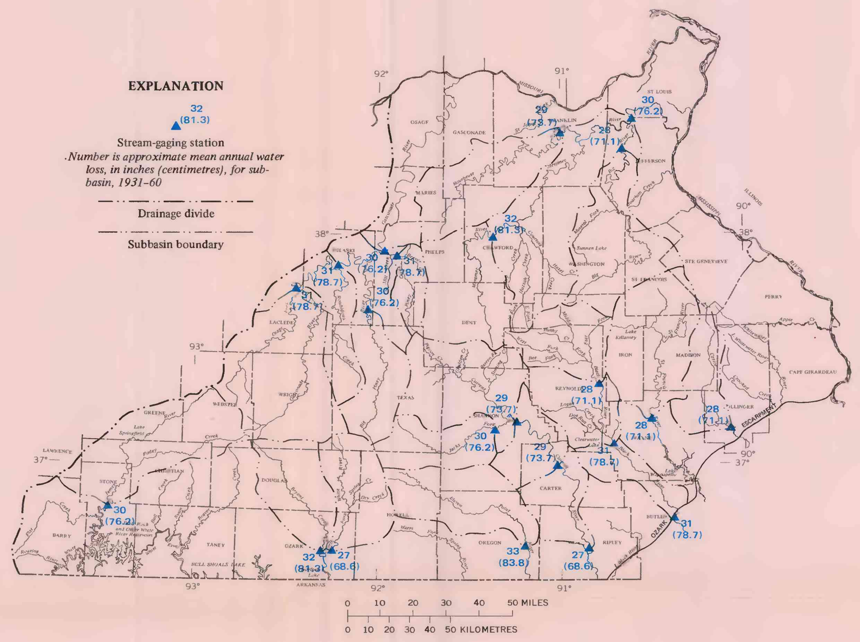
42.5 inches
(108 centimetres)
PRECIPITATION

=



13.0 inches
(33.0 centimetres)
RUNOFF

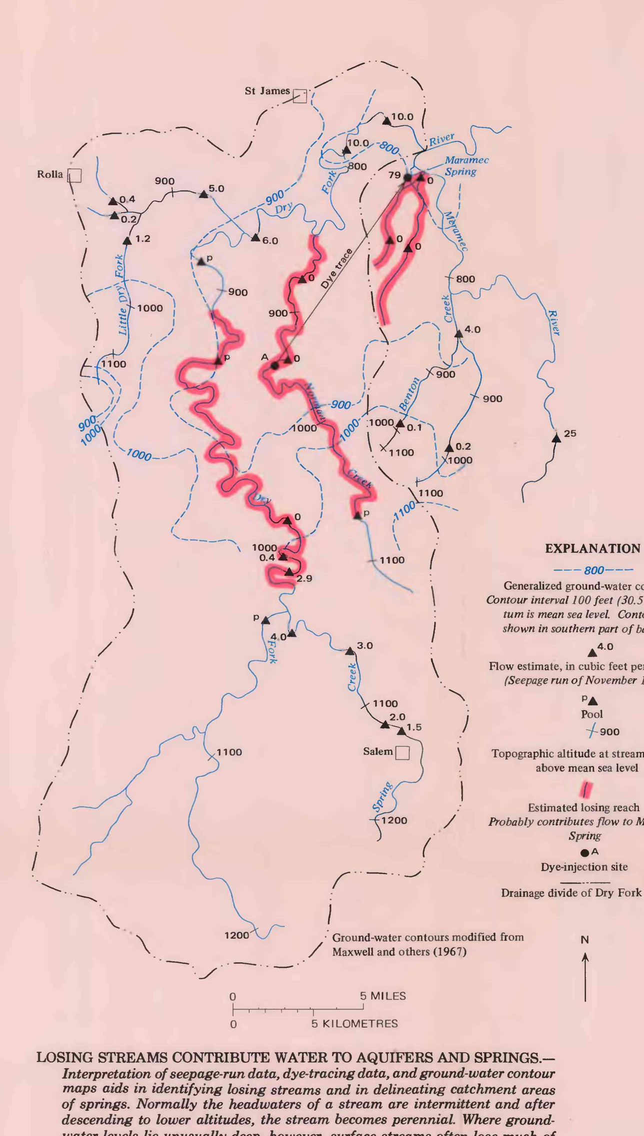
+



29.5 inches
(74.9 centimetres)
WATER LOSS

APPROXIMATELY 31 PERCENT OF THE MEAN ANNUAL PRECIPITATION BECOMES STREAMFLOW.—*The remaining 69 percent is lost primarily to evapotranspiration. The amount of underflow from the area is unknown, but is estimated to be less than 1 percent of the mean annual precipitation. Underflow to the area is believed to be negligible. Although ground-water storage may vary significantly from year to year, the long-term change in storage is assumed to be negligible. Mean annual runoff and water loss values for several subbasins in the area deviate significantly from the values shown owing to interbasin subsurface flow. (See map on sheet 3 for locations of basins that are known to contribute significant quantities of water to ground-water recharge.)*

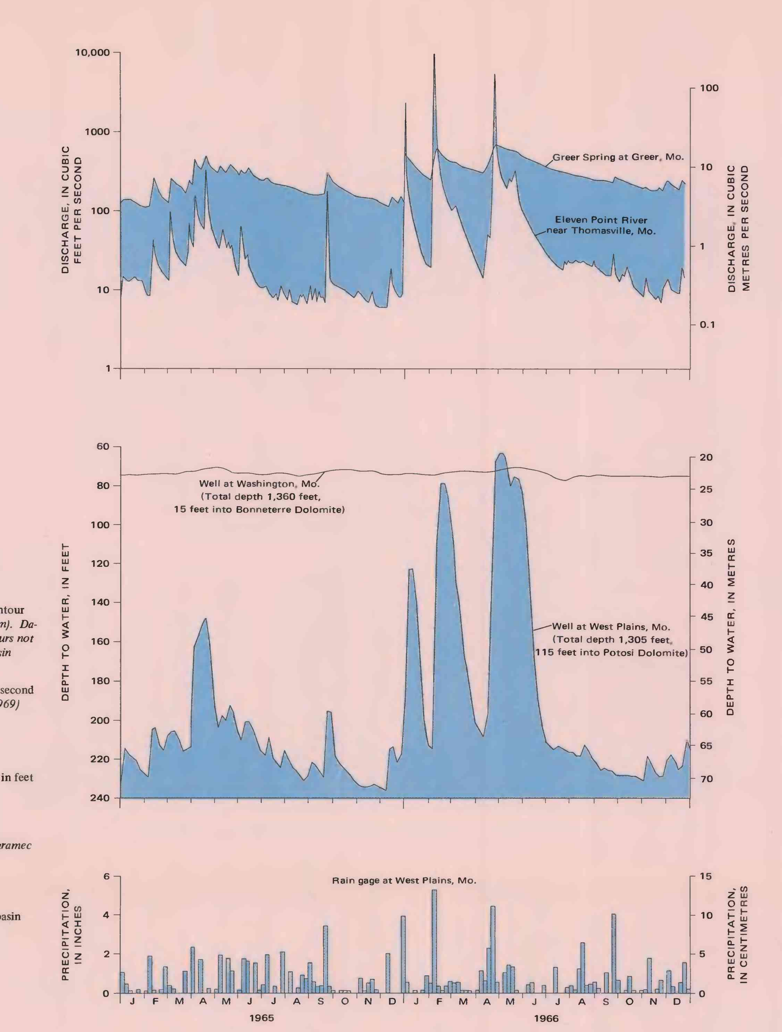
HYDROLOGIC RELATIONSHIPS



Ground-water contours modified from Maxwell and others (1967)

LOSING STREAMS CONTRIBUTE WATER TO AQUIFERS AND SPRINGS.—*Interpretation of seepage-run data, dye-tracing data, and ground-water contour maps aids in identifying losing streams and in delineating catchment areas of springs. Normally the headwaters of a stream are intermittent and after descending to lower altitudes, the stream becomes perennial. Where ground-water levels lie unusually deep, however, surface streams often lose much of their flow to subsurface drainage.*

In the Dry Fork basin east of Rolla, for example, much of the upstream flow of Dry Fork and Norman Creek is lost to underground drainage. Flow occurs throughout the length of these streams only following intense rainfalls of greater than about 2 to 4 inches (5.08 to 10.2 cm), which results in a cumulative flow that exceeds the infiltration capacity of the main-channel streambed. Ground-water levels in the losing reaches usually lie 50 to 100 feet (15.2 to 30.5 m) below the altitude of the streambed. Fluorescent dye injected in Norman Creek at Point A disappeared into the sand and gravel streambed and emerged at Maramec Spring 68–75 days later. (See dye-tracing data, sheet 2.)



PRECIPITATION IS THE SOURCE OF WATER IN STREAMS, SPRINGS, AND AQUIFERS.—*Following periods of heavy precipitation, significant quantities of water enter the ground through openings in the soil and rocks. Excess water is drained from the land surface by streams. Much of the water that enters the ground is returned to the atmosphere by evaporation from soils and transpiration by plants, but some water percolates downward to recharge aquifers and maintain the flow of springs.*

In deeply weathered carbonate terrane such as that which occurs in the West Plains area, water is conducted freely to aquifers and springs by losing streams, sinkholes, and solution openings. Ground-water levels in such areas respond rapidly to precipitation, as shown by the hydrograph for a well at West Plains, and tributary streams often have deficient flow (hydrograph for Eleven Point River near Thomasville). Large springs serve as outlets for the complex underground drainage system (hydrograph for Greer Spring) and are usually fed both by local solution openings and regional aquifers. Where deep weathering of carbonate terrane is less pronounced as in the Washington area, local recharge is limited, ground-water levels respond less rapidly to precipitation, and large springs do not occur.

Interior—Geological Survey, Reston, Va.—1976

WATER RESOURCES OF SOUTH-CENTRAL MISSOURI

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U.S. Geological Survey
and
D. E. Miller
Missouri Geological Survey and Water Resources
1976

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