LAND-RESOURCE CAPABILITY UNITS

OF PAYNE COUNTY, OKLAHOMA

By

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PREFACE

Great concern for conservation of natural resources has developed in recent years. The realization that each of us depends upon our natural resources for food, clothing, shelter, and recreation has brought about public awareness that our resources are limited. It has become obvious that unplanned growth patterns are damaging, polluting, and depleting our land base at an ever-accelerating rate. Basic to meaningful environmental decisions in our energy-dependent, technological civilization is both an awareness of the earth's limitations and an inventory of available land and mineral resources. This study provides such an inventory, along with an evaluation of many of man's activities in developing these resources. It is thought that wise land-use planning and energy and resource management can be achieved through proper utilization of data and interpretations provided in studies of land-resource capabilities. We must optimize the use of all our resources in order to continue to prosper. This requires planning in order to meet both current and long range needs.

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CHAPTER I

ABSTRACT

The Payne County area in north-central Oklahoma includes an area of about 695 square miles and is part of the transitional zone between the Central Redbed Plains and the Northern Limestone Cuesta Plains physiographic regions. The area will continue to undergo residential and industrial growth, especially in the vicinity of Oklahoma State University and Stillwater. The surface in the area is composed of alluvial floodplain and terrace, along with Late Pennsylvanian and Early Permian bedrock.

This study provides an inventory of the land and mineral resources for use by decision-makers in land-use planning. It should be of assistance in planning for the most effective use of the land and resources of Payne County in order to meet both current and long-range needs. The study area contains modest amounts of mineral resources. Ground water for domestic, industrial, and agricultural use is fairly abundant locally. Surface water is available from a few lakes in the area; surface water is also available just north of the study area.

Land-resource capability units are grouped into the sediment-dominant system, the soil-dominant system, the bedrock-dominant system, the bedrock-soil system, and the artificial system. Each unit is characterized by a specified lithology, sediment, or soil; soil thickness and texture; and other special properties. Each unit is qualitatively evalu-

ated for a number of man's activities by means of a matrix. It is felt that this matrix should be of great assistance to those who are nonscientists. Units of the sediment-dominant system are generally unfavorable for waste disposal, whereas the soil-dominant unit is generally favorable for waste disposal. The bedrock-dominant system contains 2 units which are generally suitable for construction. The bedrock-soil system contains units for which the specific type of surficial material is most variable. The artificial system (oil-field waste lands) may be poorly suited to many of man's activities because of the high salinity of the soil, general lack of vegetation, and very high susceptibility to erosion.

CHAPTER II

INTRODUCTION

Payne County is located in north-central Oklahoma, west of Tulsa and north-northeast of Oklahoma City. The study area includes a total area of about 695 square miles. The county seat and largest city is Stillwater. Other towns include Perkins, Glencoe, Ripley, Cushing, and Yale. Small communities are Ingalls, Mehan, Vinco, and Quay. The area has an economy based on education (Oklahoma State University), agriculture, oil, and an increasing number of industrial facilities. Good roads make the area very accessible: Interstate-35, U.S. Highway 177, and State Highways 108, 18, and 86 are north-south routes; State Highways 51 and 33 extend east-west; and the Cimarron Turnpike with spur connects Stillwater with Tulsa. In addition, most county roads are generally well kept with periodic grading and a surface of crushed rock. Rail service is furnished by the Atcheson, Topeka, and Santa Fe to Stillwater, Glencoe, and Cushing. The Missouri, Kansas, and Texas serves Cushing and Yale.

The Role of Environmental Geology

In order to develop a means of assuring the best and most effective use of land and resources of the area for both current and long-range needs, an inventory of land and mineral resources is necessary. Such an inventory should include an appraisal of the resources of the region and

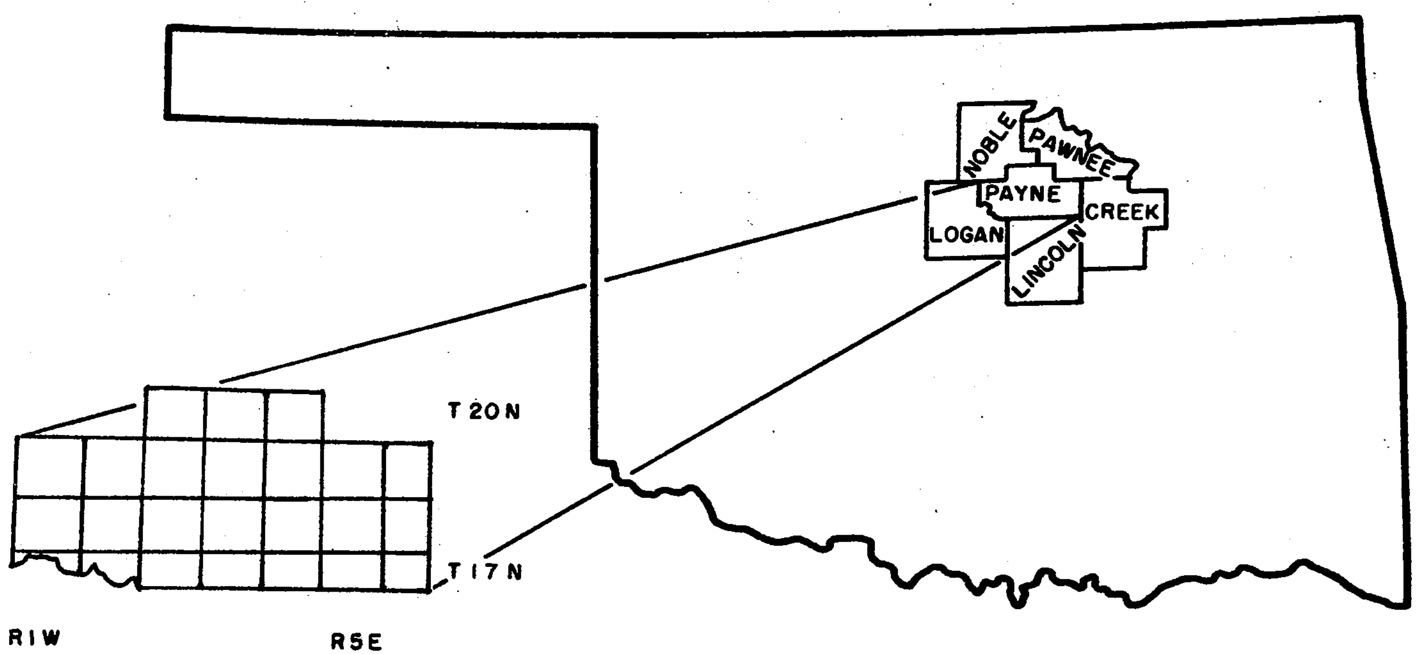

Fig. 1.-Location map of area of study

identification of significant problems, with both translated into meaningful terms. This study provides such an inventory, along with information basic to meaningful and rational environmental decisions. Planning and management should provide the basis for harmonic balance between natural physical, chemical, and biological processes and effects of industry, urban growth, and land development. Proper utilization of data and interpretations based on land-resource capabilities will result in wise land-use planning and resource management.

Objectives and General Methods

The objective of this study is to provide the framework necessary for intelligent decision-making in land-use planning and to present this information in a meaningful manner. Technical data is presented in a manner so that they can be utilized by economists, planners, engineers, lawyers, and legislative and judicial bodies. When these data are utilized in decision-making, chances are improved for development and industrialization compatible with the natural limitations of the area. Fundamental information for evaluating a number of man's activities in Payne County is presented in this study.

A base map for the study was prepared by compiling various topographic maps of the area published by the U.S. Geological Survey. This map was used as the base map for all subsequent maps. The Environmental Geology Map is a map showing the generalized geology of the area. Various geologic maps of the area were compiled in deriving this map. Also used extensively was a soil survey map and report of Payne County (Cobb and Hawker, 1918). The Environmental Geology Map is basic to the preparation and interpretation of the subsequent maps. A variety of specific information potentially valuable in land-use planning is available from the other two maps. The Land-Resource Capabilities Map was compiled by integrating data from the Environmental Geology Map, soil survey, aerial photographs, and certain engineering analyses of the various materials. The Land-Resource Capabilities Map is designed so that planners can make intelligent decisions based only on this map. The Mineral-Energy and Water Resources Map contains information about the location of oil and gas fields and other mineral resources, the distribution of fuel and power, and the quality and availability of surface and ground water. A variety of sources was used in obtaining this information.

Previous Investigations

Traditional geologic mapping of Payne County, Oklahoma has been done by Nakayama (1955), Fenoglio (1957), Ross (1972), and Garden (1973). A generalized soil survey of the area was made by Cobb and Hawker (1918). The study by Hayes *et al.* (1967) for the Oklahoma Highway Department includes generalized geologic maps and certain engineering characteristics of geologic and soil materials.

Other studies which have focused on aspects of environmental geology and land-use planning include the initial study by Baylor University of the urban geology of Greater Waco (Brown, *et al.*, 1965), the Kansas Geological Survey's study of land-use planning and environmental geology (Hilpman, Stewart, *et al.*, 1968), and an environmental mapping project of Tulsa County (Bennison, *et al.*, 1972). Also, the Illinois State Geological Survey has prepared specific maps and reports for use in planning in several counties. The Bureau of Economic Geology, University of Texas at Austin, is preparing the "Environmental Geologic Atlas of the Texas

Coastal Zone," which includes the published report of the Galveston-Houston area (Fisher, et al., 1972). Displayed is the physical, chemical, and biologic setting of the coastal zone by means of an environmental geologic map and special-use maps. The U.S. Geological Survey has made similar studies of several areas, including the Hartford North quadrangle, Connecticut (Langer, et al., 1972). The Soil Conservation Service has digitized various soil data for a number of Oklahoma counties, which can be presented as computer-plotted, soil-derivative maps for single-purpose activities. Unpublished Master of Science theses at Oklahoma State University which deal with environmental geology include the study of land-resource capabilities of the metropolitan Tulsa area by Cook (1973) and Ireland (1973).

CHAPTER III

PHYSIOGRAPHY, GENERAL GEOLOGY, AND LAND-RESOURCES

Payne County is part of the transitional zone between the Central Redbed Plains and the Northern Limestone Cuesta Plains physiographic regions. Much of the area has Redbed Plains characteristics, whereas topography typical of the Limestone Cuesta Plains is present in the eastern part of the county. The predominant slope of the area is to the southeast; local relief is commonly about 100 ft. The climate of the area is mild, with a mean annual temperature of 59°F and an average annual rainfall of 34 in. The geologic section in the central and western parts of the county is characterized by a repetitious sequence of shales, lenticular sandstones, and very thin carbonates. Thin but resistant limestones, shales, and lenticular sandstones are present in the eastern part. The amount of sandstone in the section generally increases southward at the expense of shale. The structure of the area is characterized by gentle westerly homoclinal dip. Local structural noses are present in the subsurface and increase in size and intensity with depth. The age of surface rocks ranges from Late Pennsylvanian to Early Permian (Fig. 2); units become progressively younger westward. The oldest rocks in the area are assigned to the Vamoosa Formation of the Virgilian Series, which crops out in the extreme southeastern part of the county. The overlying Pawhuska Formation is composed of two limestones, the Lecompton and Turkey Run Members, which are separated by sandstone and shale. The Lecomp-

Group	Formation	Member or Informal Unit
SUMNER GROUP	WELLINGTON	
CHASE GROUP	HERINGTON LIMESTONE	
	ENTERPRISE SHALE	
	WINFIELD LIMESTONE	
	DOYLE SHALE	
	FORT RILEY LIMESTONE	
	MATFIELD SHALE	
	WREFORD LIMESTONE	
COUNCIL GROVE GROUP	GARRISON SHALE	
	COTTONWOOD LIMESTONE	
	ESKRIDGE SHALE	
	NEVA LIMESTONE	
	ROCA SHALE	
	RED EAGLE LIMESTONE	
	JOHNSON SHALE	
	FORAKER LIMESTONE	Upper Long Creek Limestone Lower Long Creek Limestone Hughes Creek Shale Americus Limestone
ADMIRE GROUP	ADMIRE FORMATION	Five Point Limestone
WABAUNSEE GROUP	BROWNVILLE LIMESTONE	
	PONY CREEK SHALE	
	GRAYHORSE LIMESTONE	
	GANO SHALE	
	EMPORIA LIMESTONE	Elmont Limestone Harveyville Shale Reading Limestone
	AUBURN SHALE	
	WAKARUSA LIMESTONE	
	HALLET FORMATION	
	BIRD CREEK LIMESTONE	
	SEVERY SHALE	
SHAWNEE GROUP	PAWHUSKA FORMATION	Turkey Run Limestone Lecompton Limestone
	VAMOOSA FORMATION	Kanwaka Shale Vamoosa Sandstone

Fig. 2.-Stratigraphic correlation chart of members and informal units within formations cropping out in Payne County, Oklahoma

ton is generally about 5 ft in thickness. Each of the 7 Pennsylvanian Limestones above the Lecompton is generally less than 2 ft thick. Shale and lenticular sandstones are present between the limestones. Permian Rocks belong to the Wolfcampian Series and the Leonardian Series. Wolfcampian beds also include thin limestones, mudstone, and lenticular sandstones. Lithology changes upward from the continuous Red Eagle Limestone, which locally is as much as 10 ft thick, the persistent Neva Limestone, and predominant mudstone in the Roca Shale to discontinuous, nodular dolomite of the Cottonwood and the dominance of sandstone in Eskridge and Garrison Shales (Table I). The overlying Wolfcampian beds are composed of red shale or claystone, lenticular sandstones, and thin nodular dolomites. The Leonardian Wellington Formation consists of red shale or claystone with lenticular sandstones and some nodular dolomite. The Wellington is characterized by an increase of sandstone southward. Beds of the Wellington represent the youngest rocks in the study area.

Quaternary deposits of Payne County are alluvial sand, silt, and clay and eolian sand and silt, which are present primarily on the floodplain and terraces of Cimarron River and along major creeks. Cimarron River terraces are composed primarily of sand, with small amounts of gravel, silt, and clay. Silt occurs as loess blanketing parts of the terraces and uplands. Alluvial deposits on the floodplain and in the channel of Cimarron River and major creeks consist primarily of sand, with some gravel and silt-clay interbeds.

The geologic framework of the area exerts a strong influence on soil development. Residual soils reflect the underlying bedrock; some upland soils are apparently related to a veneer of loess, which is commonly expressed as upland scarplets; and soils in the stream valleys reflect the alluvial deposits on terraces and floodplains. The floodplain soils of Cimarron River and major creeks in the area, represented by the Yahola, Osage, and Miller series, are the most productive cropland soils in the area. Soils of terrace deposits are cultivated where the surface is flat-lying and not subject to rapid erosion. Terrace soils are represented by the Dougherty, Teller, Reinach, and Eufaula series. Soils overlying sandstone, shale, and limestone are suited for pasture. The Kirkland series is a well developed soil on shale bedrock. Sandstone is the parent material for shallow soils of the Bates and Vernon series. Soils overlying limestone or calcareous shales include the Summit and Vernon series.

Land-Resource Activities

Land use within the study area is principally divided among agriculture, woodlands, and residential-industry. The most widespread use of land in the area is for range-pasture. Croplands are largely concentrated along the floodplain and terrace deposits of Cimarron River and other streams in the area although some upland soils are cultivated for production of wheat. Residential growth has been experienced in recent years and the growth of small industries is increasing. Continued growth seems to be assured, with the availability of fuel resources, location, transportation facilities, and availability of water being the most important factors.

Petroleum and natural gas is the most important mineral resource; however, production is in the declining stages in the area. Sand from the terrace and alluvial deposits of Cimarron River is the second most abundant mineral resource. Limestone for concrete aggregate and county road construction has formerly been quarried at several localities. Small quantities of copper have been mined at a few sites in the past, but the potential for future commercial copper production in this area is unknown.

CHAPTER IV

GENERAL MAP INTERPRETATION

The Land-Resource Capability Study of Payne County contains maps with explanatory legends and a text which explains the preparation, interpretation, and utility of each map. For the most meaningful use of the maps, one should become familiar with the various aspects involved in basic map reading and interpretation.

Base Map Preparation

The preparation of the base map involved obtaining U.S. Geological Survey topographic quadrangle maps which cover the study area. Available maps of the 7½-min quadrangle, with a scale of 1:24,000 (or 1" = 2,000 ft.) are Lake Carl Blackwell, Stillwater North, Stillwater South, and Stillwater Southwest. The 7½-min maps were reduced photographically to the scale of 1:62,500 (or approximately 1" = 1 mile). These reduced maps were then combined with the 15-min maps of the Drumright, Agra, Yale, Perkins, Ripley, and Mulhall quadrangles to form the base map. Blue-line prints were used for field mapping and compilation, and transparent mylar overlays of the base maps were used in preparing the final maps.

Map Scale

Two kinds of horizontal scales appear near the bottom of each map. All of the maps are at the fractional scale of 1:62,500, or 1 unit of measure on the map equals 62,500 similar units in the mapped area. The graphic scale consists of a bar which is divided into units representing miles (mi) or fractions of a mi, kilometers (km) or fractions of a km, and feet (ft) for direct application to the map in measuring distance.

Topography

Contour lines drawn through points of equal elevation above mean sea level show elevation and topographic configuration. The value of a contour line is identified by a number along it, or by the number along an associated index contour. In areas of steep slope the contours will converge and in areas of gentle slope they will diverge. A contour interval is that difference in elevation between 2 successive contour lines. The contour interval for the base maps is 20 ft for the 15-min quadrangle maps and 10 ft for the 7½-min maps. Topographic contours represent a reliable and rapid means for determining the relief of the land surface and the relative slope, which are fundamental tools for land-use planning. A slope map was not prepared as a part of this study because of the size of the study area, the scale of the final maps, and the poor topographic coverage in the western part of the county. An accurate slope map could be derived from the 7½-min quadrangle maps of the Stillwater area.

Other General Map Information

Cities, towns, lakes, rivers, streams, highways, railroads, and oil tanks are shown on the maps. Such features are commonly labeled for ease in identification.

Map Limitations

Because the area of investigation is relatively large and the map scale is relatively small, the study should be considered strategic in nature rather than tactical. Whereas it is thought that this study provides persons engaged in land-use planning and resource management with a useful overview, it is not intended as a substitute for detailed investigations for site evaluations.

Map Legends

Each map includes a legend designed to explain briefly and concisely every map unit which has been delineated. Through the use of the legend and color-indexing, the maps have been designed to be as self-explanatory as possible. Details of preparation, interpretation, and utility are included in discussion of each map.

CHAPTER V

ENVIRONMENTAL GEOLOGY MAP

The Environmental Geology Map is designed to be an inventory of bedrock and sediment resources of the Payne County area. This is a basic map from which many features of the other maps were derived. Proper recognition of these resources is important to both land-resource preservation and land-resource use. The environmental geologic mapping units (Table I) were derived from interpretation of the various geologic maps of Payne County (Nakayama, 1955; Fenoglio, 1957; Ross, 1972; Garden, 1973) and the soil survey report of Payne County (Cobb and Hawker, 1918). The basic mapping units are classified into two systems according to the parent material. These two systems are the bedrock-dominant system and the sediment-dominant system. Mapping units of the Environmental Geology Map are: (1) limestone; (2) shale; (3) sandstone; (4) sandstone and shale; (5) limestone and shale; (6) sandstone, limestone, and shale; (7) terrace-alluvium; (8) floodplain-alluvium. Surface faults, which are presently inactive, are shown along with the mapping units. Faults, as planes or surfaces of bedrock discontinuity along which bedrock was displaced, represent zones of potential weakness.

Sediment-Dominant System

Sedimentary deposits of unconsolidated sand, silt, clay, and gravel compose the sediment-dominant system, which contains 2 units of first-

TABLE I

RELATIONSHIP OF GEOLOGIC AND SOIL UNITS TO THE ENVIRONMENTAL GEOLOGIC UNITS

ENVIRONMENTAL GEOLOGIC MAPPING UNIT	ASSOCIATED GEOLOGIC UNITS (from geologic map)	ASSOCIATED SOIL SERIES (from oil survey reports)
TERRACE-ALLUVIUM	Quaternary terrace	Teller, Eufaula Dougherty, Reinach
FLOODPLAIN-ALLUVIUM	Quaternary alluvium	Yahola, Osage, Miller
SHALE	Late Pennsylvanian and Early Permian shale-bearing units including the Severy, Auburn, Harveyville, Gano, Pony Creek, Admire, Hughes Creek, Roca, Eskridge, Matfield, Doyle, Enterprise, and Wellington.	Kirkland
LIMESTONE	Pennsylvanian and Permian limestone units, including Lecompton, Turkey Run, Bird Creek, Wakarusa, Reading, Elmont, Grayhorse, Americus, Red Eagle, Neva.	Summit
LIMESTONE AND SHALE	Interbedded sequences of limestone and shale units including the Upper and Lower Long Creek.	Summit, Vernon
SANDSTONE	Permian sandstone units, including numerous irregular lenses of sandstone in the Garrison, Matfield, Doyle, Enterprise, and Wellington.	Bates, Vernon
SANDSTONE AND SHALE	Various interbedded sequences of Pennsylvanian and Permian sandstone and shale units including Vamoosa, Pawhuska, Severy, Harveyville, Gano, Pony Creek, Admire, Hughes Creek, Roca, Eskridge, Garrison, Matfield, Doyle, Enterprise, Wellington.	Vernon, Bates
SANDSTONE, LIMESTONE, and SHALE	Interbedded sequences of Pennsylvanian and Permian sandstone, shale, and limestone including Brownville and Neva.	Vernon

From:

order environmental significance: (1) terrace-alluvium and (2) floodplain-alluvium. These units border Cimarron River and Stillwater Creek and other smaller streams in the area. Terrace-alluvial units are associated with former levels of major rivers and streams in the area and may be reworked by wind action. Floodplain-alluvial units are associated with present stream levels.

Bedrock-Dominant System

Bedrock consists of Pennsylvanian and Permian units of shale, sandstone, and thin beds of limestone. These basic rock types and various combinations of them comprise the bedrock (lithologic) units of first-order significance shown on the Environmental Geology Map.

Map Utility

The Environmental Geology Map has three primary uses: (1) it is the basic map for delineating units of primary or first-order environmental significance; (2) it contains much of the basic data necessary for generation of special-use maps; and (3) it can be utilized by builders, engineers, planners, economists, legislators, and others to investigate and evaluate preliminary plans for development of land resources. The map also provides a guide for further investigation and development of mineral resources.

CHAPTER IV

MINERAL-ENERGY AND WATER RESOURCES MAP

The Mineral-Energy and Water Resources Map (Fig. 4) shows the occurrence and distribution of all known mineral deposits in the area, including oil and gas, sand and gravel, limestone, copper, and sandstone. In addition, the energy distribution is outlined by the network of all major pipelines and power transmission lines. The availability and quality of both surface and ground water for municipal, agricultural, and industrial uses are outlined.

Oil and Natural Gas

Oil and natural gas in the area have been extensively developed. Although resources are thought to be near depletion, oil is still the leading mineral produced in the county. The subsurface geologic section contains numerous reservoirs which are primarily Pennsylvanian and Ordovician in age. The most productive Pennsylvanian sandstones include Cleveland, Skinner, Red Fork, and Bartlesville. The Ordovician (Simpson) sandstones have also provided significant oil production. The average depth for producing reservoirs in the area is about 3500 to 4000 ft.

Sand and Gravel

Sand is plentiful on the floodplain and terraces of Cimarron River and, together with limited amounts of gravel, is available for use in fills, asphalt, concrete, and masonry work. The material of the terraces, which commonly has a rather high iron oxide content, is generally used only in fills and asphalt. The sand pits in the terrace deposits near Perkins are usually in operation intermittently. Processed sand from the floodplain is class A and masonry grade. A slurry operation southwest of Perkins, which supplies local concrete plants and masonry contractors, produces approximately 50,000 tons annually. Another pit on the floodplain south-southeast of Perkins is presently being operated by a highway contractor.

Limestone

In the past, the Red Eagle Limestone has been quarried at several locations in the study area. Locally, the Red Eagle is a good source for road metal for county roads, concrete aggregate, and rip-rap, but it is generally thin or shaly. Other limestones which may be suitable as a local resource include the Lecompton and Wakarusa. Most other limestones in the area are considered too thin for development as resource material. Thin, nodular dolomites have been used as road metal for some county roads.

Sandstone

Sandstones of Payne County were used locally for building stone, and one sandstone was quarried for subbase material for Interstate Highway 35. However, the sandstones in Payne County are generally considered too friable for modern construction purposes.

Copper

Known deposits of copper are located southwest of Glencoe, where attempts at mining were made in the early part of this century. Associated with these copper minerals are gold, silver, and possibly uranium. Mineralization has been observed in samples from water-well drilling in an area of approximately 15 sq mi, which includes surface exposures of copper-bearing minerals. Mineralization affects very thin layers when fossil wood is abundant in sandstone. Chalcocite is the chief copper mineral; it is associated with pyrite, malachite, azurite, and some chalcanthile and covellite. Several other locations of copper mineralization are known in eastern Payne County. Recently interest has been expressed in these copper-bearing zones by several companies. The most likely origin of copper mineralization is precipitation from ground water in a reducing environment formed by organic matter.

Distribution of Energy-Power

Natural gas is the primary fuel used in Payne County. The majority of this fuel is supplied to the area by Cities Service Gas Company and Oklahoma Natural Gas Company. Major suppliers of electrical power in the area outside of the cities of Stillwater and Cushing are Oklahoma Gas and Electric Company and KAMO Electric Cooperative. Some of the KAMO substations in the area are under the care and maintenance of the Grand River Dam Authority. The distribution of energy-power is outlined on the map by the network of major pipelines and major power transmission lines.

Water Resources

Ground Water

Wells provide water for many rural homes, for municipal use in small communities, and for small industries. The area most favorable for ground water development is along the floodplain and terraces of Cimarron River.

Floodplain-alluvium and terrace-alluvium along Cimarron River ranges from 50 ft to 120 ft thick, and yields of wells range from 50 to 100 gal per min (gpm). Where alluvium is thinner and finer grained, yields are about 25 to 50 gpm. Overall water quality is fair to good, with dissolved solids content typically less than 500 mg/l. However, wells located too close to the river on the floodplain may experience a decline in water quality if they are pumped heavily for an extended period of time. This heavy pumping lowers the water table, and the flow of water into the alluvium from the river causes deterioration of ground water quality.

Floodplain-alluvium along Stillwater Creek has a thickness of about 30 to 40 ft. Average yield is about 25 to 50 gpm, although yields of 100 gpm are possible where wells penetrate local lenses of gravel at the base. Quality of the ground water is generally good. Elsewhere, with local exceptions, floodplain and terrace deposits are too thin to yield significant amounts of water.

Because the depth to the base of fresh water represents ground water development in bedrock, the approximate depth to the fresh water-salt water contact is shown by contour lines on the map. A contour interval of 100 ft is used throughout the county, except in the southeastern portion where greater depths are portrayed by a geometrically progressive contour interval. The depth to salt water is controlled by sandstone development, topography, and saline influent from Cimarron River. Areas of bedrock deposits (sandstone, limestone, and shale) are generally considered to be least favorable for ground water development, but some sandstones do yield amounts of 25 to 50 gpm. Thicker, coarser grained beds of the Vamoosa Formation may yield as much as 200 gpm in the southeastern part of the county. Other areas favorable for possible ground water development in sandstone are shown on the map east of Stillwater, southeast of Stillwater, and west of Stillwater (Fig. 4). Although the quality of water is variable in these irregular lenses of sandstone, it generally is of fair to good quality. In other areas, where sandstones may be thin or tightly cemented, the quality of water is poor to fair, and/or the depth to salt water is shallow.

Surface Water

Water from Cimarron River and the lower part of Stillwater Creek in Payne County does not meet the accepted water-quality standards for municipal and domestic use. They are characterized by very hard to brackish water, with dissolved solids greater than 1000 mg/l. Cimarron River has high hardness (calcium carbonate) and high chloride content, and the dissolved solids content occasionally exceeds that of sea water. The high mineral content is primarily due to solution of salt or gypsum from bedrock upstream. Local stream pollution may occur in close proximity to oil production, livestock operations, and waste-disposal facilities. The larger lakes in the county which provide water of good quality are Lake Carl Blackwell, Boomer Lake, and Cushing Lake. In addition, Lake McMurtry, just to the north of Payne County in Noble County, provides a source of good water to supplement the water supply from Lake Carl Blackwell for Stillwater. Abundant surface water is present just to the east at Keystone Reservoir in Pawnee and Creek Counties, but the quality of water there is fair to poor. Other possible large sources of water are the Kaw Reservoir on Arkansas River some 40 miles north in Osage County and the proposed Lower Black Bear Creek Watershed Project Site 19, just north of the Payne-Pawnee County line. However, water from Kaw Reservoir and Lower Black Bear Creek has not yet been proved to be of good quality; that is, moderate to hard water, with generally less than 500 mg/l dissolved solids. The quality in some of the smaller streams, lakes, and ponds in the area may be good, if not locally polluted.

Summary

The Payne County area contains a modest amount of mineral resources. Oil and gas have been extensively developed and a modest level of development is likely to continue for the next several years. Abundant sand occurs along Cimarron River in floodplain and terrace deposits. Although the quantity of sandstone in the area is great, it is considered to be of poor quality for most construction purposes. Limestone is available locally for limited use as road metal for county roads, concrete aggregate, and rip-rap. Copper mineralization is known to exist at several localities in the area, but the economic potential for future copper mining is as yet unknown.

Ground water from floodplain and terrace deposits is fairly abundant. Irregular lenses of sandstone bedrock also contain significant amounts of ground water. Surface water in the area is severely restricted in use because of the poor quality of Cimarron River. However, several rather large lakes in the area provide water of good quality. Continued economic growth in the area may depend upon further development of surface water of good quality and more extensive use of ground water.

CHAPTER VII

LAND-RESOURCE CAPABILITY MAP

The Land-Resource Capability Map is particularly designed for use in evaluating land resources. The mapped units have been delineated on the basis of properties of the geologic and soil units. Five broad classes of land units are present in Payne County: (1) the sediment-dominant system, for which the depositional environment involving stream processes is of first-order environmental significance; (2) the soil-dominant system (areas with soil greater than 45 in. thick) for which soil development is of first-order environmental significance; (3) the bedrock-dominant system (areas of bedrock with soil mantle less than 30 in. thick), for which characteristics of bedrock are of first-order importance; (4) bedrock-soil system (areas with soil thickness either 30-45 in. or less than 45 in.); and (5) the artificial system (oil-field waste lands), for which man's activities have significantly altered or damaged the land surface. The individual mapping units within each of these systems have been delineated by integrating features of the Environmental Geology Map with various known properties or hazards from the soil survey (Table II). First-order classification of units is based on parent (geologic) material; second-order classification, on both soil thickness and texture; and third-order classification, on properties and hazards (Table III). Particularly important in land-use planning are those properties of the capability units which may limit or enhance

TABLE II

RELATIONSHIP OF GEOLOGIC AND SOIL UNITS TO THE LAND-RESOURCE CAPABILITY UNITS

	LAND-RESOURCE CAPABILITY UNITS	BEDROCK OR SEDIMENT UNIT (from geologic map)	ASSOCIATED SOIL SERIES (from oil survey reports)
SEDIMENT-DOMINANT SYSTEM	1	Quaternary Terrace	Teller
	2	Quaternary Terrace	Eufaula
	3	Quaternary Terrace	Dougherty
	4	Quaternary Terrace	Reinach
	5	Quaternary Alluvium	Yahola
	6	Quaternary Alluvium	Osage
	7	Quaternary Alluvium	Miller
SOIL-DOMINANT SYSTEM	8	Late Pennsylvanian and Early Permian shale-bearing units including the Severy, Auburn, Harveyville, Gano, Pony Creek, Admire, Hughes Creek, Roca, Eskridge, Matfield, Doyle, Enterprise, and Wellington.	Kirkland
BEDROCK-DOMINANT SYSTEM	9	Pennsylvanian and Permian limestone units, including Lecompton, Turkey Run, Bird Creek, Wakarusa, Reading, Elmont, Grayhorse, Americus, Red Eagle, Neva.	Summit
	10	Interbedded sequences of limestone and shale units including the Upper and Lower Long Creek.	Summit, Vernon
	11	Permian sandstone units, including numerous irregular lenses of sandstone in the Garrison, Matfield, Doyle, Enterprise, and Wellington.	Bates, Vernon
	12	Interbedded sequences of Pennsylvanian and Permian sandstone, shale, and limestone including Brownville, Neva.	Vernon
BEDROCK-SOIL SYSTEM	13	Pennsylvanian and Permian shale-bearing units with some sandstone including Vamoosa, Pawhuska, Severy, Harveyville, Gano, Pony Creek, Admire, Hughes Creek, Roca, Eskridge, Garrison, Matfield, Doyle, Enterprise, Wellington.	Vernon, Kirkland
	14	Various interbedded sequences of Pennsylvanian and Permian sandstone and shale units including Vamoosa, Pawhuska, Severy, Harveyville, Gano, Pony Creek, Admire, Hughes Creek, Roca, Eskridge, Garrison, Matfield, Doyle, Enterprise, Wellington.	Vernon, Bates
ARTIFICIAL SYSTEM	15	Oil Field Waste Lands	Oil Field Waste Lands

TABLE III

CLASSIFICATION OF LAND-RESOURCE CAPABILITY UNITS

First-order classification based on rock type or parent material

Unit

Limestone
Shale
Sandstone
Sandstone and shale
Shale with sandstone
Limestone and shale
Sandstone, limestone, and shale
Terrace-alluvium
Floodplain-alluvium
Artificial land

Second-order classification based on soil development (depth to base of B horizon)

Subunit

Soil less than 30 in. thick
Soil 31 in. to 45 in. thick
Soil 0 to 45 in. thick
Soil greater than 45 in. thick

Second-order classification based on soil texture of B horizon

Subunit

Clay with low plasticity (CL)
Clay with high plasticity (CH)
Silt with low plasticity (ML)
Silt with high plasticity (MH)
Sand, well graded (with silt and/or clay) (SW, SM, SC)
Sand, poorly graded (no silt or clay) (SP)
Gravel, well graded (with silt and/or clay) (GW, GM, GC)
Gravel, poorly graded (no silt or clay) (GP)

Third-order classification based on certain properties and hazards

Subunit

High acidity
High alkalinity
High flood potential
Possible slope failures
Seepage
Steep slopes
Seasonally high water table
High susceptibility to water erosion
Low ripping potential

their use for specific purposes. These features include high flood potential, unfavorable shrink-swell potential, high acidity, high alkalinity, high permeability, low permeability, steep slopes, susceptibility to erosion, low ripping potential (high induration), seepage, seasonally high water table, and coarse texture. Although surface faults in the area are presently inactive and are thought to pose few problems in land use, they should be recognized and properly considered because they are planes of bedrock displacement and represent zones of potential weakness.

Presented in Table IV are an evaluation of a number of man's activities involving the different land-resource capability units and a characterization of them according to various properties. Land-resource units are designated as least favorable, most favorable, or moderately favorable for a particular activity according to that unit's potential for that activity. Important properties of the units are measured in qualitative terms as high, moderate, and low.

Land-Resource Capability Units

For purposes of description and discussion, each land-resource unit is designated by both number and color (Table IV, Fig. 5). The former designation is primarily for description in the text. Designation by color is for ease in recognition of the various units on the map.

Sediment-Dominant System

Unit 1. Land designated as Unit 1 on the Land-Resource Capability Map is terrace-alluvium along Cimarron River, consisting of silty, sandy soil greater than 45 in. thick. This unit represents stream deposition at a higher level earlier in the Quaternary Period; it may have undergone

TABLE IV

EVALUATION OF LAND-RESOURCE CAPABILITY UNITS FOR LAND-USE PLANNING

		Unit	Activities													Properties									
			Liquid Waste Disposal	Solid Waste Disposal	Light Construction	Heavy Construction	Highway Location (Subgrade)	Select or Sub-base Material	Base Material	Aggregate	Fill Material	Excavation	Underground Installations	Buried Cables and Pipes	Reservoir or Pond Location	Shrink-Swell Potential	Permeability	Erodibility	Water Table Position	Seepage	Acidity	Alkalinity	Ripping Potential	Slope Stability	Flood Potential
Sediment-Dominant System	Terrace-Alluvium	1	-	-	+	0	+	+	0	-	+	+	0	0	-	L	M	H	M	L	M	L	H	M	L
		2	-	-	+	0	+	+	0	-	+	+	0	0	-	L	H	H	L	L	L	M	H	L	L
		3	-	-	+	+	+	+	-	-	+	+	-	0	-	L	M	H	H	H	M	L	H	M	L
		4	-	-	+	0	0	+	0	-	+	+	-	0	-	L	H	M	H	L	L	M	H	L	L
	Floodplain-Alluvium	5	-	-	-	-	0	+	-	-	0	+	-	0	-	L	H	H	H	L	L	M	H	M	H
		6	-	-	-	-	-	-	-	-	-	+	-	0	+	H	L	L	H	L	M	L	H	L	H
		7	-	-	-	-	-	-	-	-	-	+	-	0	+	H	L	L	H	L	L	M	H	L	H
Soil-Dominant System		8	+	+	-	-	-	-	-	-	-	+	-	0	+	H	L	H	L	L	L	M	H	M	L
Bedrock-Dominant System	Lime-stone	9	-	-	+	+	+	0	+	+	-	-	-	-	-	L	M	L	L	H	L	H	L	M	L
	*	10	0	0	-	-	-	0	-	-	-	0	-	0	+	M	M	M	L	H	L	H	M	L	L
	Sand-stone	11	-	-	+	0	+	0	-	-	-	-	-	-	-	L	M	L	L	H	L	M	L	M	L
	**	12	-	-	-	-	-	0	-	-	0	0	0	-	-	L	M	M	L	H	L	L	M	L	L
Bedrock-Soil System	***	13	+	+	-	-	-	-	-	-	-	+	-	0	+	H	L	H	L	L	L	M	M	M	L
	****	14	-	-	-	-	-	0	-	-	0	0	0	-	-	M	M	M	L	H	L	M	L	M	L

* Limestone and Shale

** Sandstone, Limestone, and Shale

*** Shale with Sandstone

**** Sandstone and Shale

<u>Anticipated Capability</u>

+ Most favorable capability; minimal problems

0 Moderately favorable capability; moderate problems

\- Least favorable capability; maximal problems

<u>Key</u>

H High

M Moderate

L Low

some reworking by wind action. Materials in this unit have low plasticity, moderate permeability, moderate acidity, and high susceptibility to water and wind erosion. The principal soils developed on these deposits are of the Teller soil series. Areas of Unit 1 are considered to be least suited for waste disposal, aggregate, and reservoir or pond location. This unit is generally favorable for light construction, highway location (subgrade), select or subbase material, fill material, and excavation.

Unit 2. Unit 2 is also terrace-alluvium along Cimarron River. This sediment consists of silty, sandy soil thicker than 45 in. This unit also represents stream deposition at a higher level, with possible reworking of the deposits by wind action. These materials have low plasticity, high permeability, slight acidity, and high susceptibility to water and wind erosion. Soils developed in these areas are typically of the Eufaula series. Unit 2 has least capability in waste disposal, aggregate, and reservoir or pond location. Properties are generally favorable for light construction, highway location, select material, fill material, and excavation.

Unit 3. Land classified in Unit 3 is terrace-alluvium along Cimarron River which was deposited by the river when it was at a higher level. This unit, like Units 1 and 2, may have undergone some reworking by wind action. It is silty-sandy and is thicker than 45 in. Other properties are low plasticity, moderate permeability, moderate acidity, and high susceptibility to wind erosion. Principal soils associated with these deposits are of the Dougherty series. These materials are least suited for waste disposal, base material, aggregate, underground installations, and reservoir or pond location. These areas are most favorable for light construction, heavy construction, highway location, select material, fill material, and excavation.

Unit 4. Unit 4 is another type of terrace-alluvium along Cimarron River which was deposited when the river was at a slightly higher level than at present. This unit is very similar to stream deposits in the present floodplain, but lies above ordinary flooding. Soils developed in areas of Unit 4 are of the Reinach series. These silty, sandy soils are thicker than 45 in. and have low plasticity, high permeability, and moderate alkalinity. These materials are least suited for waste disposal, aggregate, underground installations, and reservoir or pond location. Properties are most favorable for light construction, select material, fill material, and excavation.

Unit 5. Land classified as Unit 5 lies in the floodplain of Cimarron River, Stillwater Creek, and other streams in the area. This floodplain-alluvium, which is thicker than 45 in., represents geologically Recent deposition by streams. Soil developed on these deposits are silty, sandy soils of the Yahola series, and it is characterized by low plasticity, high permeability, moderate alkalinity, and occasional flooding. These materials are least favorable for waste disposal, light construction, heavy construction, base material, aggregate, underground installations, and reservoir or pond location. These materials are most favorable for select or subbase material, and excavation.

Unit 6. Unit 6 is floodplain-alluvium, thicker than 45 in., which formed by Recent stream deposition in the Cimarron River drainage system. Soils developed on these deposits are of the Osage soil series. These are silty, clayey soils with very high plasticity, low permeability, moderate acidity, seasonally high water table, and susceptibility to flooding. Materials of Unit 6 are least favorable for waste disposal, light construction, heavy construction, highway locations, select material, base material, aggregate, fill material, and underground installations. These materials are generally favorable for excavation and reservoir or pond location.

Unit 7. Areas designated Unit 7 are also floodplain-alluvium resulting from Recent stream deposition. These are silty, clayey soils, thicker than 45 in., of the Miller series. Properties include high plasticity, low permeability, moderate alkalinity, and susceptibility to flooding. These materials are generally favorable only for excavation and reservoir or pond location. They are generally unfavorable for the other activities.

Soil-Dominant System

Unit 8. Land classified as Unit 8 is characterized by thick, clayey soil overlying shale. The soil is developed to a depth of over 45 in. and is part of the Kirkland soil series. These soil materials have high plasticity, low permeability, and moderate alkalinity. The underlying shale may locally contain sandstone. Materials in Unit 8 are generally least suited for light construction, heavy construction, highway location, select material, base material, aggregate, fill material, and underground installations. Properties are most favorable for waste disposal, excavation, and reservoir or pond location.

Bedrock-Dominant System

Unit 9. Land classified as Unit 9 is characterized by areas of limestone outcrops. Bedrock units are the Lecompton, Turkey Run, Bird

Creek, Wakarusa, Reading, Elmont, Grayhorse, Americus, Red Eagle, and Neva. These may be overlain by clayey soil less than 30 in. thick of the Summit series. Limestones are probably non-rippable where thickness exceeds 1 ft. These materials have least favorable properties for waste disposal, fill material, excavation, underground installations, buried cables and pipes, and reservoir or pond location. Unit 9 is generally most favorable for light construction, heavy construction, highway location, base material, and aggregate.

Unit 10. This unit consists of areas of interbedded limestone and shale at the surface or overlain by clayey soil less than 30 in. thick. Unit 10 is probably rippable except where thicknesses of individual limestone beds locally exceed 1 ft. Soils of this unit are generally of the Summit and Vernon series. Properties are generally well suited only for reservoir or pond location and generally least favorable or moderately favorable for all other activities.

Unit 11. Areas of Unit 11 have sandstone at the surface or sandstone overlain by sandy soil less than 30 in. thick. Soils associated with Unit 11 are generally of the Bates and Vernon series. Seepage is common along the contact with underlying shale. Materials of Unit 11 are least suited for waste disposal, base material, aggregate, fill material, excavation, underground installations, buried cables and pipes, and reservoir or pond location. Properties are most favorable for light construction and highway location.

Unit 12. Land classified as Unit 12 includes those areas of interbedded limestone, sandstone, and shale, overlain by soil less than 30 in. thick. Bedrock, possibly exposed as rock benches, includes the Brownville and Neva Limestones. Sandstone and limestone are generally rippable, except for local areas where limestone thickness exceeds 1 ft. Seepage is common along contacts with underlying shale. Materials of Unit 12 are generally least favorable or moderately favorable for all the activities listed.

Bedrock-Soil System

Unit 13. Areas designated as Unit 13 are of shale bedrock, with some sandstone, which is overlain by sandy, clayey soil, 30 to 45 in. thick. Soils include the Vernon and Kirkland series; they have high plasticity, low permeability, and moderate alkalinity. These materials are least suited for light construction, heavy construction, highway location, select material, base material, aggregate, fill material, and underground installations. Unit 13 may be suitable for waste disposal, excavation, and reservoir or pond location.

Unit 14. Unit 14 consists of areas of sandstone and shale overlain by sandy soil which varies in thickness from 0 to 45 in. Sandstone is locally exposed as rock benches, and seepage is common from the sandstone. Associated soils are generally of the Vernon and Bates series. Properties of Unit 14 are either least favorable or moderately favorable for all activities listed.

Artificial System

Unit 15. Areas designated as Unit 15 are oil-field waste lands. These are areas where liquid wastes, principally salt water and oil, have been discharged. These areas are characterized by a very high content of sodium chloride in the soil, a general lack of vegetation, and high susceptibility to water erosion. Unit 15 may be locally present within areas of each of the other systems. Because the properties may have been severely altered, each location must be evaluated individually for any special purpose or activity of man.

Evaluation of Man's Activities

Man's activities are evaluated on the basis of dominant system, soil thickness and texture, and other natural properties. Special engineering or construction techniques may improve the capability of some units.

Waste Disposal

The soil-dominant unit, Unit 8, is generally satisfactory for waste disposal and the bedrock-soil Unit 13 may also be a satisfactory host. Other units present maximal or possible problems due to high permeability or proximity to ground and surface water resources. These problems are evident in Payne County as most of the small communities dispose of solid waste by means of open dumps in creek bottoms where sandy, alluvial soils predominate. Areas of Unit 8 or Unit 13 would be satisfactory hosts for sanitary land fills.

Light Construction

Sediment-dominant units 1, 2, 3, 4, and bedrock-dominant units 9 and 11 are generally suited for light construction. Units 5, 6, 7, 8, 10, 12, 13, and 14 are least suitable as sites for light construction due to a variety of reasons, including flood potential, high shrink-swell potential, and seepage.

Heavy Construction

Suitable sites for heavy construction include Units 3 and 9. The rest are least favorable or moderately favorable due to flood potential, high shrink-swell potential, and/or slope.

Highway Location

Suitable sites for highway construction include Units 1, 2, 3, 9, and 11. Maximal problems, due to properties such as high shrinkage-swelling, susceptibility to erosion, flooding, poor drainage, and steep slopes, make Units 6, 7, 8, 10, 12, 13, and 14 least favorable sites. Seepage from sandstones overlying shales is a major problem in Payne County, as it can severely deteriorate the foundation of the streets, highways, and roads.

Select (Subbase) Material

Adequate select material for use in highway construction may be obtained from Units 1, 2, 3, 4, and 5. Units 6, 7, 8, and 13 are generally least suited for select material.

Base Material

Unit 9 provides suitable material for use as road base in highway construction. Units 3, 5, 6, 7, 8, 10, 11, 12, 13, and 14 are generally least suitable materials for this use, due primarily to high shrink-swell potential.

Aggregate

Unit 9 provides the only probable source of concrete aggregate in the study area. Other units are too fine-grained, insufficiently indurated, or too thin.

Fill Material

Units 1, 2, 3, and 4 are well suited for fill material. Units 6, 7, 8, 9, 10, 11, and 13 present maximal problems because of shrink-swell potential, rippability, or erodability.

Excavation

Land designated as Units 1, 2, 3, 4, 5, 6, 7, 8, and 13 present minimal problems in excavation, while Units 9 and 11 are areas of sandstone and limestone outcrops which present maximum problems in excavating.

Underground Installations

No unit is thought to represent minimal problems with respect to underground installations. The units present problems due to shrink-swell potential, flooding, susceptibility to erosion, drainage, or slope. Maximum problems are encountered in areas designated as Units 3, 4, 5, 6, 7, 8, 9, 10, 11, and 13.

Buried Cables and Pipes

No unit is considered favorable for this activity. Unfavorable conditions include susceptibility to erosion, shallow depth of bedrock, high acidity, and steep slope. Least satisfactory units are 9, 11, 12, and 14.

Reservoir or Pond Location

Materials included in Units 6, 7, 8, 10, and 13 are generally favorable for reservoir location. Land least suited includes Units 1, 2, 3, 4, 5, 9, 11, 12, and 14. Unfavorable properties include high permeability, drainage, topography, and depth to bedrock.

Map Utility

Land-resource capability units possess properties which regulate the impact of man's activities in an area. For example, units with high permeability, such as the terrace deposits, are generally not good sites for waste disposal because wastes can be transmitted to valuable ground and surface water resources. An impermeable clayey unit may provide a good site for waste disposal but a poor site for construction purposes due to high shrink-swell potential. It is obvious that each capability unit must be evaluated separately on its merits or limitations with regard to any specific activity. The key to good land and resource management is evaluating each capability unit for a specific use well in advance of development. The proposed development can then proceed, by using favorable capability units as a guide, with the best chance for harmonious balance with the physical and chemical limitations of the area. This map is designed so that intelligent decisions in land-use planning can be made based on this map alone.

CHAPTER VIII

CONCLUSIONS

This study provides a general appraisal of land and mineral resources of Payne County and enumeration of certain potential problems. The resources are described in meaningful terms, and information basic to environmental decisions is shown by the following maps with explanatory legends and descriptive text:

1. Land-Resource Capability Map, by delineating units according to capabilities, provides a basis for making decisions.
2. Environmental Geology Map exhibits many features of first-order environmental significance; it provides much of the basic information for deriving special-use maps.
3. Mineral-Energy and Water Resources Map presents locations of current resources, such as oil and gas, sand and gravel, limestone, copper, and ground and surface water. In addition, the distribution of energy-power is outlined by the network of major pipelines and power-transmission lines.

Land-resource capability units are delineated according to: (1) bedrock lithology, sediment, or soil; (2) soil thickness and texture; and (3) other basic properties. The distribution of these various capability units is thought to provide a meaningful map to persons involved in making land-use decisions. Those decision-makers who are nonscientists are aided in evaluating man's activities by a matrix which indicates the potential of the capability units for certain activities and shows important properties of the units.

The study area contains a modest amount of mineral resources. Oil and gas production is in the declining stages. Sand is extensive in the terrace and floodplain deposits of Cimarron River, and limestone is available for concrete aggregate and county-road construction. Interest has recently been expressed by several companies in copper mineralization at several localities in the study area. Fairly abundant water resources are available for domestic, industrial, and agricultural use. Natural gas is provided to the area by two major suppliers and electrical transmission lines operated by two companies distribute power throughout the area outside the cities of Stillwater and Cushing. Land-resource capability units are grouped into the following genetic systems:

1. The sediment-dominant system consists of 4 units of terrace-alluvium and 3 units of floodplain-alluvium.
2. The soil-dominant system contains 1 clayey unit.
3. The bedrock-dominant system includes 4 distinctive lithologic units.
4. The bedrock-soil system is represented by 2 units with intermediate thicknesses of soil.
5. The artificial system consists of 1 unit of oil-field waste lands.

The units of the sediment-dominant system are generally regarded as unsatisfactory hosts for waste disposal, but they present minimal problems in excavation. The soil-dominant unit should provide adequate security for waste disposal. The bedrock-dominant system contains 2 units generally favorable for light construction. The artificial system must be evalulated at each location in terms of proposed use, extent of damage, and parent material.

SELECTED BIBLIOGRAPHY

Baumann, W. E., and F. J. Dries, 1972, Soil and its relation to urban development: U.S. Dept. Agr., Soil Conservation Service, Oklahoma County Conservation District, 20 p.

Brown, L. F., J. M. Burket, and P. T. Flawn, 1965, Urban Geology of Greater Waco: Baylor Geol. Studies Bull. 8, 45 p.

Cobb, W. B., and H. W. Hawker, 1918, Soil survey of Payne County, Oklahoma: U.S. Dept. Agr., Bur. Soils, 39 p.

Cook, G. L., 1973, Land-resource capability units of the Wagoner County area, northeastern Oklahoma: M.S. Thesis, Okla. State Univ., 55 p.

Curtis, N. M., and W. E. Ham, 1957, Physiographic map of Oklahoma: Okla. Geol. Survey Educ. Series 4.

Fenoglio, M. S., 1957, Geology of northeastern Payne County, Oklahoma: M.S. Thesis, Univ. Okla., 84 p.

Fisher, W. L., et. al., 1972, Environmental geologic atlas of the Texas Coastal Zone, Galveston-Houston Area: Bur. Econ. Geology, Univ. Texas, 91 p.

Garden, A. J., 1973, Geology of western Payne County, Oklahoma: M.S. Thesis, Okla. State Univ., 70 p.

Hayes, C. J., et al., 1967, Engineering classification of geologic materials, Division Four: Okla. Hwy. Dept., Res. Dev. Div., 284 p.

Hilpman, P. L., G. F. Stewart, et. al., 1968, A pilot study of land-use planning and environmental geology: Kansas Geol. Survey '701' Project No. Kans. P-43 Rep. No. 15-D., 63 p.

Indian Nations Council of Governments, 1969, Natural features, generalized soils, mineral resources, surface geology maps, Project Oklahoma P-117.

Ireland, J. A., 1973, Geology and land-resource capabilities of western Rogers and southern Washington Counties, Oklahoma: M.S. Thesis, Okla. State Univ.

Jacobs, A. M., 1971, Geology for planning in St. Clair County, Illinois: Illinois State Geol. Survey Circ. 465, 35 p.

Kincannon, D. I., and T. A. Haliburton, 1972, Solid waste collection and disposal for rural areas, Payne County, Oklahoma: Okla. State Univ. School Civil Eng., 64 p.

Langer, W. H., et. al., 1972, Folio of the Hartford North quadrangle, Connecticut: U.S. Geol. Survey Folio 1-784 F.

Nakayama, E., 1955, Geology of southeastern Payne County, Oklahoma: M.S. Thesis, Univ. Okla., 68 p.

Oklahoma Natural Gas, 1973, Gas pipelines in the state of Oklahoma.

Oklahoma Oil Maps, 1971, State of Oklahoma pool and dry hole map.

Roberts, T. N., and K. R. Burns, 1966, Products pipelines of Oklahoma: Okla. Geol. Survey Map GM-11.

Ross, J. S., 1972, Geology of central Payne County, Oklahoma: M.S. Thesis, Okla. State Univ., 87 p.

Stiles, L. R., et. al., 1973, Payne County conservation district long range total resource conservation program: Cons. Districts of Okla., 53 p.

U.S. Dept. Agr., Soil Cons. Serv., Oklahoma Cons. Com., Office of Community Affairs and Planning, Okla. County Cons. District, 1974, Soil is the key to proper land use; soil interpretations for resource development, Oklahoma County, Oklahoma, 35 p.

Wilson, P., et. al., Appraisal of the water and land resources of Oklahoma, Region X: Oklahoma Water Resources Board Pub. 40, 137 p.

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