THE DETERMINATION OF AGRICULTURAL AND NON-AGRICULTURAL SOIL POTENTIALS FOR BETTER LAND USE IN STILLWATER, OKLAHOMA

By

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1973

Submitted to the Faculty of the Graduate College
of the Oklahoma State University
in partial fulfillment of the requirements
for the Degree of
MASTER OF SCIENCE
December, 1975

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ACKNOWLEDGMENTS

The author is grateful for the assistance of Dr. Lawrence Morrill and Dr. Douglas Kent for their suggestions and advice as members of the thesis committee. To Dr. Fenton Gray, thesis advisor, I wish to extend special thanks for his sincere interest and thoughtful guidance in the planning and preparation of this thesis.

Additional thanks go to my collegues and friends who have encouraged me throughout my course of study. The contributions of Mr. Earl Nance for his help in soil correlation and field checking, Mr. John Blair for the reproduction of the transparencies, and Mrs. Kathy Henslick, the typist, are truly appreciated.

Finally without the patience and confidence of my wife Cathy, the task of completing this thesis would have been impossible. A great sacrifice on her part has allowed this milestone to become a reality.

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CHAPTER I

INTRODUCTION

The conflict between man and his environment has prevailed through the ages. Where man has constructed structures without an appreciation for the physical environment of the site, failures often occurred. Some men have spent a lifetime studying the physical environment and the way it reacts to stresses applied by man. Although many relationships remain to be studied, the science has progressed far enough to be of practical use. It is unfortunate that the average citizen and particularly those in decision making positions are not aware of this valuable tool. Those involved in the study of the earth's environment may be guilty of keeping the secret. Whatever the reason may be for this lack of public awareness, many are presently trying to correct the situation.

This thesis attempts to reach a small segment of people, the decision makers, planners, land developers, and citizens of Stillwater, Oklahoma. Each and every one use the soil in some way. Some farm the soil, others build homes and businesses on it, and most drive automobiles over it. Just as some soils grow plants better than other soils, some soils support buildings and other urban uses better than others.

The study supplies information concerning the capabilities and limitations of Stillwater soils. Application of this knowledge in the development of Stillwater by public and private concerns will result in better land use. The product of better land use saves citizens trouble and money. The cost of repairing cracked walls in a building or the cost of maintenance on city streets are far more than the cost of doing the job right the first time. Part of that job is to choose the most suitable soils for each use and be aware of the soil conditions present.

CHAPTER II

REVIEW OF LITERATURE

Soil and Soil Forming Factors

Soil is a natural body on the surface of the earth which has evolved from the factors of soil formation. There are five soil forming factors: parent material, climate, living organisms, relief, and time.

Parent Material

Soil is the product of physical and chemical weathering of rocks and unconsolidated geologic material. Rock types vary in their petrology, mineral composition, and grain size, which directly influence their weathering rate.

Variability in the weathering of parent material accounts for the generation of many soil types. The same rock, holding the other soil forming factors constant, develops the same soil; and by varying one or more of the other forming factors a given rock type results in a different soil.

Relief

Relief implies relative elevation and is defined as the elevations or inequalities of a land surface considered collectively (19). The shape, gradient, length, and exposure control the effects of moisture and temperature on soil development.

Climate

Climate affects soil development directly and indirectly. The factors of temperature and moisture control weathering, leaching, and other soil forming processes. Climate also determines the fauna and flora found in a given area which in turn affect soil development. Stillwater's climate is subhumid. (See Table I).

Living Organisms

As the parent material gradually weathers by physical and chemical processes, plants begin to grow. Decayed plants and animal residues are mixed with the mineral fraction of the soil. The decayed organic matter imparts color, promotes good structure, and helps stabilize the soil.

The soils of Stillwater were developed under the influence of grasses, for the most part. Some areas on sandy soiled uplands were formed under a forest type vegetation. Today, forested belts occur along the streams, and small patches of trees cover some of the upland sandy soils. Most of the land in Stillwater is treeless; grasslands, either used for pasture or cleared for cultivation.

Time

Time is necessary for the development of soil from parent material. The longer the time allowed for soil forming processes, the more developed a soil will be. Young soils will show little or no

TABLE I

MEAN AVERAGE TEMPERATURE AND PRECIPITATION
OF PAYNE COUNTY OKLAHOMA

Temp.**	ppt.*	Temp.	ppt.	Temp.	ppt.	Temp.	ppt.
January		February		March		April	
38.1	1.66	42.6	1.5	50.1	2.19	60.8	3.18
May		June		July		August	
68.3	4.82	77.9	4.40	82.7	3.29	82.4	3.27
September		October		November		December	
74.1	3.68	63.7	2.80	49.1	1.89	40.6	1.33

Annual	
Temp.	ppt.
60.9	34.1

*ppt. (inches)

**Temp. (^{o}F)

horizonation. A moderate length of time for soil development usually has weak to good horizonation and old soils show strong horizonation.

In Stillwater the young soils occur in the flood plains of streams and on steeply sloping areas, the mature soils on alluvial terraces adjacent to the larger streams; and the well developed soils on the level to gently sloping upland areas.

Soil Profiles and Soil Survey

The study of soil characteristics is called soil morphology. The soil morphologist studies soils in the field and in the lab. He studies the characteristics of color, texture, structure, and consistence in the field which enable him to detect horizonation in the soil profile. A soil profile is a two dimensional vertical exposure of soil that includes all the layers that have been pedogenically altered during soil formation. Sampling each layer or horizon of a soil profile and bringing them into the laboratory, the soil morphologist performs standard chemical, physical, and mineralogical tests. The test data and field descriptions are combined to classify and define a soil. The soil data and descriptions represent the basic elements in the soil survey. Soil survey is the systematic examination, description, classification, and mapping of soils in an area (18). The basic unit used to map soil contains one particular soil type, with inclusions of other soil types, too small to map separately. Another mapping unit is the soil complex. The soil complex consists of two or more soil types which occur together in such a way that they cannot be separated and mapped independently.

Once the soil descriptions and the laboratory data are completed, and the detailed soils map prepared; soil interpretations are made.

Soil Interpretations

Soil science has the distinction of being a branch of science that has been able to maintain its sense of application throughout its growth. The problem of soil conservation, and the need for food production are two factors which initially called for the study of soils. Today in a world of increased population and tremendous urban growth these two factors still prevail. In fact the growth of society demanded that soil science study the problems associated with non-agricultural uses. The problems primarily deal with urban expansion and recreation in relation to soil.

Until relatively recent times, soil scientists in the United States studied, mapped, and classified soils with the goal to improve agricultural production. Physical, chemical, and mineralogical properties were correlated with production yields and management practices to determine the soil factors important for good crop yields.

When urban growth exploded and many soil related problems resulted, planners began to realize the need for soil information. The soil scientist was called on for answers which he often times was unable to give. This was the onset of a new challenge for soil science. When engineering characteristics of soil such as shrink-swell, liquid limit, and placticity index were compared with the physical, chemical and mineralogical characteristics, strong correlations were found. The Soil Conservation Service developed a guide for interpreting soils for engineering use (16). This guide combines information typically collected by the soil scientist with data from several soil engineering tests, and assigns a limitation rating for many specific engineering uses. The engineering interpretations include soil limitations associated with:

1) Septic tank absorption fields
2) Sewage lagoons
3) Shallow excavations
4) Dwellings with basements
5) Dwellings without basements
6) Sanitary landfills
7) Local roads and streets
8) Road fill sources
9) Sand and gravel sources
10) Topsoil sources

The system developed by the Soil Conservation Service is used in the more recently published county soil survey reports. Soils typical of a county are rated for engineering considerations. These surveys are particularly useful for county planning and can be adapted for city, subdivision, and even individual planning. Examples of cities and regional planning commissions successfully incorporating soils information into their overall plan are numerous (1,9,13,15,22). One of the most vivid and well documented examples is Fairfax County, Virginia (15,22). Around 1950, Fairfax County, which lies just outside Washington, D.C., began undergoing rapid development. After many soil related problems resulted, the county hired a full time soil scientist. His job was to study and map the soils of the County and to act as a consultant in soil related problems. The soil scientist is credited with many valuable contributions. He established the soil suitability for many uses in cooperation with the health department, and the highway department. He evaluated several tracts of land as possible sites for new schools before the land was purchased. The soil scientist determined the areas presently subject to flooding, and those which would probably be susceptable in the future as a result of increased runoff. The combination of problems avoided and money saved by the people of Fairfax County amply justifies the role of the soil scientist in urban planning.

Agricultural Interpretations

The agricultural interpretations are divided into a general classification as to the suitability of land for agricultural use, and more detailed schemes where yields are predicted for specific crops, and soils classified as range sites.

Capability Groups of Soils

Capability classification is the grouping of soils to show, in a general way, their suitability for most kinds of farming. It is a practical classification based on limitations of the soils, the risk of damage when they are used, and the way they respond to treatment. The soils are classified according to degree and kind of permanent limitations, but without landforming that would change the slopes, depth, or other characteristics of the soils: and without consideration of possible major reclamation projects.

In the capability system, all kinds of soils are grouped at two levels, the capability class, and subclass. These are discussed in the following paragraphs.

Capability classes, the broadest grouping, are designated by Roman numerals I through VIII. As the numerals increase, they indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class I.	Soils have few limitations that restrict their use.
Class II.	Soils have some limitations that reduce the choice of plants or require moderate conservation practices.
Class III.	Soils have severe limitations that reduce the choice of plants, require special conservation practices, or both.
Class IV.	Soils have very severe limitations that restrict the choice of plants, require very careful management, or both.
Class V.	Soils subject to little or no erosion but other limitations, impractical to remove, that limit their use largely to pasture, range, woodland, or wildlife food and cover.
Class VI.	Soils have severe limitations that make them generally unsuited to cultivation and limit their use largely to pasture or range, woodland, or wildlife food and cover.
Class VII.	Soils have very severe limitations that make them unsuited to cultivation and that restrict their use largely to grazing, woodland, or wild-life.
Class VIII.	Soils and landforms have limitations that preclude their use for commercial plant production and

restrict their use of recreation, wildlife,
and watersupply, or to aesthetic purposes.

Capability Subclasses are soil groups within one class; they are designated by adding a small letter, e, or w, s, or c, to the class numeral, for example, IIe. The letter e shows the main limitation is risk of erosion unless close-growing plant cover is maintained; w shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); s shows that the soil is limited mainly because it is shallow, droughty, or stony; and c used in only some parts of the United States, shows that the chief limitation is climate that is too cold or too dry.

In class I there are no subclasses, because the soils have few limitations. Class V can contain, at the most, only subclasses indicated by w, s, and c, because the soils in it are subject to little or no erosion, though they have other limitations that restrict their use largely to pasture, range, woodland, wildlife, or recreation (2,17).

Predicted Yields

The system shows predicted long-term average yields of important crops and of tame pasture. The crops are wheat, grain sorghum, and alfalfa. Yields are given for soils under improved management. The predictions are averages for a period long enough to include both dry and wet years. When the moisture supply is favorable, yields are generally higher than those predicted. They are lower when moisture is unfavorable. Crop failures are also included when the average yields are estimated.

Yields are predicted for farms using improved management practices including:

1) proper rates of seeding, timely dates for planting, and efficient methods of harvesting
2) sufficient control of weeds, insects, and diseases
3) use of terraces and contour farming where needed
4) applications of lime and fertilizers in amounts indicated by soil tests
5) use of adapted improved varieties of crops
6) use of cover crops on sandy soils that tend to blow
7) installation of surface drains where needed
8) management of crop residue and tillage so as to control erosion, maintain soil structure, increase infiltration of water, and assist the emergence of seedlings (2).

Range Sites

A range site is a distinctive kind of rangeland that is sufficiently uniform in climate, soil, and elevation to produce a particular kind of climax vegetation. The soils on any one range site produce the same climax vegetation. Climax vegetation is the combination of plants that originally grew on the site. It is generally the most productive vegetation for the site, and it will maintain itself under conditions similar to those that existed before the site was cultivated or heavily grazed.

Livestock seek out the more palatable and nutritious grasses, and under heavy grazing, these choice plants, or decreasers, are weakened and gradually eliminated. The choice plants are replaced by less palatable plants, or increasers. With heavy grazing continued these increasers are weakened and the site becomes occupied by less desirable grasses and weeds, which are invaders.

Four classes of range condition are recognized; excellent, good, fair, and poor. Excellent range is when 76 to 100 percent of the plant cover consists of original vegetation. Good condition range has 51 to 75 percent; fair condition range is with 26 to 50 percent; and poor condition is 25 or less percent in original vegetation.

The study area has ten types of range sites, which are grouped according to their ability to produce similar kinds and amounts of climax vegetation. The description of the range site includes:

1) important soil characteristics
2) names of the principal plants
3) estimated total annual yield of herbage on a site which is in excellent condition when moisture conditions are favorable and unfavorable (2).

Non Agricultural Interpretations

The soil scientist approaches non-agricultural interpretations from two angles. As the number of such uses is large and variable, soil scientists often find themselves unqualified to make an interpretation. Although the soil scientist possesses the most information about the soil, some decisions in land use require the knowledge of other professionals. The soil scientist supplies his soils information in tables. The tables include data on important soil properties such as; depth to bedrock, depth to water table, engineering soil classification values, liquid limit, plasticity index, permeability, and shrink-swell potential.

Many soil interpretations associated with urban growth are within the capabilities of the soil scientist. Soil interpretations for liquid waste disposal systems, building homes, schools, parks, roads, and other needs involved with a clean, safe, and aesthetic environment for man to live in can be made. The Soil Conservation Service rates soils as having slight, moderate, and severe limitations for specific uses (16). Other states developed similar guidelines based on the limitations concept which apply specifically to their soil conditions (7,22).

Johnson and Bartelli introduced the concept of soil potential (8). They define soil potential as the ability of a soil to produce, yield, or support a given structure or activity at a cost expressed in economic, social, and environmental units of value. McCormack points out that the outlook for continuing success in urban planning in the long run is much greater when the effort is centered around the positive objective of maximizing the productivity of the land rather than around the objective of avoiding problems (11). McCormack shows that people often erroneously equate severe limitations with poor soil potential using the soil suitability for building foundations in New Orleans as an example. All soils in New Orleans have severe limitations for building foundations, but special designs make some soils more suitable for use than others. Another city might have slight soil limitations for building foundations. It is important for this city to develop a ranking of soil potentials for buildings. Depending on local objectives, some of the soils might be considered poorly suited for building because they may be prime agricultural land, because they may not be permeable enough for septic tank filter fields, or because they are ideal wildlife habitats. Local objectives must be agreed upon before soil potential values can be assigned, and the soil potential cannot be separated from local objectives if it is to be useful (11).

CHAPTER III

METHODS AND MATERIALS

The detailed soils map (scale: 4" = 1 mile) of Sections 9, 16, 21, and 28; T. 19 N.; R. 2 E., a four mile strip of land west of Stillwater served as the base map. Descriptions of the soil mapping units are located in Chapter IV. The descriptions represent the soils in the Stillwater area, which the author wrote while mapping and field checking various parts of the study area.

Physical and chemical soil data is presented in Tables for reference in Appendix C. The physical and chemical analyses were performed at the Oklahoma State University Soil Morphology Laboratory between 1968 and 1975. The data includes cation exchange capacity, exchangeable cations, exchangeable hydrogen, exchangeable aluminum, pH, percent organic matter, total phosphorous, and particle size distribution.

Block diagrams show the relation between soil types, geologic material, and topographic position. The diagrams represent relationships found in the study area, and can be applied to the Stillwater area.

Tables of engineering data compiled by the Oklahoma Highway Department are presented in Appendix B. The tables contain information on sieve analysis, liquid limit, plasticity index, shrinkage limit, shrinkage ratio, volumetric change, and AASHO rating, a soil classification used by highway engineers, for the major horizons of each soil type.

A number of soil interpretations based mainly on the guidelines of the Soil Conservation Service are evaluated for each mapping unit and presented in Tables (16). Several of the interpretations important in the urban development of a city like Stillwater are mapped on transparent material. By overlying specific combinations of the transparent interpretive maps and considering local planning, objectives, soil potentials are formulated. The environmental aspects, the economic potential of various land uses, and the economic feasibility of constructing working systems remain as the final components in determining soil potentials (11). The soil potentials described reflect the soil properties, pollution hazards, and relative costs of overcoming the soil limitations.

The economic value of soils fluctuate as demands for various land use such as food production, industrial sites, and residences change. The local planning objectives are not included. These last two factors of soil potential are left for the Stillwater planners to consider as Stillwater grows.

CHAPTER IV

DISCUSSION AND RESULTS

The city of Stillwater lies in the center of Payne County, Oklahoma. Stillwater serves as the County Seat and is the largest town in the county. The city has grown in recent years and growth is predicted to increase steadily in the future. Industries moving into Stillwater and the expansion of Oklahoma State University are creating a housing shortage in Stillwater. Housing developments are springing up around Stillwater, particularly northeast and southwest of the city. Many of the subdivisions have been developed without regard to the soil conditions, but the home owner has been introduced to them when septic systems failed and foundations cracked. The lack of a recent soil survey publication for Payne County, or the lack of understanding soils by the general public may be to blame. The reason for past failures is not the issue. What Stillwater will do in the future is. This paper will try to shed some light on the potential of Stillwater's soils for better land use. When soils are used for what they are best suited, the community receives the benefits. Economic and environmental considerations combined with the soil properties result in a clean, aesthetically pleasing and economically prosperous community.

The soil survey of Payne County is expected to be completed by 1978. The mapping of the county and particularly of Stillwater will be completed much sooner. This thesis assigns interpretive values on

Stillwater's soils for some important land uses, and provides a method which will help planners, developers, and citizens use land wisely. To accomplish these goals four sections of land were selected for study. Sections 9, 16, 21, and 28 of T.19N.; R.2E, located just west of Stillwater, were chosen because they contain most of the soils common to Stillwater and because some development has already occurred there. The Oklahoma State University Agronomy Farm is located in parts of sections 9, 16, and 21. Sections 21 and 28 contain several subdivisions including Quail Ridge, Meadow Park, Willow Park Estates, and Surrey Hills Estates. See Figure 1 for location of the study area.

Geology

The geology of Stillwater is dominated by the Permian bedrock composed of interbedded sandstones, siltstones, and claystones. The sandstones and siltstones are non-continuous deposits. Geologic evidence supports the ancient occurrence of stream channels associated with a deltaic depositional environment. The sands deposited in the swift moving river channels while the clays remained in suspension until deposition in calmer waters. With the lowering of sea level and the uplifting of the land, the Permian rocks have been exposed to weathering for many years. More recent rivers fluctuated in size responding to changes in climate, while continually cutting deeper into the more ancient Permian bedrock. The downcutting left deposits of alluvium on areas topographically higher than present stream levels. These old alluvial deposits are called terraces. The flat areas adjacent to stream channels, which are flooded during periods of high water are known as floodplains or bottomlands. The floodplain is

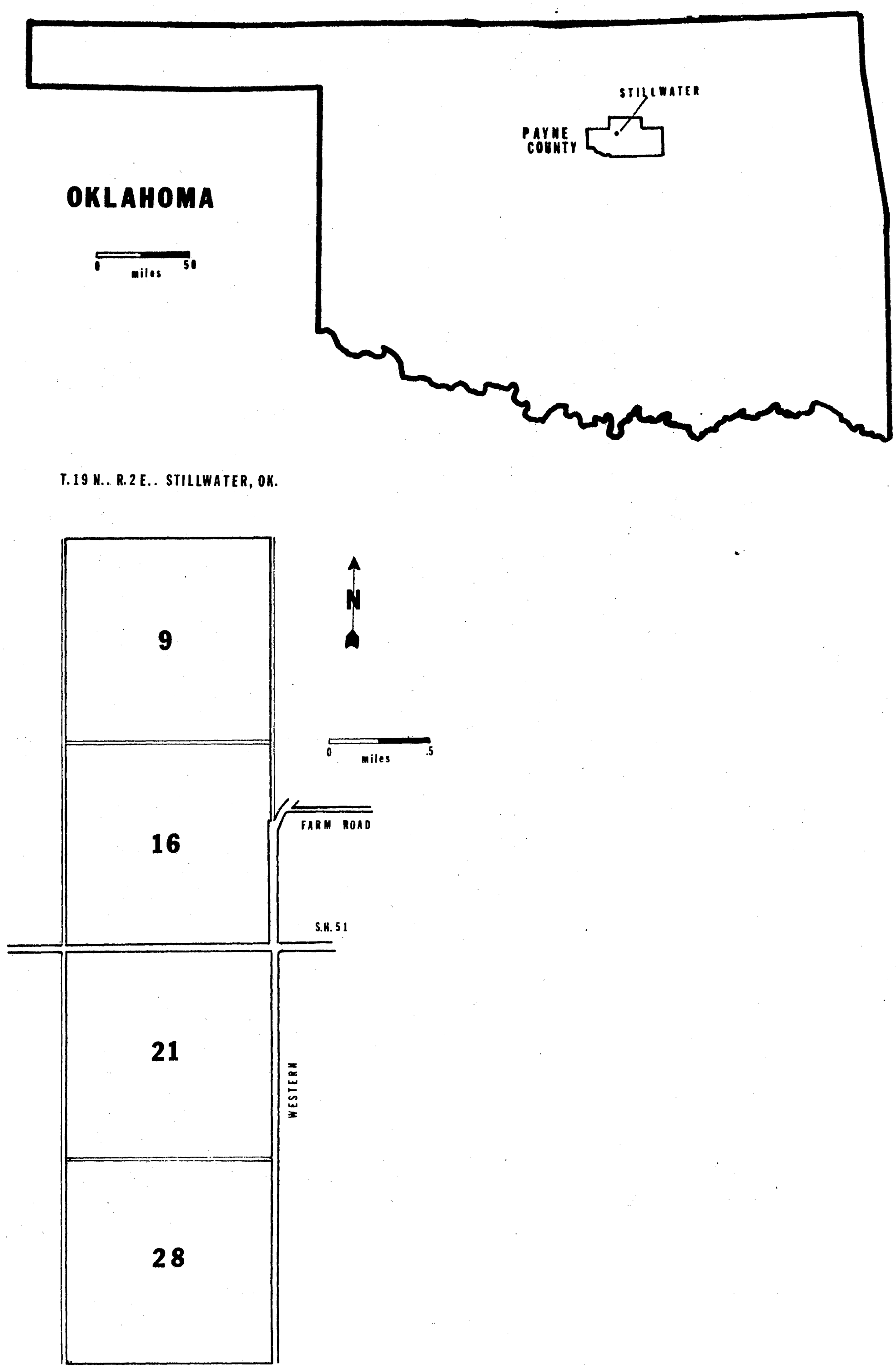


Figure 1. Location of the Study Area.

composed of recent alluvium deposited as the stream meanders back and forth in its valley.

Soil Development

In all of the geologic deposits mentioned before, the soil forming processes have established varying degrees of soil development.

The upland soils can be separated into two types on the basis of slope. The nearly level to gently sloping uplands are deep soils with strong horizonation. Time has allowed a senile soil profile to develop. On the steeper sloping uplands, time has allowed for strong soil development, but erosion has kept pace removing the weathered material. Shallow soils with weak horizonation result in this situation. The influence of parent material contributes to the understanding of upland soil development too. Sandstone is more resistant to weathering; therefore, sandy soils are developed on the flat upland areas, while the more clayey soils are found on the gently to steeper sloping hillsides.

Soils developed in terrace deposits of old alluvium occur adjacent to the larger streams in positions topographically higher than present floodplains. These soils have mature soil profiles typical of a moderately long period of time for soil development. Horizonation is moderate to strong. The textures are typically loamy, but can be finer or sandier with rounded sandstone pebbles found in some areas.

The floodplain soils have weak soil horizonation. Organic matter accumulation in the surface horizon is the most apparent result of the soil forming processes. Little time has elapsed which limits the extent of soil development. The textures are quite variable as the soil is formed in recent alluvium containing stratification below the reaches of pedologic processes. Extremes from loamy sand nearest the stream channels to clay in the low lying areas are found.

The more common upland soils are Stephenville, Darnell, and Lucien which are sandy; Zaneis, and Chickasha which are loamy; and Kirkland, Renfrow, Vernon, and Bethany which are clayey soils. The dominant terrace soils are Norge, the clayey member, and Teller which is loamy. The floodplain soils are represented by several textural classes. The soils in order of decreasing clay content are the Miller clay, the Port clay loam, the Port silt loam, and the Pulaski sandy loam. Figures 2 and 3 are block diagrams showing the relationships between the dominant soils, the geologic materials, and topographic position in Stillwater.

The reader will develop an understanding of Stillwater's soils and their location by relating the soil descriptions with the block diagrams.

Soil Descriptions

The soil mapping units are described as they are found in the study area. Following the descriptions of the mapping units is Figure 4, the soils map, and the soil legend. The soils map of the study area will serve as the base map from which the interpretive maps are drawn.

Bethany Silt Loam (6pA) 0 - 1%

The Bethany silt loam consists of deep, well drained, slowly permeable soils on nearly level uplands.

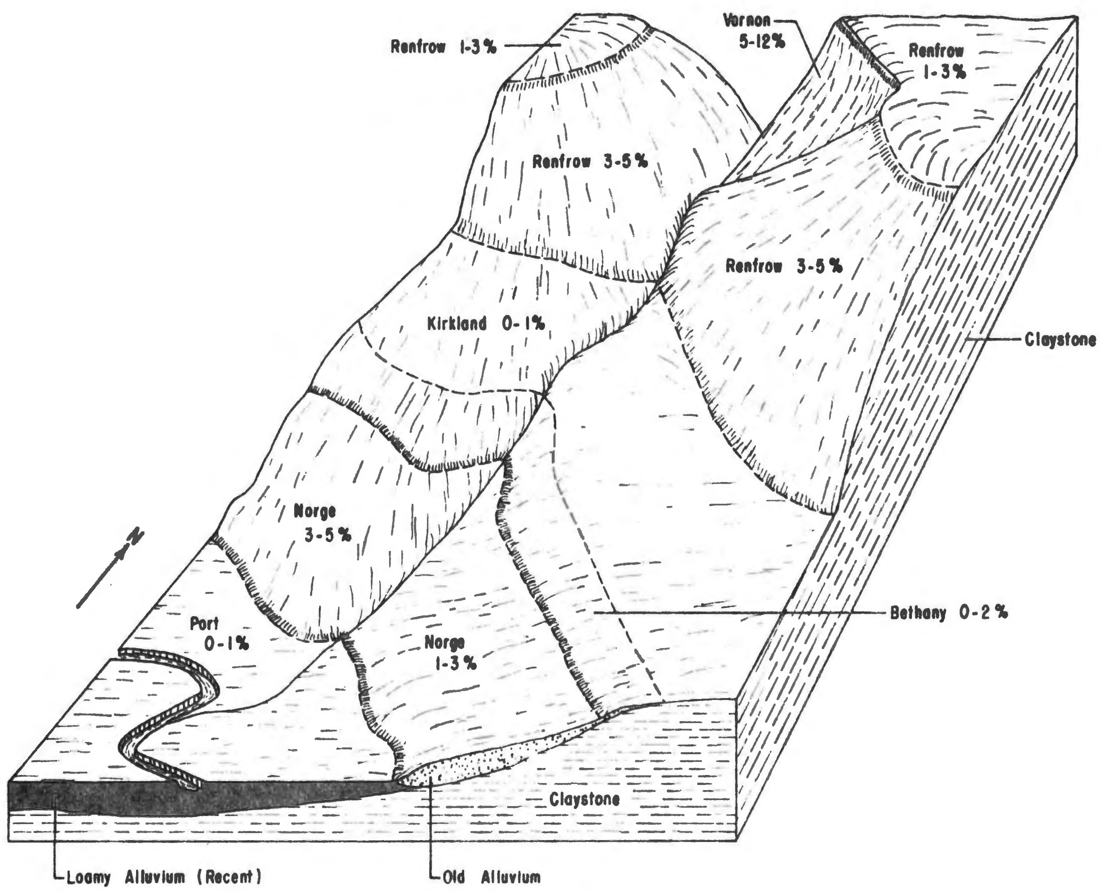


Figure 2. Block Diagram Showing Soil, Geologic Material, and Topography in the Northern Part of Study Area.

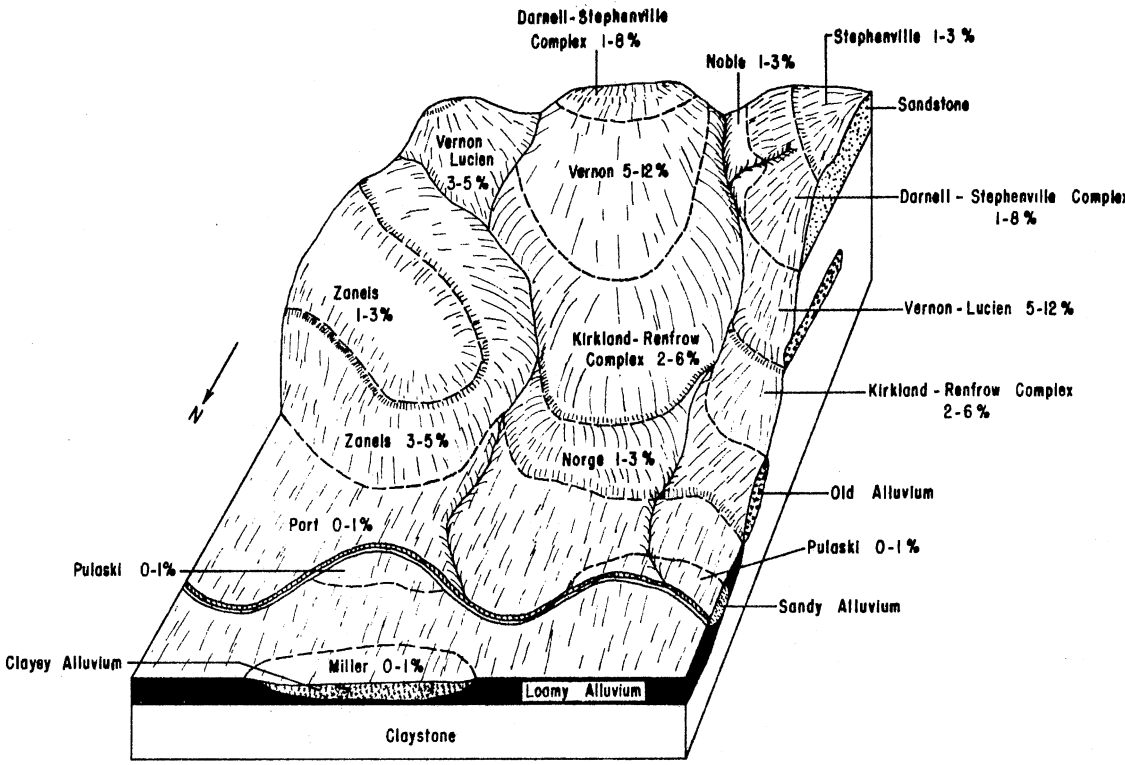


Figure 3. Block Diagram Showing Soils, Geologic Material, and Topography in Southern Part of Study Area.

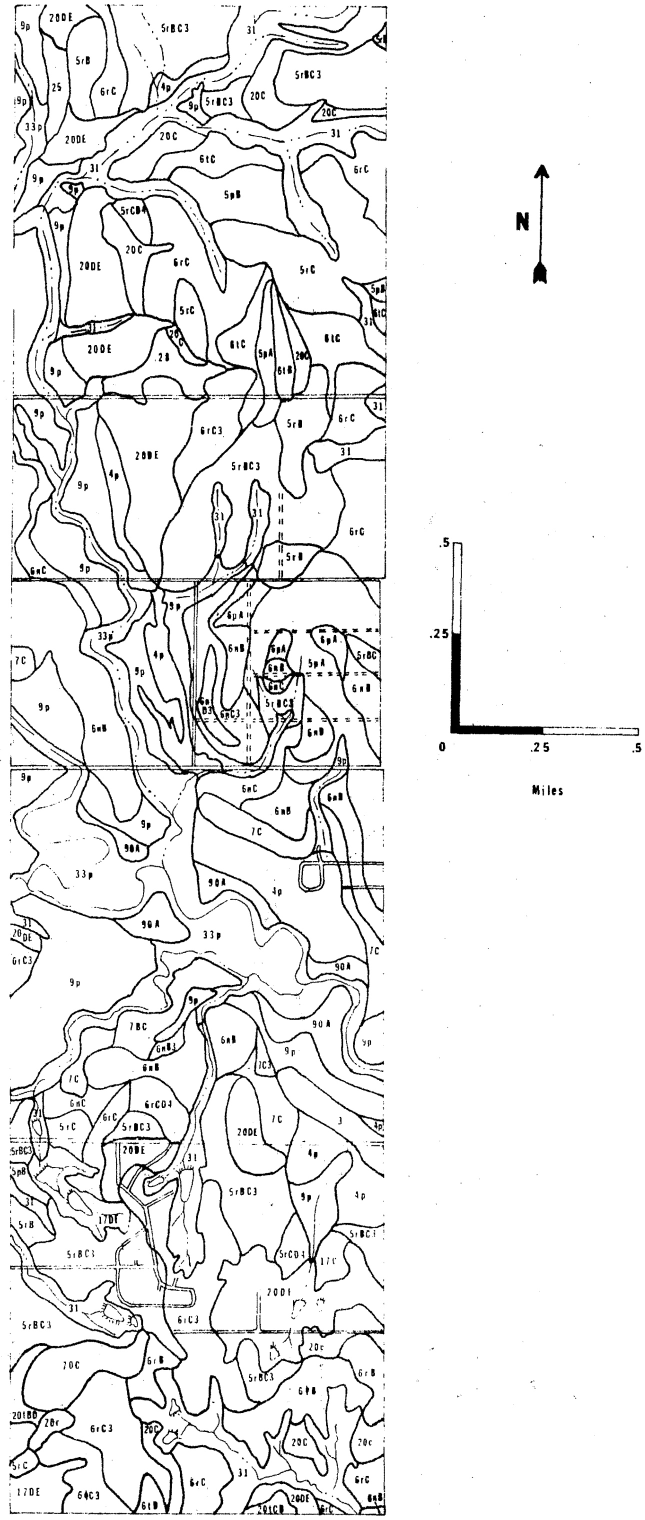
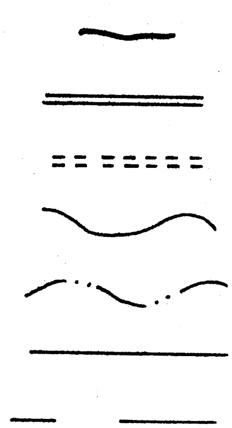


Figure 4. Detailed Soils Map.

Map Symbol	Field Name of Mapping Unit
3	Miller clay, 0-1% slopes
4p	Port clay loam, 0-1%
5pA	Kirkland silt loam, 0-1% slopes
5pB	Kirkland silt loam, 1-3% slopes
5rB	Renfrow silt loam, 1-3%
5rC	Renfrow silt loam, 3-5% slopes
5rBC3	Renfrow-Kirkland complex, 2-6% slopes, eroded
5rCD4	Renfrow soil, 2-6% slopes, severely eroded
6rB	Zaneis loam, 1-3% slopes
6rC	Zaneis loam, 3-5% slopes
6rC3	Zaneis loam, 3-5% slopes, eroded
6rCD4	Zaneis loam, 3-8% slopes, severely eroded
6ϕB	Zaneis-Slickspot complex, 1-3% slopes
6ϕC3	Zaneis-Slickspot complex 3-5% slopes, eroded
6tB	Chickasha loam, 1-3% slopes
6tC	Chickasha loam, 3-5% slopes
6pA	Bethany silt loam, 0-1% slopes
6nB	Norge loam, 1-3% slopes
6nC	Norge loam, 3-5% slopes
6nD3	Norge loam, 5-8% slopes, eroded
7C	Teller loam, 3-5% slopes
7BC3	Teller loam, 1-5% slopes, eroded
70C	Stephenville sandy loam, 3-5% slopes
9p	Port silt loam, 0-1% slopes
90A	Pulaski sandy loam, 0-1% slopes
17C	Vernon clay loam, 3-5% slopes
17DE	Vernon clay loam, 5-12% slopes
20C	Vernon-Lucien complex, 3-5% slopes
20DE	Vernon-Lucien complex, 5-12% slopes
20tBD	Stephenville-Darnell complex, 1-8% slopes
25	Darnell-Rock Outcrop complex, 8-30% slopes
28	Rough Broken land
31	Breaks-alluvial land complex
33p	Broken alluvial land

Soil Legend



Soil Boundaries

Improved Roads

Unimproved Roads

Perennial Streams

Intermittent Streams

Map area bounded by road

Map area not bounded by road

The Bethany is geographically associated with Norge, and Kirkland soils. The Norge soil is redder than the Bethany. The Kirkland has an abrupt change in texture from a silt loam in the A horizon to a clay in the B horizon. The Bethany has a more gradual increase in clay with depth going from a silt loam in the A to a silty clay loam which grades into a clay texture at depth.

The typical pedon of Bethany silt loam from an area of Bethany silt loam 0 to 1 percent is located 1815 feet east and 2475 ft north of the southeast corner of Sec. 16; T.19N.; R.2E; Payne County, Oklahoma.

Ap - 0 to 8 inches; very dark grayish brown (10YR 3/2) silt loam; weak, fine, granular structure; friable moist; smooth clear boundary.

A12 -8 - 14 inches; very dark grayish brown (10YR 3/2) silt loam; moderate, medium granular; friable moist; smooth clear boundary.

B1 - 14 to 19 inches; very dark grayish brown (10YR 3/2) silty clay loam; moderate, medium, subangular blocky; firm moist; smooth clear boundary.

B21t - 19 to 28 inches; very dark grayish brown (10YR 3/2) clay; strong, medium, blocky structure; very firm moist; gradual boundary.

B22t - 28 to 40 inches; very dark grayish brown (10YR 3/2) clay; strong, medium blocky; very firm moist, gray and red mottles; common fine black concretions; smooth gradual boundary.

B3 - 50 to 55 inches; brown (10YR 4/3) clay loam; moderate, medium blocky; very firm moist; mottles; many, fine, white calcium carbonate concretions; many, fine, black iron and manganese concretions; gradual boundary.

C - 55 to 65 inches; brown (10YR 4/6) clay loam; massive; very firm moist; many coarse reddish brown mottles; calcareous.

The A horizons are silt loams in most places but can be loam. The subsoil is either silty clay loam, clay loam, or clay. All horizons are dark brown or dark grayish brown in hues of 10YR and 7.5YR.

Broken Alluvial Land (33p)

This is a miscellaneous mapping unit consisting of land associated with the creeks and streams around Stillwater. The soils resemble the adjoining mapping units of the area such as Pulaski, Port silt loam, and Port clay loam. The unit includes the streams and the immediately adjoining deep loamy soils. The stream banks slope very strongly with cliffs being common.

Natural vegatation consists of floodplain forest composed of cottonwood, elm, hickory, pecan, and oaks with an understory of shrubs and tall grasses. This land provides an excellent wildlife habitat and and serves to stabilize the stream banks preventing gullying and erosion of the arable floodplain soils.

Breaks - Alluvial Land Complex (31)

This mapping unit consists of small nonarable valleys cut into the upland soils at the upper reaches of intermittent streams. The soil material varies with the material which it is draining. The slope varies from 0 - 12 percent and the erosion rate is quite high. Most areas are covered with short and mixed grasses limiting the land use to pasture.

Chickasha Loam (6tB) 1 - 3%, (6tC) 3 - 5%

These two mapping units are deep, well drained, moderately permeable soils. They are formed on gently sloping ridge tops of sandstone.

The Chickasha loam is found associated with Kirkland, Renfrow, Vernon-Lucien and Zaneis soils. The Chickasha loam is less clayey than either the Kirkland or the Renfrow, and is deeper than the Lucien-Vernon soils. The Zaneis is similar in profile characteristics but is redder than the Chickasha.

The typical pedon of Chickasha loam from an area of Chickasha loam 3 to 5 percent is located 660 ft east and 600 ft. north of the southwest corner of the SE¼ of Sec. 9; T.19N.; R.2E.; Payne County, Oklahoma.

Ap - 0 to 9 inches; very dark brown (7.5YR 2/3) loam; weak, fine, granular structure; friable moist; smooth abrupt boundary.

B1 - 9 to 20 inches; dark brown (7.5YR 3/3) loam; weak, fine, subangular blocky; friable moist, smooth clear boundary.

B21t - 20 to 28 inches; dark brown (7.5YR 3/4) clay loam, moderate, fine, subangular blocky; firm moist; smooth gradual boundary.

B22t - 28 to 39 inches; reddish brown (5YR 4/6) clay loam; moderate, medium, subangular blocky; firm moist; smooth gradual boundary.

B3 - 29 to 54 inches; bright reddish brown (5YR 5/8) clay loam; weak, coarse, subangular blocky; moist firm; smooth gradual boundary.

C - 54 to 62 inches; dark reddish brown hard sandstone.

The A horizon is usually loam but may be sandy loam in some areas. The color is clay loam and sometimes sandy clay loam. The color may vary from 10YR to 5YR. The C horizon consists of slightly weathered and unaltered sandstone.

<u>Darnell Sandy Loam (20tBD) 1 - 8%, (25c) 8 - 30%</u>

The Darnell sandy loam is a shallow, somewhat excessively drained soil with moderately rapid permeability. This soil occurs on gently to strongly sloping areas on rough uplands. In the Stillwater area Darnell soils are mapped only as complexes, with the Stephenville

(20tBD) and sandstone rock outcrops (25c).

The Darnell is found in association with Stephenville soils which are deeper than Darnell soils.

The typical pedon of Darnell sandy loam from an area of Darnell-Stephenville complex 1 - 8% is located 100 feet east and 1300 feet south of the northwest corner of the NW¼ of Sec. 28; T.19N.; R.2E; Payne County, Oklahoma.

A1 - 0 to 6 inches; brown (7.5YR 5/2) fine sandy loam; weak, fine, granular structure; very friable moist; gradual smooth boundary.

B2 - 6 to 14 inches; reddish brown (7.5YR 4/4) fine sandy loam; weak, fine, granular structure; very friable moist; gradual wavy boundary.

C - Red weathered sandstone grading to unaltered sandstone.

The A horizon ranges from brown to reddish brown in 10YR, 7.5YR and 5YR hues of color. The B2 horizon is brown to reddish brown in hues of 7.5YR, 5YR, and 2.5YR. The C horizon is soft red sandstone.

Kirkland Silt Loam (5pA) 0 - 1%, (5pB) 1 - 3%

The Kirkland silt loam consists of deep, dark colored, well drained, very slowly permeable soils on level to very gently sloping uplands.

The Kirkland is geographically associated with Renfrow, Bethany and Norge soils. The Renfrow is redder; and the Norge is redder and less clayey than Kirkland. The Bethany gradually increases in clay content with depth where the Kirkland changes texture abruptly from silt loam to clay.

The typical pedon of Kirkland silt loam from an area of Kirkland silt loam 0 to 1 percent is located 350 feet west and 550 feet north of the southeast corner of Sec. 16; T.19N.; R.2E; Payne County, Oklahoma.

Ap - 0 - 8 inches; dark brown (10YR 3/3) silt loam; weak, fine, granular structure; friable moist; smooth clear boundary.

A1 - 8 to 14 inches; dark brown (10YR 3/3) silt loam; moderate, fine, granular structure; friable moist; abrupt boundary.

B2t - 14 to 32 inches, very dark grayish brown (10YR 3/2) silty clay; moderate, medium, blocky structure; very fine moist; smooth gradual boundary.

B3 - 32 to 42 inches; brown (10YR 4/3) silty clay; weak, medium, blocky structure; very firm moist; common, fine, black concretions of iron and manganese; common, fine, white concretions of calcium carbonate; diffuse boundary.

C - 42 to 54 inches; 50% brown (10YR 4/3) and 50% strong brown (7.5YR 5/8) clay; massive; very firm moist; many, fine black concretions; few, fine, white concretions.

The A horizons are usually silt loams with colors of dark brown 10YR hue. The B horizons can vary from silty clay to clay and are also 10YR hue in color. The C horizon can vary widely in color with hues of 10YR, 7.5YR, 5YR, and 2.5YR.

<u>Lucien Sandy Loam (20C) 3 - 5%, (20DE) 5 - 12%</u>

The Lucien sandy loam consists of shallow, somewhat, excessively drained, moderately permeable, soils found on sloping to steep upland areas. The Lucien is developed in sandstone along the ridge tops.

The Lucien sandy loam is found in association with Vernon soils and mapped only as a complex of Lucien-Vernon. The Vernon is more clayey and developed in claybeds.

The typical pedon of the Lucien fine sandy loam from an area of Lucien-Vernon complex 3 to 5 percent is located 25 feet west and 20 feet north of the southeast corner of the NE ¼ of Sec. 28; T.19N.;

R.2E.; Payne County, Oklahoma.

A1 - 0 to 5 inches; brown (10YR 5/3) sandy loam; weak, fine, granular sturcture; very friable moist; clear smooth boundary.

B2 - 5 to 12 inches; dark reddish brown (5YR 3/4) sandy loam; weak, medium, granular structure; very friable when moist; gradual smooth boundary.

C - 12 inches; Reddish friable sandstone slightly weathered near the soil-rock contact.

The A horizon is usually a sandy loam texture, but can vary in color from a hue of 10YR to 2.5YR. The sandstone can vary in color and in hardness; however it is usually red and soft.

Miller Clay (3) 0 - 1%

The Miller clay consists of deep, poorly drained, very slowly permeable soils, in clayey alluvium on the floodplains of Stillwater Creek. These soils are on level concave areas.

Miller soils are geographically associated with Port loam, and Port clay loam soil. The Miller soil is more clayey than both Port soils.

The typical pedon of Miller clay of an area of Miller clay 0 to 1 percent, is located in a cultivated field 50 feet west and 50 feet north of the southeast corner of Sec. 21; T.19N.; R.3E.; Payne County, Stillwater, Oklahoma.

Ap - 0 to 10 inches; reddish brown (5YR 4/4) clay; moderate, medium, subangular blocky structure; very hard, very firm; few fine roots; clear smooth boundary.

A1 - 10 to 19 inches, reddish brown (5YR 4/3) clay; moderate medium subangular blocky structure; very hard when dry, very firm moist; few fine roots; clear smooth boundary.

AC - 19 to 31 inches; reddish brown (2.5YR 4/4) clay; massive; very hard, very firm; very few fine roots; diffuse boundary.

C - 31 to 42 inches dark red (2.5YR 3/6) clay; massive; very hard, very firm.

The A horizon is clay and cracks on surface when dry. The color has a hue of 5YR. The AC is clay, with 2.5YR hues and massive structure. Burried horizons may be present.

The soil mapped as Miller in the study area must be treated as a soil complex. Three soils occur within this mapping unit. One is the Miller clay as described above. A second soil is similar to the Miller, but salts are found at a depth of 20 inches limiting the growth of some vegetation. The third soil is found in two degrees. Salts occur through out the soil profile which limits the vegetation to salt grasses, while in some areas the salt content is so high that the soil is void of all vegetation. The occurrence and distribution of the three soil types within the mapping unit constitutes the use of a soil complex.

Norge Loam (6nB) 1 - 3%, (6nC) 3 - 5%

The Norge loam is a deep, well drained, slowly permeable soil found on gently sloping alluvial terraces. The soil is found adjacent to Stillwater Creek and the other larger creeks around Stillwater.

Norge loam occurs in association with Teller, Bethany, Kirkland and Renfrow soils. The Teller is sandier than the Norge while the Kirkland and Renfrow are more clayey. The Bethany has similar surface characteristics but has a more clayey subsoil than the Norge. The Norge is also redder than the Bethany.

The typical pedon of Norge from an area of Norge loam 1 to 3 percent is located in a cultivated field on the Oklahoma State Agronomy farm 50 feet west and 1530 feet south of the northeast corner of the

SE ¼ of Sec. 16; T.19N.; R.2E.; Payne County, Oklahoma.

Ap - 0 to 8 inches; reddish brown (5YR 4/3) loam; weak, fine, granular structure; friable moist; clear smooth boundary.

A12 - 8 to 13 inches; reddish brown (5YR 4/3) loam; moderate, medium, granular structure; friable moist; gradual smooth boundary.

B1 - 13 to 18 inches; reddish brown (5YR 4/4) clay loam; moderate, medium granular structure; firm moist; gradual smooth boundary.

B21t - 18 to 30 inches; red (2.5YR 4/6) heavy clay loam; moderate, medium, subangular blocky; firm moist; few, fine, black concretions; gradual smooth boundary.

B22t - 30 to 40 inches; yellowish red (5YR 4/6) clay; weak, fine, subangular blocky; very firm moist; few, fine, black concretions; gradual smooth boundary.

B22t - 30 to 40 inches; yellowish red (5YR 4/6) clay; weak, fine, subangular blocky; very firm moist; many, fine, black concretions; gradual boundary.

B3 - 40 - 53 inches; reddish brown (2.5YR 4/4) heavy clay loam; weak, fine, subangular blocky; very firm moist, many fine, black concretions; many, fine, white concretions; rounded sandstone pebbles.

The A horizon varies from loam to silt loam in texture and from 7.5 to 5YR hue in color. The subsoil ranges from clay loam to clay, and in hues of 5YR to 2.5YR. Sandstone pebbles are sometimes found in the subsoil.

Norge Loam (6nC3) 3 - 5% Eroded; (6nD3)
4 - 6% Eroded

These Norge loam mapping units are similar to the Norge loam 6nB and 6nC except, that these are moderately eroded and, in the case of 6nD3, slightly steeper. The eroded Norge loams have thinner surface horizons of 0 to 6 inches. This limits their use for agricultural production and they require special management. The subsoil is essentially the same as that of the Norge loam, 6nB.

Port Clay Loam (4p) 0 - 1%

The Port clay loam consists of deep, well drained, slowly permeable soils formed in the alluvium of Stillwater Creek and the other creeks around Stillwater. These soils are occasionally to frequently flooded, and have slopes generally less than 1 percent.

Port clay loam are found in association of Port silt loam, Miller, and Yahola soils. Generally they are found in the slight depressional areas in the Port silt loam. The Miller is more clayey, and the Port silt loam and Yahola are much less clayey than the Port clay loam soils.

The typical pedon of Port clay loam from an area of Port clay loam 0 to 1 percent, in a cultivated field on the Oklahoma State University Agronomy farm in Stillwater is located 495 feet west and 1320 feet south of northeast corner of the SW¼, of Sec. 16; T.19N.; R2E.; Payne County, Oklahoma.

Ap - 0 to 8 inches; dark reddish brown (2.5YR 3/3) silty clay loam; weak, medium, granular structure; firm moist; hard when dry; smooth abrupt boundary.

AC - 8 to 19 inches; yellowish red (5YR 3/6) silty clay loam; weak, fine, subangular blocky; friable moist; hard when dry; smooth clear boundary.

C1 - 19 to 32 inches; yellowish red (5YR 3/6) loam; massive; friable moist; hard when dry; smooth abrupt boundary.

C2 - 32 to 45 inches; yellowish red (5YR 5/6) sandy loam; massive; very friable moist; soft when dry.

The A horizon may have a texture of clay loam or silty clay loam and colors range from brown to dark reddish brown in hues 7.5YR through 2.5YR. The AC horizon can be loam, clay loam, silty clay loam or sandy clay loam. The C horizon is stratified alluvium of a texture from clay loam to sandy loam. The C horizon may sometimes be calcareous.

Port Silt Loam (9p) 0 - 1%

The Port silt loam consists of deep, well drained, moderately permeable soils developed in the alluvium of Stillwater Creek and other creeks in the Stillwater area. These soils are occasionally to frequently flooded, and generally slope less than 1 percent.

Port silt loam are geographically associated with the Port clay loam, Miller and Pulaski soils. Miller and Port clay loam soils are more clayey than the Port silt loam, while the Pulaski soils are sandier.

The typical pedon of the Port silt loam from an area of Port silt loam 0 to 1 percent, in a cultivated field on the Oklahoma State University Agronomy farm in Stillwater in located 825 feet west and 1320 feet south of the northeast corner of the SW¼, of Sec. 16; T.19N.; R.2E.; Payne County, Oklahoma.

Ap - 0 to 13 inches, dark reddish brown (5YR 3/3) silt loam; weak, medium, granular structure; friable moist; smooth abrupt boundary.

A12 - 13 to 24 inches; yellowish red (5YR 4/6) silt loam; weak, medium, subangular blocky; friable moist; smooth clear boundary.

A13 - 24 to 32 inches; dark reddish brown (2.5YR 3/4) silty clay loam; moderate, medium, prismatic structure; friable moist, smooth clear boundary.

AC - 32 to 43 inches; dark reddish brown (2.5YR 3/4) silt loam; moderate, medium, subangular blocky; firm moist; smooth clear boundary.

C - 43 to 55 inches; reddish brown (5YR 4/4) silt loam; weak, fine, subangular blocky, firm when moist.

The A horizons show a wide range of texture from silt loam, to loam, or even sandy loam. The color varies from brown to reddish brown in hues of 7.5YR and 5YR. The AC horizons have a similar range of color and texture. Colors usually 5YR or 2.5YR hue and textures from silt loam to sandy loam and silty clay loam to sandy clay loam.

The C horizon of stratified alluvium ranges from clay loam to loam textures and is sometimes calcareous.

Pulaski Sandy Loam (90A)

The Pulaski sandy loam consist of deep, somewhat excessively well drained soils on the floodplain of Stillwater Creek. The soil has moderately rapid permeability. It is usually found in areas immediately adjacent to the creek.

The soils geographically associated with the Pulaski are the Port silt loam, the Port clay loam, and the Miller clay. The Pulaski is much sandier than all of them.

The typical pedon of Pulaski sandy loam from an area of Pulaski sandy loam 0 to 1 percent is located 50 feet west and 825 feet north of the southeast corner of Sec. 21; T.19N.; R.2E.; Payne County, Oklahoma.

A1 - 0 to 15 inches; reddish brown (2.5YR 5/4) fine sandy loam; moderate, fine, granular structure; very friable moist; common roots; smooth clear boundary.

AC - 15 to 39 inches; reddish brown (2.5YR 4/4) loam; moderate, medium, subangular blocky; friable moist; smooth gradual boundary.

C - 39 to 65 inches; reddish brown (2.5YR 5/4) fine sandy loam; single grain; very friable moist.

The A horizon is typically fine sandy loam but is sometimes loamy sand or loam. Color of A is dominantly reddish brown, but varies from reddish brown through yellowish red to brown in hues of 2.5YR to 7.5YR. The AC horizon is reddish brown to red. The C horizon is stratified and ranges from loam to loamy sand in texture.

Renfrow Silt Loam (5rB) 1 - 3%, (5rC) 3 - 5%

These mapping units are deep, well drained, very slowly permeable soils occurring on gently sloping uplands.

The Renfrow is associated with Kirkland, Zaneis, Chickasha, Norge, Teller, and Vernon soils. The Renfrow is more clayey than the Zaneis, Chickasha, Norge, and Teller soils. It is redder than the Kirkland, and deeper than the Vernon. The Kirkland and Renfrow soils are very similar in profile characteristics except for their color. In some areas they occur so intermixed that separating them for mapping is impractical, and they are mapped as a complex.

The typical Renfrow silt loam from an area of Renfrow silt loam 1 to 3 percent is located 1320 feet west and 50 feet north of the southeast corner of the NE¼ Sec. 16; T.19N.; R.2E.; Payne County, Oklahoma.

Ap - 0 to 8 inches; dark reddish brown (5YR 3/3) silt loam; moderate, medium, granular structure; friable moist; clear boundary.

B2t - 9 to 36 inches; dark red (2.5YR 3/6) clay; moderate, medium subangular blocky; very firm moist; gradual boundary.

B3 - 36 to 42 inches; reddish brown (2.5YR 4/4) clay; weak, medium, subangular blocky; very firm moist; few, fine, black iron and manganese concretions, few, fine concretions of calcium carbonate; smooth gradual boundary.

C - 42 to 50 inches; red (2.5YR 4/6) clay; massive; partially weathered calcareous claybeds.

The A horizon ranges from silt loam to loam, or even clay loam in texture. The color is reddish brown to brown in hues 10YR, 7.5YR, and 5YR. The B horizon is clay in texture and usually changes abruptly from the loam A horizon, though some have transitional B1 horizons with a gradual increase in clay content.

Renfrow soils (5rCD4) 2 - 6%, Severely Eroded

This mapping unit consists of moderately deep soils on uplands.

They resemble the profile description of 5rB and 5rC except that their entire surface horizon has been removed by erosion. The profile of this soil is normally heavy clay loam or clay throughout.

Renfrow - Kirkland Complex (5rBC3) 2 - 5%, Eroded

This complex is composed of Renfrow and Kirkland soils on gently sloping side slopes along drainageways. The soils are moderately eroded with some of the surface horizon having been removed. The two soils occur in such a pattern that it is impractical to map them as separate units; particularly, as their interpretations for use are essentially the same.

Rough Broken Land (28)

This unit is a land type which consists of steeply sloping areas broken by numerous intermittent drainage channels. Gullies are numerous and erosion is very active. Vegetative cover is important which limits land use to grazing.

Stephenville Fine Sandy Loam (70C) 3 - 5%

The Stephenville fine sandy loam is a moderately deep, well drained, moderately permeable soil on gently sloping upland ridges. The Stephenville is developed on sandstone.

Stephenville soils are associated with Darnell, Vernon, and Zaneis soils. Darnell and Vernon are shallower than the Stephenville soils, and the Zaneis is less sandy.

The typical pedon of Stephenville fine sandy loam from an area of Stephenville fine sandy loam 3 to 5 percent is located 1980 feet north and 660 feet east of the southwest corner of Sec. 28; T.19N., R.2E.; Payne County, Oklahoma.

A1 - 0 to 6 inches; grayish brown (10YR 5/2) sandy loam; weak, medium, granular structure; very friable moist; smooth clear boundary.

A2 - 6 to 14 inches; grayish brown (10YR 5/4) loamy sand; massive; very friable moist; smooth clear boundary.

B21t - 14 to 22 inches; red (2.5YR 5/6) sandy clay loam; weak, medium, subangular blocky structure; friable moist; diffuse boundary.

B22t - 22 to 33 inches; red (2.5YR 4/8) sandy clay loam; weak, medium, subangular blocky structure; friable moist; abrupt wavy boundary.

C - 33 to 38 inches; red sandstone.

The A1 horizon is reddish brown in 5YR hues, brown in 10YR and 7.5YR hues and grayish brown in 10YR hues. The texture is usually a fine sandy loam but loamy fine sand occurs. The A2 is absent in many areas where plowing has occurred. The A1 is normally loamy fine sand or sandy loam. The B2t horizons are sandy clay loam of 2.5YR and 5YR hues. The C consists of red and yellowish red sandstone.

<u>Teller Loam (7C) 3 -5%</u>

The Teller loam consists of deep, well drained soils with medium permeability, formed in alluvial terraces along Stillwater Creek. These soils are gently to moderately sloping, ranging from 1 to 5 percent.

Teller soils are geographically associated with Norge soils. Norge soils are normally on older terraces. Time has allowed for the development of a thicker argillic horizon in the Norge. Norge soils are usually more fine textured throughout the profile than the Teller.

The typical pedon of Teller loam of an area of Teller loam, 3 to 5 percent convex slope, is located 1650 feet west and 990 feet south of the northeast corner of Sec. 21; T.19N.; R.2E.; Payne County, Stillwater, Oklahoma.

A1 - 0 to 11 inches; yellowish red (5YR 4/6) loam, yellowish red (4YR 5/6) dry; strong, medium, granular structure; hard, firm; many fine roots; abrupt smooth boundary.

B21t - 11 to 22 inches; reddish brown (2.5YR 4/4) clay loam, red (2.5YR 5/6) dry; moderate, medium, subangular blocky; hard, firm; common fine roots; gradual smooth boundary.

B22t - 22 to 36 inches; red (2.5YR 4/6) clay loam, red (2.5YR 5/6) dry; strong, medium angular blocky structure; hard, firm; common fine roots; few fine black concretions; gradual smooth boundary.

B23t - 36 to 53 inches; red (2.5YR 4/6) clay loam, red (2.5YR 5/6) dry; moderate, medium, subangular blocky structure; hard, firm; common, fine, soft, black concretions; few, fine, soft, white calcareous concretions; common fine roots; gradual smooth boundary.

B3 - 53 - 60 inches; dark red (2.5YR 3/6) very fine sandy clay loam, red (2.5YR 4/6) dry; weak, medium, subangular block; hard, firm; many, fine, soft, black concretions; few fine roots; abrupt smooth boundary.

C - 60 to 72 inches; red (2.5YR 4/6) light sandy loam, red (2.5YR 5.6) dry; single grain structureless; few fine roots; very friable.

The A1 horizon is loam to fine sandy loam in hues of 5YR and 7.5YR. The B2t are clay loam to sandy clay loam with hues of 2.5YR and 5YR.

Teller Loam (7BC3) 1 - 5%, Eroded

This mapping unit is similar to the Teller loam 7C except that erosion has removed some of the surface horizon. Erosion restricts the agricultural use of this soil in that special management practices need to be followed. The surface horizon varies from 4 to 8 inches thick and from hues of 7.5YR to 5YR color. The subsoil is clay loam to sandy clay loam and ranges from 5YR to 2.5YR hue in color.

Vernon Clay Loam (17C) 3 - 5%, (17DE) 5 - 12%

The Vernon clay loam consists of shallow, somewhat excessively drained, very slowly permeable soils on sloping to steep upland areas. The Vernon soils are found mostly on the side slopes of upland ridges, and are developed in claybeds.

The Vernon clay loam is found in association with the Kirkland, Renfrow, Norge, Teller, Zaneis, and Lucien soils. All except the Lucien are much deeper than the Vernon clay loam. The Vernon is mapped as an independent unit or as a complex with the Lucien. Both are shallow, but the Lucien is much less clayey than the Vernon.

The typical pedon of Vernon clay loam from an area of Vernon clay loam 3 to 5 percent is located 660 feet west and 1815 feet south of the northeast corner of Sec 18; T.19N.; R.2E.; Payne County, Oklahoma.

A1 - 0 to 4 inches; red (2.5YR 4/2) clay loam; moderate, medium, granular structure; friable moist; abrupt boundary.

AC - 4 to 14 inches; dark red (2.5YR 3/6) clay; weak, fine, blocky structure; very firm moist; slightly calcareous; gradual boundary.

C - 16 inches; Reddish brown (2.5YR 4/4) slightly weathered claybed; very calcareous.

The A horizon is dominantly clay loam in texture but can occur as a loam. The color is invariably a hue of 2.5YR. The AC horizon ranges from a heavy clay loam to clay and can vary from 8 - 15 inches in thickness. The C horizon is red calcareous clay beds.

Zaneis Loam (6rB) 1 - 3%, (6rC) 3 - 5%

The Zaneis soils are deep to moderately deep occurring on gently sloping uplands. These soils are well drained, and have moderately slow permeability.

Zaneis soils occur with Renfrow, Kirkland, Chickasha, Norge, and Teller soils. The Zaneis soils are less clayey than the Renfrow and Kirkland soils, and have a redder subsoil than the Chickasha. The Zaneis soils overlie sandstone or siltstone within a depth of 60 inches, where Norge and Teller soils are deeper.

The typical pedon of Zaneis loam from an area of Zaneis loam 1 to 3 percent, is located 530 feet west and 530 feet south of the northeast corner of Sec 16; T.19N.; R.2E.; Payne County, Oklahoma.

Ap - 0 to 9 inches; dark brown (7.5YR 3/2) loam; moderate, medium, granular structure; friable moist; gradual boundary.

B2 - 9 - 18 inches; dark reddish brown (5YR 3/4) heavy loam; weak, medium, subangular blocky; friable moist; clear boundary.

B21t - 18 to 30 inches; dark reddish brown (5YR 3/4) moist clay loam; moderate, medium, subangular blocky; firm moist; clear boundary.

B22t - 30 to 40 inches; red (2.5YR 4/6) sandy clay loam; moderate, medium, subangular blocky; firm moist; gradual boundary.

B3 - 40 to 48 inches; red (2.5YR 4/8) light sandy clay loam; weak, medium, subangular blocky; firm moist; diffused boundary.

C - 48 inches; slightly weathered, yellowish red (5YR 4/6) sandstone.

The A horizon varies in color from dark reddish brown to brown, and in texture from fine sandy loam to loam. The B horizon vary from 20 to 40 inches in thickness and from dark reddish brown to reddish brown to red in color. Textures are usually clay loam but may be light to heavy sandy clay loam. The C horizon is usually partially weathered yellowish red sandstone beginning from 36 to 50 inches below the surface.

Zaneis Loam (6rC3) 3 - 5% Moderately Eroded

This mapping unit is very similar to the Zaneis loam 6rB and 6rC except that this soil is moderately eroded. It has brown loam surface horizons and reddish brown to red clay loam subsoils overlying soft partially weathered sandstone. Most of these soils have been under tillage in the past which accounts for some of the erosion damage.

The typical pedon of Zaneis loam moderately eroded is from an area of Zaneis loam 3 to 5 percent moderately eroded is located 50 feet east and 50 feet south of the northwest corner of the SW¼ of Sec. 21; T.19N.; R.2E.; Payne County, Oklahoma.

Ap - 0 to 5 inches; dark brown (7.5YR 3/2) loam; moderate, medium granular structure; friable moist; clear boundary.

B1 - 5 - 13 inches; dark reddish brown (5YR 3/4) light clay loam; moderate, medium granular structure; friable moist; gradual smooth boundary.

B2t - 13 to 24 inches; dark reddish brown (2.5YR 3/6) clay loam; weak, medium, subangular blocky, firm moist; gradual smooth boundary.

B3 - 24 - 31 inches; red (2.5YR 4/6) sandy clay loam; weak, medium, subangular blocky; firm moist; gradual smooth boundary.

C - 31 inches; partially weathered sandstone which grades to unaltered sandstone.

The A horizon ranges in color from brown to dark brown or dark reddish brown in hues of 7.5YR and 5YR. Texture is usually loam but fine sandy loam areas do occur. The B horizons are dark reddish brown to red in hues of 2.5YR and 5YR, and range from clay loam to sandy clay loam in texture. The depth to sandstone varies from 25 to 40 inches.

Zaneis Loam (6rCD4) 3 - 8% Severely Eroded

This mapping unit is very small and contains soils that are severely eroded. The surface soil is a reddish brown clay loam.

Zaneis-Slickspot Complex (6ϕB) 1 - 3%, (6ϕC3)
3 - 5% Moderately Eroded

The dominant soil in this mapping unit is Zaneis loam 6rB and 6rC; however, approximately 10 to 20 percent of the mapping unit is composed of light colored slickspots.

A typical slickspot pedon is described below.

A1 - 0 to 2 inches; dark brown (10YR 3/3) loam; platy structure; friable moist; clear boundary.

B1 - 2 to 7 inches; dark reddish brown (5YR 3/2) heavy clay loam; weak, medium, blocky structure; very firm moist; visible presence of salts; gradual smooth boundary.

B2t - 7 to 29 inches; dark reddish brown (5YR 3/4) heavy clay loam; weak, medium, blocky structure; very firm moist; salts; gradual smooth boundary.

B3 - 20 to 40 inches; dark reddish brown (5YR 3/4) clay loam, weak, medium blocky to massive; very firm moist; salts; clear smooth boundary.

C - 40 inches; weathered siltstone and clay beds.

The texture of the A horizon ranged from silt loam to loam; and the color ranged from hues of 10YR and 7.5YR. The C horizon is composed of weathered sandstone and calcareous claybeds.

Soil Interpretations

Application of knowledge for the betterment of man is the ultimate justification of scientific research. Soil interpretations fulfill that role in the study of soil science. All the branches of soil science, soil chemistry, soil physics, soil fertility, soil mineralogy and soil morphology combine their knowledge to obtain the most productive use of soil.

Soil interpretations are divided into two general areas, agricultural and non-agricultural. Although often separated as they are here for descriptive purposes, agricultural and non-agricultural interpretations are inseparable in relation to land-use planning. As the earth becomes more populated the food crisis and the growth of urban areas become more serious. Soils with the highest potential for certain crops should grow those crops, and soils which have good potential for supporting safe, sanitary, and aesthetically pleasing home sites should have homes constructed on them. This philosophy is in line with the free enterprize system and good business, in that soil best suited for wheat gives the highest yield per acre for wheat, and soil best suited for building purposes provide sites with the fewest construction problems thus reducing construction costs and future problems to the building owner. A point of conflict arises when the best soil for agricultural purposes is the same soil best suited for urban uses. Here the considerations such as the long range needs and goals of an area determine the best use of the land.

Agricultural Interpretations

The soil mapping units are interpreted for two agricultural land uses, cultivation and range sites. Table II lists the mapping units and their interpretations.

TABLE II

GUIDE TO LAND CAPABILITY CLASSIFICATION AND RANGE SITES

Map Symbol	Mapping Unit	Land Capability Class	Site
6pA	Bethany silt loam 0-1%	I	Loamy Prairie
6tB	Chickasha loam 1-3%	IIe	Loamy Prairie
6tC	Chickasha loam 3-5%	IIIe	Loamy Prairie
25	Darnell fine sandy loam 1-8%	VIIs	Shallow Savannah
5pA	Kirkland silt loam 0-1%	IIs	Claypan Prairie
5pB	Kirkland silt loam 1-3%	IIIe	Claypan Prairie
3	Miller clay 0-1%	IIIw	Heavy Bottomland and Alkalai Bottomland
6nB	Norge loam 1-3%	IIe	Loamy Prairie
6nC	Norge loam 3-5%	IIIe	Loamy Prairie
6nD3	Norge, eroded 5-8%	IVe	Loamy Prairie
4p	Port clay loam 0-1%	IIw	Loamy Bottomland
9p	Port silt loam 0-1%	IIw	Loamy Bottomland
90A	Pulaski fine sandy loam 0-1%	IIw	Loamy Bottomland
5rB	Renfrow silt loam 1-3%	IIIe	Claypan Prairie
5rC	Renfrow silt loam 3-5%	IVe	Claypan Prairie
5rBC3	Renfrow-Kirkland complex 2-6%	IVe	Claypan Prairie
5rCD4	Renfrow, severely eroded 2-6%	VIe	Eroded Clay
70C	Stephenville sandy loam 3-5%	IIIe	Sandy Savannah
7C	Teller loam 3-5%	IIIe	Loamy Prairie
7BC3	Teller loam, eroded, 1-5%	IIIe	Loamy Prairie
17C	Vernon clay loam 3-5%	IVe	Red Clay Prairie
17DE	Vernon Clay loam 5-12%	VIe	Red Clay Prairie
20C	Vernon-Lucien complex 3-5%	IVe	Red Lay Prairie and Shallow Savannah
20DE	Vernon-Lucien complex 5-12%	VIe	Red Clay Prairie and Shallow Savannah
20tBD	Stephenville-Darnell complex 1-8%	VIe	Sandy Savannah and Shallow Savannah
6rB	Zaneis loam 1-3%	IIe	Loamy Prairie
6rC	Zaneis loam 3-5%	IIIe	Loamy Prairie
6ϕB	Zaneis-Slickspot complex 1-3%	IVs	Loamy Prairie and Slickspot
6ϕC3	Zaneis-Slickspot complex 3-5% eroded	IVs	Loamy Prairie and Slickspot
28	Rough broken land	VIIs	Red Clay Prairie
31	Breaks-Alluvial land complex	VIs	Loamy Prairie and Loamy Bottomland
33p	Broken Alluvial land	Vw	Loamy Bottomland

Land Capability Classification

Each mapping unit is grouped into a Capability Class. The Capability Classes are defined as follows:

Good	I	Deep, nearly level, well drained, moderately fine textured soils with a thick dark surface layer.
	IIe	Deep and moderately deep, well drained, gently sloping soils with a loamy surface horizon.
	IIw	Deep, well drained, nearly level soils, freqently to occasionally flooded on local bottomlands with a moderately coarse to moderately fine textured surface horizon.
	IIs	Deep, well drained, nearly level upland soils with a thin medium textured surface layer over a fine textured subsoil, and are droughty in summer.
Fair	IIIe	Deep and moderately deep, well drained, gently sloping and moderately sloping soils, with mostly loamy surface layers, and moderately fine to fine textured subsoils, and are susceptible to erosion.
	IIIw	Deep, poorly drained, nearly level soils on local flood plains, and are fine textured throughout the profile with accumulations of soluble salts in the subsoil.
Poor	IVe	Deep and shallow, well drained to somewhat excessively well drained, moderately sloping and sloping soils with fine textured profiles, and are very susceptible to erosion.

Poor	IVs	Deep and moderately deep, gently sloping and moderately sloping soils, with 15 to 40% of the area being slickspots which have low productivity, and are droughty.
	Vw	The soil includes streams and rough broken bottomland areas adjacent to streams.
	VIe	This group contains sloping, eroded soils on uplands, along drainage ways, and are very susceptible to erosion with use limited to pastures.
	VIIs	These soils are shallow, droughty, and erodable with low productivity with rock outcrops of clay and sandstone being common.

The urban planner is not concerned with the finer points of farm management. What the planner needs to know is, which soils make the best agricultural land. For this purpose the Land Capability Classification classes are generalized into three soil potentials for cultivation. Classes I, IIe, IIw, and IIs are considered to have a good potential for farming. Classes IIIe and IIIw have fair potential and classes IVe, IVs, Vw, IVe, and VIIs have poor potential. Figure 5 is a map showing the soil potentials for cultivation based on the criteria stated above.

Predicted Yields

Table III shows the maximum yields a farmer can expect using improved management practices. The crops rated are wheat, grain sorghum, and alfalfa. The data represents information gathered from recent research, Oklahoma Agricultural Experiment Station Bulletin

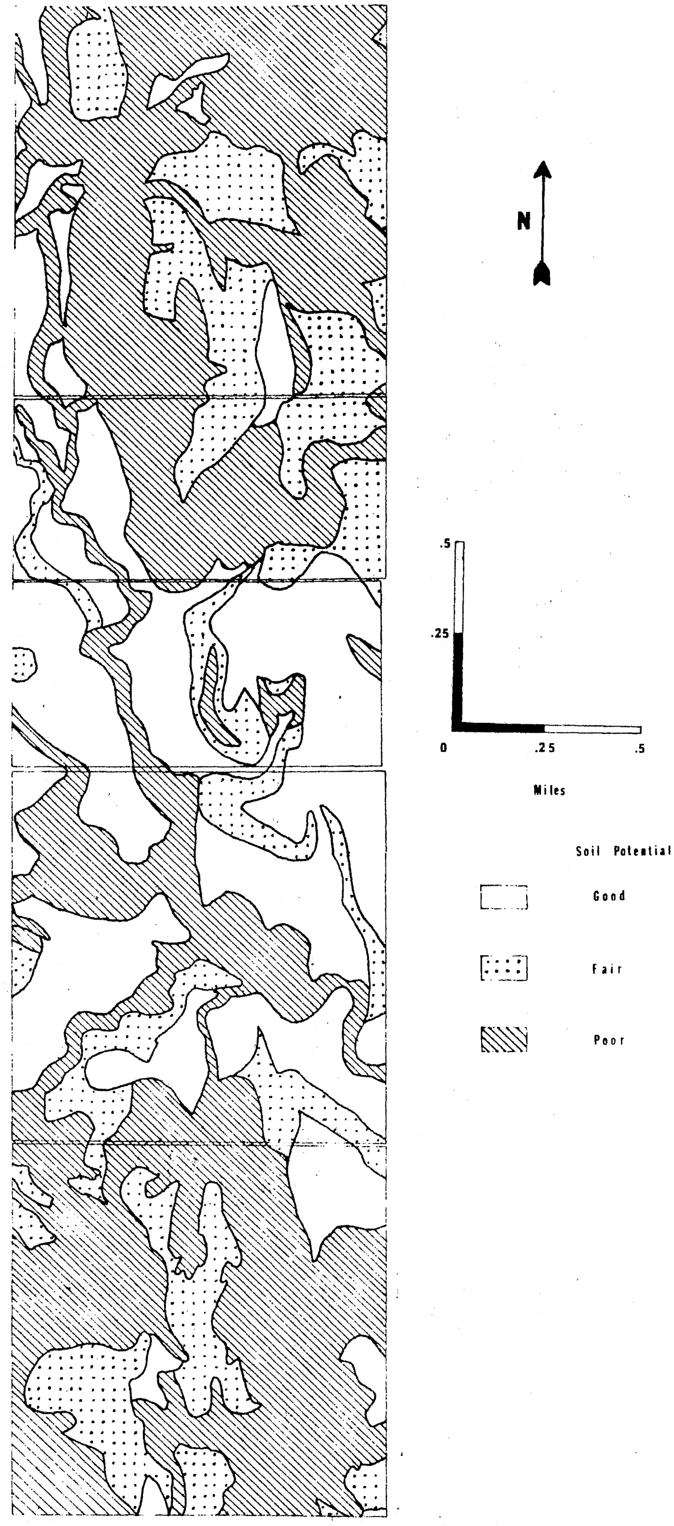


Figure 5. Soil Potential Map for Cultivation.

TABLE III

AVERAGE ESTIMATED YIELDS FOR SOILS OF THE STILLWATER AREA UNDER IMPROVED MANAGEMENT PRACTICES (2,5,21)

Map Symbol	Type	Slope (%)	Wheat (bushels/acre)	Grain Sorghums (bushels/acre)	Alfalfa tons/acre
6pA	Bethany	0-1	35	45	3.0
6tB	Chickasha	1-3	32	35	2.2
6tC	Chickasha	3-5	30	31	1.5
25	Darnell	1-8	-	-	-
5pA	Kirkland	0-1	30	35	1.8
5pB	Kirkland	1-3	28	31	1.0
3	Miller	0-1	28	47	-
6nB	Norge	1-3	32	44	2.8
6nC	Norge	3-5	30	42	2.5
6nD3	Norge eroded	5-8	23	-	-
4p	Port clay loam	0-1	35	60	5.0
9p	Port silt loam	0-1	35	60	5.0
90A	Pulaski	0-1	27	45	3.2

TABLE III (CONTINUED)

Map Symbol	Type	Slope (%)	Wheat (bushels/acre)	Grain Sorghum (bushels/acre)	Alfalfa (tons/acre)
5rB	Renfrow	1-3	26	35	2.0
5rC	Renfrow	3-5	19	28	-
5rBC3	Renfrow-Kirkland Complex Eroded	2-6	16	-	-
5rCD4	Renfrow severely Eroded	2-6	10	-	-
70C	Stephenville	3-5	18	28	-
7C	Teller	3-5	23	35	-
7BC3	Teller eroded	2-5	19	-	-
17C	Vernon	3-5	15	16	-
17DE	Vernon	5-12	-	-	-
20C	Vernon-Lucien Complex	3-5	14	-	-
20DE	Vernon-Lucien Complex	5-12	-	-	-
6rB	Zaneis	1-3	28	38	2.5

TABLE III (CONTINUED)

Map Symbol	Type	Slope (%)	Wheat (bushels/acre)	Grain Sorghum (bushels/acre	Alfalfa (ton/acre)
6rC	Zaneis	3-5	24	31	-
6rC3	Zaneis eroded	3-5	16	-	-
6ϕB	Zaneis-Slickspots Complex	1-3	22	23	-
6ϕC3	Zaneis-Slickspots Complex	3-5	18	16	-

B-650, and soil surveys from surrounding counties.

Figure 6 is a soil potential map for wheat productivity. The soils are grouped into three classes, less than 16, 16 to 25, and 26 to 35 bushels per acre. This type of map can be extremely useful to the farmer.

Range Sites

The range sites are given for each mapping unit in Table II. There are ten range sites represented in the study area.

Figure 7 is a soil potential map for range sites. The range sites are grouped according to the annual yield of air-dry herbage in years of favorable moisture. Soils with good potential as range sites yield more than 4000 pounds per acre annually. Soils with fair and poor potential for range sites are from 4,000 to 2,700 pounds per acre and less than 2,700 pounds per acre, respectively.

Alkali Bottomland Range Sites

Only the slickspots in Miller soils are in this range site. These slickspots contain soluble salts, take in water very slowly, and are droughty. Among the native plants that grow on this site are switch-grass, alkali muhly, and inland saltgrass.

Where this site is in excellent condition, the estimated annual yield of air dry herbage is 3,200 pounds per acre in years of favorable moisture.

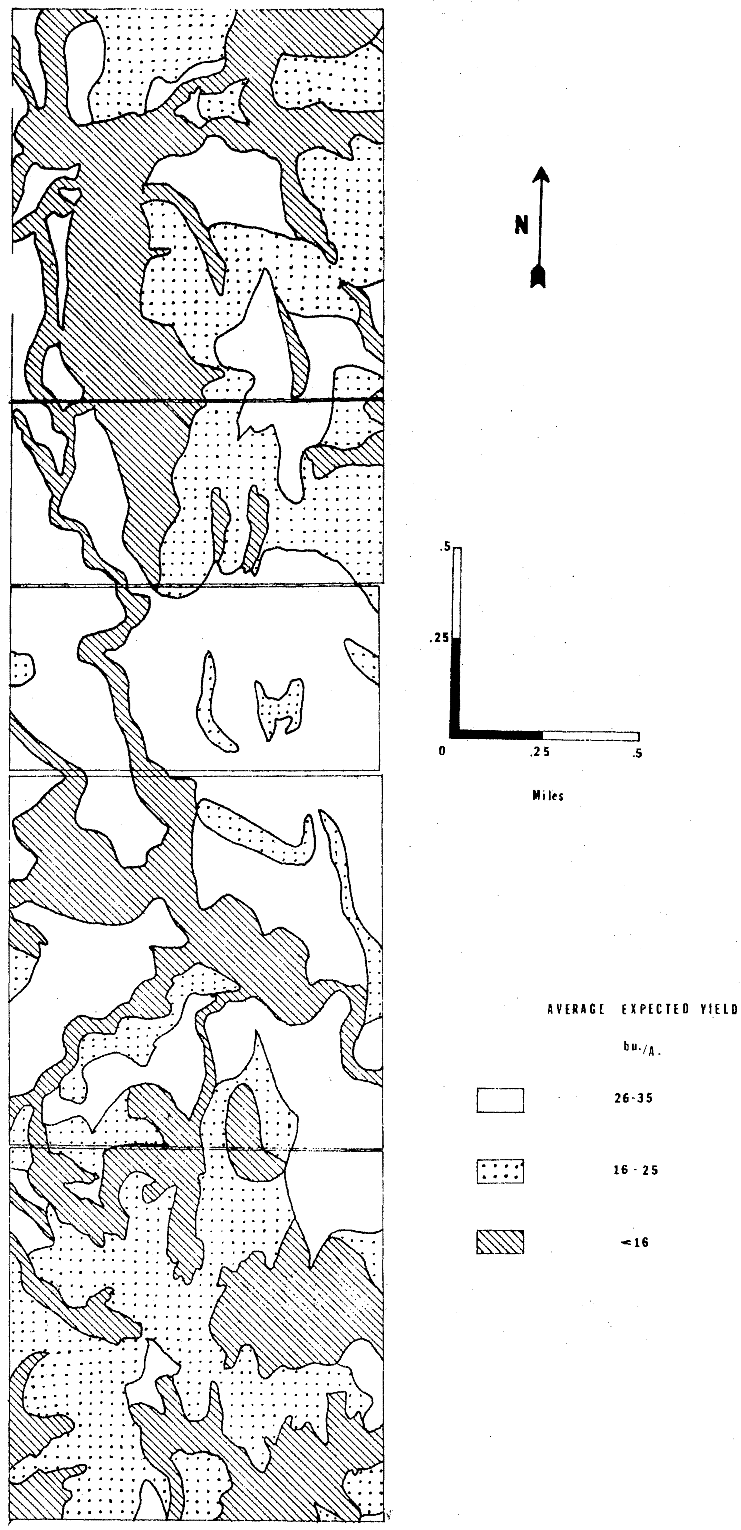


Figure 6. Wheat Productivity Map.

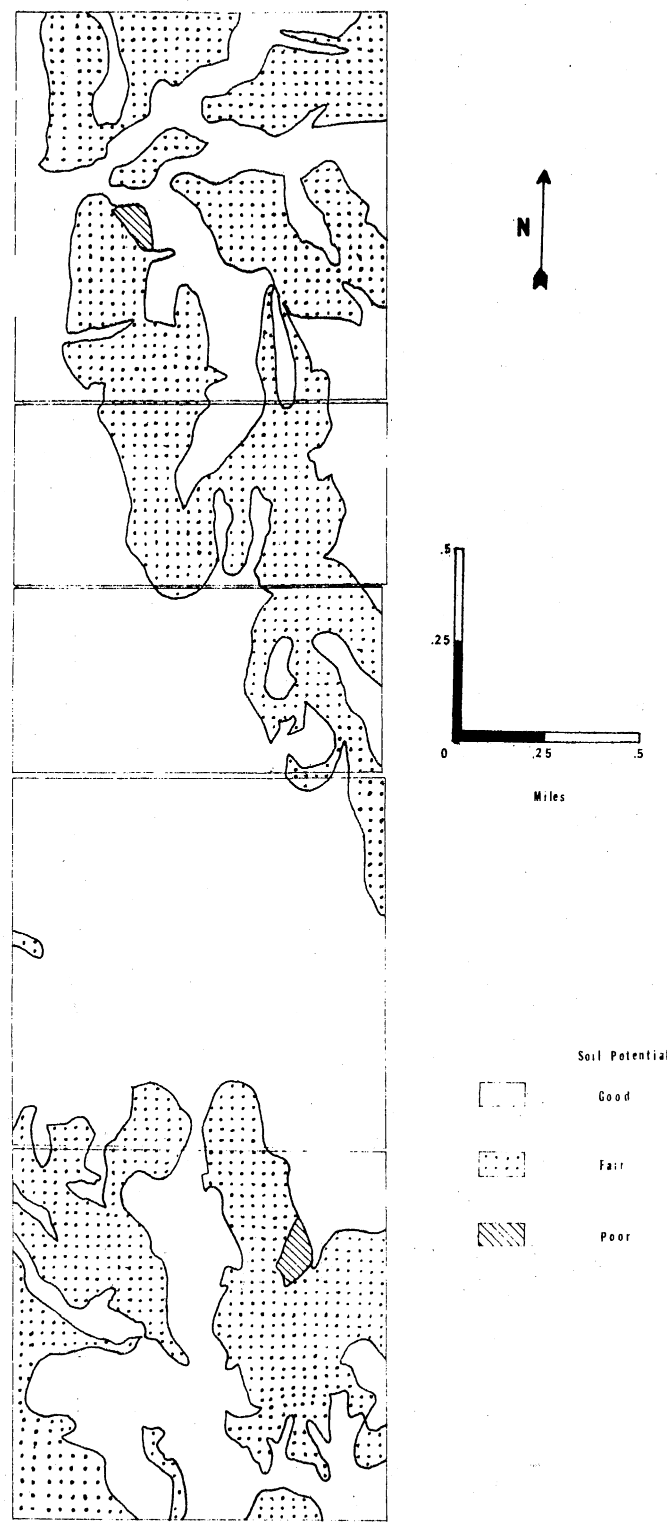


Figure 7. Range Site Potential Map.

Claypan Prairie Range Site

This range site consists of soils underlain by compact clay. This clay somewhat restricts the movement of water and the growth of plants.

Blue grama, buffalograss, and unpalatable weeds increase greatly if this site is continuously and heavily overgrazed.

Where this site is in excellent condition the estimated annual yield of air-dry herbage is 4000 pounds per acre in years of favorable moisture and 2000 pounds per acre in years of unfavorable moisture.

Eroded Clay Range Site

The land in this range site consists of formerly cultivated fields. Today, erosion is so severe that little forage is produced.

Where this site is in excellent condition, the estimated annual yield of air-dry herbage is 1,400 pounds per acre in years of favorable moisture and 800 pounds per acre in years of unfavorable moisture.

Heavy Bottomland Range Sites

Miller soils are only members of this range site. Much of the time they are wet and during the summer they are droughty.

When the heavy bottomland range site is in excellent condition the estimated annual yield of air-dry herbage is 5,500 pounds per acre in years of favorable moisture and 2500 pounds per acre in years of unfavorable moisture.

Loamy Bottomland Range Site

This range site consists of deep, dark, loamy soils on bottomlands. It is the highest producing range site in the Stillwater area.

When the range site is in excellent condition it is capable of producing 8,500 pounds per acre annually of air-dry herbage in years of favorable moisture and 4,500 pounds per acre in years of unfavorable moisture.

Loamy Prairie Range Site

This range site consists of nearly level to gently rolling soils. These soils generally have a loam or silt loam surface layer. They are permeable, easily penetrated by roots, and have good moisture storing capacity.

This is the most productive upland range site in Stillwater. Where the site is in excellent condition, the estimated annual yield of air-dry herbage is 5,000 pounds per acre in years of favorable moisture and 2,500 pounds per acre in years of unfavorable moisture.

Red Clay Prairie Range Site

This range site consists of clayey rolling soils on uplands. These soils absorb water slowly where the surface is protected by grasses. Careful management of grazing is needed so that the plant cover remains and protects the soils from erosion.

Where the site is in excellent condition, the estimated annual yield of air-dry herbage is 2,700 pounds per acre in years of favorable moisture and 1,600 pounds per acre in years of unfavorable moisture.

Sandy Savannah Range Site

This range site consists of gently to strongly sloping fine sandy loams. These soils support a mixture of tall grasses and woody plants. Heavy prolonged grazing or fire and heavy grazing thin out the grasses and forbs and release space for invaders, particularly woody plants. Areas which have never been cultivated or which are in fair or poor condition have a thick stand of post oak or blackjack oak.

Where a site is in excellent condition, the estimated annual yield of air-dry herbage, excluding trees and brush, is 4,500 pounds per acre in years of favorable moisture and 2,500 pounds per acre in years of unfavorable moisture.

Shallow Savannah Range Site

This range site consists of shallow sandy upland soils. The presence of sandstone at shallow depths limits the penetration of roots. The better forage plants are scarce, but woody plants grow in the cracks of the rock.

When the range site is in excellent condition, the estimated annual yield of air-dry herbage, excluding trees and brush, is 3,200 pounds per acre in years of favorable moisture and 1,400 pounds per acre in years of unfavorable moisture.

Slickspot Range Site

This range site consists of slickspots and is closely intermingled with Loamy Prairie range sites. The vegetation on the slickspot sites differs significantly from the Loamy Prairie range sites.

When this site is in excellent condition the estimated annual yield of air-dry herbage is 1,800 pounds per acre in years of favorable moisture and 800 pounds per acre in years of unfavorable moisture.

Non-Agricultural Interpretations

The non-agricultural interpretations for septic tank absorption fields, sewage lagoons, small buildings with basements and without basements, roads and streets, and parks and playgrounds are considered. Table IV shows the suitability of the mapping units for each activity.

The determination of the soil potential was a two step process. The soil properties which affect the success or failure of the proposed land use were defined. This was done by the Soil Conservation Service in the guide for engineering uses of soils (16). The concept of soil limitation used by the guide is converted to soil potential. An unbiased system which rates the soils on the basis of soil properties was needed. A numerical rating in conjunction with the soil limitation served the purpose. Each soil property that had a slight soil limitation for a specific use was assigned the number five. For moderate and severe limitations, three and one were assigned, respectively. An average value for each mapping unit for a specific use was determined by summing the values and then dividing by the number of properties considered. The average values were arranged sequentially which resulted in an unbiased ordering and subsequent grouping of soils for a specific land use based on soil properties. Three groups of soil potential are used; good, fair, and poor.

The second step was more subjective. Certain soil conditions, the cost of overcoming the soil conditions, the past performance of

TABLE IV

SOIL POTENTIALS FOR SIX URBAN LAND USES

Map Symbols	Soil Mapping Unit	Soil Potential: Septic Tank Absorption Fields	Sewage Lagoon	Dwellings with Basements	Dwellings without Basements	Local Roads and Streets	Parks and Playgrounds
6pA	Bethany silt loam 1-3%	poor	good	fair	fair	fair	fair
33p	Broken Alluvial land	poor	poor	poor	poor	poor	poor
31	Breaks-Alluvial land complex	poor	poor	poor	poor	poor	poor
6tB	Chickasha loam 1-3%	good	good	good	good	good	good
6tC	Chickasha loam 3-5%	good	fair	good	good	good	good
25	Darnell 8-30%	fair	poor	poor	good	fair	poor
5pA	Kirkland silt loam 0-1%	poor	good	fair	fair	fair	poor
5pB	Kirkland silt loam 1-3%	poor	good	fair	fair	fair	fair

TABLE IV (CONTINUED)

Map Symbols	Soil Mapping Unit	Soil Potential: Septic Tank Absorption Fields	Sewage Lagoon	Dwellings with Basements	Dwellings without Basements	Local Roads and Streets	Parks and Playgrounds
20C	Lucien-Vernon complex 3-5%	fair	fair			fair	fair
	Lucien	good	poor	fair	good	good	good
	Vernon	poor	fair	poor	poor	poor	poor
20DE	Lucien-Vernon complex 5-12%	fair	poor		fair	fair	poor
	Lucien	good	poor	fair	good	good	fair
	Vernon	poor	poor	poor	poor	poor	poor
3	Miller clay 0-1%	poor	poor	poor	poor	poor	poor
6nB	Norge loam 1-3%	fair	good	good	good	good	good
6nC	Norge loam 3-5%	fair	good	good	good	good	fair
6nD3	Norge loam 5-8%, eroded	fair	fair	good	good	good	fair
4p	Port clay loam 0-1%	poor	poor	poor	poor	fair	poor

TABLE IV (CONTINUED

Map Symbols	Soil Mapping Unit	Soil Potential: Septic Tank Absorption Fields	Sewage Lagoon	Dwellings with Basements	Dwellings without Basements	Local Roads and Streets	Parks and Playgounds
9p	Port silt loam 0-1%	poor	poor	poor	poor	good	fair
90A	Pulaski 0-1%	poor	poor	poor	poor	good	fair
5rB	Renfrow silt loam 1-3%	poor	good	fair	fair	fair	fair
5rC	Renfrow 3-5%	poor	good	fair	fair	fair	fair
5rBC3	Renfrow-Kirkland complex 2-6%, eroded	poor	good	fair	fair	fair	fair
5rCD4	Renfrow 2-6%, severely eroded	poor	good	fair	fair	fair	fair
28	Rough Broken Land	poor	poor	poor	poor	poor	poor
70C	Stephenville 3-5%	good	fair	good	good	good	good
20tBD	Stephenville-Darnell complex 1-8%	good	poor	fair	good	good	fair

TABLE IV (CONTINUED)

Map Symbols	Soil Mapping Unit	Soil Potential: Septic Tank Absorption Fields	Sewage Lagoons	Dwellings with Basements	Dwellings without Basements	Local Roads and Streets	Parks and Playgrounds
7C	Teller loam 3-5%	good	good	good	good	good	good
7BC3	Teller loam 1-5%, eroded	good	good	good	good	good	good
17C	Vernon clay loam 3-5%	poor	fair	poor	poor	poor	poor
17DE	Vernon clay loam 5-12%	poor	poor	poor	poor	poor	poor
6rB	Zaneis loam 1-3%	fair	good	good	good	good	good
6rC	Zaneis 3-5%	fair	good	good	good	good	fair
6rC3	Zaneis 3-5%, eroded	fair	good	good	good	good	fair
6rCD4	Zaneis 3-8% severely eroded	fair	fair	good	good	good	fair
6ϕB	Zaneis-Slickspot complex 1-3%	fair	good	poor	poor	poor	poor

TABLE IV (CONTINUED)

Map Symbols	Soil Mapping Unit	Soil Potential: Septic Tank Absorption Fields	Sewage Lagoon	Dwellings with Basements	Dwellings without Basements	Local Roads and Streets	Parks and Playgrounds
	Zaneis	fair	good	good	good	good	good
	Slickspot	poor	good	poor	poor	poor	poor
6ϕC3	Zaneis-Slickspot complex 3-5% eroded	fair	good	poor	poor	poor	poor
	Zaneis	fair	good	good	good	good	fair
	Slickspot	poor	good	poor	poor	poor	poor

the soil for the desired use, and the environmental aspects were weighed. These factors varied in their effect. For some uses the factors did not alter the initial order, but for others a few changes occurred.

The soil potential represents an indication of a soils relative suitability for a specific use. A poor potential does not necessarily mean that a soil is unusable for that use, but it may be prohibitively expensive to make it practical. Most adverse soil conditions can be overcome either by altering the soil or by engineering design. A soil with a good potential does not mean that there are no problems to overcome. The potential separates the soils with problems that are easier to overcome from those that are more difficult to overcome. The soil potential does not propose to take the place of on site investigations. The soil mapping unit indicates the dominant soil within its boundary and allows for different soil types to occur there. The soil potential represents the dominant soil type and is extremely useful in planning or in locating areas that contain soils with a specific potential.

Septic Tank Absorption Fields

The disposal of liquid waste for individual homes which are beyond the reach of city sewer lines poses considerable problems in many soils. The soils around Stillwater are generally poorly suited for this use. Certain soils are much better suited for absorption fields if other alternatives are not feasible. The soil properties considered in numerically rating the soils are permeability, percolation rate, depth to water table, flooding, slope, depth to bedrock or other impervious materials, stoniness class, and rockiness class. Once the mapping units were grouped based on the numerical rating procedure, each soil was re-evaluated. The secondary factors considered for the use of absorption fields include flooding, type of bedrock, and relative cost of constructing an operable system.

Figure 8 is a soil potential map for use of septic tank absorption fields. Most Stillwater soils have several soil conditions that make the use of absorption fields either expensive to construct operable systems or a health hazard where the systems are not properly designed and installed. An alternative is the use of sewage lagoons where ever possible, particularly in subdivisions. Most Stillwater soils have good soil potentials for sewage lagoons. The use of sewage lagoons has the added advantage of centralizing the sewage of the area. When the city sewer lines eventually reach the area, hook up to the city sewer line will be less costly for the city and the home owners alike.

Table V shows the potential rating and the limitations which must be overcome when designing and installing septic systems.

Sewage Lagoons

A sewage lagoon is a second method for disposing of household wastes. The soils of Stillwater are generally well-suited for the use of sewage lagoons. The use of sewage lagoons are restricted to groups of homes, like subdivisions, which can share the cost of construction. The advantages of centralized sewage and improved health conditions where soils are unsuitable for absorption fields cannot be overstated.

The soil properties considered in the numerical rating of the

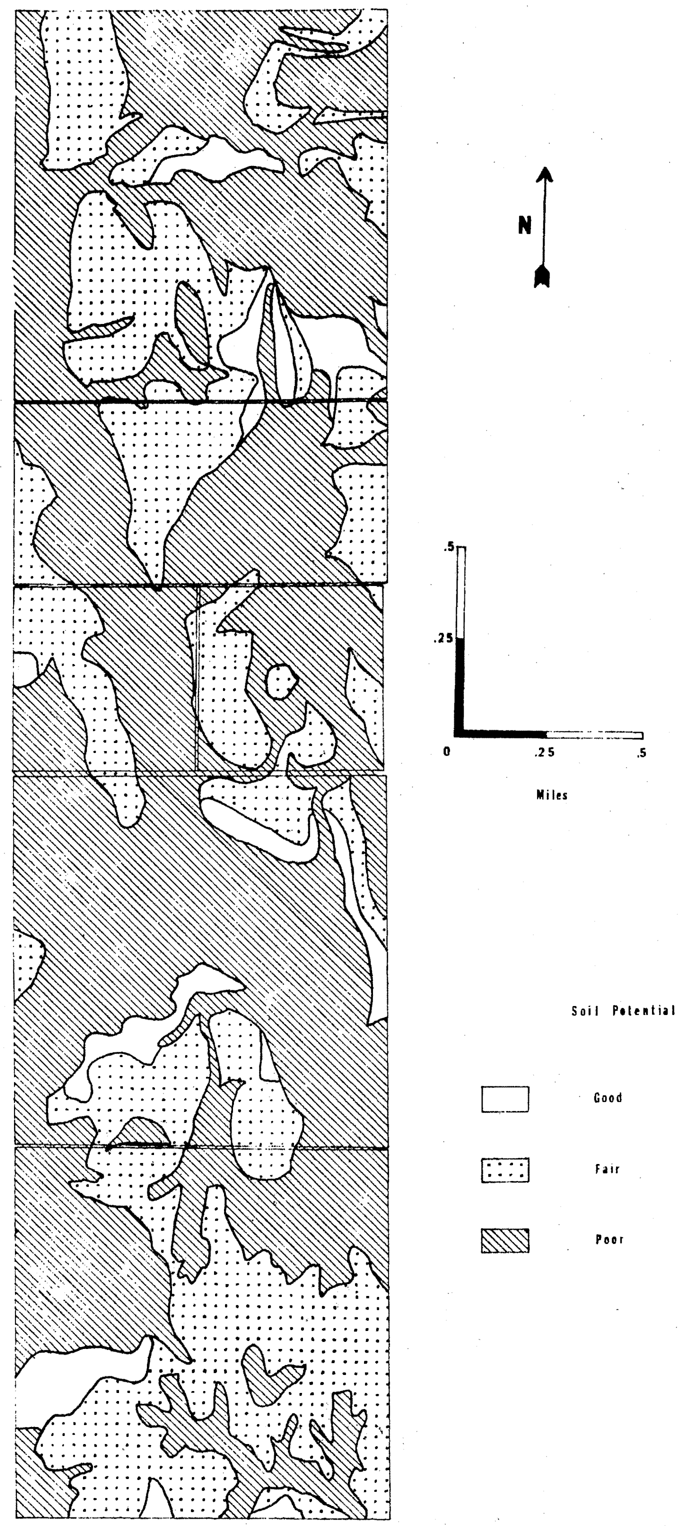


Figure 8. Soil Potential Map for Septic Tank Absorption Fields.

TABLE V

SOIL POTENTIALS AND LIMITATIONS FOR SEPTIC TANK ABSORPTION FIELDS

Map Symbol	Soil Potential	Limitations
6pA	poor	slow permeability
33p	poor	flooding
31	poor	flooding
6tB	good	moderate permeability
6tC	good	moderate permeability
25	fair	less than 20 inches to sandstone
20tBD	good	20 to 40 inches to sandstone
5pA	poor	very slow permeability
5pB	poor	very slow permeability
20C		
Lucien	fair	less than 20 inches to sandstone
Vernon	poor	very slow permeability, less than 20 inches to claybed
20DE		
Lucien	fair	less than 20 inches to sandstone
Vernon	poor	very slow permeability, less than 20 inches to claybed
3	poor	flooding, very slow permeability, depth to water table
6nB	fair	slow permeability
6nC	fair	slow permeability
6nD3	fair	slow permeability

TABLE V (CONTINUED)

Map Symbol	Soil Potential	Limitations
4p	poor	flooding, slow permeability, depth to water table
9p	poor	flooding, moderate permeability, depth to water table
90A	poor	flooding, depth to water table
5rB	poor	very slow permeability
5rC	poor	very slow permeability
5rBC3	poor	very slow permeability
5rCD4	poor	very slow permeability
28	poor	slow permeability, steep slopes
70C	good	20 to 40 inches to sandstone
7C	good	moderate permeability
7BC3	good	moderate permeability
17C	poor	very slow permeability, less than 20 inches to claybeds
17DE	poor	very slow permeability, less than 20 inches to claybeds
6rB	fair	moderately slow permeability, 50 inches to sandstone
6rC3	fair	moderately slow permeability, 50 inches to sandstone
6rCD4	fair	moderately slow permeability, 50 inches to sandstone
6ϕB	fair	
Slickspot	poor	very slow permeability
6ϕC3	fair	
Slickspot	poor	very slow permeability

soil are permeability, depth to water table, depth to bedrock, slope, percent organic matter, flooding, and Unified group of material used for the lagoon floor. The secondary factors considered were slope, and flooding.

Figure 9 is the soil potential map for the use of sewage lagoons. The map shows the relatively favorable potential for the use of sewage lagoons in Stillwater soils. Table VI gives the soil potential rating and limitations which need to be overcome when designing and constructing sewage lagoons on Stillwater soils.

Small Dwellings With Basements

The soils of Stillwater are fairly well suited for the construction of small dwellings with basements. A small dwelling is considered to be a building of three stories or less. The soil properties considered are soil drainage class, depth to water table, flooding, slope, shrink-swell potantial, Unified group, and depth to bedrock. The factors of flooding and shrink-swell potential require special attention in establishing the soil potential.

The problems imposed by shrink-swell are easily overcome with well designed reinforced foundations. The cost out weighs the utility of a basement for many people. The threat of flooding should not be underestimated. Stillwater possesses an ample number of alternative sites, where the construction of small dwellings with or without basements can be located. Areas subject to flooding should always be avoided.

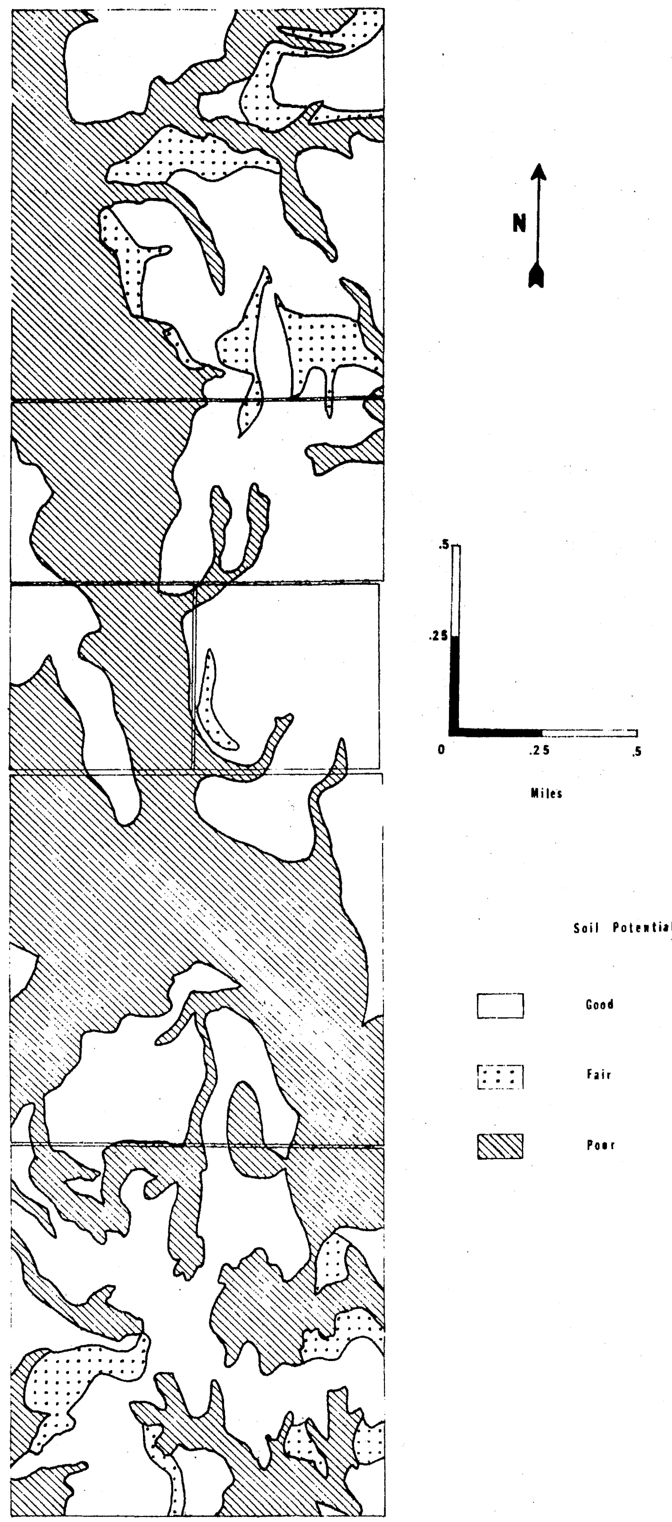


Figure 9. Soil Potential Map for
Sewage Lagoons.

TABLE VI

SOIL POTENTIALS AND LIMITATIONS FOR SEWAGE LAGOONS

Map Symbols	Soil Potential	Limitations
6pA	good	2.4% organic matter
33p	poor	flooding, steep slopes, rapid permeability
31	poor	flooding, steep slopes
6tB	good	moderate permeability, 50 inches to sandstone, 2.2% organic matter
6tC	fair	moderate permeability, 50 inches to sandstone, 3-5% slopes, 2.1% organic matter
25	poor	8-30% slopes, moderate permeability, sandstone at less than 20 inches
20tBD	poor	1-8% slopes, moderate permeability, 15-40 inches to sandstone
5pA	good	50 inches to claybed, 2.4% organic matter
5pB	good	50 inches to claybed, 1-3% slopes, 2.4% organic matter
20C		
Lucien	poor	less than 20 inches to sandstone, slope 3-5%, moderate permeability
Vernon	fair	less than 20 inches to claybed, slope 3-5%
20DE		
Lucien	poor	less than 20 inches to sandstone, slope 5-12%, moderate permeability
Vernon	poor	less than 20 inches to clay bed, slope 5-12%
3	poor	flooding, depth to water table, 2.6% organic matter

TABLE VI (CONTINUED)

Map Symbols	Soil Potential	Limitations
6nB	good	2.2% organic matter, 1-3% slopes
6nC	good	3-5% slopes, 2.0% organic matter
6nD3	fair	5-8% slopes
4p	poor	flooding, depth to water table, 2.1% organic matter
9p	poor	flooding, depth to water table, moderate permeability, 2.1% organic matter
90A	poor	flooding, depth to water table, rapid permeability
5rB	good	1-3% slopes
5rC	good	3-5% slopes
5rBC3	good	2-6% slopes, 50 inches to claybeds
5rCD4	good	2-6% slopes, 50 inches to claybeds
28	poor	steep slopes
70C	fair	moderate permeability, sandstone at 40 inches, 3-5% slopes
7BC3	good	moderate permeability, 1-5% slopes
17C	fair	depth to claybed less than 20 inches, slope 3-5%
17DE	poor	depth to claybed less than 20 inches, slope 5-12%
6rB	good	50 inches to sandstone, 2.4% organic matter
6rC	good	50 inches to sandstone, 2.2% organic matter, 3-5% slopes
6rC3	good	45 inches to sandstone, 2.0 organic matter, 3-5% slopes

TABLE VI (CONTINUED)

Map Symbols	Soil Potential	Limitations
6rCD4	fair	40 inches to sandstone, 3-8% slopes
6ϕB	good	50 inches to sandstone, 2.4% organic matter
6ϕC3	good	45 inches to sandstone, 2.0% organic matter

Small Dwellings Without Basements

The soils in Stillwater are well suited to small buildings without basements. The same properties important for dwellings with basements hold for dwellings without basements. The cost of foundations for dwellings without basements is considerably less.

Figure 10 is a soil potential map for small dwellings without basements. The map shows most areas in Stillwater as good or fair soil potentials. Table VII gives the soil potential rating and limitations which must be dealt with when designing and constructing foundations for small dwellings without basements.

Local Roads and Streets

The soils in Stillwater have two soil properties that cause problems, shrink-swell and depth to bedrock. Shrink-swell is the most severe, but with proper treatment the problem can be overcome.

Figure 11 is the soil potential map for local roads and streets. This map can be useful in planning local roads. The location of streets on soils more suitable for roads can save many dollars on construction and maintenance. Table VIII is useful in determining the problems a soil poses to road construction and for calculating the cost to overcome these limitations.

Parks and Playgrounds

The consideration of parks and playgrounds is important to every community. The soil properties which determine the soil potential are wetness, flooding, permeability, slope, texture of surface layer, and

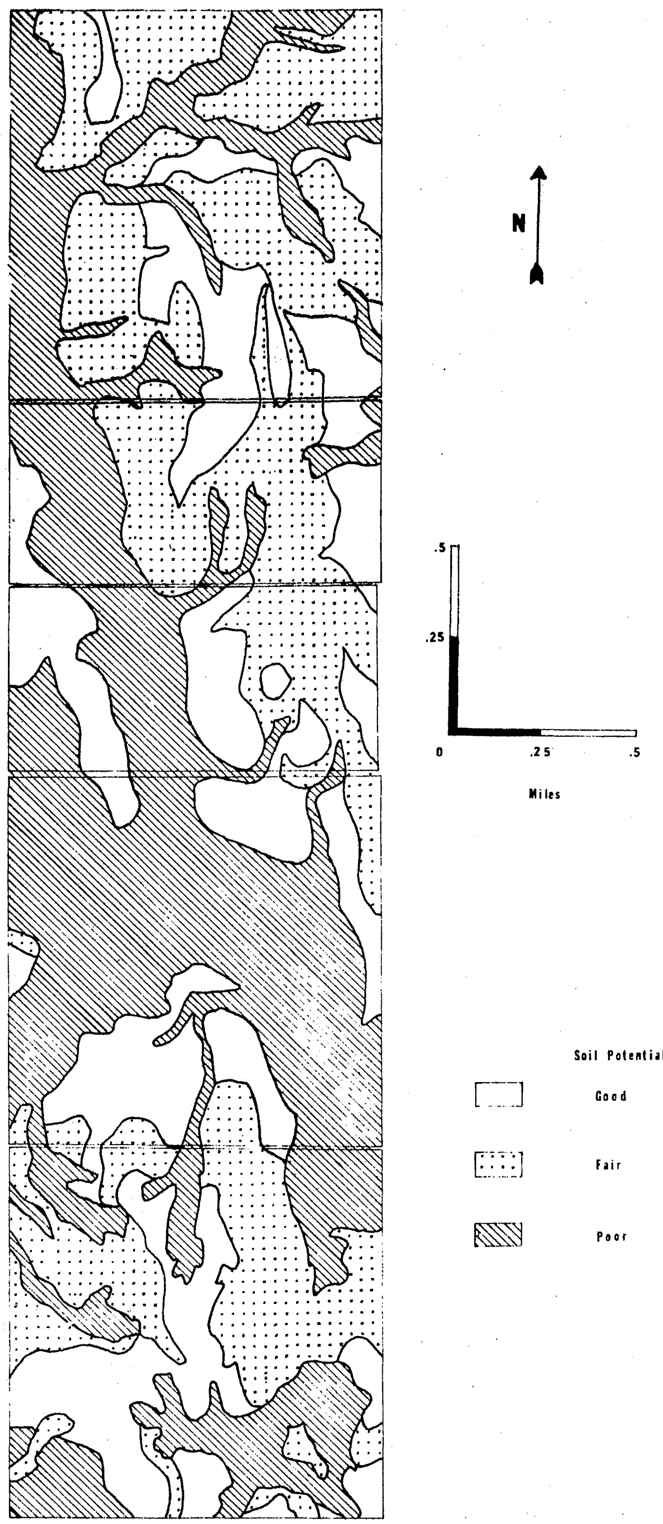


Figure 10. Soil Potential Map for Small Dwellings without Basements.

TABLE VII

SOIL POTENTIALS AND LIMITATIONS FOR SMALL DWELLINGS WITHOUT BASEMENTS

Map Symbols	Soil Potential	Limitations
6pA	fair	moderate shrink-swell potential, unified soil group of CH
33p	poor	flooding, steep slopes
31	poor	flooding, steep slopes
6tB	good	moderate shrink-swell potential
6tC	good	moderate shrink-swell potential
25	poor	8-30% slopes, sandstone within 20 inches
20tBD	good	1-8% slopes, sandstone at a depth of 20 to 40 inches
5pA	fair	high shrink-swell potential, unified soil group of CH
5pB	fair	high shrink-swell potential, unified soil group of CH
20C	fair	
Lucien	good	sandstone within 20 inches
Vernon	poor	claybed within 20 inches, high shrink-swell potential, unified soil group of CH
20DE	fair	
Lucien	good	5-12% slopes, sandstone within 20 inches
Vernon	poor	5-12% slopes, claybed within 20 inches, high shrink-swell potential, unified group of CH
3	poor	flooding, poor soil drainage, high shrink-swell potential, unified soil group of CH
6nB	good	moderate shrink-swell potential, Unified soil group of Ml,CL

TABLE VII (CONTINUED)

Map Symbols	Soil Potential	Limitations
6nC	good	moderate shrink-swell potential, unified soil group of Ml, Cl
6nD3	good	moderate shrink-swell potential, unified soil group of Ml, Cl
4p	poor	flooding, unified soil group of Cl-ML, moderate shrink-swell potential
9p	poor	flooding, unified soil group of CL-ML
90A	poor	flooding, depth to water table
5rB	fair	high shrink-swell potential, unified soil group of CH
5rC	fair	high shrink-swell potential, unified soil group of CH
5rBC3	fair	high shrink-swell potential, unified soil group of CH
5rCD4	fair	high shrink-swell potential, unified soil group of CH
28	poor	steep slopes, rock outcrops
70C	good	depth to sandstone about 40 inches
7C	good	moderate shrink-swell potential
7BC3	good	moderate shrink-swell potential
17C	poor	high shrink-swell potential, unified soil group of CH, depth to claybed about 20 inches
17DE	poor	high shrink-swell potential, unified soil group of CH, dpeth to claybed about 20 inches, 5-12% slopes
6rB	good	moderate shrink-swell potential, unified soil group of CL

TABLE VII (CONTINUED)

Map Symbols	Soil Potential	Limitations
6rC	good	moderate shrink-swell potential, unified soil group of CL
6rC3	good	moderate shrink-swell potential, unified soil group of CL
6rCD4	good	moderate shrink-swell potential, unified soil group of CL
6ϕB Slickspot	poor	poorly drained, high shrink swell potential
6ϕC3 Slickspot	poor	poorly drained, high shrink-swell potential

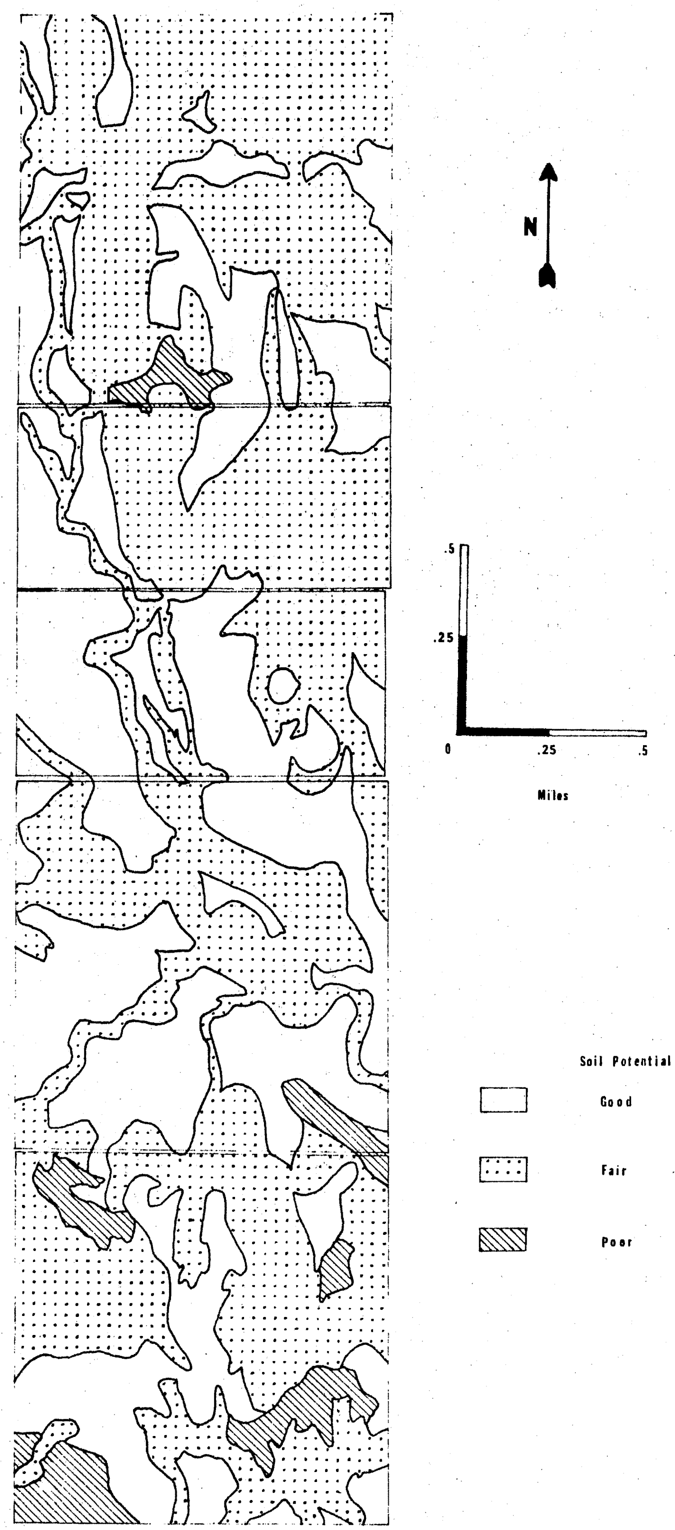


Figure 11. Soil Potential Map for Local Roads and Streets.

TABLE VIII

SOIL POTENTIALS AND LIMITATIONS FOR
LOCAL ROADS AND STREETS

Map Symbols	Soil Potential	Limitations
6pA	fair	AASHO rating A-7, moderate shrink-swell potential
33p	poor	flooding, steep slopes
31	poor	flooding, steep slopes
6tB	good	AASHO rating A-6, moderate shrink-swell potential
6tC	good	AASHO rating A-6, moderate shrink-swell potential
25	fair	sandstone within 15 inches, 8-30% slopes, sandstone outcrops
20tBD	good	sandstone at 15-40 inches
5pA	fair	AASHO rating A-7, high shrink-swell potential
5pB	fair	ASSHO rating A-7, high shrink-swell potential
20C	fair	
Lucien	good	sandstone within 20 inches
Vernon	poor	20 inches to claybeds, AASHO rating A-7, high shrink-swell potential
20DE	fair	
Lucien	good	sandstone within 20 inches, 5-12% slopes
Vernon	poor	20 inches to claybeds, AASHO rating A-7, high shrink-swell potential, 5-12% slopes
3	poor	poorly drained, flooding, ASSHO rating A-7, high shrink-swell potential
6nB	good	AASHO rating A-6, moderate shrink-swell potential

TABLE VIII (CONTINUED)

Map Symbols	Soil Potential	Limitations
6nC	good	AASHO rating A-6, moderate shrink-swell potential
6nD3	good	AASHO rating A-6, moderate shrink-swell potential
4p	fair	flooding, ASSHO rating A-7, moderate shrink-swell potential
9p	good	flooding
90A	good	flooding
5rB	fair	ASSHO rating A-7, high shrink-swell potential
5rC	fair	ASSHO rating A-7, high shrink-swell potential
5rBC3	fair	ASSHO rating A-7, high shrink-swell potential
5rCD4	fair	ASSHO rating A-7, high shrink-swell potential
28	poor	steep slopes, rock outcrops
70C	good	ASSHO rating A-6
7C	good	moderate shrink-swell potential
7BC3	good	moderate shrink-swell potential
17C	poor	20 inches to claybeds, AASHO rating A-7, high shrink-swell potential
17DE	poor	20 inches to claybeds, AASHO rating A-7, high shrink-swell potential, 5-12% slopes
6rB	good	AASHO rating A-7, moderate shrink-swell potential

TABLE VIII (CONTINUED)

Map Symbols	Soil Potential	Limitations
6rC	good	AASHO rating A-7, moderate shrink-swell potential
6rC3	good	AASHO rating A-7, moderate shrink-swell potential
6rCD4	good	AASHO rating A-7, moderate shrink-swell potential
6ϕB Slickspots	poor	poorly drained, high shrink-swell potential
6ϕC3 Slickspots	poor	poorly drained, high shrink-swell potential

depth to bedrock. Other important properties include droughtiness and capability to maintain grass cover under intensive use (12).

Figure 12 is the soil potential map showing the areas suitable for parks and playgrounds. Table IX gives the soil potential rating and limitations which must be recognized and overcome when planning parks and playgrounds.

Soil Property Maps

Figure 13 is a soil property map. Figure 13 shows the depth to bedrock, a condition important to nearly every soil use. Other soil property maps can be drawn from the soils map using specific soil properties from the tables in Appendix A. Examples of other useful maps include slope, permeability, and shrink-swell potential.

Land Use Map

The present land-use map is a tool which can serve in two capacities. It may be used to identify areas which remain available for development, and secondly, one can compare the soil potentials proposed in this thesis to the actual development that has already occurred in the study area.

The map is broken into four units, residential, woodland, pasture, and cropland. When the soil potential estimates are compared to the actual use of the land, it becomes apparent that most of the residential areas using septic tanks are located on soils with poor potential for absorption fields. This shows that soils information has not been utilized in the planning phase of Stillwater's growth in the past. Figure 14 is a present land-use map of the study area.

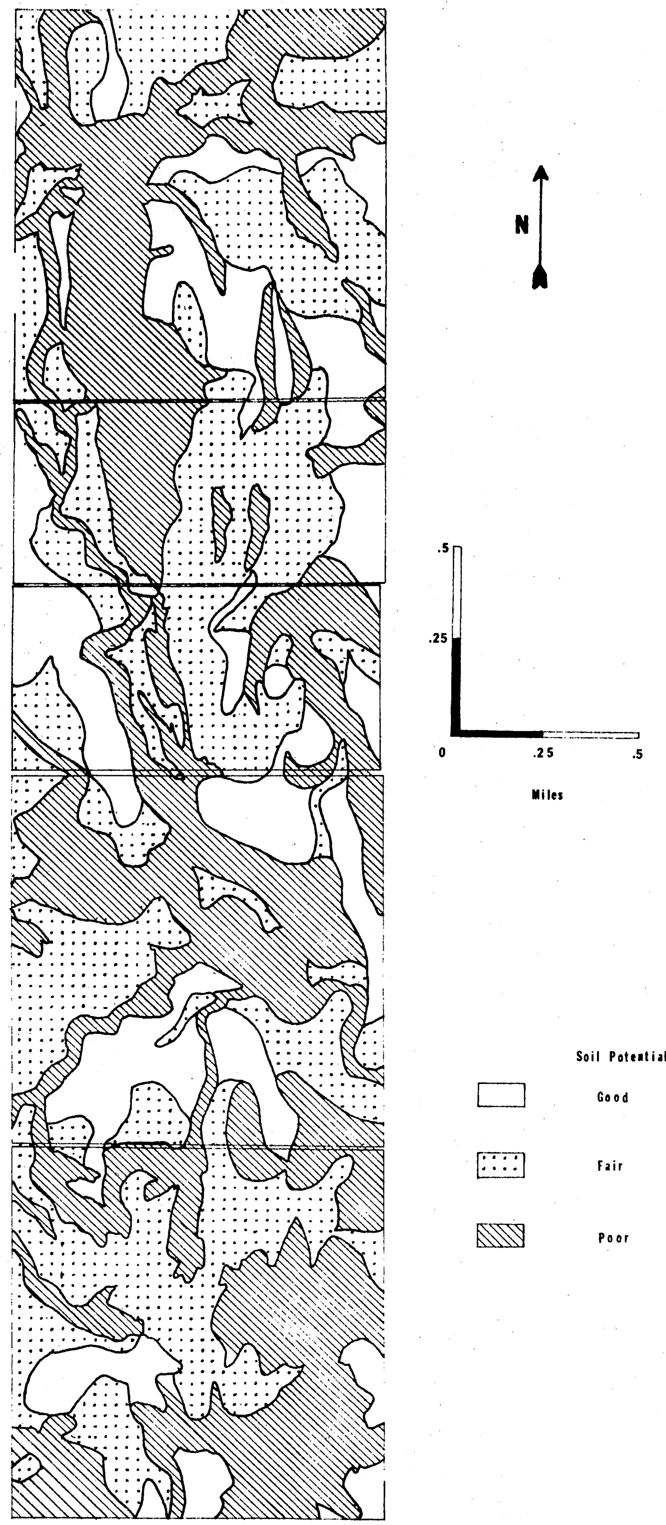


Figure 12. Soil Potential Map for Parks and Playgrounds.

TABLE IX

SOIL POTENTIALS AND LIMITATIONS FOR PARKS AND PLAYGROUNDS

Map Symbol	Soil Potential	Limitations
6pA	fair	slow permeability, silt loam surface layer
33p	poor	flooding, steep slopes, wet
31	poor	flooding, steep slopes
6tB	good	1-3% slopes
6tC	good	3-5% slopes
25	poor	8-30% slopes, less than 20 inches to sandstone
20tBD	poor	1-8% slopes, 15 to 40 inches to sandstone
5pA	poor	very slowly permeable, silt loam surface layer, droughty in summer
5pB	fair	very slowly permeable, silt loam surface layer
20C		
Lucien	poor	20 inches to sandstone, 3-5% slopes
Vernon	poor	20 inches to claybed, 5-12% slopes, clay loam surface layer
3	poor	flooding, seasonal wetness, droughty in summer, very slow permeability, clay surface horizon
6nB	good	moderate permeability, 1-3% slopes
6nC	fair	3-5% slopes
4p	poor	flooding, seasonal wetness, clay loam surface layer
9p	fair	flooding, seasonal wetness
90A	fair	flooding, seasonal wetness

TABLE IX (CONTINUED)

Map Symbol	Soil Potential	Limitations
5rB	fair	silt loam surface layer, 1-3% slopes, very slow permeability
5rC	fair	silt loam surface layer, 3-5% slopes, very slow permeability
5rBC3	fair	silt loam surface, 2-6% slopes. very slow permeability
5rCD4	fair	silt loam surface, 2-6% slopes, very slow permeability
28	poor	steep slopes, rock outcrops
70C	good	3-5% slopes
7C	good	3-5% slopes
7BC3	good	1-5% slopes
17C	poor	3-5% slopes, very slow permeability, 20 inches to claybed, clay loam surface layer
6rB	good	1-3% slopes
6rC	fair	3-5% slopes
6rC3	fair	3-8% slopes
6rCD4	fair	3-8% slopes
6ϕB	poor	seasonal wetness, slow permeability, droughty in summer
6ϕC3	poor	seasonal wetness, slow permeability, droughty in summer, 3-5% slopes

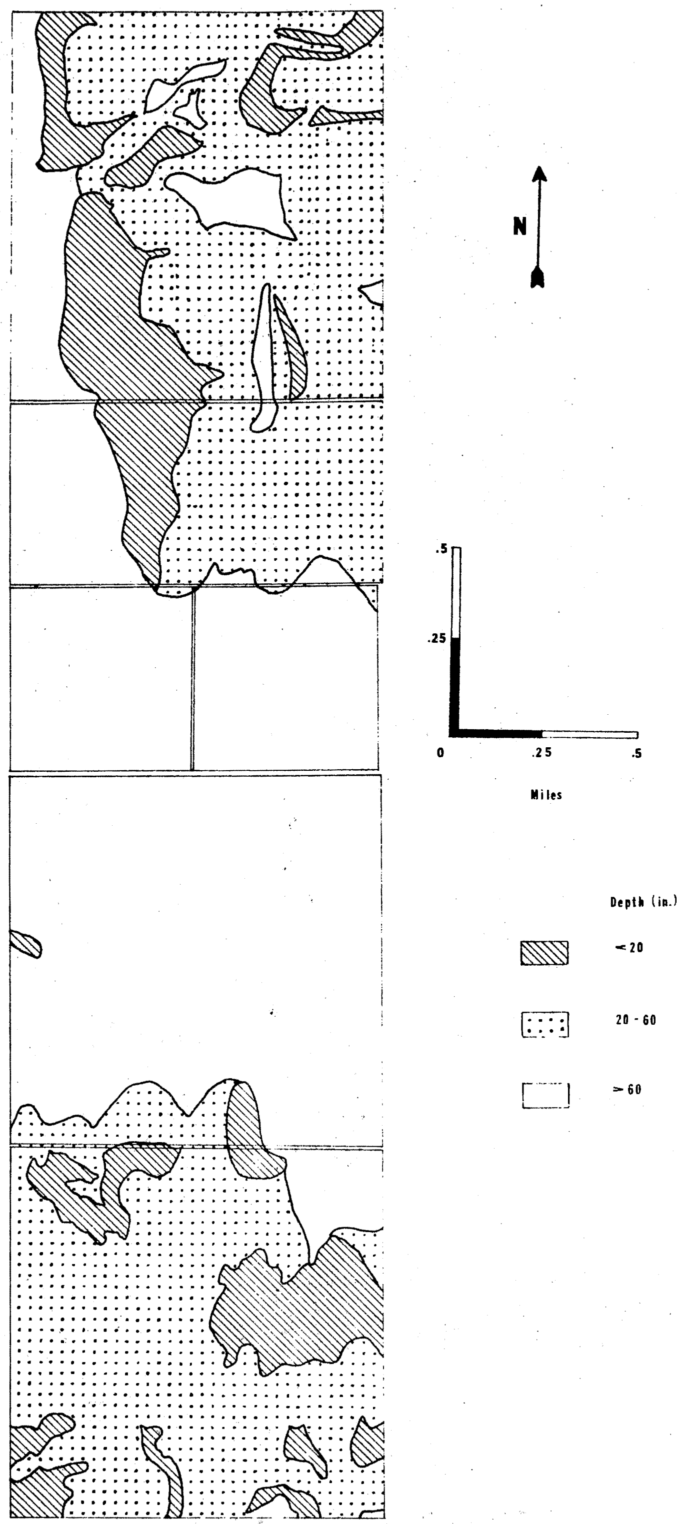


Figure 13. Soil Factor Map for Depth to Bedrock.

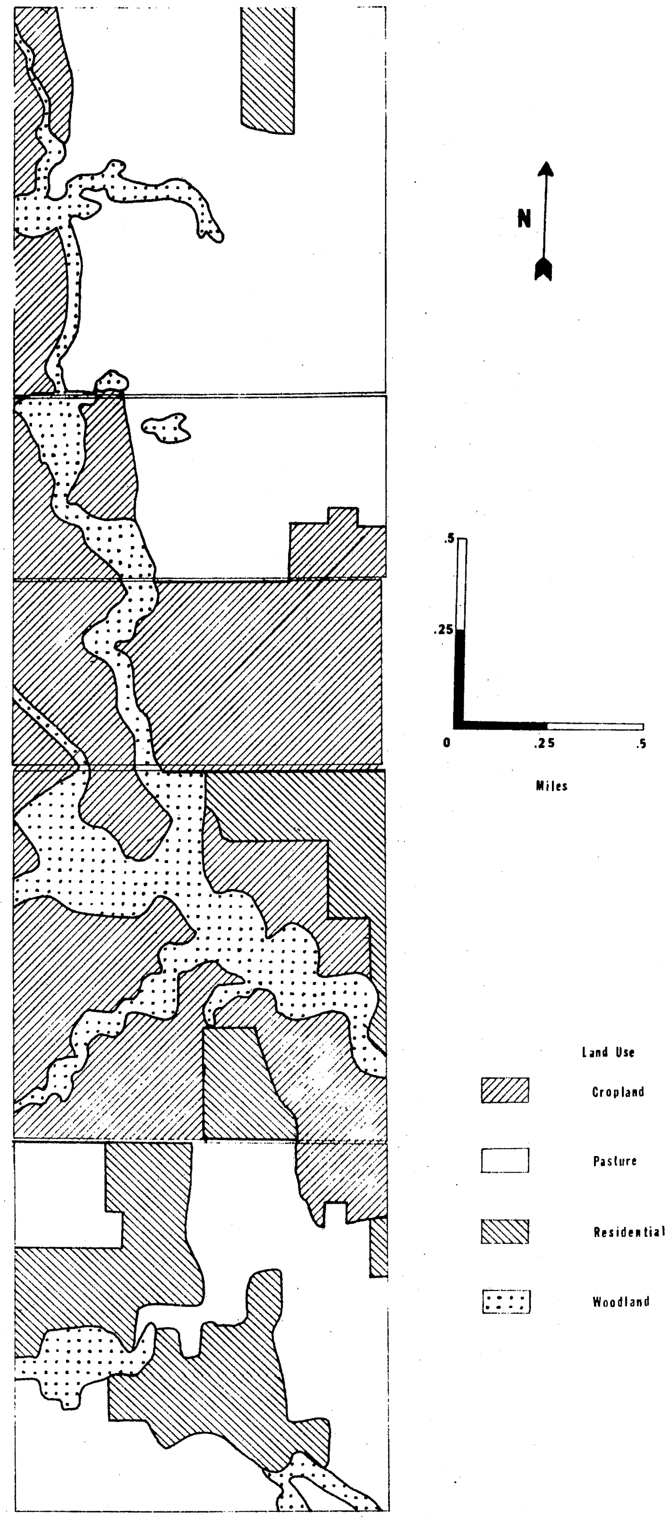


Figure 14. Present Land Use Map.

Transparent Overlays

The material presented so far gives the planner, the land developer, and the citizen interpretations which indicate soil suitability for individual uses. Although this may be useful in making many decisions, the planner and land developer need to get an overall picture which combines all or several of the uses discussed. To obtain this view the soil potential maps are converted into color transparencies. The soils map colored according to the soil potential for cultivation, serves as a base for the overlays. The planner can see the land valuable for farming in relation to the land most suitable for urban development on one map. This should assist the planner in making wise land use decisions. (The transparencies are located in the pocket found on the back cover).

Combining the transparencies of dwellings without basements, local roads and streets, and sewage lagoons, the developer can rate possible sites in the Stillwater area for this type of subdivision. In the study area this combination shows that sizable acreage composed of Zaneis (6rB, 6rC, 6rC3), Norge (6rB, 6nC3), Teller (7C, 7BC3), and Chickasha (6tB) have good soil potential for all three uses. In addition many acres of land have two good and one fair soil potential. Various other combinations of good, fair, and poor potentials occur. The choice of the more suitable sites for development and prior knowledge of the soil conditions combine to give a logical planning and construction guide.

The combination of dwellings without basements, local roads and streets and septic tank absorption fields shows that small acreage composed of Stephenville (7OC), Teller (7C, 7BC3), and Chickasha

(6tB, 6tC) have good soil potentials for all three uses. Many acres have two poor potentials out of three. This strongly indicates the relative poor suitability for such a development.

Although this thesis covers only four sections of land in Stillwater, the tables of interpretations allow potential maps of the entire Stillwater area to be made. All the desirable interpretations are not made in the thesis, but the soil descriptions in Chapter IV, the table of soil properties in Appendix A, the table of engineering data in Appendix B, and the physical and chemical data in Appendix C should supply the soils information needed to make sound interpretations.

CHAPTER V

SUMMARY AND CONCLUSIONS

The utility of soil information in local and regional planning is well documented. Soil interpretations give the planner a means to identify prime agricultural land and areas more suitable for specific urban uses. The soils data combined with the economic and social demands take into consideration the key factors for good land use. The agricultural interpretations for cultivation, predicted yield and range sites with septic tank absorption field, sewage lagoon, small dwellings with and without basements, local roads and streets, and parks and playground interpretations accord the planner and land developer a solid foundation for using soils information in their work.

The occurrence of highly interbedded sandstones and claystones promotes the formation of many atypical soils in the Stillwater area. Instead of a soil being developed in a sandstone or a claystone, some soils are developed partially in sandstone and partially in claystones. A soil with a sandy textured surface with a clay subsoil will have interpretative values very different from a soil developed completely in sandstone. This is particularly a problem, when a soil developed from two parent materials is mapped as a soil developed from one. One must keep in mind the possibility of having an inclusion of soil that has interpretations vastly different from the typical soil within a single mapping unit. This fact alone points out the need for an on-site investigation before a final decision is reached or construction begins. The problem of soil variation within mapping units does not undermine the effectiveness of soil potentials as a tool for planning and locating the most suitable areas for development. The typical soil remains the dominant soil type within the mapping unit.

Transparent overlays appear to be an effective means of seeing the soil potentials for several uses in relation to one another and identifying prime agricultural land versus the best land for urban development. The economic and social demands remain as the final factors in developing the definition of true soil potential, as defined by Johnson and Bartelli (8). These factors can only be properly evaluated by the planner, when he incorporates the soils information into the comprehensive plan.

The opportunity now exists for the planners and developers of Stillwater to make a positive contribution in the city's future growth. Preparation of interpretive maps and transparent overlays of the entire Stillwater area would significantly alter the growth of the city in a positive way, making the community a better place to live.

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APPENDIX A

IMPORTANT SOIL PROPERTIES

TABLE X

TABLE OF IMPORTANT SOIL PROPERTIES

Soil Type	Soil Symbol	Slope	Depth to Bedrock (inches)	Permeability (inches/hour)	Drainage Class	Shrink Swell Potential	Unified Soil Classification	Flooding
Bethany	6pA	0-1	> 60	.06-.2	well drained	Moderate	CH	None
Darnell	25	1-8	16	2.0-6.3	somewhat excessively drained	Slight	SM	None
Chickasha	6tB	1-3	50	.63-2.0	well drained	Moderate	CL	None
	6tC	3-5	50	.63-2.0	well drained	Moderate	CL	None
Kirkland	5pA	0-1	50	< .50	well drained	High	CH	None
	5pB	1-3	50	< .50	well drained	High	CH	None
Miller	3	0-1	> 72	< .06	poorly drained	High	CH	Rare
Norge	6nB	1-3	> 60	.06-.2	well drained	Moderate	ML, CL	None
	6nC	3-5	> 60	.06-.2	well drained	Moderate	ML, CL	None
	$6nD_3$	4-6	> 60	.06-.2	well drained	Moderate	ML, CL	None
Port	4p	0-1	> 72	.05-.2	well drained	Moderate	CL - ML	Occasional

TABLE X (CONTINUED)

Soil Type	Soil Symbol	Slope	Depth to Bedrock (inches)	Permeability (inches/hour)	Drainage Class	Shrink Swell Potential	Unified Soil Classification	Flooding
	9p	0-1	>72	.6-2.0	well drained	Slight	CL, ML	Occasional
Pulaski	90A	0-1	>72	2.0-6.3	well drained	Slight	SM	Occasional to Frequent
Renfrow	5rB	1-3	50	<.50	well drained	High	CH	None
	5rC	3-5	50	<.50	well drained	High	CH	None
	5rCD4	2-6	50	<.50	well drained	High	CH	None
Renfrow-Kirkland Complex	5rBC3	2-6						
Renfrow			50	<.05	well drained	High	CH	None
Kirkland			50	<.05	well drained	High	CH	None
Stephenville	70C	3-5	40	.63-2.0	somewhat excessively drained	Slight	SC	None
Stephenville Darnell Complex	20tBD	1-8						

TABLE X (CONTINUED)

Soil Type	Soil Symbol	Slope	Depth to Bedrock (inches)	Permeability (inches/hour)	Drainage Class	Shrink Swell Potential	Unified Soil Classification	Flooding
Stephenville			40	.63-2.0	somewhat excessively drained	Slight	SC	None
Darnell			15	2.0-6.3	somewhat excessively drained	Slight	SM	None
Teller	$7BC_3$	1-5	>60	.6-2.0	well drained	Moderate	CL	None
	7C	3-5	>60	.6-2.0	well drained	Moderate	CL	None
Vernon	17C	3-5	15	<.06	somewhat excessively drained	High	CH	None
	17DE	5-12	15	<.06	somewhat excessively drained	High	CH	None
Vernon-Lucien Complex	20C	3-5						

TABLE X (CONTINUED)

Soil Type	Soil Symbol	Slope	Depth to Bedrock (inches)	Permeability (inches/hour)	Drainage Class	Shrink Swell Potential	Unified Soil Classification	Flooding
Vernon			15	<.06	somewhat excessively drained	High	CH	None
Lucien			15	.63-2.0	somewhat excessively drained	Slight	SM	None
Vernon-Lucien Complex	20DE	5-12						
Vernon			10	<.06	somewhat excessively drained	High	CH	None
Lucien			12	.63-20	somewhat excessively drained	Slight	SM	None
Zaneis	6rB	1-3	50	.2-.8	well drained	Moderate	CL	None
	6rC, $6rC_3$	3-5	45	.2-.8	well drained	Moderate	CL	None
Zaneis-Slickspot Complex	6ϕB	1-3						

TABLE X (CONTINUED)

Soil Type	Soil Symbol	Slope	Depth to Bedrock (inches)	Permeability (inches/hour	Drainage Class	Shrink Swell Potential	Unified Soil Classification	Flooding
	6φC	3-5						
Zaneis			50	.2-.8	well drained	Moderate	CL	None
Slickspot			50	<.06	poorly drained	High	CH	None

APPENDIX B

ENGINEERING TEST DATA

TABLE XI

TABLE OF ENGINEERING TEST DATA

Soil Series & Horizons		AASHO Class.	Sieve Analysis % Passing No. 10	No. 40	No. 60	No. 200	Liquid Limit	Plasticity Index	Shrinkage Limit	Shrinkage Ratio	Volumetric Change	Potential Vertical Change
Bethany	A	A-4	100	98	89	71	22	4	-	-	-	-
	B	A-6	100	99	89	74	38	8	10	2.01	48	-
	C	A-6	100	99	84	61	30	12	12	1.93	31	-
Chickasha	A	A-4	100	99	99	50	26	6	-	-	-	-
	B	A-4	100	100	100	54	28	9	-	-	-	-
	C	A-6	100	100	100	64	35	16	14	1.86	22	-
Darnell	A	A-4	100	100	99	66	24	3	-	-	-	-
Kirkland	A	A-4	100	100	98	81	29	9	17	1.78	28	-
	B	A-7	100	100	100	88	51	26	10	2.02	44	.39
Lucien	A	A-4	100	99	95	51	25	5	17	1.78	8	-
	AC	A-4	100	100	99	64	26	6	17	1.78	7	-
	C	A-4	100	99	99	41	22	2	17	1.78	11	-
Miller	A	A-6	100	100	99	93	33	12	13	1.85	29	-
	AC	A-7	100	100	100	96	44	19	10	2.00	56	.15
	C	A-6	100	100	100	96	38	18	9	2.06	43	-

TABLE XI (CONTINUED)

Soil Series & Horizons		AASHO Class.	Sieve Analysis % Passing No. 10	No. 40	No. 60	No. 200	Liquid Limit	Plasticity Index	Shrinkage Limit	Shrinkage Ratio	Volumetric Change	Potential Vertical Change
Norge	A	A-4	100	100	99	82	35	9	19	1.71	17	-
	B	A-6	100	100	99	82	39	19	13	1.90	42	-
	C	A-6	100	100	99	73	36	18	14	1.87	36	-
Port	A	A-4	100	100	99	81	26	7	16	1.77	20	-
	C	A-4	100	100	99	52	NP	NP	-	-	-	-
Pulaski	A	A-4	100	98	86	40	NP	NP	-	-	-	-
	C	A-4	100	99	93	45	21	5	-	-	-	-
Renfrow	A	A-4	100	99	98	79	28	5	-	-	-	-
	B	A-7	100	99	98	85	50	25	9	2.03	65	.36
	C	A-7	100	98	97	82	42	21	11	2.01	47	.21
Stephen-ville	A	A-4	100	99	68	55	28	5	-	-	-	-
	B	A-6	100	100	99	80	36	15	13	1.88	36	-
	C	A-6	100	100	100	81	28	11	13	1.90	23	-
Teller	A	A-4	100	99	81	45	NP	NP	-	-	-	-
	B	A-6	100	98	88	53	29	12	13	1.88	29	-
	C	A-6	100	98	95	69	32	12	17	1.76	24	-

TABLE XI (CONTINUED)

Soil Series & Horizons		AASHO Class.	Sieve Analysis % Passing No. 10	No. 40	No. 60	No. 200	Liquid Limit	Plasticity Index	Shrinkage Limit	Shrinkage Ratio	Volumetric Change	Potential Vertical Change
Vernon	A	A-7	100	99	99	93	41	19	11	1.99	49	.15
	C	A-7	100	99	99	93	62	31	18	1.77	54	.63
Zaneis	A	A-6	100	99	98	73	36	12	17	1.75	34	-
	B	A-7	100	100	99	85	46	21	12	1.94	61	.21
	C	A-6	100	100	99	85	39	19	15	1.83	32	.15

APPENDIX C

PHYSICAL AND CHEMICAL SOIL CHARACTERIZATION DATA WITH SOILS ARRANGED ALPHABETICALLY

FIELD SOIL PHASE: BETHANY SILT LOAM
LOCATION: 1000' SE OF NW CORNER OF THE SE 1/4 OF SEC. 16-T19N-R2E, NEAR WEATHER STATION, AGRONOMY FARM, STILLWATER, PAYNE COUNTY, OKLAHOMA.
SAMPLERS: DALE ROGERS & EDWARD OITSCHE DATE: 12-19-68

PROFILE DESCRIPTION:

SAMPLE NUMBER	HORIZON	DEPTH (CM.)	THICKNESS (CM.)	COLOR (M)	TEXTURE	STRUCTURE	CONSISTENCE	MOTTLED COLORS
68-OK-60- 3- 1	AP	0- 18	18	10.0YR 2/2	SIL	1GR	DH,MFR	
68-OK-60- 3- 2	B1	18- 30	12	10.0YR 3/2	SICL	1SBK	DH,MFI	
68-OK-60- 3- 3	B21T	30- 51	21	10.0YR 3/2	C	2SBK	DVH,MFI	
68-OK-60- 3- 4	B22T	51- 71	20	10.0YR 3/2	C	2BK	DVH,MVFI	
68-OK-60- 3- 5	B23T	71- 94	23	10.0YR 3/2	SIL	2BK	DH,MFI	
68-OK-60- 3- 6	B3	94-124	30	2.5YR 3/6	C	1SBK	DH,MFI	
68-OK-60- 3- 7	C	124-127	3	10.0YR 3/6				

CHEMICAL DATA: ANALYST: D. BAKHTAR & D. ROGERS

SAMPLE NUMBER	PH1:1		CEC	EXCHANGEABLE CATIONS, MEQ/100 GMS						%BASE SATURATION		%	P.P.M.
	H2O	KCL		H	CA	MG	K	NA	AL	NAAC	SUM OF CAT.	OM	TOTAL P
68-OK-60- 3- 1	6.3	5.5	17.9	2.60	10.60	3.10	1.80	0.10	0.00	87.1	85.7	2.20	349.0
68-OK-60- 3- 2	5.7	4.9	26.1	4.90	14.10	5.30	1.70	0.10	0.00	93.4	81.2	2.40	246.0
68-OK-60- 3- 3	6.0	5.0	29.4	5.70	18.20	6.90	2.10	0.10	0.00	92.8	82.7	1.90	182.0
68-OK-60- 3- 4	6.1	5.2	36.4	5.40	19.20	6.10	2.30	0.20	0.00	76.3	83.7	1.30	142.0
68-OK-60- 3- 5	6.3	5.2	26.0	3.50	12.10	7.50	0.40	0.10	0.00	77.3	85.2	0.80	105.0
68-OK-60- 3- 6	6.5	5.3	17.4	2.40	10.70	4.90	0.40	0.20	0.00	93.1	87.1	0.50	121.0
68-OK-60- 3- 7	6.6	5.4	15.2	3.00	9.80	5.30	0.40	0.20	0.00	96.9	84.0	0.30	127.0

PHYSICAL DATA: ANALYST: D. BAKHTAR & D. ROGERS

SAMPLE NUMBER	%SAND	%SILT	%CLAY	TEXTURE	%>2MM	SAND SUBFRACTIONS				
						%VCS	%CS	%MS	%FS	%VFS
68-OK-60- 3- 1	21.8	54.5	23.7	SIL	N A	NA	NA	NA	NA	NA
68-OK-60- 3- 2	16.6	47.7	35.7	SICL	N A	NA	NA	NA	NA	NA
68-OK-60- 3- 3	12.1	39.2	48.7	C	N A	NA	NA	NA	NA	NA
68-OK-60- 3- 4	10.8	39.7	49.5	C	N A	NA	NA	NA	NA	NA
68-OK-60- 3- 5	25.9	37.6	26.8	L	N A	NA	NA	NA	NA	NA
68-OK-60- 3- 6	29.3	24.6	46.1	C	N A	NA	NA	NA	NA	NA
68-OK-60- 3- 7	29.8	30.6	39.6	CL	N A	NA	NA	NA	NA	NA

FIELD SOIL TYPE: CHICKASHA LOAM
LOCATION: 2575' E AND 500' S OF THE NW CORNER OF SEC. 16.T.19N,R2E.
PAYNE COUNTY, OKLAHOMA.
SAMPLER: WILSON & GRAY DATE: 4-25-73

PROFILE DESCRIPTION:

SAMPLE NUMBER	HORIZON	DEPTH (CM.)	THICKNESS (CM.)	COLOR (M)	TEXTURE	STRUCTURE	CONSISTENCE	MOTTLED COLORS
73-OK-60- 1- 1	AP	0- 23	23	7.5YR2/3	L	1FSBK-GR	DH,MFR	
73-OK-60- 1- 2	B1	23- 51	28	7.5YR3/3	SIL	FSBK	DH,MFR	
73-OK-60- 1- 3	B21T	51- 69	18	7.5YR3/4	SICL	2FSBK	DH,MFI	
73-OK-60- 1- 4	B22T	69- 97	28	5.0YR4/6	C	2MSBK	DVH,MFI	
73-OK-60- 1- 5	B3	97-135	38	5.0YR5/8	C	1CSBK		
73-OK-60- 1- 6	C	135-140	5	2.5YR3/4	SS	M	DVH,MEFI	

CHEMICAL DATA: ANALYST: WILSON

SAMPLE NUMBER	PH1:1 H2O	PH1:1 KCL	CEC	EXCHANGEABLE CATIONS,MEQ/100 GMS H	CA	MG	K	NA	AL	%BASE SATURATION NAAC	SUM OF CAT.	% OM	P.P.M. TOTAL P
73-OK-60- 1- 1	6.2	5.6	15.0	4.68	5.33	2.52	0.46	0.19	0.00	56.8	64.5	2.29	209.4
73-OK-60- 1- 2	6.1	4.9	17.2	4.91	6.72	4.37	0.31	0.17	0.00	67.2	70.2	1.99	174.7
73-OK-60- 1- 3	6.2	5.0	23.5	5.18	9.53	7.52	0.25	0.22	0.00	74.6	77.2	1.35	157.8
73-OK-60- 1- 4	6.3	5.3	18.6	4.07	7.52	6.80	0.26	0.20	0.00	79.4	78.4	0.52	107.2
73-OK-60- 1- 5	6.4	5.5	17.2	2.96	6.72	6.13	0.20	0.31	0.00	77.6	81.9	0.24	90.3
73-OK-60- 1- 6	7.1	5.6	8.6	0.32	3.61	2.77	0.09	0.41	0.00	79.9	95.6	0.07	137.0

PHYSICAL DATA: ANALYST: WILSON

SAMPLE NUMBER	%SAND	%SILT	%CLAY	TEXTURE	%>2MM	SAND SUBFRACTIONS %VCS	%CS	%MS	%FS	%VFS	SILT SUBFRACTIONS %CSI	%MSI	%FSI
73-OK-60- 1- 1	37.6	45.1	17.3	L	0.0	0.1	0.1	0.2	17.6	19.6	29.9	11.8	29.9
73-OK-60- 1- 2	34.4	40.4	25.2	L	0.0	0.1	0.1	0.4	19.0	14.8	29.9	7.8	29.9
73-OK-60- 1- 3	31.2	32.7	36.1	CL	0.0	0.1	0.1	0.1	18.2	12.8	19.9	12.0	19.9
73-OK-60- 1- 4	37.8	29.4	32.8	CL	0.0	0.1	0.2	0.3	24.2	13.1	17.8	10.1	17.8
73-OK-60- 1- 5	42.3	28.1	29.6	CL	0.0	0.1	0.2	0.3	23.9	17.8	20.1	5.9	20.1
73-OK-60- 1- 6	63.4	22.4	14.1	SL	0.0	0.1	0.1	0.1	29.7	33.4	13.3	5.4	13.3

FIELD SOIL TYPE: KIRKLAND CLAY LOAM
LOCATION: 1600' NW OS THE SW CORNER OF THE SE 1/4 OF SEC. 16-T19N-R2E,
AGRONOMY FARM, PAYNE COUNTY, STILLWATER, OKLAHOMA.
SAMPLER: ROGERS & BITSCHE DATE: 12/20/68

PROFILE DESCRIPTION:

SAMPLE NUMBER	HORIZON	DEPTH (CM.)	THICKNESS (CM.)	COLOR (M)	TEXTURE	STRUCTURE	CONSISTENCE	MOTTLED COLORS
68-OK-60- 4- 1	AP	0- 15	15	10.0YR 3/2	CL	1GR	DH,MFR	
68-OK-60- 4- 2	B22T	15- 48	33	10.0YR 3/2	SICL	2BK	DVH,MVFI	
68-OK-60- 4- 3	B23T	48- 76	28	10.0YR 4/3	CL	2BK	DVH,MVFI	
68-OK-60- 4- 4	B24T	76- 97	21	7.5YR 5/4	CL	2BK	DVH,MVFI	
68-OK-60- 4- 5	B25T	97-122	25	5.0YR 4/6	L	2BK	DVH,MFI	
68-OK-60- 4- 6	B3	122-145	23	10.0YR 5/1	CL	1BK	DVH,MFI	
68-OK-60- 4- 7	C	145-150	5	10.0YR 4/6	CL			

CHEMICAL DATA: ANALYST: D. BAKHTAR & D. ROGERS

SAMPLE NUMBER	PH1:1 H2O	PH1:1 KCL	CEC	EXCHANGEABLE CATIONS,MEQ/100 GMS H	CA	MG	K	NA	AL	%BASE SATURATION NAAC	SUM OF CAT.	% OM	P.P.M. TOTAL P
68-OK-60- 4- 1	5.3	4.2	14.4	5.10	9.80	3.90	0.30	0.50	0.00	100.0	74.0	2.40	246.0
68-OK-60- 4- 2	6.7	5.5	27.8	1.80	17.30	4.40	0.40	2.10	0.00	87.0	93.1	1.60	152.0
68-OK-60- 4- 3	7.8	6.7	28.6	0.00	18.10	9.10	0.30	2.40	0.00	104.5	100.0	0.90	102.0
68-OK-60- 4- 4	7.9	6.8	28.2	0.00	17.50	8.10	0.30	4.00	0.00	106.0	100.0	0.60	96.0
68-OK-60- 4- 5	7.7	6.7	26.6	0.00	10.50	6.20	0.30	3.30	0.00	76.3	100.0	0.40	78.0
68-OK-60- 4- 6	7.6	6.5	21.2	1.00	13.30	7.40	0.30	4.30	0.00	119.3	96.2	0.30	38.0
68-OK-60- 4- 7	7.5	6.6	21.9	1.50	10.80	6.10	0.30	4.20	0.00	97.7	93.4	0.20	89.0

PHYSICAL DATA: ANALYST: D. BAKHTAR & D. ROGERS

SAMPLE NUMBER	%SAND	%SILT	%CLAY	TEXTURE	%>2MM	SAND SUBFRACTIONS %VCS	%CS	%MS	%FS	%VFS
68-OK-60- 4- 1	27.2	48.5	24.3	L	N A	NA	NA	NA	NA	NA
68-OK-60- 4- 2	14.6	38.2	47.2	C	N A	NA	NA	NA	NA	NA
68-OK-60- 4- 3	22.5	32.2	45.3	C	N A	NA	NA	NA	NA	NA
68-OK-60- 4- 4	27.5	36.1	36.3	CL	N A	NA	NA	NA	NA	NA
68-OK-60- 4- 5	30.6	34.6	34.8	CL	N A	NA	NA	NA	NA	NA
68-OK-60- 4- 6	42.5	28.1	29.4	CL	N A	NA	NA	NA	NA	NA
68-OK-60- 4- 7	32.8	33.3	33.9	CL	N A	NA	NA	NA	NA	NA

FIELD SOIL TYPE: LUCIEN
LOCATION: 2170' EAST AND 330' SOUTH OF THE NW CORNER OF SEC. 16, T19N,
R2E, STILLWATER, PAYNE COUNTY, OKLAHOMA.
SAMPLERS: GRAY AND WILSON DATE: 4-25-73

PROFILE DESCRIPTION:

SAMPLE NUMBER	HORIZON	DEPTH (CM.)	THICKNESS (CM.)	COLOR (M)	TEXTURE	STRUCTURE	CONSISTENCE	MOTTLED COLORS
73-OK-60- 2- 1	AP	0- 13	13	5.0YR3/3	SL	1FSBK-GR	DS,MFR	
73-OK-60- 2- 2	B	13- 41	28	5.0YR3/4	SL	1FSBK	DS,MFR	
73-OK-60- 2- 3	C	41- 46	5	2.5YR3/4	SS			

CHEMICAL DATA: ANALYST: WILSON

SAMPLE NUMBER	PH1:1 H2O	PH1:1 KCL	CEC	EXCHANGEABLE CATIONS,MEQ/100 GMS H	CA	MG	K	NA	AL	%BASE SATURATION NAAC	SUM OF CAT.	% OM	P.P.M. TOTAL P
73-OK-60- 2- 1	6.3	5.5	12.8	4.00	4.53	1.78	0.38	0.08	0.00	52.9	62.9	3.03	79.0
73-OK-60- 2- 2	6.5	5.4	11.8	3.44	4.57	2.51	0.15	0.08	0.00	61.8	68.0	1.31	74.0
73-OK-60- 2- 3	6.7	5.5	6.0	0.69	2.30	1.74	0.05	0.04	0.00	68.9	85.7	0.09	36.0

PHYSICAL DATA: ANALYST: WILSON

SAMPLE NUMBER	%SAND	%SILT	%CLAY	TEXTURE	%>2MM	SAND SUBFRACTIONS %VCS	%CS	%MS	%FS	%VFS	SILT SUBFRACTIONS %CSI	%MSI	%FSI
73-OK-60- 2- 1	57.9	23.4	18.7	SL	0.0	0.1	0.1	0.5	46.2	11.0	15.6	4.0	15.6
73-OK-60- 2- 2	54.8	25.2	20.0	SCL	0.0	0.1	0.2	0.4	44.0	10.0	16.3	7.4	16.3
73-OK-60- 2- 3	N A	N A	N A		N A	NA	NA	NA	NA	10.0	NA	NA	NA

FIELD SOIL PHASE: NORGE LOAM
LOCATION: 600' SE OF THE NW CORNER OF THE SE 1/4 OF SEC. 16-T19N-R2E.
AGRONOMY FARM, STILLWATER, PAYNE COUNTY.
SAMPLERS: DALE ROGERS & EDWARD BITSCHE DATE 12-17-68

PROFILE DESCRIPTION:

SAMPLE NUMBER	HORIZON	DEPTH (CM.)	THICKNESS (CM.)	COLOR (M)	TEXTURE	STRUCTURE	CONSISTENCE	MOTTLED COLORS
68-OK-60- 2- 1	AP	0- 18	18	7.5YR 3/2	L	2GR	DH,MFR	
68-OK-60- 2- 2	B1	18- 28	10	7.5YR 4/2	CL	1BK	DH,MFR	
68-OK-60- 2- 3	B21T	28- 43	15	5.0YR 3/6	C	2BK	DH,MFR	
68-OK-60- 2- 4	B22T	43- 64	21	2.5YR 3/6	C	2BK	DVH,MFI	
68-OK-60- 2- 5	B23	64- 89	25	10.0YR 6/2	C	2BK	DVH,MVFE	
68-OK-60- 2- 6	IIC1	89-114	25	5.0YR 6/1	CL	2BK	DVH,MVFI	
68-OK-60- 2- 7	IIC2	114-132	18	10.0YR 5/8	CL	2BK	DVH,MVFI	
68-OK-60- 2- 8	IIC3	132-142	10	5.0YR 6/2	CL	2BK	DVH,MVFE	
68-OK-60- 2- 9	IIC4	142-221	79	5.0YR 7/2	SICL	2BK	DVH,MVFI	
68-OK-60- 2-10	IIIC	221-411	190	5.0YR 6/4	SIL	1BK	DVH,MVFI	
68-OK-60- 2-11	IVC	411-414	3	10.0YR 4/6		M	DH,MFR	

CHEMICAL DATA: ANALYST: BAKTAR & ROGERS

	PH1:1			EXCHANGEABLE CATIONS,MEQ/100 GMS						%BASE SATURATION		%	P.P.M.
SAMPLE NUMBER	H2O	KCL	CEC	H	CA	MG	K	NA	AL	NAAC	SUM OF CAT.	OM	TOTAL P
68-OK-60- 2- 1	6.1	5.0	11.4	3.70	6.70	3.20	0.20	0.10	0.10	89.4	72.9	2.20	134.0
68-OK-60- 2- 2	5.6	4.6	15.7	4.90	7.00	3.40	0.20	0.10	0.10	68.1	68.2	2.10	229.0
68-OK-60- 2- 3	5.6	4.8	24.4	4.90	11.30	7.80	0.40	0.10	0.10	80.3	79.7	1.60	154.0
68-OK-60- 2- 4	5.8	5.2	21.9	3.70	13.30	6.30	0.40	0.10	0.00	91.7	84.5	1.10	83.0
68-OK-60- 2- 5	7.3	6.8	24.0	0.00	28.60	6.70	0.40	0.10	0.00	149.1	100.0	0.50	74.0
68-OK-60- 2- 6	7.6	6.9	26.1	0.50	25.30	6.20	0.40	0.10	0.00	122.6	98.5	0.30	55.0
68-OK-60- 2- 7	7.5	6.5	23.3	0.00	17.20	9.00	0.40	0.20	0.00	115.0	100.0	0.20	48.0
68-OK-60- 2- 8	7.7	7.1	26.8	0.00	18.70	8.00	0.30	0.20	0.00	101.3	100.0	0.10	230.0
68-OK-60- 2- 9	7.6	6.6	28.8	1.50	10.70	6.20	3.60	0.50	0.00	72.9	93.3	0.20	46.0
68-OK-60- 2-10	7.6	6.4	9.3	0.00	5.80	7.10	0.20	0.40	0.00	145.1	100.0	0.00	23.0
68-OK-60- 2-11	7.3	6.2	18.2	1.50	9.20	4.50	0.20	0.20	0.00	77.4	90.4	0.00	29.0

PHYSICAL DATA: ANALYST: BAKTAR & ROGERS

						SAND SUBFRACTIONS				
SAMPLE NUMBER	%SAND	%SILT	%CLAY	TEXTURE	%>2 MM	%VCS	%CS	%MS	%FS	%VFS
68-OK-60- 2- 1	47.8	37.2	15.0	L	N A	NA	NA	NA	NA	NA
68-OK-60- 2- 2	36.5	39.8	23.7	L	N A	NA	NA	NA	NA	NA
68-OK-60- 2- 3	21.3	40.6	38.1	CL	N A	NA	NA	NA	NA	NA
68-OK-60- 2- 4	17.7	45.5	36.8	SICL	N A	NA	NA	NA	NA	NA
68-OK-60- 2- 5	17.8	39.8	42.4	C	N A	NA	NA	NA	NA	NA
68-OK-60- 2- 6	21.0	40.6	38.4	CL	N A	NA	NA	NA	NA	NA
68-OK-60- 2- 7	22.4	40.7	36.9	CL	N A	NA	NA	NA	NA	NA
68-OK-60- 2- 8	20.8	45.8	33.4	CL	N A	NA	NA	NA	NA	NA
68-OK-60- 2- 9	11.8	53.4	34.8	SICL	N A	NA	NA	NA	NA	NA
68-OK-60- 2-10	49.0	32.5	18.5	L	N A	NA	NA	NA	NA	NA
68-OK-60- 2-11	15.8	50.9	33.3	SICL	N A	NA	NA	NA	NA	NA

FIELD SOIL TYPE: MILLEP LIKE
LOCATION: 50' W AND 50' N OF THE SE CORNER OF SEC21, T19N, R2E,
PAYNE COUNTY, OKLAHOMA
SAMPLERS: PESCHEL AND DOUTHIT

PROFILE DESCRIPTION:

SAMPLE NUMBER	HORIZON	DEPTH (CM.)	THICKNESS (CM.)	COLOR (M)	TEXTURE	STRUCTURE	CONSISTENCE	MOTTLED COLORS
75-OK-60- 3- 1	AP	0- 25	25	5. YR4/4	C	2MSBK	DVH,MVFI	
75-OK-60- 3- 2	A1	25- 48	23	5. YR4/3	C	2MSBK	DVH,MVFI	
75-OK-60- 3- 3	AC	48- 79	31	2.5YR4/4	C	M	DVH,MVFI	
75-OK-60- 3- 4	C	79-109	30	2.5YR3/6	C	M	DVH,MVFI	

CHEMICAL DATA: ANALYST: PESCHEL

	2H1:1			EXCHANGEABLE CATIONS,MEQ/100 GMS						%BASE SATURATION		%	P.P.M.
SAMPLE NUMBER	H2O	KCL	CEC	H	CA	MG	K	NA	AL	NAAC	SUM OF CAT.	OM	TOTAL P
75-OK-60- 3- 1	7.6	6.6	26.3	1.71	11.28	8.31	0.36	0.23	0.00	76.8	92.2	2.90	280.8
75-OK-60- 3- 2	7.8	6.4	28.5	0.85	8.44	11.28	0.23	0.59	0.00	72.0	96.0	1.90	181.6
75-OK-60- 3- 3	7.9	6.8	23.8	0.00	17.98	12.13	0.19	0.38	0.00	100.0	100.0	1.54	166.7
75-OK-60- 3- 4	8.3	7.7	23.5	0.00	16.79	15.86	0.19	0.73	0.00	100.0	100.0	1.26	182.6

PHYSICAL DATA: ANALYST: PESCHEL

						SAND SUBFRACTIONS				
SAMPLE NUMBER	%SAND	%SILT	%CLAY	TEXTURE	%>2MM	%VCS	%CS	%MS	%FS	%VFS
75-OK-60- 3- 1	5.8	56.0	38.2	SICL	0.0	0.1	0.1	0.2	0.1	5.4
75-OK-60- 3- 2	2.9	47.1	50.0	SIC	0.0	0.1	0.1	0.1	0.5	2.2
75-OK-60- 3- 3	2.8	57.1	40.0	SIC	0.0	0.1	0.1	0.1	0.3	2.4
75-OK-60- 3- 4	2.5	58.1	39.4	SICL	0.0	0.1	0.1	0.1	0.4	1.9

FIELD SOIL TYPE: PORT CLAY LCAM
LOCATION: 420' S, 300' W FROM THE NE CORNER OF SEC. 20, T19N, R2E,
PAYNE COUNTY, OKLAHOMA.
SAMPLERS: WILSON DATE: 6-21-73

PROFILE DESCRIPTION:

SAMPLE NUMBER	HORIZON	DEPTH (CM.)	THICKNESS (CM.)	COLOR (M)	TEXTURE	STRUCTURE	CONSISTENCE	MOTTLED COLORS
73-OK-60- 7- 1	AP	0- 20	20	2.5YR3/3	CL	1BK	DH,MF	
73-OK-60- 7- 2	AC	20- 48	28	5.0YR3/6	C	1BK	DH,MF	
73-OK-60- 7- 3	C	48- 79	31	5.0YR3/6	L	M	DH,MFR	
73-OK-60- 7- 4	C2	79-112	33	5.0YR5/6	SL	M	DS,MFR	

CHEMICAL DATA: ANALYST: WILSON

	PH1:1			EXCHANGEABLE CATIONS,MEQ/100 GMS						%BASE SATURATION		%	P.P.M.
SAMPLE NUMBER	H2O	KCL	CEC	H	CA	MG	K	NA	AL	NAAC	SUM OF CAT.	OM	TOTAL P
73-OK-60- 7- 1	6.5	5.8	22.1	2.27	9.74	6.02	0.52	0.33	0.00	75.2	88.0	2.15	65.0
73-OK-60- 7- 2	6.8	6.0	18.9	0.00	8.69	5.78	0.31	0.17	0.00	79.2	100.0	0.95	42.0
73-OK-60- 7- 3	6.9	6.1	11.6	0.00	4.93	3.15	0.15	0.13	0.00	72.3	100.0	0.50	30.0
73-OK-60- 7- 4	7.0	6.2	8.7	0.00	3.11	2.06	0.10	0.13	0.00	62.1	100.0	0.29	10.0

PHYSICAL DATA: ANALYST: WILSON

						SAND SUBFRACTIONS					SILT SUBFRACTIONS		
SAMPLE NUMBER	%SAND	%SILT	%CLAY	TEXTURE	%>2MM	%VCS	%CS	%MS	%FS	%VFS	%CSI	%MSI	%FSI
73-OK-60- 7- 1	8.9	61.3	29.8	SICL	0.0	0.1	0.1	0.3	2.4	6.0	29.0	26.6	29.0
73-OK-60- 7- 2	12.2	56.1	31.6	SICL	0.0	0.1	0.1	0.1	3.2	8.7	25.6	24.6	25.6
73-OK-60- 7- 3	41.8	38.3	19.9	L	0.0	0.1	0.1	0.1	21.3	20.4	25.6	10.4	25.6
73-OK-60- 7- 4	65.2	23.3	11.5	SL	0.0	0.1	0.1	0.2	41.8	23.0	16.3	6.2	16.3

FIELD SOIL TYPE: PORT SILT LOAM
LOCATION: 1200' S AND 300' W OF THE NE CORNER OF SEC 20, T19N, R2E,
PAYNE COUNTY, OKLAHOMA
SAMPLER: DOUTHIT AND HENLEY

PROFILE DESCRIPTION:

SAMPLE NUMBER	HORIZON	DEPTH (CM.)	THICKNESS (CM.)	COLOR (M)	TEXTURE	STRUCTURE	CONSISTENCE	MOTTLED COLORS
75-CK-60- 1- 1	AP	0- 33	33	5. YR3/3	CL	1MGR	MFR	
75-OK-60- 1- 2	A12	33- 61	28	5. YR4/6	CL	1MSBK	MFR	
75-OK-60- 1- 3	A13	61- 81	20	2.5YR3/4	CL	2MPR	MFR	
75-CK-60- 1- 4	AC	81-109	28	2.5YR3/4	SICL	2MSBK	MFI	
75-OK-60- 1- 5	C	109-140	31	5. YR4/4	SIL	1FSBK	MFI	

CHEMICAL DATA: ANALYST: PESCHEL

SAMPLE NUMBER	PH1:1 H2O	PH1:1 KCL	CEC	EXCHANGEABLE CATIONS,MEQ/100 GMS H	CA	MG	K	NA	AL	%BASE SATURATION NAAC	SUM OF CAT.	% OM	P.P.M. TOTAL P
75-CK-60- 1- 1	6.1	5.2	15.4	2.27	8.90	6.26	0.44	0.11	0.00	96.0	87.4	2.09	302.6
75-CK-60- 1- 2	6.3	5.2	16.0	0.57	9.07	6.30	0.23	0.13	0.00	98.6	96.5	0.89	173.7
75-CK-60- 1- 3	6.6	5.5	21.0	0.85	10.71	7.22	0.23	0.13	0.00	87.3	95.5	0.88	158.8
75-OK-60- 1- 4	6.7	5.6	13.7	0.57	8.57	5.00	0.15	0.11	0.00	100.0	96.0	0.62	124.1
75-CK-60- 1- 5	7.9	6.9	12.0	0.00	10.46	4.41	0.15	0.09	0.00	100.0	100.0	0.59	129.0

PHYSICAL DATA: ANALYST: PESCHEL

SAMPLE NUMBER	%SAND	%SILT	%CLAY	TEXTURE	%>2MM	SAND SUBFRACTIONS %VCS	%CS	%MS	%FS	%VFS
75-OK-60- 1- 1	6.4	69.2	24.4	SIL	0.0	0.1	0.1	0.1	0.9	5.3
75-CK-60- 1- 2	5.7	68.7	25.7	SIL	0.0	0.1	0.1	0.1	0.4	5.1
75-OK-60- 1- 3	5.1	64.2	30.7	SICL	0.0	0.1	0.1	0.1	0.6	4.3
75-OK-60- 1- 4	11.4	68.0	20.7	SIL	0.0	0.1	0.1	0.1	1.9	9.3
75-CK-60- 1- 5	8.1	74.3	17.5	SIL	0.0	0.1	0.1	0.1	0.3	7.6

FIELD SOIL TYPE: PULASKI SANDY LOAM
TYPICAL LOCATION: 2430' N AND 270' E OF THE SE CORNER OF THE SE 1/4
OF SECTION 18, T19N, R2E.

PROFILE DESCRIPTION:

SAMPLE NUMBER	HORIZON	DEPTH (CM.)	THICKNESS (CM.)	COLOR (M)	TEXTURE	STRUCTURE	CONSISTENCE	MOTTLED COLORS
74-CK-60- 1- 1	AP	0- 23	23	5. YR3/4	SIL	1M-FGR	DH,MFR	
74-CK-60- 1- 2	A1	23- 33	10	5. YR3/6	SIL	2MGR	DSH,MFR	
74-OK-60- 1- 3	AC	33- 51	18	2.5YR4/4	SIL	2MGR	DSH,MFR	
74-CK-60- 1- 4	C1	51- 86	35	5. YR6/6	VFS	SG	DL,MVFR	
74-OK-60- 1- 5	C2	86-137	51	5. YR5/6	SIL	1FGR	DS,MVFR	

CHEMICAL DATA: ANALYST: PESCHEL

SAMPLE NUMBER	PH1:1 H2O	PH1:1 KCL	CEC	EXCHANGEABLE CATIONS,MEQ/100 GMS H	CA	MG	K	NA	AL	%BASE SATURATION NAAC	SUM OF CAT.	% OM	P.P.M. TOTAL P
74-CK-60- 1- 1	5.9	5.1	13.0	3.98	5.71	3.02	0.34	0.00	0.00	70.0	69.5	1.43	0.1
74-OK-60- 1- 2	6.4	5.5	7.7	1.42	3.74	1.89	0.13	0.00	0.00	75.2	80.2	0.41	0.1
74-OK-60- 1- 3	6.6	5.6	8.1	1.42	4.62	2.35	0.14	0.00	0.00	87.9	83.3	0.40	0.1
74-CK-60- 1- 4	7.2	5.8	9.6	1.71	5.17	3.11	0.19	0.01	0.00	88.5	83.2	0.28	0.1
74-OK-60- 1- 5	7.2	5.9	12.3	1.42	7.31	3.19	0.21	0.01	0.00	87.0	88.3	0.05	0.1

PHYSICAL DATA: ANALYST: PESCHEL

SAMPLE NUMBER	%SAND	%SILT	%CLAY	TEXTURE	%>2MM	SAND SUBFRACTIONS %VCS	%CS	%MS	%FS	%VFS
74-OK-60- 1- 1	40.0	42.4	17.5	L	0.0	0.1	0.1	0.1	15.8	24.0
74-CK-60- 1- 2	63.1	26.9	10.0	SL	0.0	0.1	0.1	0.6	41.3	21.1
74-CK-60- 1- 3	54.9	32.5	12.5	SL	0.0	0.1	0.1	0.1	27.2	27.5
74-CK-60- 1- 4	39.6	47.9	12.5	L	0.0	0.1	0.1	0.1	11.8	27.6
74-CK-60- 1- 5	24.0	56.0	20.0	SIL	0.0	0.1	0.1	0.1	4.5	19.3

FIELD SOIL PHASE: RENFROW
LOCATION: LAKE CARL BLACKWELL, 1074' W, 125' S OF THE NE CORNER OF
THE SW CORNER OF SEC. 3;T19N;R1W. PAYNE COUNTY, OKLAHOMA
SAMPLER: JIM FORD DATE: 3-21-72

PROFILE DESCRIPTION:

SAMPLE NUMBER	HORIZON	DEPTH (CM.)	THICKNESS (CM.)	COLOR (M)	TEXTURE	STRUCTURE	CONSISTENCE	MOTTLED COLORS
72-OK-60- 1- 1	AP	0- 18	18	5.0YR3/3	CL	3MGR	MFR	
72-OK-60- 1- 2	B21T	18- 36	18	2.5YR3/4	CL	2MSBK	MFI	
72-OK-60- 1- 3	B22T	36- 61	25	2.5YR3/4	CL	2MBK	MFI	
72-OK-60- 1- 4	B3	61- 86	25	2.5YR3/4	C	M	MVFI	
72-OK-60- 1- 5	C	86- 97	11	2.5YR3/6	C			

CHEMICAL DATA: ANALYST: BAKHTAR

SAMPLE NUMBER	PH1:1 H2O	PH1:1 KCL	CEC	EXCHANGEABLE CATIONS, MEQ/100 GMS H	CA	MG	K	NA	AL	%BASE SATURATION NAAC	SUM OF CAT.	% OM	P.P.M. TOTAL P
72-OK-60- 1- 1	8.1	7.4	12.0	0.00	19.91	0.76	0.33	0.52	0.00	100.0	100.0	1.60	7.3
72-OK-60- 1- 2	8.1	7.4	14.3	0.00	19.65	2.07	0.31	0.51	0.00	100.0	100.0	0.93	7.8
72-OK-60- 1- 3	8.2	7.2	20.4	0.00	16.72	1.83	0.26	0.47	0.00	94.5	100.0	0.43	6.4
72-OK-60- 1- 4	8.1	7.1	21.1	0.00	12.37	4.87	0.48	0.88	0.00	88.2	100.0	0.43	8.3
72-OK-60- 1- 5	8.1	7.2	19.8	0.00	12.47	6.03	0.43	0.98	0.00	100.0	100.0	0.28	8.3

PHYSICAL DATA: ANALYST: BAKHTAR

SAMPLE NUMBER	%SAND	%SILT	%CLAY	TEXTURE	%>2MM	SAND SUBFRACTIONS %VCS	%CS	%MS	%FS	%VFS
72-OK-60- 1- 1	20.7	55.5	23.8	SIL	0.0	0.1	0.2	0.3	5.3	14.7
72-OK-60- 1- 2	1.6	58.9	39.4	SICL	0.0	0.1	0.1	0.1	0.1	1.3
72-OK-60- 1- 3	10.3	55.2	34.4	SICL	0.0	0.1	0.1	0.2	0.7	9.3
72-OK-60- 1- 4	5.1	42.3	52.5	SIC	0.0	0.1	0.1	0.1	0.6	4.2
72-OK-60- 1- 5	1.0	46.2	52.8	SIC	0.0	0.1	0.1	0.1	0.2	0.5

SOIL TYPE: STEPHENVILLE SANDY LOAM
LOCATION: 400' S AND 950' W OF E 1/4 OF SEC. 17, T19N, R3E,
PAYNE COUNTY, OKLAHOMA.
SAMPLER: WILSON

PROFILE DESCRIPTION:

SAMPLE NUMBER	HORIZON	DEPTH (CM.)	THICKNESS (CM.)	COLOR (M)	TEXTURE	STRUCTURE	CONSISTENCE	MOTTLED COLORS
74-OK-60- 4- 1	AP	0- 15	15	5.0YR4/3	SL	1MGR	DS,MVFR	
74-OK-60- 4- 2	A1	15- 28	13	5.0YR4/3	SL	1MGR	DS,MVFR	
74-OK-60- 4- 3	A2	28- 51	23	5.0YR4/3	LS	SG	DL,MVFR	
74-OK-60- 4- 4	B21T	51- 69	18	2.5YR3/4	SCL	2MSBK	DSH,MFR	
74-OK-60- 4- 5	B22T	69- 94	25	2.5YR3/4	SCL	2MSBK	DSH,MFR	
74-OK-60- 4- 6	B3	94-102	8	2.5YR3/6	L	2MSBK	DH,MFR	

CHEMICAL DATA: ANALYST: ROOZITALAB

SAMPLE NUMBER	PH1:1 H2O	PH1:1 KCL	CEC	EXCHANGEABLE CATIONS, MEQ/100 GMS H	CA	MG	K	NA	AL	%BASE SATURATION NAAC	SUM OF CAT.	% OM	P.P.M. TOTAL P
74-OK-60- 4- 1	6.3	5.3	3.2	1.42	1.22	1.18	0.09	0.09	0.00	81.1	64.4	0.91	104.2
74-OK-60- 4- 2	6.0	4.8	2.4	1.42	1.13	0.42	0.09	0.09	0.00	71.2	55.0	0.50	92.3
74-OK-60- 4- 3	6.5	5.2	1.5	0.85	0.88	0.46	0.05	0.11	0.00	99.1	63.9	0.27	59.6
74-OK-60- 4- 4	5.3	4.0	13.4	8.81	3.40	3.95	0.18	0.17	2.27	57.5	46.6	0.82	138.9
74-OK-60- 4- 5	5.0	3.8	11.9	11.65	1.22	2.69	0.18	0.19	5.63	35.9	26.8	0.29	127.0
74-OK-60- 4- 6	5.0	3.8	9.1	7.39	1.05	3.36	0.11	0.16	3.10	51.5	38.8	0.29	97.3

PHYSICAL DATA: ANALYST: ROOZITALAB

SAMPLE NUMBER	%SAND	%SILT	%CLAY	TEXTURE	%>2MM	SAND SUBFRACTIONS %VCS	%CS	%MS	%FS	%VFS
74-OK-60- 4- 1	83.2	11.8	5.0	LS	0.0	0.1	0.1	34.4	40.4	8.2
74-OK-60- 4- 2	83.4	11.5	5.0	LS	0.0	0.1	0.1	38.7	38.8	5.8
74-OK-60- 4- 3	83.6	10.1	6.3	LS	0.1	0.1	0.1	28.2	48.7	6.5
74-OK-60- 4- 4	48.7	20.0	31.3	SCL	0.0	0.1	0.1	18.6	24.9	5.1
74-OK-60- 4- 5	49.9	22.6	27.6	SCL	0.1	0.1	0.1	2.3	37.4	10.1
74-OK-60- 4- 6	56.6	23.3	20.1	SCL	0.2	0.2	0.2	12.0	34.8	9.5

FIELD SOIL TYPE: TELLER
LOCATION: 1650' W AND 990' S OF THE NE CORNER OF SEC21, T19N, R2E,
PAYNE COUNTY, OKLAHOMA
SAMPLERS: PESCHEL AND DOUTHIT

PROFILE DESCRIPTION:

SAMPLE NUMBER	HORIZON	DEPTH (CM.)	THICKNESS (CM.)	COLOR (M)	TEXTURE	STRUCTURE	CONSISTENCE	MOTTLED COLORS
75-OK-60- 4- 1	A1	0- 28	28	5. YR4/6	L	3MGR	DH,MFI	
75-OK-60- 4- 2	B21T	28- 56	28	2.5YR4/4	CL	2MSBK	DH,MFI	
75-OK-60- 4- 3	B22T	56- 91	35	2.5YR4/6	CL	3MABK	DH,MFI	
75-OK-60- 4- 4	B23T	91-135	44	2.5YR4/6	CL	2MSBK	DH,MFI	
75-OK-60- 4- 5	B3	135-152	17	2.5YR3/6	FSCL	1MSBK	DH,MFI	
75-OK-60- 4- 6	C	152-183	31	2.5YR4/6	SL	0	MVFR	

CHEMICAL DATA: ANALYST: PESCHEL

SAMPLE NUMBER	PH1:1 H2O	PH1:1 KCL	CEC	EXCHANGEABLE CATIONS,MEQ/100 GMS H	CA	MG	K	NA	AL	%BASE SATURATION NAAC	SUM OF CAT.	% OM	P.P.M. TOTAL P
75-OK-60- 4- 1	5.5	4.4	16.2	5.12	4.88	2.67	0.72	0.19	0.11	52.3	62.3	1.99	333.4
75-OK-60- 4- 2	6.3	5.0	23.9	3.41	10.30	5.17	0.33	0.17	0.00	66.8	82.4	0.99	150.8
75-OK-60- 4- 3	6.6	5.6	23.9	1.71	10.85	4.79	0.26	0.26	0.00	67.6	90.5	0.60	121.1
75-OK-60- 4- 4	8.0	7.0	19.6	0.00	14.33	4.37	0.23	0.28	0.00	98.1	100.0	0.19	109.2
75-OK-60- 4- 5	8.0	6.9	17.1	0.00	12.59	3.90	0.23	0.26	0.00	99.6	100.0	0.19	99.3
75-OK-60- 4- 6	8.4	7.4	5.7	0.00	3.48	1.61	0.10	0.25	0.00	96.2	100.0	0.19	53.6

PHYSICAL DATA: ANALYST: PESCHEL

SAMPLE NUMBER	%SAND	%SILT	%CLAY	TEXTURE	%>2MM	SAND SUBFRACTIONS %VCS	%CS	%MS	%FS	%VFS
75-OK-60- 4- 1	34.5	45.5	20.0	L	0.0	0.1	0.1	0.2	12.9	21.2
75-OK-60- 4- 2	21.7	47.0	31.3	CL	0.0	0.1	0.1	0.2	9.7	11.7
75-OK-60- 4- 3	18.3	50.4	31.3	SICL	0.0	0.1	0.1	0.1	9.7	8.4
75-OK-60- 4- 4	24.1	47.8	28.2	CL	0.0	0.1	0.1	0.2	10.0	13.8
75-OK-60- 4- 5	35.2	42.3	22.5	L	0.0	0.1	0.1	0.1	11.7	23.2
75-OK-60- 4- 6	74.1	18.9	6.9	SL	0.0	0.1	0.1	0.1	38.6	35.3

SOIL TYPE: VERNON
LOCATION: 2150' E AND 250' S OF THE NW CORNER OF SEC. 16,T.19N.,R.2.E.
PAYNE COUNTY, STILLWATER, OKLAHOMA.
SAMPLERS: GRAY AND WILSON DATE: 4-25-73

PROFILE DESCRIPTION:

SAMPLE NUMBER	HORIZON	DEPTH (CM.)	THICKNESS (CM.)	COLOR (M)	TEXTURE	STRUCTURE	CONSISTENCE	MOTTLED COLORS
73-OK-60- 3- 1	AP	0- 15	15	5.0YR2/3	CL	1SBK	DVH,MFI	
73-OK-60- 3- 2	AC	15- 38	23	2.5YR3/3	C	FSBK-MSBK	DVH,MFI	
73-OK-60- 3- 3	C	38- 43	5	2.5YR3/4	C	M	DVH,MFI	

CHEMICAL DATA: ANALYST: WILSON

SAMPLE NUMBER	PH1:1 H2O	PH1:1 KCL	CEC	EXCHANGEABLE CATIONS,MEQ/100 GMS H	CA	MG	K	NA	AL	%BASE SATURATION NAAC	SUM OF CAT.	% OM	P.P.M. TOTAL P
73-OK-60- 3- 1	6.3	5.3	17.5	3.88	7.27	5.43	0.22	0.07	0.00	74.3	77.0	3.03	184.0
73-OK-60- 3- 2	6.6	5.6	34.6	3.67	17.36	10.50	0.21	0.10	0.00	81.4	88.5	1.72	110.0
73-OK-60- 3- 3	8.5	7.3	37.1	0.00	40.87	15.32	0.19	0.31	0.00	100.0	100.0	1.10	116.0

PHYSICAL DATA: ANALYST: WILSON

SAMPLE NUMBER	%SAND	%SILT	%CLAY	TEXTURE	%>2MM	SAND SUBFRACTIONS %VCS	%CS	%MS	%FS	%VFS	SILT SUBFRACTIONS %CSI	%MSI	%FSI
73-OK-60- 3- 1	42.2	34.3	23.5	L	0.0	0.1	0.2	0.4	24.8	16.6	21.5	9.3	21.5
73-OK-60- 3- 2	17.5	33.6	48.8	C	0.0	0.1	0.1	0.2	9.5	7.6	15.1	11.4	15.1
73-OK-60- 3- 3	17.5	33.3	49.2	C	0.0	0.1	0.1	0.3	4.2	12.8	14.0	12.2	14.0

FIELD SOIL PHASE: ZANETS
LOCATION: LAKE CARL BLACKWELL; 700' E, 85' S OF THE NW CORNER OF THE
SW 1/4 OF SEC. 4; T19N;R1W. PAYNE COUNTY,OKLAHOMA
SAMPLER: JIM FORD DATE 3/21/72

PROFILE DESCRIPTION:

SAMPLE NUMBER	HORIZON	DEPTH (CM.)	THICKNESS (CM.)	COLOR (M)	TEXTURE	STRUCTURE	CONSISTENCE	MOTTLED COLORS
72-OK-60- 4- 1	AP	0- 23	23	7.5YR 3/2	L	2MGR	MVFR-DSH	
72-OK-60- 4- 2	B1	23- 36	13	5YR 3/3	L	1MSBK	MFR-DH	
72-OK-60- 4- 3	B21T	36- 56	20	2.5YR 3/6	CL	2MSBK	MFR-DH	
72-OK-60- 4- 4	B22T	56- 74	18	2.5YR 3/6	CL	1FSBK	MFR-DH	
72-OK-60- 4- 5	B23T	74-132	58	2.5YR 4/6	CL	2CBK	MFI-DEH	
72-OK-60- 4- 6	B3	132-155	23	2.5YR 4/6	CL	1CSBK	MFI-DEH	

CHEMICAL DATA: ANALYST: D.BAKHTAR

	PH1:1			EXCHANGEABLE CATIONS,MEC/100 GMS						%BASE SATURATION		%	P.P.M.
SAMPLE NUMBER	H2O	KCL	CEC	H	CA	MG	K	NA	AL	NAAC	SUM OF CAT.	OM	TOTAL P
72-OK-60- 4- 1	6.2	5.2	13.0	5.26	6.40	4.59	0.27	0.19	0.00	87.9	68.5	2.37	191.5
72-OK-60- 4- 2	5.9	4.9	22.3	7.22	8.25	N A	0.24	0.44	0.00	70.7	N A	1.76	177.6
72-OK-60- 4- 3	6.3	4.9	22.2	5.47	6.81	6.81	0.26	0.70	0.00	65.8	72.7	1.02	129.0
72-OK-60- 4- 4	7.1	5.8	16.7	3.64	6.69	8.25	0.38	1.65	0.00	101.6	82.3	0.78	114.1
72-OK-60- 4- 5	8.1	7.0	19.0	1.22	8.91	10.61	0.41	3.18	0.00	121.9	95.0	0.41	140.9
72-OK-60- 4- 6	8.1	6.9	17.2	0.94	7.73	8.78	0.32	2.88	0.00	114.4	95.4	0.26	158.8

PHYSICAL DATA: ANALYST: D.BAKHTAR

						SAND SUBFRACTIONS				
SAMPLE NUMBER	%SAND	%SILT	%CLAY	TEXTURE	%>2MM	%VCS	%CS	%MS	%FS	%VFS
72-OK-60- 4- 1	30.9	47.8	21.3	L	0.0	0.1	0.1	0.4	12.5	18.0
72-OK-60- 4- 2	22.3	42.7	35.0	CL	0.0	0.1	0.1	0.2	8.7	13.3
72-OK-60- 4- 3	22.8	45.3	31.9	CL	0.0	0.1	0.1	0.2	9.7	13.9
72-OK-60- 4- 4	24.2	43.8	31.9	CL	0.0	0.1	0.1	0.2	9.1	14.9
72-OK-60- 4- 5	20.0	47.2	32.8	CL	0.7	0.1	0.2	0.3	7.3	12.5
72-OK-60- 4- 6	26.5	48.2	25.3	L	0.9	0.1	0.1	0.2	9.0	17.2

VITA

Dean Michael Peschel

Candidate for the Degree of

Master of Science

Thesis: THE DETERMINATION OF AGRICULTURAL AND NON-AGRICULTURAL SOIL POTENTIALS FOR BETTER LAND USE IN STILLWATER, OKLAHOMA

Major Field: Agronomy

Biographical:

Personal Data: Born in Portsmouth, New Hampshire, July 2, 1950, the son of Mr. and Mrs. Arthur Peschel.

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