SOIL POTENTIALS IN THE PLANNING OF GOOD LAND-USE IN THE LAKE CARL BLACKWELL AREA, OKLAHOMA

By

TERRY ALLEN TINDALL

Bachelor of Science

Brigham Young University

Provo, Utah

1977

Submitted to the Faculty of the Graduate College
of Oklahoma State University
in partial fulfillment of the requirements
for the Degree of
MASTER OF SCIENCE
May, 1979

SOIL POTENTIALS IN THE PLANNING OF GOOD
LAND-USE IN THE LAKE CARL
BLACKWELL AREA, OKLAHOMA

Thesis Approved:

Fenton Gray
Thesis Adviser

Robert M. Reed

John E. Stone

Norman N Durham
Dean of Graduate College

ACKNOWLEDGMENTS

The author wishes to express his sincere gratitude for all of those involved with making this study a success: Especially Dr. Fenton Gray, my major adviser, for all his help and advice; to Dr. Robert Reed and Dr. John Stone, members of my graduate committee for their assistance and suggestions; also to Mr. Earl Nance whose knowledge of the area and expertise in soil survey procedure and techniques were invaluable. My thanks is especially extended to those friends in the Agronomy Department at Oklahoma State University, whose encouragement and friendship have been sincerely appreciated.

Finally, to my wife Camille for her understanding and love, without whose help this goal would never have been completed, also for her sacrifice of time and effort in typing this manuscript I am grateful.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

INTRODUCTION

Throughout the history of Man land has been used to meet his own demands and pleasures. The utilization of land may be practically categorized into two primary sections. The first is that land which has been overworked, underplanned, and misused. This land has been scarred for future generations by erosion, infertility, and the concept of Man that it is there for his purpose alone. The time for the assumption of land as an ultimate resource is over. With that termination comes the increased need for planning the wisest use of this precious resource. The other category of land is one in which Man has realized that through careful consideration, planning, and proper use, the land he has utilized is still productive, and aesthetic. It has been left for those who follow in such a state as to continue proper management practices.

The importance of this thesis is to demonstrate the use of soil survey information in proper land-use planning. Regional planners and others have realized that soil survey information is a valuable tool for making decisions. These decisions are then implemented by those involved in both agricultural and non-agricultural fields in either developing the land in an engineering sense or in making the land the most productive for agriculture.

Effective planning should involve people everywhere. Costly errors in judgement can be minimized. This thesis illustrates a way that a small rural area can be planned for the future, before decision making efforts are begun.

Lake Carl Blackwell is a man-made reservoir owned and maintained by Oklahoma State University. It is located in the northwestern part of Payne County, Oklahoma. The southern edge of the lake is the northern boundary of the study area. This land in the early settlement of Oklahoma was used extensively for agronomic crops. Because of the types of soil and the carelessness of these early farmers, the land has suffered and deteriorated greatly. The majority of land has been managed by the State under the jurisdiction of Oklahoma State University from the 1930's until the present. Its location in the State may be seen from Figure 1.

The land is utilized for four primary functions; rangeland, agronomic crops, wildlife habitat, and recreation. The Animal Science Department does extensive research on most of the land. The Agronomy Department has a field of sorghum and wheat on the Stillwater Creek flood plain located in the northwestern portion of the study area. The most noted usage of the land is for recreation by the people living in the surrounding area. The University maintains several recreational facilities including picnic and camping areas, boat ramps, docking facilities, swimming areas, stores, cabins, and hunting blinds for waterfowl. The lake is currently a primary water supply for the city of Stillwater.

Many problems have been encountered in the past in land development. When soils are used for what they are best suited, the entire area benefits. Both economic and environmental considerations combined with good interpretations create a rural setting which will maintain

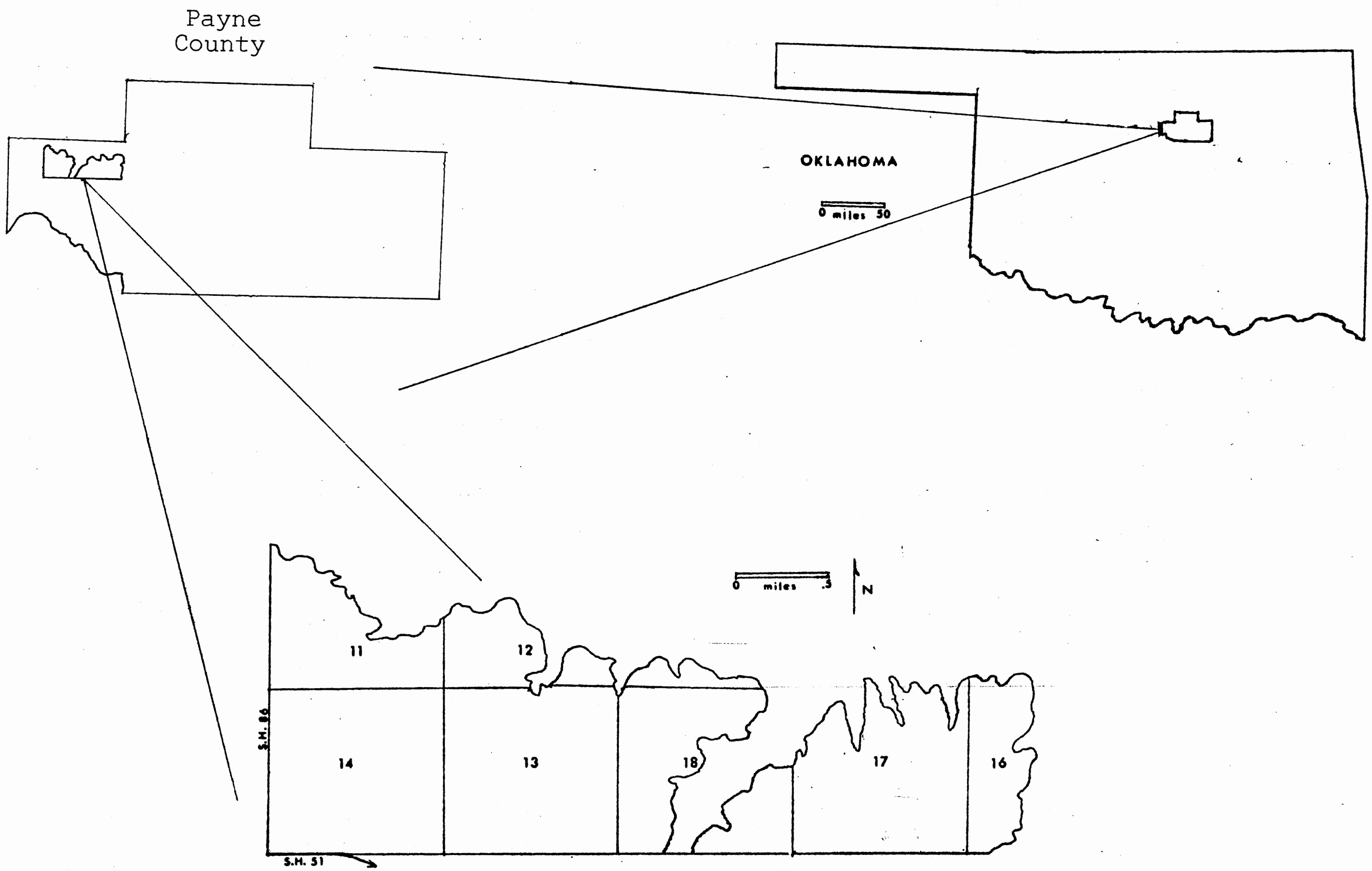


Figure 1. Location of Study Area

its aesthetic and economic appeal for future generations.

The principal objectives of this thesis are threefold. First, to make a detailed soil survey of the Lake Carl Blackwell area. Second, to interpret from the soil characteristics their potential for land-use planning decisions. Third, to present land-use planning information on interpretive maps for practical application.

Most of the counties in Oklahoma have an up to date published soil survey. Payne county is an exception. However, the projected date for completion of the soil survey is 1982.

This thesis will work in conjunction with the soil survey in the study area and will provide the needed basis by which planners, developers, and the University may make wise land-use planning decisions.

CHAPTER II

REVIEW OF LITERATURE

Soil and Those Factors Which Contribute to its Formation

To accurately identify the properties of a particular substance, its limitations must be realized at the outset. For this purpose definitions are utilized.

Soil

The unconsolidated mineral material on the immediate surface of the earth that has been subjected to and influenced by genetic and environmental factors of: parent material, climate (including moisture and temperature effects), macro- and microorganisms, and relief all acting over a period of time and producing a product, soil, that differs from the material from which it is derived in many physical, chemical, biological, plus morphological properties (23).

Soil-Forming Factors in the Lake Carl Blackwell Area

A factor of soil formation is an agent, force, condition, or relationship, or combination of these, which influences, has influenced, or may influence a parent material of a soil, with the potential of changing it. A tremendous list of influences on soil formation might be assembled. Therefore, a select few factors have been chosen and specified as the most pertinent by soil geneticists. The five factors are: parent material, relief, climate, organisms, and time. These factors serve in pedological investigations and in gathering data for future interpretations by the land-use planner (4).

The parent material of the Lake Carl Blackwell area is primarily residual in origin, but does include colluvium and alluvial deposits. The soil formed is in direct relationship to the mineralogical properties of this primary geological material. For example, sandstone usually will produce a rather coarse-textured soil. The same type of relationship holds for a shale formation and the fine-textured soil usually associated with it. However, there is variability in this process and that accounts for the many different soils generated in a relatively small area.

The primary lithologies underlying the Lake Carl Blackwell area are sandstones, shales, and siltstones of the Permian Age. Understanding the geology of an area is important in understanding the material from which soils weathered. Since the deposits in the Permian are discontinuous, the resulting soils formed in this area are very complex. It has been theorized through geological examination that the beds were part of an ancient delta. The deposits of sand, silt, and clay in this delta have been exposed for several years to weathering and erosion. The main factor contributing to erosion in this area is running water. By various upliftings and downcuttings through the topography the major streams have changed their shapes and positions leaving a variety of topographical features. The present flood plain consists of smooth, relatively flat areas adjacent to the streams. Terraces, which are remnants of flood plains, occur higher in the landscapes. The stream terraces are associated with the downcutting of streams. The area is characterized by three main types of parent material and their associated soils: the upland area or caprock of sandstone with its associated shallow, coarse-textured soils; the footslopes with colluvial deposits of shales and sandstones being eroded from above; and the fine sediment bottomlands being deposited locally by water. The associated geomorphic features, with their respective soils and their relationship to other soils, may be seen in block diagrams of Figures 2 and 3 (5). They also illustrate the soils relationships to topography and geological material.

A primary consideration to soil formation in the Lake Carl Blackwell area is relief. Relief was defined by the soil survey staff (24) as the elevations or inequalities of the land surface considered collectively. The soil scientist is concerned primarly with the shape and gradient of a given topography. The study area consists of both concave slopes and convex slopes with curvilinear features on the major flood plains and lacustrine deposits. The effects of exposure to moisture and temperature relate to soil development at a particular site. The percent slope of an area influences the total accumulation of colluviated material at the base of a slope. The soil developed from this accumulation may differ from the original parent material in color, texture, and mineralogy.

The two most commonly measured features of climate that have been correlated to soil properties are rainfall and temperature. The relative changes in climate in a small region, or microclimate,

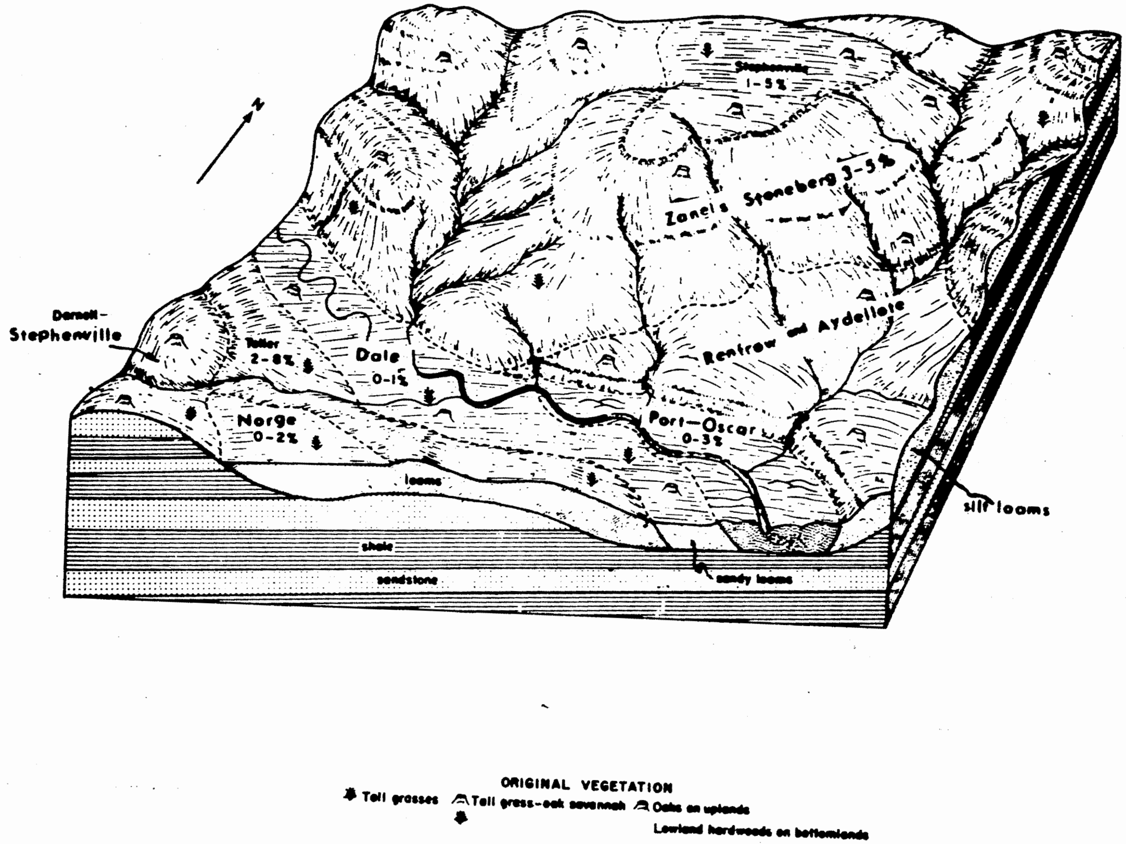
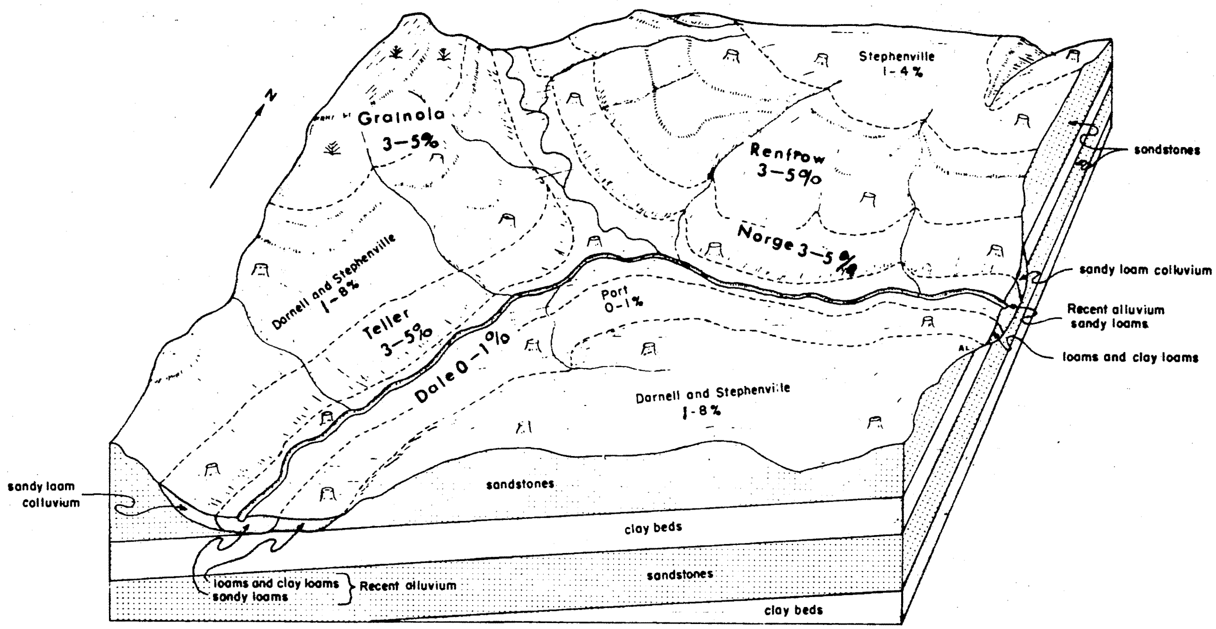


Figure 2. Block Diagram Showing Soil, Geological Material, and Topography in Western Part of Study Area



ORIGINAL VEGETATION
Tall Grasses Oaks (uplands)
Lowland hardwood

Figure 3. Block Diagram Showing Soil, Geological Material, and Topography in Eastern Part of Study Area

influence soil development. This can easily be seen by the difference in vegetation on a north slope as opposed to a southern slope. The difference in the soils is attributed to the amount of available moisture for plant growth, the differences in leaching of minerals, and the temperature which affects decomposition of organic material. The climate of the Lake Carl Blackwell area has been termed warm sub-humid by Trewartha (25). (See Table I.)

The role of organisms in the development of soil must not be overlooked. Wilde (26) points out that the biological factor in soil formation is so influential and versatile that even soil reaction is not always a dependable criterion in pedologic theory. The equation by Jenny (4) S = fo (organisms) means that a soil is a function of organisms when all other factors are kept constant. As organisms decay they contribute color and develop optimum soil structure which increases resistance to erosion. The vegetation in the Lake Carl Blackwell area adds organic material and nitrogen to the soil. It consists mostly of tall and midgrasses with open stands of deciduous trees. Along the major water courses there is more of a canopy effect of deciduous trees.

All soil formation has begun at some particular time. The length of that time will reflect the development of the soil. A young soil and an old soil are only separated by time and the processes of development within that time span. It should be pointed out that the stages in development of a soil as young, mature, and old is only relevant to the state of the environment at the present. Environmental changes may upset the delicate balance of nature and tend to increase the soil development or decrease it by erosive factors. Those factors in the study area which might contribute to erosion may include farming,

TABLE I

MEAN AVERAGE TEMPERATURE AND PRECIPITATION
OF PAYNE COUNTY, OKLAHOMA

Month	Temperature (C)	Precipitation (cm)
January	3.4	4.22
February	5.91	3.81
March	10.12	5.56
April	16.0	8.08
May	20.16	12.24
June	25.5	11.18
July	28.16	8.36
August	28.0	8.30
September	23.4	9.35
October	17.6	7.11
November	9.5	4.80
December	4.7	3.38
Annual	20.5	86.39

overgrazing, range fires, or flooding.

The primary age of soils in the study area have been termed mature. They have good horizonation and other characteristics which would classify them as such. The young soils in the area are usually associated with stream flood plains and relatively steep slopes. None of the soils may be termed old or senile in the study area.

Soil Surveys and Land-Use Planning

A method in the determination of land for its greatest use is the soil survey. Although the soil survey still has highly developed agricultural overtones it is by no means completely restricted for those whose principal interests are agriculture. Now more than ever those soils described and the interpretation thereof contained within the soil survey are to be utilized by those involved in all types of land-use. There have been many changes from the original soil surveys, and some changes have been directed towards interpretations for the uses by either nonprofessionals or those with a limited understanding of soils. These changes have increased interpretation of soil qualities or properties by a much broader range of people. These modifications have brought new life into a soil survey and have given laymen the opportunity to utilize the information it contains for their specific purposes. It is important to realize that good agricultural land is becoming more scarce as thousands of acres a year are being utilized for urban expansion. It has been estimated by the end of this year that over 38 million acres of farm land will be lost to public development (17). We cannot afford such a loss.

Furthermore, with the ever increasing areas of soil being devoted to housing, factories, highways, etc., there is an increasing danger of costly mistakes in locating structures on soils ill-suited for that particular purpose (1). This illustrates the obvious need for soil surveys and a classification system for planning land-use, including the use of land for multiple purposes where possible. This planning process should encompass entire watersheds. The actual use of land must embrace the concept of good stewardship through the employment of "best management practices" for alternative land-uses.

Interpretation of Soil Characteristics for Effective Land-Use Planning

Just as the 'road to hell' is paved with good intentions, so does chaos follow ineffective planning in urban and rural areas. That is why effective planning is needed and the only way to accomplish it is through careful and precise interpretation of soil characteristics. Land and water resources are limited and subject to grave misuse through improper land-use and poorly planned urban developments. For years, a soil survey was used specifically in developing agricultural programs. However, with the encroachment of urban development upon our rural lands this is no longer the case. Urban areas as well must now be considered for growth and development (11,12).

Soil properties exert a tremendous influence upon the manner in which Man will utilize the land (2). Soils are an irreplaceable resource and a need exists to examine not only how the land and soil is presently used, but how it can be best used and managed. This requires an area-wide soil survey which shows geographical locations of various kinds of soils. It also identifies their chemical, biological, and physical properties, and interprets these properties for land-use and facilities planning (10,14).

For any planning application, preliminary assessments of soil suitabilities should be made of (8):

1. The engineering properties of soils as an aid in site selection for commercial, residential, industrial, agricultural, and recreational land-use developments.
2. The soil and plant relationships for agricultural and non-agricultural uses.
3. Engineering properties of soils as an aid in the selection of highways, railways, airports, pipelines, and other transportation facility locations, and
4. The location of potential sources of sand, gravel, and other mineral resources.

Historically, the study of soils has been directed primarily to single-purpose applications, and little utilization of multiple land uses. This is changing and now consideration is being made for numerous uses. The Soil Conservation Service has published a guide for interpreting engineering uses of the soil which has greatly augmented the efforts of soil scientists (20). This combines information gathered by soil scientists with that data obtained for engineering uses. Limitations are then associated with a soil for many purposes including:

1. Dwellings with basements
2. Dwellings without basements
3. Local roads and streets
4. Road fill sources

5. Sand and gravel sources
6. Sanitary landfills
7. Septic tank absorption fields
8. Sewage lagoons
9. Shallow excavations
10. Topsoil excavations
11. Corrosivity

The soil survey reports include engineering interpretations for each soil series contained within the boundaries of the report. This information is then utilized by the planner as a basis for his planning programs. If more planning, both urban and regional, were done using the soil survey as a basis many costly mistakes would be eliminated (14,18).

Soil Potential for Agricultural Uses

This study includes both agricultural and non-agricultural interpretations. The agricultural land is systematically classified into units according to their capabilities and limitations. Agricultural land is classified into range sites and predicted yields for major crops are given. In this study only tame pastures are predicted for yield.

Land Capability Classification

Land is classified according to the most suitable sustained use while providing for adequate protection from erosion or other means of deterioration.

Thus, an area of soils which are deep, well drained, have a stable surface structure, slopes of 1 to 2%, may be cropped intensively, almost indefinitely, with little danger of erosion or loss of productivity. These soils have great capabilities and very few limitations in their use. In contrast an area of soils which are shallow and with steep slopes has limited capabilities and productivity for a wide range of purposes decreases. The characteristics of soils are one of the criteria for identifying the best land-use (13,21).

The Soil Conservation Service has set up a system of interpreting the soils for soil and water conservation purposes. This system has eight capability classes (6). These classes are numbered from I to VIII - the lower the Roman Numeral, the greater the capability of the land to response and management. Those lands with the greatest limitations in capabilities and more difficult to manage are grouped in classes VI, VII, and VIII. (See Table II.)

The following briefly describes the guidelines used in this study for classifying land into capability classes. These are outlined by R. L. Hausenbuiler (9).

Class I -- Soils without particular limitations to use. High productivity requires no more than the normal management practices.

Class II -- Soils with limitations that restrict somewhat the kinds of plants that may be grown satisfactorily or that may require moderate conservation to avoid deterioration.

Class III -- Soils with severe limitations that restrict somewhat the kinds of plants that may be grown satisfactorily, or require special conservation

TABLE II

GUIDE TO LAND CAPABILITY CLASSIFICATION, TAME PASTURE CAPABILITY, AND RANGE SITES IN THE LAKE CARL BLACKWELL AREA

Map Symbols	Land Capability Class	A.U.M.S*	Range Site
AyB	IIIe	2.5	Claypan Prairie
Ba	VIs	-	Loamy Prairie
DaA	I	8.5	Loamy Bottomland
DS	VIe	5.0	Shallow Savannah
GrA	IVe	4.0	Red Clay Prairie
GrB	IVe	3.0	Red Clay Prairie
Gr3	VIe	2.0	Eroded Clay
LuA	IVe	5.0	Loamy Prairie
NoB	IIe	6.5	Loamy Prairie
No3	IVe	5.0	Loamy Prairie
PO	IIw	5.0	Loamy Bottomland
PoA	IIw	8.5	Loamy Bottomland
ReA	IIIe	3.0	Claypan Prairie
SoA	IIe	5.0	Loamy Prairie
StB	IIIe	5.5	Sandy Savannah
TeB	IIIe	6.5	Loamy Prairie
ZaB	IIe	6.0	Loamy Prairie
ϕ	VII	-	Alkali Bottomland

*Tame Pasture Capabilities expressed in Animal Unit Months (A.U.M.S) practices, or both.

Class IV -- Soils with severe limitations that restrict the choice of plants or that require very intensive conservation and careful management, or both.

Class V -- Soils with little or no erosion hazard but with other limitations, impractical to remove, that limit use primarily to pasture, range, woodland, or for wildlife feeding and cover. They will respond, however, to proper management.

Class VI -- Soils with severe limitations, often an erosion hazard, that make them unsuitable for use with cultivated crops. Greater management input is required to obtain similar productivity or to prevent soil deterioration by erosion or other means than class V land.

Class VII -- Soils having severe limitations that limit use to grazing, woodland, or wildlife cover or feeding. Extreme care must be exercised to protect the soil even with low intensity users of grazing and timber harvest.

Class VIII -- Soils and landforms which prohibit use for plant production of any type, including the harvest of trees. Users are restricted to recreation, wildlife cover and feeding, water supply or aesthetic purposes.

In each of the land capability classes are subclasses which have the same kind of dominant limitations for agricultural uses. The four kinds of limitations recognized in these subclasses are risks of erosion (e); wetness, drainage, or overflow (w); root-zone limitations (a); and climatic limitations (c). Thus, a soil may be found in class III (e) indicating that it is in class III due to erosion or III (w) because of poor drainage (3).

Use of the Soils for Range

Range is land on which the natural plant community is composed mainly of grasses, grasslike plants, forbs, and shrubs that are valuable for grazing. They are abundant enough to justify use for grazing by domestic animals.

Different types of soils vary in their capacity to produce grass and other plants for grazing. Soils that produce about the same type and amounts of forage, if the range is in similar conditions, make up a range site. The range site tends to produce the same kind of climax vegetation. Climax vegetation is the stabilized plant community; it is able to reproduce itself and remains unchanged as long as the environment remains unchanged. On the plains, the climax vegetation consists of plants which are growing at the time of settlement.

Decreasers are plants within the climax vegetation that tend to decrease in relative amounts under close grazing. In the study area this tends to be the tallest and most productive perennial grasses that are the most palatable to livestock. Increasers are those plants within the climax vegetation that increase as the decreasers are reduced through grazing. With heavy grazing the decreasers are continually reduced and the range site is then taken over by invaders. They usually add little if any benefit to grazing.

Four range condition classes are used to indicate how the range has departed from the climax vegetation brought about by overgrazing or other uses. The classes show the relative condition between the present vegetation and that vegetation which could grow there.

A range is in excellent condition if 75 to 100 percent of the vegetation is the same as that in a climax state. A good rating is given if the percentage is 50 to 75; fair condition is 25 to 50 percent; and in poor condition if the percentage is 25 or less.

A primary objective of good range management is to keep rangeland in excellent or good condition. If this is accomplished, water is conserved, yield is improved, and the soils are protected from erosion. The description of range sites include, 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 (7).

Tame Pastures

The primary use of land in the study area is for range land and tame pastures. In planning a tame pasture program, one must consider the total yearly production of pasture plants in Animal Units Months (AUM) (as given in Table II). An Animal Unit Month is expressed as the amount of forage or feed required to feed one animal unit (one cow, one horse, one mule, five sheep, or five goats) for a period of 30 days. A pasture program needs to be planned so that forage will be available during each month of the year. A study of the growth habits of the different plants is necessary to assure adequate forage each month.

CHAPTER III

METHODS AND MATERIALS

An area was selected at the southern end of Lake Carl Blackwell and includes sections or portions of sections; 11, 12, 13, 14 of T.19N.; R.2.E.; and sections 7, 16, 17, 18 of T.19N.; R.1.E. A detailed soils map (scale: 4.3 cm. = 1 mile) was prepared in complete accord with the updated Soil Taxonomy. The soil survey served as a basis for all interpretations made in the study area. Soil descriptions were written for all soils in the survey area. These were made from field notes and mapping during the summer of 1978.

The mapping began by utilizing aerial photographs taken of the project area in December of 1973. These photographs were enlarged to approximately 9.08 cm to the mile. Stereoscopic techniques were utilized to separate topography for preliminary field investigation. Obvious topography was separated such as intermittant streams, flood plains, rock outcroppings and severely eroded areas. Field investigation followed utilizing manual labor with spades and hand augers. A soil probe was also used which was mounted on a 1971 International Harvestor pickup. Both methods were helpful in obtaining soil samples to compile field notes for soil boundary designations and characteristics. Field reviews were made by professional soil scientists in the fall of 1978 and the spring of 1979. The soils information obtained was then interpreted for individual soil classification.

The updated soil taxonomy is a basic system of soil classification for making and interpreting soil surveys. It differs in many ways from earlier systems and from others that are in current use in other parts of the world. Soils are continuous through the topography, but at the present we lack the knowledge to classify them as such. We break the continuum into segments that have limited and defined ranges in properties so that quantitative soil interpretations may be made.

The physical and chemical soil analysis was performed by the Soil Characterization Laboratory between 1972 and 1978 (19). The data includes cation exchange capacity, exchangeable cations, exchangeable hydrogen, exchangeable aluminum, pH, percent organic matter, total phosphorus, and particle size analysis. These data are used to aid in the classification and interpretation of the soil and appear in Appendix C.

Also, included are tables of engineering data compiled by the Oklahoma Highway Department. This information is presented in Appendix B. Information in these tables include sieve analysis, plasticity index, shrinkage limit, liquid limit, shrinkage ratio, corrosivity, and AASHO rating, and also a soil classification used by highway engineers for major horizons of each soil type.

Through the Soil Conservation Service's Guidelines for Engineering Interpretations (20), interpretations were evaluated for each mapping unit and soil properties which affect the suitability of the specific land-use are determined.

The concept of soil limitation used by the Soil Conservation Service was converted to soil potential. The soil potential represents an indication of the soils suitability for a specific use (14). A poor potential does not necessarily mean that a soil is unusable, but the cost to overcome the problem may make it unfeasible. It should be made clear that most adverse soil conditions may be overcome either by changing the soil conditions or by altering the engineering design. Likewise a soil with a good potential rating does not mean there are no problems to overcome. The purpose of the soil potential is one of separating easily overcome problems from those that are difficult to solve. By no means do these soil potentials take the place of on site investigations. The soil map indicates an area of a dominant type of characteristics and includes a small percentage of soils with various properties (16).

The data collected is presented on tables in this report. This information was then used to produce soil potential maps for the future planning of the Lake Carl Blackwell area.

CHAPTER IV

RESULTS AND DISCUSSION

Soil Descriptions

The soil mapping units are described as they are found in the project area. Preceding the soil mapping unit descriptions, is the detailed soils map Figure 4, and the soil legend, Table III. The detailed soils map in this paper serves as a base map from which the soil potential maps are drawn.

Aydelotte Loam (AyB) 3 to 5% Slopes

The Aydelotte soils are on moderately sloping uplands. Slopes are generally between 3 to 5%. These soils have formed from material weathered from shale. This soil is geographically associated with, Renfrow, Grainola, and Zaneis soils. They lack the structure of the Grainola soils. The Renfrow soil has a mollic epipedon and the Zaneis is more coarse-textured. The Aydelotte series is a member of the fine, mixed, thermic family of Udertic Paleustalfs. These soils typically have reddish brown loam Ap horizon, reddish brown and red clay B2t and B3 horizons.

Typifying Pedon: Aydelotte loam - pasture

Horizon	Depth, cm	Description
Ap	0-12	Reddish brown (5YR 3/4) moist; loam; weak medium granular structure; friable; slightly acid; clear smooth boundary.

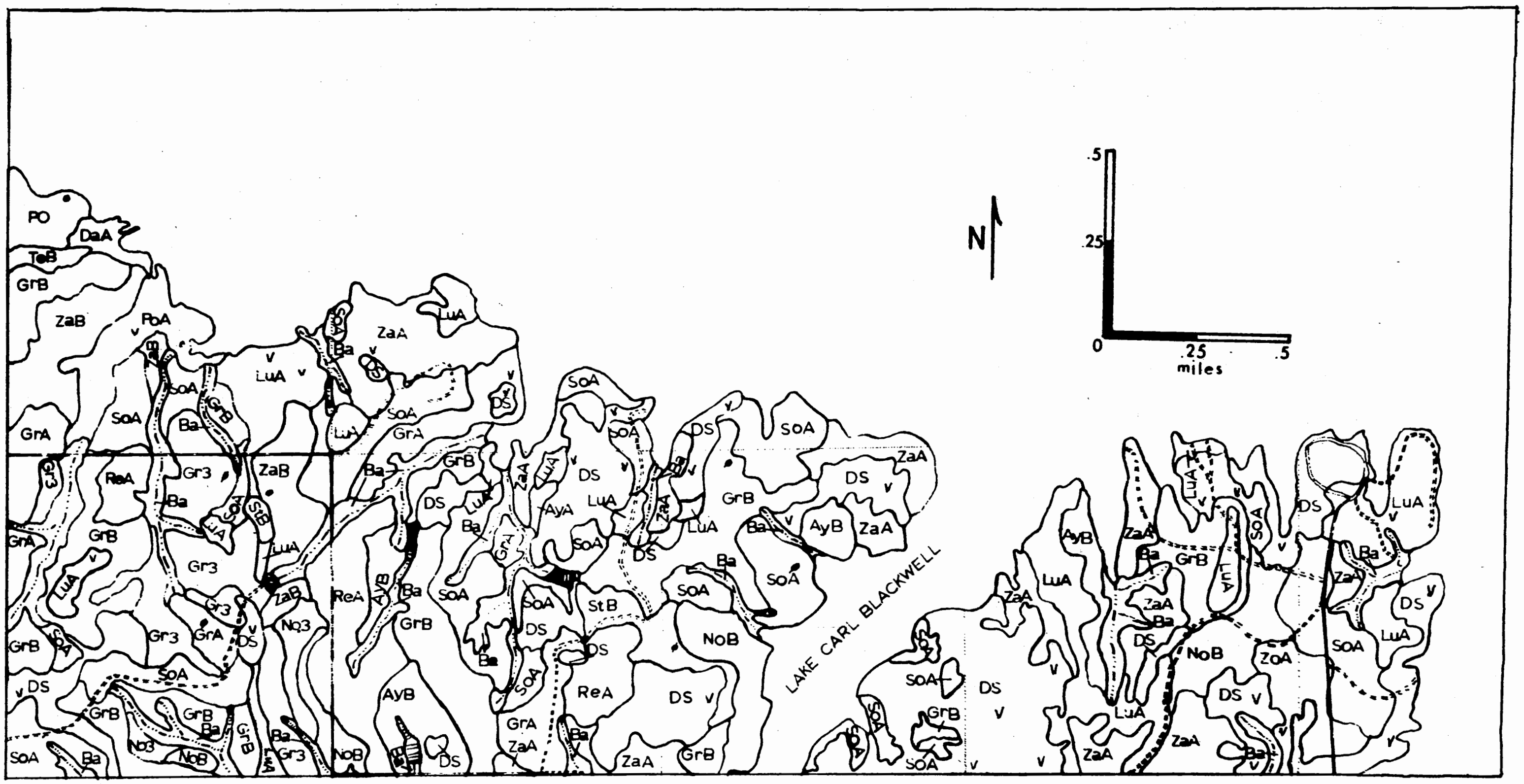


Figure 4. Detailed Soils Map

TABLE III

SOIL MAPPING LEGEND

Map Symbols	Field Name of Mapping Unit
AyB	Aydelotte loam, 3 to 5% slopes
Ba	Broken-Alluvial land complex
DaA	Dale silt loam, 0 to 2% slopes
DS	Darnell-Stephenville complex, 1 to 8% slopes
GrA	Grainola silty clay loam, 1 to 3% slopes
GrB	Grainola silty clay loam, 3 to 5% slopes
Gr3	Grainola silty clay loam, severely eroded
LuA	Lucien sandy loam, 2 to 5% slopes
NoB	Norge loam, 3 to 5% slopes
No3	Norge loam, severely eroded
PO	Port-Oscar complex, 1 to 3% slopes
PoA	Port silt loam, 0 to 3% slopes
ReA	Renfrow silt loam, 1 to 3% slopes
StB	Stephenville sandy loam, 3 to 5% slopes
SoA	Stoneburg loam, 2 to 5% slopes
TeB	Teller loam, 3 to 5% slopes
ZaB	Zaneis loam, 3 to 5% slopes
ϕ	Slickspots

Soil Legend

Soil Boundaries

Improved Roads

Unimproved Roads

Intermittent Streams

Map Boundary

v Rock Outcropping

B21t	12-44	Reddish brown (5YR 4/4) moist; silty clay loam; moderate fine blocky and subangular block structure; very firm; clay films on faces of peds; neutral; gradual wavy boundary.
B22t	44-76	Red (5YR 4/6) moist; clay; moderate medium blocky structure; very firm; few nonintersecting slickensides; few Fe-Mn oxide concretions; clay films on faces of peds; moderately alkaline; diffuse wavy boundary.
B3	76-126	Red (2.5YR 4/6) moist; clay; weak fine blocky structure; very firm; few nonintersecting slickensides in upper part; few fragments of shale in lower part; few fine Fe-Mn oxide concretions; clay films on faces of peds; few seams and bodies of soft powdery $CaCo_3$; calcareous; moderately alkaline.

Thickness of solum ranges from 80 to more than 180 cm. The Ap or A1 horizon is typically loam but includes clay loam. It is dark brown (5YR 3/4, 5/4), brown (7.5YR 4/4) and slightly acid or neutral. The B2t horizon is clay, silty clay or clay loam. It is reddish brown (5YR 4/3, 4/4). The upper part is slightly acid through mildly alkaline and the lower part is moderately alkaline. The B3 horizon is clay, silty clay, or clay loam. It is red (2.5YR 4/6, 5/6). Thin seams of sandstone less than 7.6 cm thick occur in some areas.

Broken Alluvial Land Complex (Ba)

This is a miscellaneous mapping unit consisting of land associated with streams and drainage ways in the Lake Carl Blackwell area. The soils usually resemble adjoining mapping units such as Grainola, Norge, Zaneis, or Stephenville. The unit includes the stream itself and the immediately adjoining alluvial soils. The sloping sides of these drainage ways vary greatly from 1 to 3% to over 20% with an average slope of 10%.

Natural vegetation consists of mainly tall and midgrasses with an open stand of deciduous trees. These are primarily composed of willow, cottonwood, elm, hickory, pecan, and oaks with an understory of shrubs. The primary land-use would be for wildlife habitat and recreation in the form of hiking trails. The vegetation in these areas are extremely vital in stablizing the slopes and soils and thereby preventing erosion.

Dale Silt Loam (DaA) 0 to 2% Slopes

The Dale soils are on nearly level to gently sloping terraces or flood plains. Slope gradients range from 0 to 3% but are dominantly 0 to 2%. The soils are formed in loamy alluvium. Most areas are subject to damaging floods once in 10 to 20 years or more, however, some areas are never flooded.

The soils competing with the Dale in the study area have a redder hue and a thicker mollic epipedon.

Typifying Pedon: Dale silty loam, cultivated - sorghum

Horizon	Depth, cm	Description
Ap	0-20	Very dark brown (10YR 3/2) moist, silt loam; weak fine granular structure; hard; friable; many fine roots; slightly acid; abrupt smooth boundary.
B1	20-38	Dark brown (7.5YR 3/2) moist, silt loam; moderate medium granular structure; hard; friable; many fine roots; neutral, clear smooth boundary.
B21	38-64	Dark brown (7.5YR 4/4) moist, silt loam; weak coarse prismatic structure; hard; friable; few fine roots; mildly alkaline; gradual smooth boundary.
C	64-100	Reddish brown (5YR 4/3) moist, silt loam; massive; hard; friable; few fine roots; few calcium carbonate concretions; moderately alkaline.

Thickness of the mollic epipedon ranges from 16 to 44 cm. The A horizon is very dark grayish brown, (10YR 3/2), brown (10YR 5/3), dark brown (7.5YR 4/2). It is mainly silt loam, but includes loam, silty clay loam. It is neutral or slightly acid. The B21 horizon is brown or dark brown (7.5YR 3/2 4/4). The C horizon is red (2.5YR 5/6, 4/6), reddish brown (5YR 4/3, 4/4). The C horizon is usually the texture of the control section, but in some places has thin strata of sand or finer texture material. There also exists some MnO and MnO2 strata and concretions below 70 cm.

Darnell-Stephenville Complex (DS) 1 to 8% Slopes

This complex is on moderately deep to shallow, gently sloping through strongly sloping well drained soils on uplands. Darnell is a shallow soil formed in material weathered from sandstone mainly on side slopes. Slopes are mostly from 1 to 8%, but range up to 12% in some areas. These soils are so intermingled that they could not be separated at the scale selected for mapping. Individual areas range from 10 to more than 200 acres. Stephenville is a moderately deep soil formed in material weathered from sandstone on narrow convex ridge-tops and side slopes.

Darnell soils make up about 50% of the mapping unit but ranges from 25 to 50%. The surface layer is a dark brown fine sandy loam 13 cm thick. The subsurface layer is a yellowish brown fine sandy loam. Yellowish brown weakly cemented sandstone occurs at 36 cm deep.

Natural fertility and organic matter content is low. It is slightly acid through mildly alkaline. Available water capacity is low. Permeability is moderately rapid and runoff is rapid. The root zone is shallow and easily penetrated by plant roots.

Stephenville soils make up about 35% of the mapping unit but ranges from about 30 to 60%. Typically the surface layer is grayish brown fine sandy loam 13 cm thick. The subsurface layer is brown fine sandy loam to about 30 cm. The subsoil is a yellowish red sandy clay loam. Reddish brown weakly cemented sandstone occurs at 80 cm.

Natural fertility is medium and organic matter content is low. It is medium acid through neutral. Available water capacity is medium.

Permeability is moderate and runoff is medium to rapid. The root zone is moderately deep and is easily penetrated by plant roots.

Included in this mapping unit are small areas of sandstone outcrops and soils with a clay subsoil deep over shale or sandstone. Total inclusions are about 15%.

A large part of this area is used for improved pasture. Most of the area is still in the native timber of post oak, blackjack oak, and hickory and is used for rangeland. A small percent is in urban uses. This complex has a low potential for cropland. The erosion hazard and avilable water capacity are limitations. Yields, even under good management, are very low in most years.

This mapping unit has a medium potential for pasture and rangeland. These uses are effective for controlling erosion. Overgrazing, fertility, and brush competition are the principle concerns of management. Proper stocking rates, rotation grazing, timely deferment of grazing, brush control, and fertilization of tame pastures help keep the plants and soil in good condition.

This complex has a medium potential for urban uses. Depth to rock and soil strength are the principle limitations. For dwellings, roads, and streets these can be overcome at a reasonable extra cost. For septic tank absorption fields or sewage lagoons, measures to overcome limitations are costly.

Grainola Silty Clay Loam (GrA) 1 to 3% Slopes

This is a moderately deep, gently sloping, well drained soil that has very slow permeability. It occurs on narrow ridge crests and short side slopes on uplands in areas of 20 to 200 acres.

Included with this soil in mapping and making up 10% are areas of soil that have a profile similar to that described as representative for the series except the depth to shale is less than 40 cm.

Grainola soil is medium in natural fertility and low in organic matter content. It has a low response to fertilization. Available water capacity in the upper 60 cm ranges from 8 to 12 cm. Depth to the water table is more than 120 cm.

Grainola soil is used mostly for native grasses. Some areas are used for wildlife, recreation and urban land.

The main concerns of management are maintaining soil structure and water intake and controlling soil erosion. Grainola soil has a low potential for growing cultivated crops and tame pasture plants. It has a medium potential for growing native grasses. The quality of native grasses can be maintained or improved by using proper grazing, protecting from fire, and employing rotational grazing. Weeds need to be controlled in heavy invaded areas. Plant food on tame pasture plants will increase their quality and quantity.

Grainola soil has a low potential for most recreational uses. It has a severe limitation for camp areas and playgrounds due to its very slow permeability. The clayey surface layer severely limits the use of this soil for picnic areas, paths, and trails.

Grainola soil has a low potential for most urban uses. It has severe limitations for septic tank absorption fields since it has very slow permeability. The slope limits this soil for lagoons and the clayey surface layer and subsoil severely limits its uses for sanitary landfills, cover material, and shallow excavations. The Grainola soil with its low strength and high shrink-swell has severe limitations for all types of buildings, roads, and streets.

Included in with the Grainola are small percentages of Lucien, Renfrow, Zaneis, Stoneburg, and slickspot soils.

Typifying Pedon: Grainola silty clay loam

Horizon	Depth, cm	Description
A1	0-15	Dark reddish brown (5YR 3/4) moist, silty clay loam; weak fine granular structure; friable; slightly acid; clear wavy boundary.
B1	15-25	Reddish brown (2.5YR 4/4) moist, silty clay loam; weak medium subangular blocky structure; firm; slightly acid; shiny ped surfaces; gradual boundary.
B1	25-46	Reddish brown (2.5YR 4/4) moist, silty clay, moderate coarse blocky breaking to fine blocky structure; clay films on ped surfaces; very firm; neutral; few slickensides; gradual wavy boundary.
B22t	46-71	Red (2.5YR 4/6) moist, silty clay; weak coarse blocky structure; very firm; clay films on ped surfaces; few secondary carbonates; few fine Fe-Mn oxide bodies; few shale fragments; few slickensides; moderately alkaline; gradual wavy boundary.
B3t	71-96	Yellowish red (5YR 5/6) moist, silty clay loam; weak coarse blocky structure; firm; secondary carbonates; shiny ped surfaces; few Fe-Mn oxide bodies; few gypsum crystals; moderately alkaline; clear wavy boundary.
Cr	96-120	Bedded shale, siltstone and sandstone that varies from gray to red in color; moderately alkaline.

The Ap or A1 horizon is dark reddish brown, reddish brown or dark brown in hues 5YR or 7.5YR. Textures are dominantly silty clay loam but include silt loam. Reaction ranges from medium acid through moderately alkaline. The B1 horizon is present in some areas. The B2t horizon is reddish brown, dark reddish brown or red in hues 2.5YR or 5YR, streaked or splotched with shades of red, gray or olive from the parent shales in some areas, reaction is neutral through moderately alkaline. The B3t horizon, where present, is reddish brown, red or yellowish red in hues 2.5YR or 5YR. Textures are silty clay loam or silty clay. Reaction is mildly or moderately alkaline.

Grainola Silty Clay Loam (GrB) 3 to 5% Slopes

These soils are similar to the GrA soils except in slope where the percent changes from 1 to 3% in the GrA soils to 3 to 5% in the GrB soils.

Grainola Silty Clay Loam (Go3) Severely Eroded

These soils consist of the Grainola soils which have been deeply eroded with gullies up to 32 meters in depth and 90 meters across. This erosion is primarily caused by poor management practices and over grazing. These soils have very limited use without taking the necessary steps to overcome the limitations. However, they may be overcome and uses may be extended.

Lucien Sandy Loam (LuA) 2 to 5% Slopes

These soils are gently sloping through moderately sloping on uplands. They are formed from material weathered from sandstone and formed under the influence of grass vegetation. They provide excellent range and are primarily dark colored in the surface. Included in these areas are small areas of Grainola, Zaneis, and Stoneburg, or other soils similar to Lucien with less than 30 cm in solum thickness.

Typifying Pedon: Lucien sandy loam

Horizon	Depth, cm	Description
A1	0-18	Dark brown (7.5YR 3/2) moist, sandy loam; moderate fine and medium granular structure; friable; neutral; clear smooth boundary.
B2	18-30	Reddish brown (5YR 4/3) moist, very fine sandy loam; moderate medium granular structure; slightly hard, few rock fragments; slightly acid; gradual wavy boundary.

Cr	30-40	Red (2.5YR 5/6) moist, soft, fine grained sandstone; slightly alkaline.

Solum thickness ranges from 25 cm to 58 cm. The A1 horizon is reddish brown to dark brown (2.5YR 4/3 to 5YR through 10YR) hues. Reaction is neutral through slightly alkaline. The B2 horizon ranges from brown to yellowish red in hues (7.5YR, 5YR, or 2.5YR). Reaction is neutral, slightly acid, moderately acid. The Cr horizon is rippable sandstone that is reddish brown (2.5YR 4/4) to red (2.5YR 4/6) in some horizons there may be beds of clay interbedded with the sandstone. There are rock fragments in some profiles ranging from 6 cm to 10 cm in length. Fragments of rock from 6 cm to 25 cm may cover as much as 20% of the surface in some areas.

Norge Loam (NoB) 3 to 5% Slopes

These are moderately sloping soils on upland. Slopes are dominantly 3 to 5% but range from 1 to 8%. They have formed from either loamy sediments associated with alluvial deposits or from colluvium. Included with these soils are similar soils that do not have mollic epipedons, similar soils with clay textures in the lower portion of the B horizons. Competing series are Zaneis, Stoneburg, and Grainola. These soils may be excluded from the Norge series because of color.

Typifying Pedon: Norge loam

Horizon	Depth, cm	Description
A1	0-26	Dark brown (7.5YR 3/2) moist, loam; moderate granular structure; friable; slightly acid; clear smooth boundary.
B21t	26-40	Dark reddish brown (5YR 3/3) moist, clay loam; moderate medium subangular blocky structure; friable; slightly acid; patchy clay films; gradual smooth boundary.
B22t	40-63	Dark reddish brown (2.5YR 3/4) moist, clay loam; moderate medium prismatic structure; firm; clay films on ped surfaces; slightly acid; diffuse smooth boundary.
B23t	63-110	Reddish brown (2.5YR 4/4) moist, clay loam; moderate medium prismatic breaking to medium

		subangular blocky structure; firm; clay films on ped faces; slightly acid; diffuse smooth boundary.
B24t	110-150	Reddish brown (2.5YR 4/4) moist, loam; weak coarse prismatic; friable; clay films on ped surfaces; neutral; gradual smooth boundary.
B3	150-204	Red (2.5YR 4/5) moist, loam; weak coarse prismatic structure; friable; patchy clay films on surfaces; neutral; gradual smooth boundary.

The A1 horizon is dark reddish brown or dark brown in hues, 5YR and 7.5YR. Texture is dominantly loam but includes silt loam or silty clay loam. The B21t and B22t horizons are silt loam or clay loams. Reaction is slightly acid or medium acid. The B23t horizon is dark reddish brown, reddish brown, or yellowish red in hues (5YR or 2.5YR). Textures are silty clay loam and clay loam. Reaction is medium acid through neutral. Some MnO_2 concretions are evident. A B24t horizon is present in some areas. The B3 horizon is red, yellowish red, or reddish brown in hues (2.5YR and 5YR). Textures are loam, silt loam, clay loam or silty clay loam, some gypsum crystals, calcium carbonate concretions and MnO_2 concretions are present. Reaction is neutral through moderately alkaline.

Norge Loam (No3) Severely Eroded

For a description of these soils refer to Norge loam 3 to 5% slopes. These soils differ typically from the Norge 3 to 5% slopes in that the A1 horizon is thinner and not mollic. These soils may also be on steeper slopes and include areas of deep gullies.

Included with these soils in mapping are areas of similar soils that have a clay subsurface texture in the lower B horizons. Also included are small percentages of Zaneis, Grainola, and some Renfrow.

Port Silt Loam (PoA) 0 to 3% Slopes

The Port series consist of deep well drained flood plain soils. They are moderately permeable soils formed in calcareous loamy recent alluvium. These soils are on nearly level through very gently sloping flood plains. Included in mapping are 40% similar soils, they usually lack the mollic epipedons, or are redder in color.

Typifying Pedon: Port silt loam, wheat stubble field

Horizon	Depth, cm	Description
Ap	0-14	Dark reddish brown (5YR 3/3) moist, silt loam; moderate medium granular structure; soft, very friable; over washed sediments; neutral; clear smooth boundary.
A1	14-50	Dark reddish brown (5YR 3/3) moist, silt loam; moderate coarse granular structure; very friable; neutral; clear smooth boundary.
B2	50-84	Reddish brown (5YR 4/4) moist, silty clay loam; weak fine subangular blocky structure; firm; few thin strata of darker material; neutral; abrupt smooth boundary.
Ab	84-100	Dark brown (7.5YR 3/2) moist, loam; weak medium granular structure, very friable; clear smooth boundary.
C	100-104	Reddish brown (2.5YR 4/4) moist, clay loam; massive thin stratas of darker material of fine or silty texture; some secondary carbonates; moderately alkaline.

The A, B2, and C horizons are loam, silt loam, silty clay loam or clay loam. Thin stratas of sandy clay loam are present in some areas. The Ap or A1 horizon is dark brown or reddish brown in hues (7.5YR; 5YR or 2.5YR). Reaction is medium acid through neutral. The B2 and C horizons are similar to the A1 horizons only slightly redder in some areas. Reaction is slightly acid through moderately alkaline. There are buried horizons within the area due to the streams flooding every 10 to 15 years.

Port-Oscar Complex (PO) 0 to 3% Slopes

This complex is a mixture of occasionally flooded soils that are impractical to separate on this scale of mapping. They consist of about 30% Port soils; 15% soils similar to Port except the mollic is 20 to 40 cm thick; 15% soils similar to Port except the control section (25 to 100 cm) is fine-loamy; 20% Oscar soils; 10% soils similar to

Port, except they lack a mollic epipedon and 10% soils similar to Port except they have a udic moisture regime. Slopes range from 0 to 2%. Oscar soils are slightly outside the series range in that they have a mollic epipedon. Port soils are moderately well drained. There are sodic (alkali) soil spots ranging in diameter up to 46 meters. These soils are primarily cultivated and are located on alluvium adjacent to Stillwater creek. They are subject to flooding once in 10 to 20 years.

For the range in characteristics for the Port series refer to Port silt loam 0 to 3% slopes.

Oscar range in characteristics: Overwashed loam sediments up to 50 cm thick are present in some areas; where present they are reddish brown or brown hues 5YR or 7.5YR. The Ap or A1 horizon (excluding overwashed sediments) is dark brown or dark reddish brown in hues 5YR and 7.5YR. Reaction is slightly acid through moderately alkaline. Textures are loam or silt loam. The B2t natric horizon colors are dark reddish brown, or very dark grayish brown in hues 10YR. Reaction is moderately or mildly alkaline. Texture is silty clay loam or clay loam. The B3 horizon is reddish brown or yellowish red in hues 5YR or 7.5YR. Texture is silt loam, clay loam, or silty clay loam.

Renfrow Silt Loam (ReA) 1 to 3% Slopes

Renfrow soils are on gently sloping uplands. Slopes are mainly between 1 to 3% but range 0 to 5%. The soil formed in material weathered from clay or shale. They are well drained, but very slowly permeable. They have formed under tall and midgrass vegetation.

Typifying Pedon: Renfrow silt loam

Horizon	Depth, cm	Description
A1	0-22	Dark reddish brown (5YR 3/2) moist, silt loam; moderate medium granular structure; hard, friable; slightly acid; gradual smooth boundary.
B21t	22-50	Reddish brown (5YR 4/3) moist, clay loam moderate medium subangular blocky structure; hard; clay films on ped surfaces; friable; slightly acid; gradual smooth boundary.
B22t	50-90	Reddish brown (2.5YR 4/4) moist, clay; moderate coarse blocky structure; hard, firm; continuous clay films on ped surfaces; calcium carbonate concretions, also MnO_2 concretions; gypsum crystals also present; gradual smooth boundary.
B3	90-125	Dark red (2.5YR 3/6) moist, clay; weak coarse blocky structure; extemely hard; very firm; patchy clay films on surfaces of peds; calcium carbonate concretions, MnO_2 concretions; some gypsum crystals.

The A1 horizon is dark reddish brown or dark grayish brown in hues 5YR, 7.5YR or 10YR and is slightly acid or neutral in reaction. The B21t color is reddish brown in hues 5YR or 10YR. Texture is clay loam, or clay that is neutral through slightly alkaline in reaction. The B22t is similar to B21t in color and texture and is slightly acid through moderately alkaline in reaction. Most pedons are calcareous in the lower part. The B3 horizon is red, or yellowish red in hues 2.5YR or 5YR. It is similar to the B2 horizon in texture. It is neutral through moderately alakaline. There are small percentages of Aydelotte, Zaneis or Grainola soils mapped as inclusions with the Renfrow. The Aydelotte does not have a mollic epipedon. The Zaneis is less clayey and the Grainola is more clay textured in the surface horizon.

Stephenville Sandy Loam (StB) 3 to 5% Slopes

These occur on moderately sloping soils on uplands. Slopes range from 3 to 5%. The soils weathered from material from sandstone. They are well drained and moderately permeable. The native vegetation is dominantly post oak, blackjack oak, hickory with an understory of big and little bluestem.

Typifying Pedon: Stephenville sandy loam

Horizon	Depth, cm	Description
A1	0-8	Dark brown (7.5YR 3/3) moist, sandy loam; weak fine granular structure; very friable; slightly acid; clear smooth boundary.
A2	8-24	Brown (7.5YR 5/4) moist, sandy loam, weak fine granular structure; very friable; medium acid; clear smooth boundary.
B2t	24-50	Reddish brown (5YR 5/4) moist, sandy clay loam; weak fine subangular blocky structure; firm; medium acid; clay films on ped surfaces; clear smooth boundary.
Cr	50-74	Sandstone

Range in characteristics: To small for establishing range in characteristics.

Included with these soils are small areas of Grainola and Lucien soils and soils gradational in development between Stoneburg and Grainola. Also included are small areas of soils similar to Stoneburg with less than 51 cm of solum thickness.

Stoneburg Loam (SoA) 2 to 5% Slopes

These soils cover an extensive area around Lake Carl Blackwell. They are on uplands, mainly convex ridge tops and the upper portions of side slopes. The slopes range from 1 to 8% but are dominantly 2 to 5%. The soil weathered from material weathered from sandstone, mainly of Permain Age. They are well drained with medium runoff and slow permeability.

These soils vary somewhat from the Stoneburg series in color of the A horizon.

Typifying Pedon: Stoneburg loam

Horizon	Depth, cm	Description
A1	0-18	Dark reddish brown (5YR 3/3) moist, loam; moderate medium granular structure; friable;

		medium acid; clear smooth boundary.
B21t	18-35	Reddish brown (5YR 4/4) moist, clay loam; weak medium subangular blocky structure; hard, friable; clay films on ped surfaces; clear smooth boundary.
B22t	35-55	Yellowish red (5YR 4/6) moist, clay loam; weak medium subangular blocky structure; hard, firm; medium acid; clay films on ped surfaces; clear smooth boundary.
B3	55-80	Yellowish red (5YR 4/6) moist, loam, and reddish yellow (7.5YR 6/6) moist; weak coarse subangular blocky structure; firm; medium acid; patchy clay films on ped surfaces; clear smooth boundary.
Cr	80-96	Yellowish red (5YR 5/6) moist, soft sandstone and reddish yellow (7.5YR 6/6) moist; penetrate the matrix of the upper part but occurs only in fractures and bedding planes in lower part.

The A1 horizon is dark brown (7.5YR 3/3) or dark reddish brown (5YR 3/3, 3/4). It is dominantly loam but includes fine sandy loam or silt loam. Reactions are medium acid through neutral. The B21t horizon colors are brown (7.5YR 4/4, 5/4) reddish brown or dark reddish brown (5YR 4/4, 3/4). Textures are loam or clay loam and reactions are medium acid through neutral. The B3 horizon has colors and textures similar to the B2t horizons. The Cr horizon or R layer is bedded sandstone with colors in shades of reds or brown.

Included with these soils in mapping are small areas of Aydelotte, Lucien, Grainola, and Zaneis soils. Also included are soils that are gradational in development between Stoneburg and Grainola over shales.

Teller Loam (TeB) 3 to 5% Slopes

The Teller soils consist of deep, well-drained, moderately permeable soils that formed in loamy sediments on terraces of Pliestocene Age. These moderately sloping soils are on broad, smooth prairies adjacent to the flood plain. The native vegetation is tall prairie grasses.

Typifying Pedon: Teller loam

Horizon	Depth, cm	Description
Ap	0-20	Dark brown (7.5YR 3/3) moist, loam; weak fine granular structure; very friable; medium acid; clear smooth boundary.
B1	20-30	Reddish brown (5YR 3.5/4) moist, loam; moderate, medium subangular blocky structure; friable; patchy clay films, slightly acid; gradual smooth boundary.
B21t	30-53	Reddish brown (5YR 4/4) moist, clay loam; moderate medium prismatic breaking to moderate fine subangular blocky structure; friable; clay films on ped surfaces; slightly acid; gradual smooth boundary.
B22t	53-76	Red (2.5YR 3.5/6) moist, loam; weak medium prismatic breaking to weak coarse subangular blocky structure; friable; slightly acid; diffuse smooth boundary.
B23t	76-112	Red (2.5YR 3.5/6) moist, loam; weak coarse prismatic breaking to weak coarse subangular blocky structure; very friable; neutral; patchy clay films; diffuse smooth boundary.
B3	112-203	Red (2.5YR 4/6) moist, very fine sandy loam (few stratas of more sandy textures); weak coarse prismatic structure; very friable; neutral.

The Teller loam is not extensive enough to establish a range in characteristics.

<u>Zaneis Loam (ZaB) 3 to 5% Slopes</u>

The Zaneis soils are on moderately sloping uplands. Slopes range from 0 to 8% but dominantly 3 to 5%. They are formed in material weathered from alternating layers of weakly consolidated sandstone and sandy shale. They are well drained, moderately slow permeability and slow through rapid runoff. The native vegetation is tall and midgrasses. The principle associated soils are, Teller, Lucien, Renfrow, Stephenville, and Grainola soils. Lucien soils are less than

50 cm to bedrock and lack B2t horizons, Stephenville soils lack mollic epipedons and are 50 to 100 cm to bedrock. Grainola soils have more than 35% clay in the control section.

Typifying Pedon: Zaneis loam

Horizon	Depth, cm	Description
A1	0-16	Dark reddish brown (7.5YR 3/2) moist, loam; weak fine granular structure; friable; medium acid; gradual smooth boundary.
B21t	16-36	Dark reddish brown (5YR 3/4) moist, clay loam; moderate, medium subangular blocky structure; firm; thin clay films; medium acid; gradual smooth boundary.
B21t	36-50	Reddish brown (5YR 4/4) moist, clay loam; weak medium prismatic structure parting to moderate fine subangular blocky structure; firm; continuous clay films on ped surfaces; medium acid; gradual smooth boundary.
B21t	50-82	Yellowish red (5YR 5/6) moist, clay loam; weak medium prismatic structure; firm; nearly continuous clay films on ped surfaces; slightly acid; gradual smooth boundary.
B3	82-122	Yellowish red (5YR 4/8) moist, clear loam; weak medium prismatic structure breaking to fine subangular blocky structure; hard; friable; patchy clay films; few fragments of sandstone; MnO2 concretions; neutral; clear smooth boundary.
Cr	122-155	Weathered bedded yellowish red (5YR 4/6) moist, sandstone that crushes to heavy sandy loam.

The Ap or A1 horizon is dark brown or dark reddish brown in hues 7.5YR or 5YR. Reaction is medium acid through neutral. The B1t horizon is dark reddish brown, reddish brown, or dark brown, in hues 5YR and 7.5YR. Texture is loam, clay loam, or sandy clay loam. Reaction is medium or slightly acid. The B2t horizon is reddish brown, yellowish red or red in hues 5YR or 2.5YR. Texture is clay loam or sandy clay loam. Reaction is slightly acid through medium acid. The B3 horizon and colors and textures are similar to the B2t horizon.

Slickspots (ϕ)

These are small areas of soils which are affected by the accumulation of sodium salts. They are adverse to the normal characteristics and are quite detrimental to the productivity of the area. These spots have a tendency to be shallow to bedrock with very fine textures.

Soil Classification

The soils of the United States and many other countries are classified according to their characteristics. The present system has been in effect since 1965 by Cooperative Soil Survey. This system is flexible enough to change as the knowledge of soils increase or the soil itself increases. The new system designated as "Soil Taxonomy" is a multiple category system utilizing six categories. These include order, suborder, great group, subgroup, families, and finally the individual soil series. This system attempts to define the soil individual and to identify those with which it is associated. The soils of the Lake Carl Blackwell are are classified according to Soil Taxonomy and appear in Table IV.

Soil Interpretations

A primary responsibility of the soil scientist is to make accurate interpretations of the soil properties with which he is working. If this is not done effectively the best uses of the land will not be made. Soil interpretations are more accurate if their total input is from all areas of soil science, these areas are; soil physics, soil chemistry, engineering, soil mineralogy, soil fertility, and soil morphology, a combination of these branches produce the most productive use of the soil.

TABLE IV

CLASSIFICATION OF THE SOILS IN THE LAKE CARL BLACKWELL AREA PAYNE COUNTY, OKLAHOMA

Soil Series	Family	Subgroup	Order
Aydelotte	Fine, mixed, thermic	Udertic Paleustalfs	Alfisols
Dale	Fine-silty, mixed, thermic	Pachic Haplustolls	Mollisolls
Darnell	Loamy, siliceous, thermic, shallow	Udic Ustochrepts	Inceptisols
Grainola	Very-fine, mixed, thermic	Vertic Haplustalfs	Alfisols
Lucien	Loamy, mixed, thermic, shallow	Typic Haplustolls	Mollisols
Norge	Fine-silty, mixed, thermic	Udic Paleustolls	Mollisols
Oscar	Fine-silty, mixed, thermic	Typic Natrustalfs	Alfisols
Port	Fine-silty, mixed, thermic	Cumulic Haplustolls	Mollisols
Renfrow	Fine, mixed, thermic	Udertic Paleustolls	Mollisols
Stephenville	Fine-loamy, siliceous, thermic	Ultic Haplustalfs	Alfisols
Stoneburg	Fine-loamy, mixed, thermic	Udic Haplustolls	Mollisols
Teller	Fine-loamy, mixed, thermic	Udic Argiustolls	Mollisols
Zaneis	Fine-loamy, mixed thermic	Udic Argiustolls	Mollisols

As was stated previously the soil interpretations are divided into two sections, agricultural and non-agricultural interpretations. Although these two areas seem to be at opposite ends of a scale, they do infact interrelate with the land-use planner. With the ever increasing demand for urbanization countless acres of prime agricultural land is being taken to provide the needed space. The planner through effective interpretations is able to determine the wisest use of the land. Anyone knows that if the land can be best utilized for agriculture it ought to be used that way. The same is true concerning soils used for septic tanks, roads or buildings. The problem comes when the soil used for agriculture is also best suited for non-agricultural practices. This is of great concern presently and considerations for long range needs are being applied towards the best solutions.

Agricultural Interpretations

The soils in the Lake Carl Blackwell area have been interpreted into two agricultural uses, tame pastures and range sites. Table II lists the soils in the area, their land capability classification and also their range site.

The land-use planner is not completely concerned with all the factors of the land capability classifications. He is primarily concerned with what soils will make the best agricultural land. For this purpose the land capability classification has been generalized into three soil potentials for cultivation. Classes I, IIe, IIw, and IIs are considered good potential for farming. Classes IIIe, IIIw have a fair potential rating. Classes IVe, Vw, VIe and VIIs have poor potential for cultivation. The study area is generally classed in

IVe land and would be primarily considered poor for cultivation, but good for range land.

Range Sites

There are six range sites in the study area and these are presented in Table II. Figure 5 is a soil potential map for range sites. Range sites are classed by their annual yield of air-dry herbage in years of favorable moisture. Soils with good potential as range sites yield more than 4,000 pounds per acre annually. Soils with fair potential for range sites are from 4,000 to 2,700 pounds per acre and poor less than 2,700 pounds per acre.

Alkali (Sodic) Bottomland Range Site

These range sites consist of those soils which are affected by sodium salt accumulation. The slickspots and the Oscar soils are in this category. They have slow permeability. The major vegetation on this range site consists of inland salt grass, switch grass, and alkali muhly.

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

Claypan Prairie Range Site

This site consists of deep gently sloping or moderately sloping loamy soils that have a clayey or loamy subsoil. These soils are on uplands and include the Aydelotte and the Renfrow soils.

The vegetation consists mainly of: little bluestem, big bluestem,

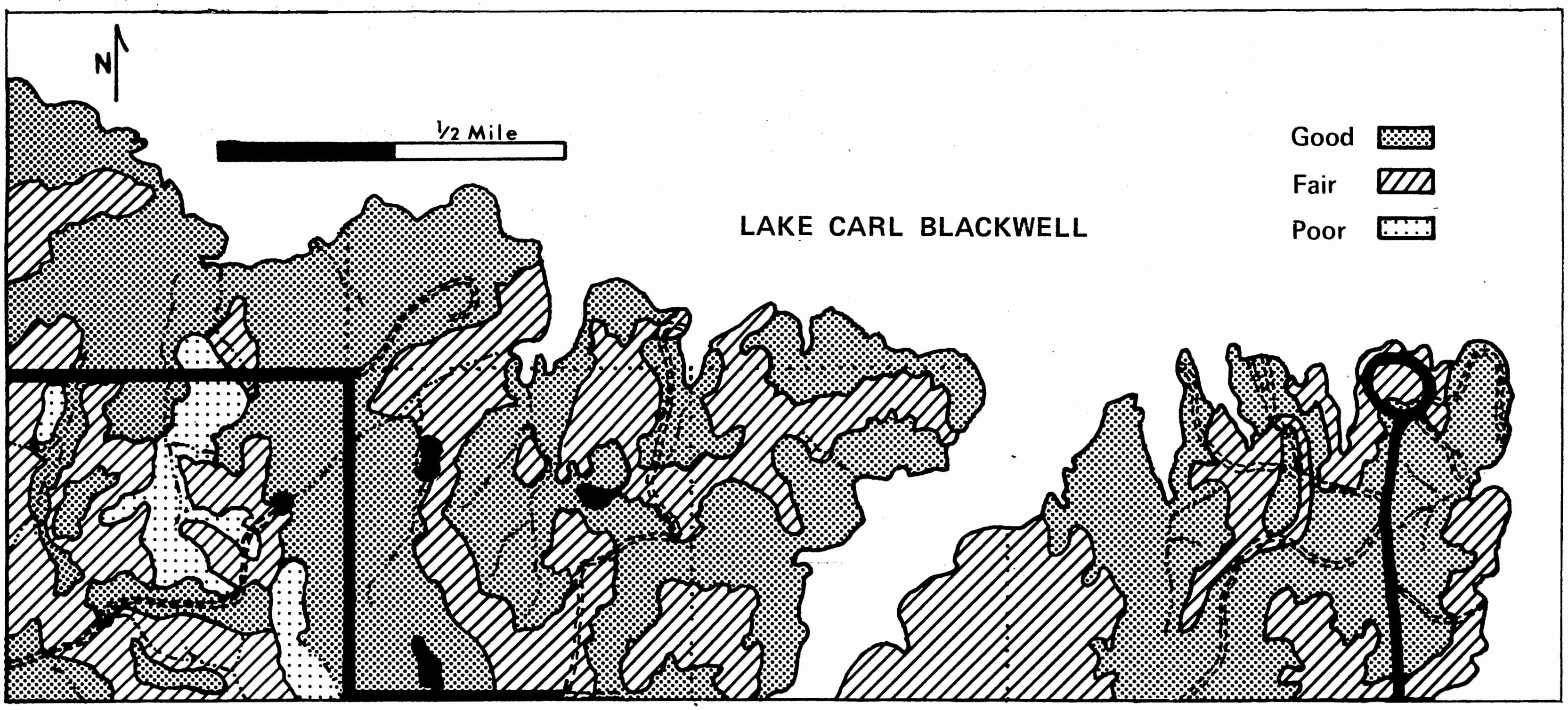


Figure 5. Range Site Potential Map

switchgrass, Indian grass, forbs, and unpalatable weeds.

Estimated yield in years of favorable rain is up to 4,000 pounds of air-dry herbage. In times of less rainfall it is 2,000 pounds.

Eroded Clay Range Site

The only soil occupying this particular site is the Grainola severely eroded soil. Little forage is produced in this site because of the extreme amounts of erosion.

Where this site is in excellent condition the estimated yields would be 1,400 pounds per acre of herbage in favorable years. Where this is not the case estimates usually range close to 800 pounds per acre.

Loamy Prairie Range Site

This area consists of gently sloping through steep soils on uplands. They are loamy, throughout and consist of the soils Lucien, Norge, Stoneburg, Teller, Zaneis, and upland part of Broken Alluvial Land Complex. They are easily penetrated by roots, well drained, and have good moisture storing capacity.

This is the most productive upland range site in the study area and produces an estimated yield in favorable years of adequate moisture 5,000 pounds per acre of air-dry herbage. In years of unfavorable moisture this yield drops to 2,500 pounds per acre. This is if the site is in excellent condition and not overly grazed or eroded.

Loamy Bottomland Range Site

This range site consists of deep, dark, loamy soils on bottomlands.

These are the Dale, Port, and flood plain soils of Broken Alluvial Land Complex. It is by far the most productive range site around Lake Carl Blackwell.

When the range site is in excellent condition it is capable of producing 8,500 pounds of air-dry herbage if the moisture is good. If this is not the case it can still produce 4,500 pounds per acre. The soils in this site are the Dale and Port series.

Red Clay Prairie Range Site

This range site consists of clayey gently sloping or moderately sloping 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. The Grainola soils are included in this range site.

Where the site is in excellent condition and under optimum moisture conditions, the estimated annual air-dry herbage is 2,700 pounds per acre. In years of less favorable moisture conditions the amount decreases to 1,600 pounds per acre.

Shallow Savannah Range Site

This range site consists of shallow upland soils. The presence of sandstone at shallow depths limits root penetration. The palatable forage is limited with the most common native vegetation being a variety of oak species, grasses, and forbs. The soil which dominates this range site is the Darnell series of the Darnell-Stephenville Complex.

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

Sandy Savannah Range Site

This range site consists of gently sloping to strongly sloping soils with a sandy to loamy subsurface. These Stephenville soils support a mixture of tall grasses and woody plants. Overgrazing thins out the grasses and forbs and helps to increase the invadors, particularly woody plants. The main soil in this range site is the Stephenville series.

In excellent condition with the optimum moisture levels one might expect 3,200 pounds per acre of air-dry herbage excluding trees and brush and 1,400 pounds per acre in years of unfavorable moisture.

Non-Agricultural Interpretations

Septic tank absorption fields, small dwellings with basements, sewage lagoons, local roads and streets, parks and playgrounds, and sanitary landfills, are the non-agricultural interpretations which were considered. The soil potential and suitability for each of these interpretations are presented in Table V.

The soil potentials for these six land-uses were determined by this process. The soil properties which affect the suitability of the specific land-use were determined by the Soil Conservation Service. The concept of soil limitation used by the Soil Conservation Service was converted to soil potential. This was done by averaging the number of properties considered with their associated soil limitations. These groupings were classed then as soil potentials in the groups; good, fair, and poor. The soils were then considered for other conditions,

TABLE V

SOIL POTENTIALS FOR SIX URBAN LAND USES

Map Symbols	Soil Mapping Unit	Local Roads and Streets	Dwellings with Basements	Sanitary Landfills Trench	Sewage Lagoons	Septic Tank Absorption Fields	Parks and Playgrounds
AyB	Aydelotte loam, 3 to 5% slopes	fair	fair	poor	good	poor	fair
Ba	Broken-Alluvial land complex	poor	poor	poor	poor	poor	fair
DaA	Dale silt loam, 0 to 2% slopes	fair	poor	poor	poor	poor	fair
DS	Darnell - Stephenville complex, 1 to 8% slopes	good	fair	poor	poor	good	fair
GrA	Grainola silty clay loam, 1 to3% slopes	poor	poor	fair	good	poor	fair
GrB	Grainola silty clay loam, 3 to 5% slopes	poor	poor	fair	good	poor	fair
Gr3	Grainola silty clay laom, severely eroded	poor	poor	fair	fair	poor	poor
LuA	Lucien sandy loam, 2 to 5% slopes	good	fair	poor	poor	fair	fair
NoB	Norge loam, 3 to 5% slopes	good	good	good	good	fair	fair

TABLE V (Continued)

Map Symbols	Soil Mapping Unit	Local Roads and Streets	Dwellings with Basements	Sanitary Landfills Trench	Sewage Lagoons	Absorption Fields	Parks and Playgrounds
No3	Norge loam, severely eroded	good	good	good	fair	fair	fair
PO	Port - Oscar complex, 1 to 3% slopes	fair	poor	poor	poor	poor	fair
PoA	Port silt loam, 0 to 3% slopes	fair	poor	poor	poor	poor	fair
ReA	Renfrow silt loam, 1 to 3% slopes	fair	fair	poor	good	poor	fair
StB	Stephenville sandy loam, 3 to 5% slopes	good	good	fair	fair	good	good
SoA	Stoneburg loam, 2 to 5% slopes	good	good	good	good	fair	good
TeB	Teller loam, 3 to 5% slopes	fair	good	poor	fair	fair	fair
ZaB	Zanies loam, 3 to 5% slopes	good	good	good	good	fair	good
ϕ	Slickspots	poor	poor	poor	poor	poor	poor

including, the cost of overcoming the conditions, the past performance of the soil for the desired use, and certain environmental aspects. Usually these last effects had no significant influence upon the initial order. It should be stressed again that the soil mapping unit is the dominant soil in that area, however, there are inclusions of other soils with varying properties and characteristics. With this in mind, on site investigations should always be made to determine the specific characteristics of the soil at the projects location.

Septic Tank Absorption Fields

A major problem faced by urban and rural planners is the disposing of liquid wastes from individual homes. The soils around the Lake Carl Blackwell in general are ill-suited for this. The best areas, however, might be found and that is the particular purpose of soil potential maps, to help provide a basis for any type of use. Certain soils are better suited than others for absorption fields if other alternatives for waste disposal are not feasible.

Septic tank absorption fields are subsurface systems of tile or perforated pipe that distribute effluent from a septic tank into natural soil. The soil material from a depth of 45.64 cm to 184 cm is evaluated. The soil properties considered are those that affect both absorption of effluent, construction, and operative of the system. Properties that affect absorption are permeability, depth to bedrock or water table, and susceptibility to flooding. Slope is a soil property that affects difficulty of layout, construction, risk of erosion, lateral seepage, and downslope flow of effluent. Large rocks also increase construction costs. Figure 6 is a soil potential map for use in septic tank

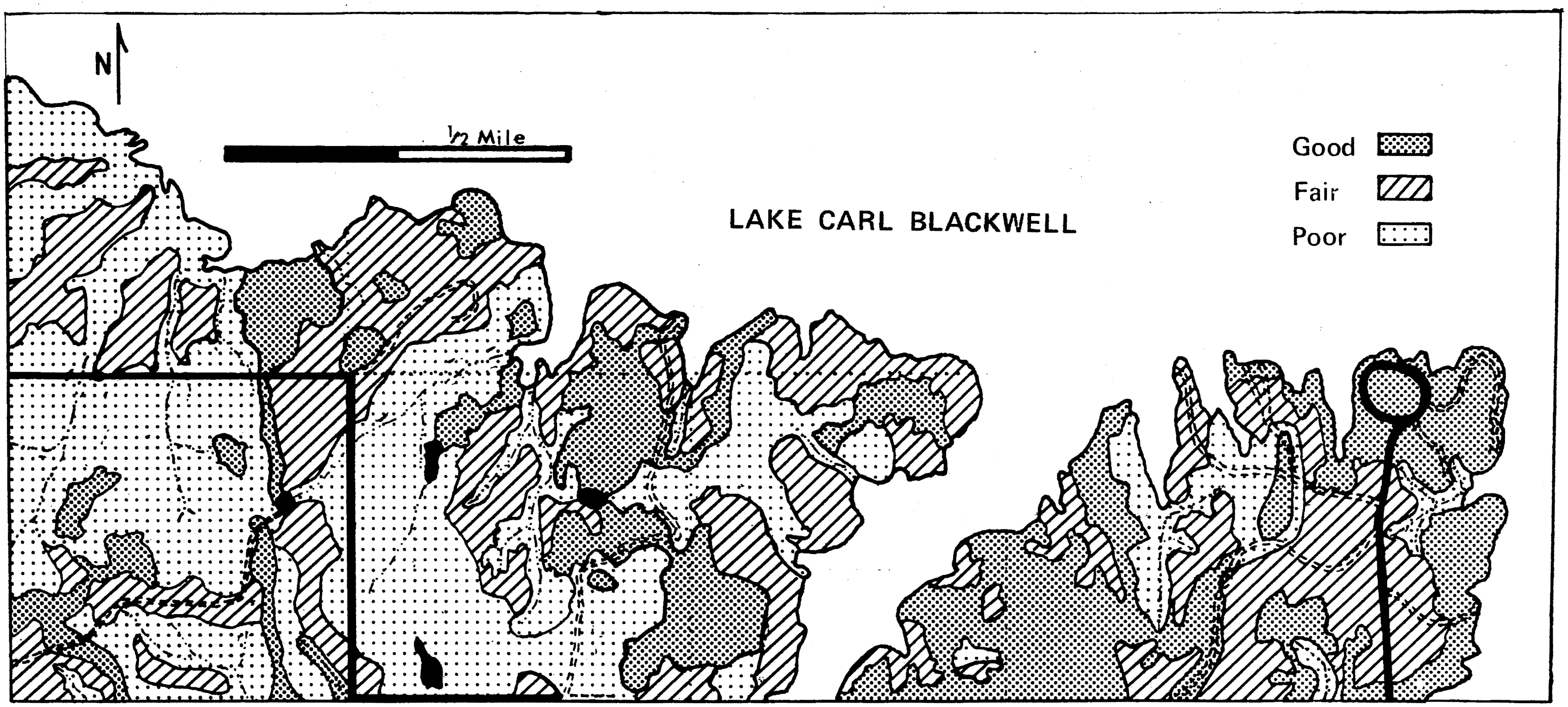


Figure 6. Soil Potential Map for Septic Tank Absorption Fields

absorption fields. Most of Lake Carl Blackwell soils have several soil conditions that make the use of absorption fields expensive to construct, inoperable or a health hazard, because insufficient steps have not been taken to overcome existing limitations. An alternative which should be considered is the construction of sewage lagoons. The use of such lagoons centralizes to a greater extent the sewage of a single area.

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

Sewage Lagoons

Sewage lagoons are shallow ponds constructed to hold sewage within a depth of 61 cm to 142 cm, long enough for bacteria to decompose the solids. A lagoon has a nearly level floor and sides, or embankments, compacted to a medium density and the pond is protected from flooding. Properties are considered that affect the pond floor and the embankment. Those that affect the pond floor are permeability, organic matter, and slope. If the floor needs to be leveled, depth to bedrock becomes important. The soil properties that affect the embankment are the engineering properties of the embankment material as interpreted from the Unified Soil Classification and the amounts of stones, if any, that influence the ease of excavation and compaction of the embankment material.

Those soils in the study area are well suited for this particular purpose. The use of sewage lagoons are restricted to groups of homes much like a subdivision, which can share the cost of construction. The advantages of centralized sewage are improved health conditions, especially where soils are unsuitable for absorption fields.

TABLE VI

SOIL POTENTIAL AND LIMITATIONS FOR SEPTIC TANK ABSORPTION FIELDS

Map Symbols	Soil Potential	Limitations
AyB	poor	very slow permeability
Ba	poor	subject to flooding
DaA	poor	subject to flooding
DS	good	1 to 8% slopes, depth to bedrock
GrA	poor	very slow permeability
GrB	poor	very slow permeability
Gr3	poor	very slow permeability
LuA	good	2 to 5% slopes, shallow to bedrock
NoB	fair	slow permeability
No3	fair	slow permeability
PO	poor	subject to flooding
PoA	poor	subject to flooding
ReA	poor	very slow permeability
StB	good	3 to 5% slopes, depth to bedrock
SoA	fair	40 inches to sandstone
TeB	fair	slow permeability
ZaB	fair	slow permeability
ϕ	poor	slow permeability, shallow to bedrock

Figure 7 is the soil potential map for the use of sewage lagoons. Table VII gives the soil potential rating and the limitations which need to be overcome when designing and constructing sewage lagoons in the general area of Lake Carl Blackwell.

Small Dwellings With Basements

These are defined as: Dwellings which are not more than three stories high that are supported by foundation footings in undisturbed soil. The features that affect the ratings of a soil for such dwellings are those that relate to capacity to support load and resist settlement under load, and those that relate to ease of excavation. Soil properties that affect capacity to support load are wetness, susceptibility to flooding, density, plasticity, texture, and shrink-swell potential. Those that affect excavations are wetness, slope, depth to bedrock, and content of stones and rocks.

The Lake Carl Blackwell area offers some very good sites for homes. There also exists some areas where building homes or other small dwellings with a basement should be avoided. These areas are illustrated more clearly in Figure 8 which is the soil potential map for small dwellings with basements. The soil and its respective limitations are listed on Table VIII. An important point to note are the special problems of a soils tendency to shrink upon drying and swell upon wetting. Special consideration should be taken when this property is encountered. Another specific problem often encountered by some is the building of homes on a flood plain. This should be entirely avoided altogether. Each year thousands of dollars are lost due to poor planning in establishing a development on flood plains.

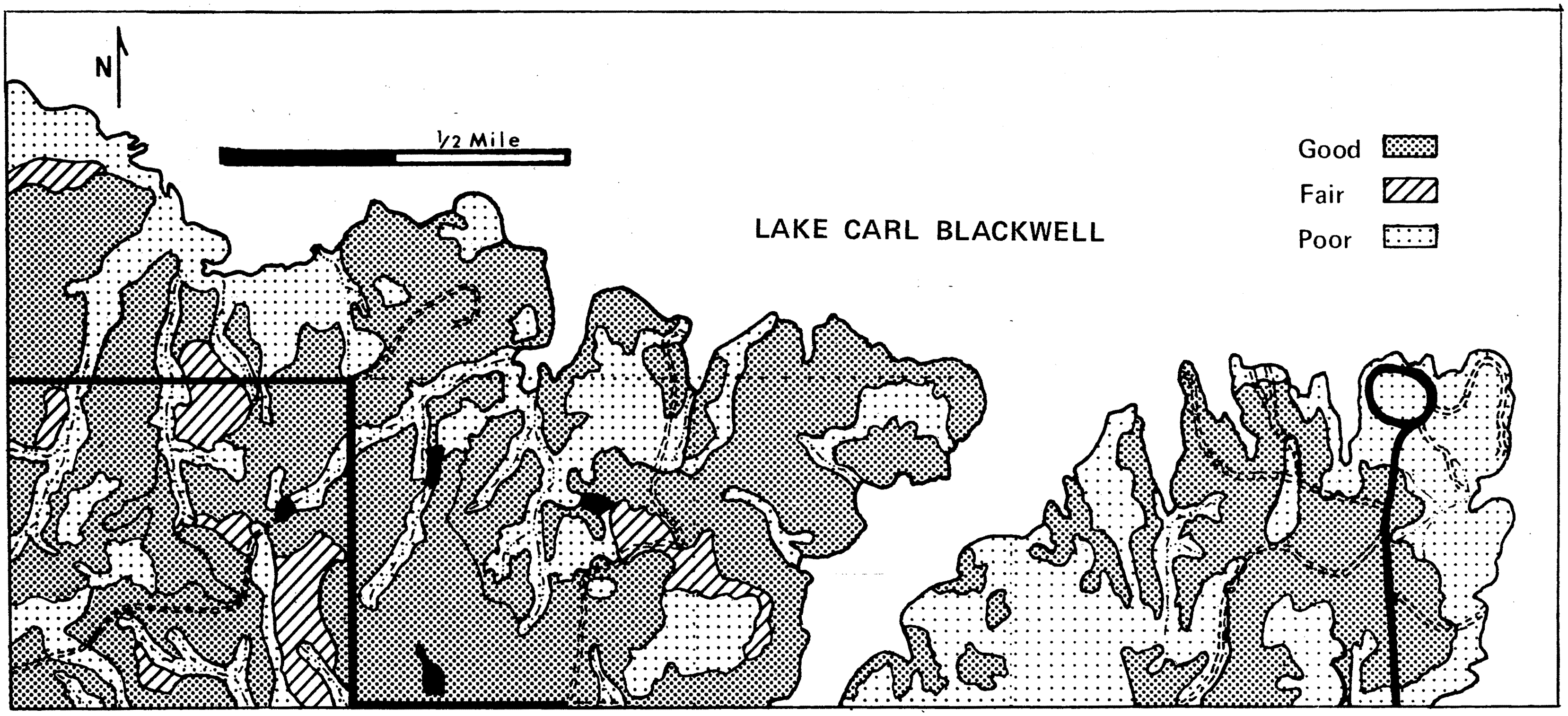


Figure 7. Soil Potential Map for Sewage Lagoons

TABLE VII

SOIL POTENTIAL AND LIMITATIONS FOR SEWAGE LAGOONS

Map Symbols	Soil Potential	Limitations
AyB	good	3 to 5% slopes
Ba	poor	subject to flooding
DaA	poor	subject to flooding
DS	poor	1 to 8% slopes, moderate permeability, 15 to 40 inches to sandstone
GrA	good	1 to 3% slopes
GrB	good	3 to 5% slopes
Gr3	fair	severe erosion, 3 to 5% slopes
LuA	poor	shallow to sandstone
NoB	good	3 to 5% slopes
No3	fair	severe erosion, slope
PO	poor	subject to flooding
PoA	poor	subject to flooding
ReA	good	1 to 3% slopes
StB	fair	3 to 5% slopes, depth to sandstone, moderate permeability
SoA	good	2 to 5% slopes, depth to sandstone
TeB	fair	moderate permeability 3 to 5% slopes
ZaB	good	3 to 5% slopes, depth to bedrock
ϕ	fair to poor	can be shallow to bedrock, embankments are unstable

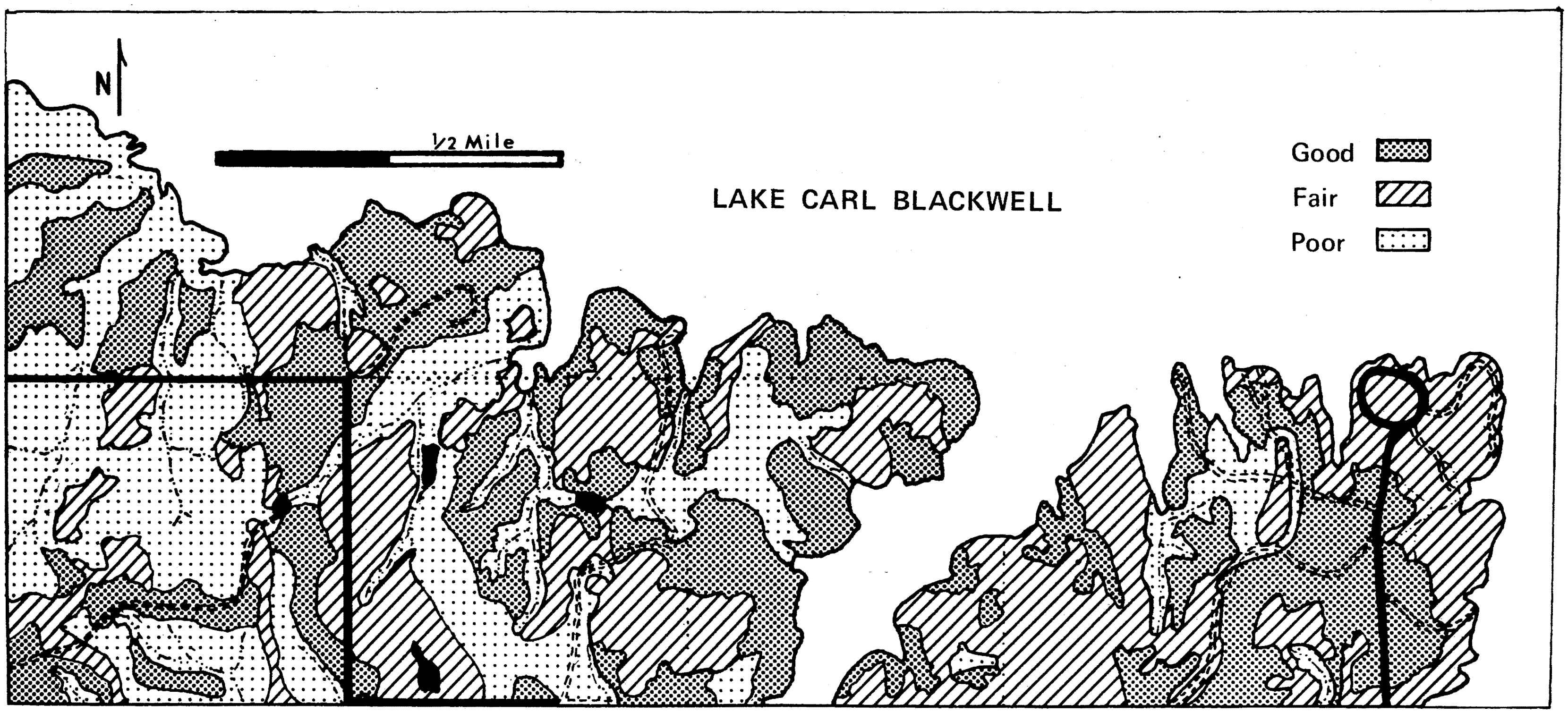


Figure 8. Soil Potential Map for Small Dwellings With Basements

TABLE VIII

SOIL POTENTIAL AND LIMITATIONS FOR DWELLINGS WITH BASEMENTS

Map Symbols	Soil Potential	Limitations
AyB	fair	high shrink-swell potential, unified soil group of CH, CL
Ba	poor	subject to flooding
DaA	poor	subject to flooding
DS	fair	1 to 8% slopes, sandstone at 10 to 40 inches
GrA	poor	high shrink-swell potential, unified soil group of CH, clay beds at 40 inches
GrB	poor	high shrink-swell potential, unified soil group of CH, clay beds at 40 inches
Gr3	poor	high shrink-swell potential, unified soil group of CH, clay beds at 40 inches
LuA	fair	10 to 20 inches to sandstone
NoB	good	3 to 5% slopes, shrink-swell
No3	good	3 to 5% slopes, shrink-swell
PO	poor	subject to flooding soil group CL, ML
PoA	poor	subject to flooding, soil group CL, ML
ReA	fair	high shrink-swell potential, unified soil group of CH
StB	good	3 to 5% slopes, depth to bedrock

TABLE VIII (Continued)

Map Symbols	Soil Potential	Limitations
SoA	good	2 to 5% slopes, depth to bedrock
TeB	good	3 to 5% slopes,
ZaB	good	3 to 5% slopes, shrink-swell
ϕ	poor	poorly drained high shrink-swell

Local Roads and Streets

The two major soil properties which affect the utilization of land for roads and streets are the depth to bedrock and the soils tendency to shrink on drying and swell upon wetting. There is also a problem of locating roads and streets in areas where flooding may occur. Of the two soil properties themselves the shrink-swell potential is the most serious, however, with proper treatment this problem may be overcome. The greatest criteria for streets and roads is to locate them on soils where these problems are not encountered and thereby save much time and money on maintenance and repair. The soil potential map for local roads and streets can act as a standard for the future development of this area. This map appears as Figure 9. The limitations of each soil and the soil itself is listed on Table IX.

Parks and Playgrounds

Congress is continually allocating money to purchase land for the establishment of parks for the enjoyment of the American people. On a local basis dealing with the communities and counties, parks and playgrounds are an important part of a planners format and should be carefully considered. A primary consideration should include, depth to bedrock or water table, susceptibility to flooding, degree of erodability, texture of surface horizon, and also droughtiness and capability to maintain a grass cover under intensive use (15). Lake Carl Blackwell offers a unique type of atmosphere for a park and various types of recreation. It has been well planned and serves the county and the town of Stillwater. The soil potential map for parks and

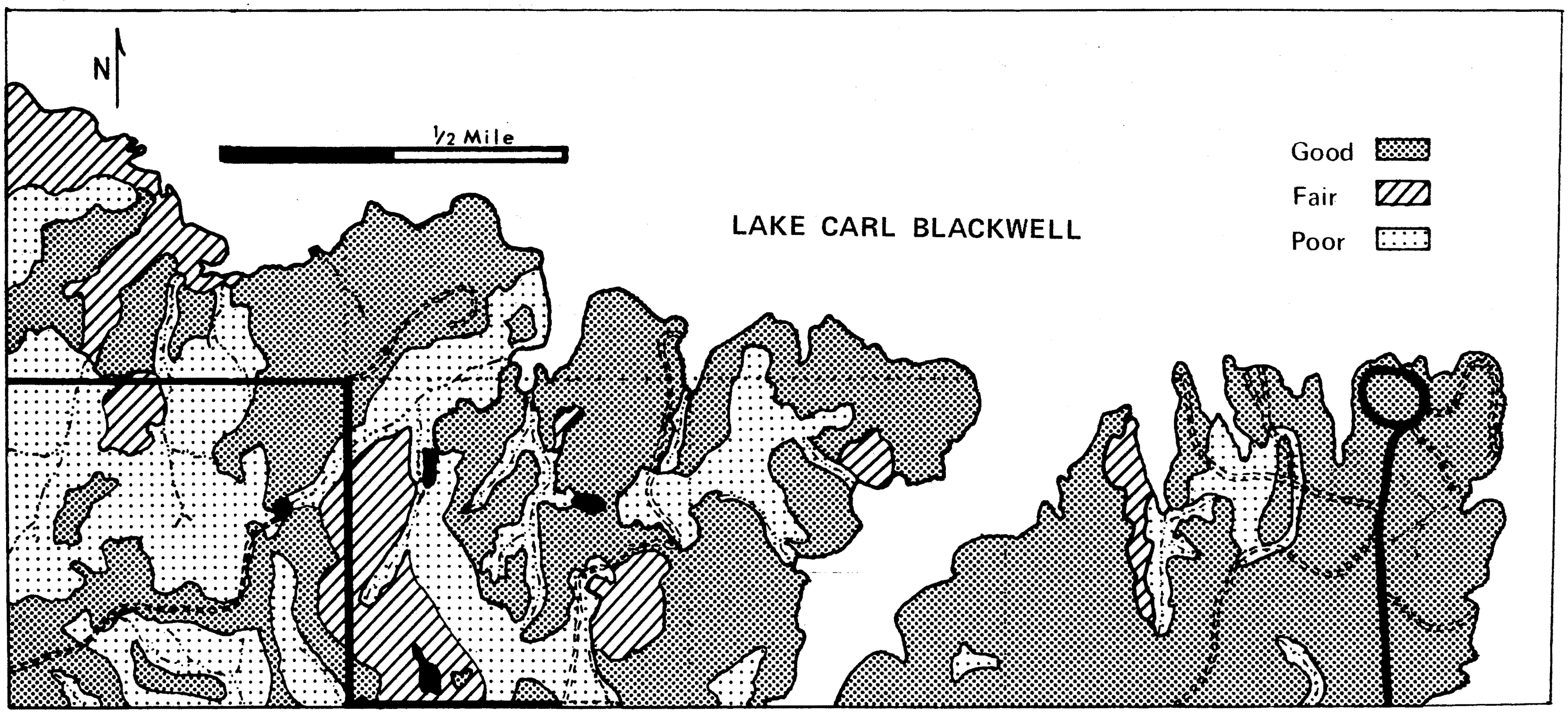


Figure 9. Soil Potential Map for Local Roads and Streets

TABLE IX

SOIL POTENTIAL AND LIMITATIONS FOR LOCAL ROADS AND STREETS

Map Symbols	Soil Potential	Limitations
AyB	fair	AASHO rating A-7, high shrink-swell potential
Ba	poor	subject to flooding, steep slopes
DaA	fair	low strength, moderate shrink-swell potential, subject to flooding
DS	good	sandstone 15 to 40 inches
GrA	poor	20 inches to clay beds, AASHO rating A-7, high shrink-swell potential
GrB	poor	20 inches to clay beds, AASHO rating A-7, high shrink-swell potential
Gr3	poor	20 inches to clay beds, AASHO rating A-7, high shrink-swell potential, severe gullies
LuA	good	sandstone within 20 inches
NoB	good	AASHO rating A-6, moderate shrink-swell potential, low strength
No3	good	AASHO rating A-6, moderate shrink-swell potential
PO	fair	subject to flooding, AASHO rating A-7, shrink-swell potential
PoA	fair	subject to flooding, AASHO rating A-7, shrink-swell potential

TABLE IX (Continued)

Map Symbols	Soil Potential	Limitations
ReA	fair	AASHO rating A-7, high shrink-swell potential
StB	good	AASHO rating A-6
SoA	good	moderate shrink-swell potential, low strength AASHO rating A-5
TeB	fair	moderate shrink-swell potential, low strength
ZaB	good	AASHO rating A-7, moderate shrink-swell potential
ϕ	poor	poorly drained, high shrink-swell potential

playgrounds appears in Figure 10. The soil and its limitations appear on Table X.

Sanitary Landfills-Trench

Sanitary landfill is a method of disposing of refuse in dug trenches. The waste is spread in thin layers, compacted, and covered with soil throughout the disposal period. Landfill areas are subject to heavy vehicular traffic. Some soil properties that affect suitability for landfill are ease of excavation, hazard of polluting ground water, and trafficability. The best soils have moderately slow permeability, withstand heavy traffic, and are friable and easy to excavate. Unless otherwise stated the soils in this report apply to a depth of 183 cm. For some soils reliable predictions maybe made to a depth of 254 to 481 cm, but regardless of that, on site investigations should always be made before final selection is made.

The soil potential map for sanitary landfills is presented in Figure 11. The limitations for the most part in the Lake Carl Blackwell area would be rated as fair to the location of a sanitary landfill, but again there are sites which would be perfect and those sites may easily be determined through the guidelines presented in this study. The soils and their specific limitations are presented on Table XI.

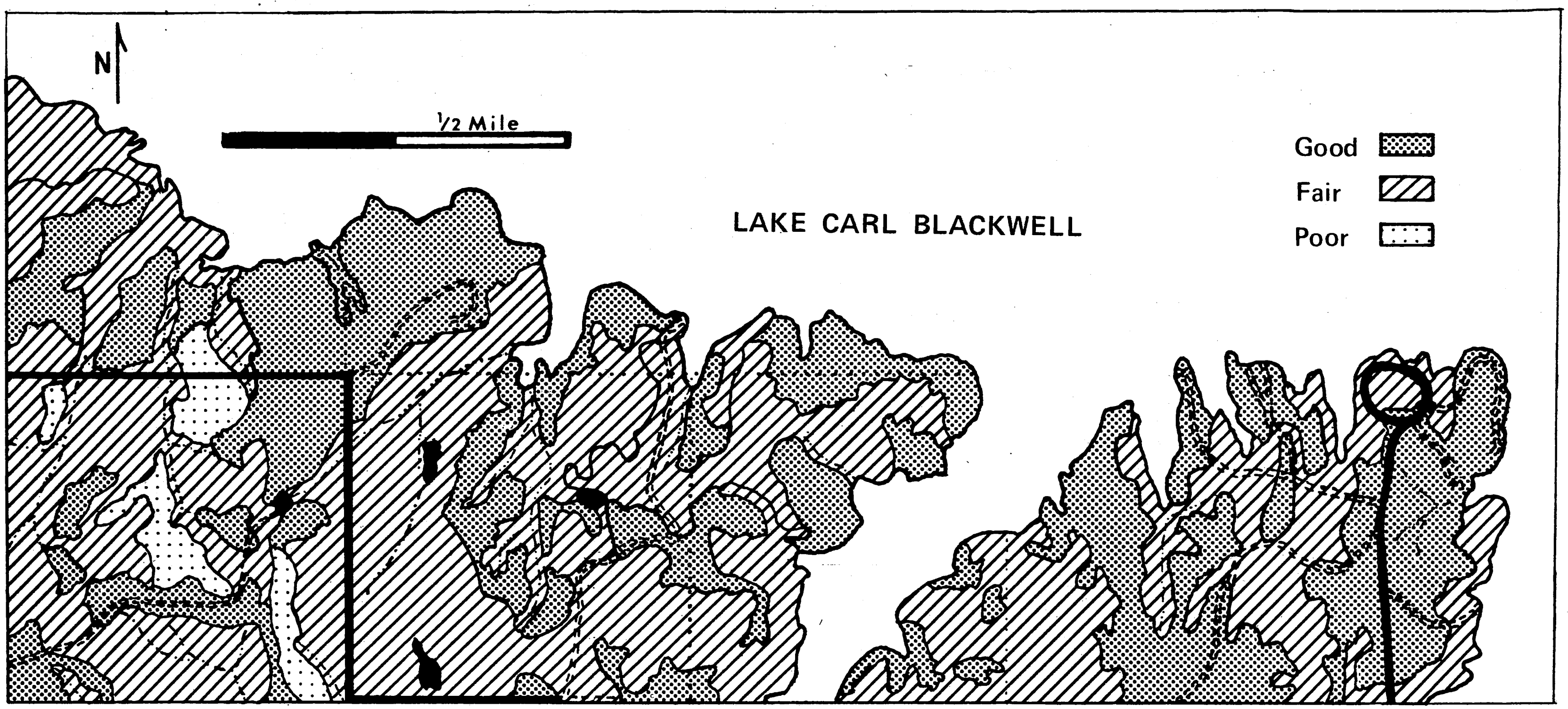


Figure 10. Soil Potential Map for Parks and Playgrounds

TABLE X

SOIL POTENTIAL AND LIMITATIONS FOR PARKS AND PLAYGROUNDS

Map Symbols	Soil Potential	Limitations
AyB	fair	very slow permeability, silt loam surface, 3 to 5% slopes
Ba	fair	subject to flooding, annual wetness
DaA	fair	subject to flooding, annual wetness
DS	fair	1 to 8% slopes, shallow to sandstone, droughty
GrA	fair	shrink-swell potential, 1 to 3% slopes
GrB	fair	shrink-swell potential, 3 to 5% slopes
Gr3	poor	shrink-swell potential, severe erosion
LuA	fair	2 to 5% slopes, shallow to sandstone
NoB	fair	3 to 5% slopes
No3	fair	3 to 5% slopes, severe erosion
PO	fair	subject to flooding, annual wetness
PoA	fair	subject to flooding, annual wetness
ReA	fair	very slow permeability, 1 to 3% slopes
StB	good	3 to 5% slopes, depth to bedrock

TABLE X (Continued)

Map Symbols	Soil Potential	Limitations
SoA	good	2 to 5% slopes, depth
TeB	good	3 to 5% slopes
ZaB	fair	3 to 5% slopes
ϕ	poor	shallow, lack of vegetation, wet

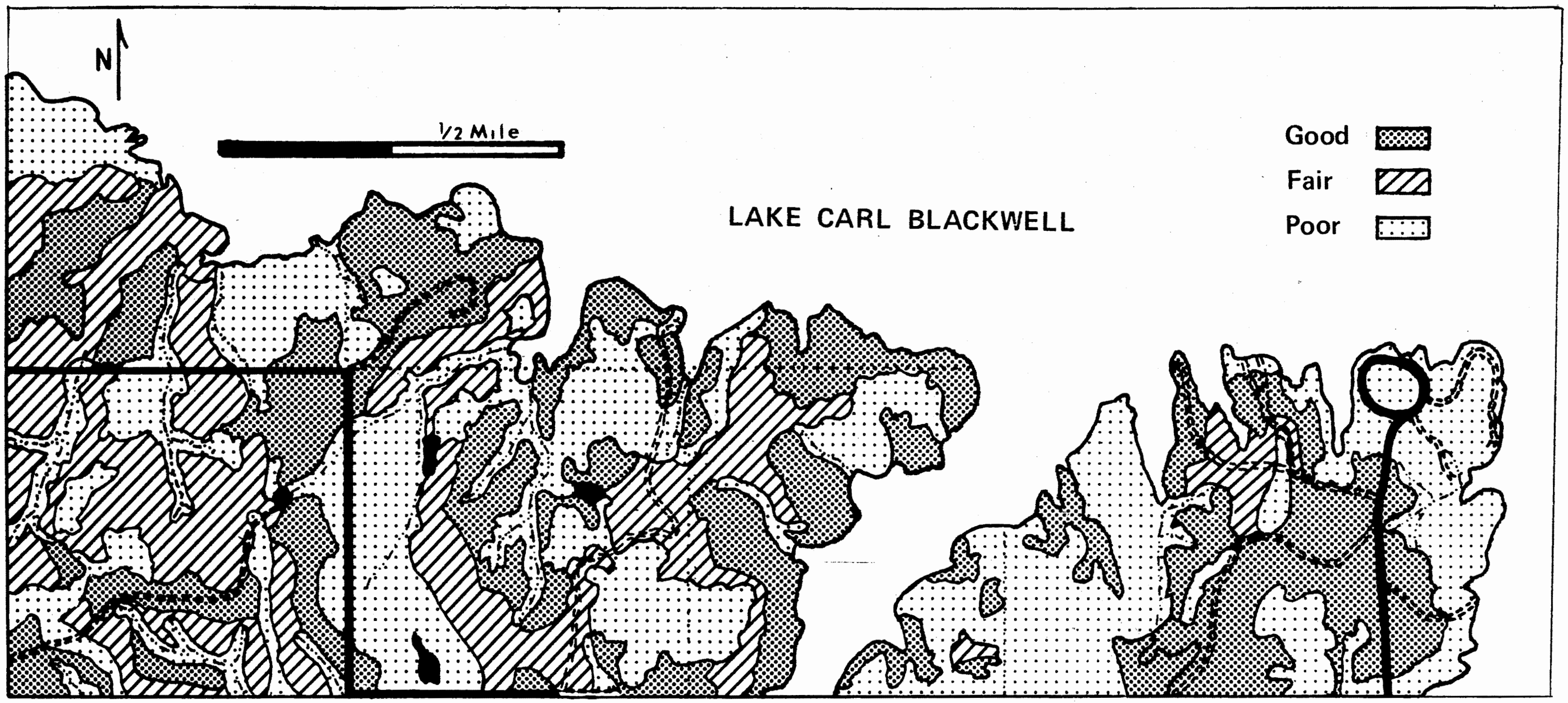


Figure 11. Soil Potential Map for Sanitary Landfills-Trench

TABLE XI

SOIL POTENTIAL AND LIMITATIONS FOR SANITARY LANDFILLS-TRENCH

Map Symbols	Soil Potential	Limitations
AyB	poor	too clayey
Ba	poor	subject to flooding
DaA	poor	subject to flooding
DS	poor	shallow to sandstone, seepage
GrA	fair	clayey
GrB	fair	clayey
Gr3	fair	clayey
LuA	poor	shallow to bedrock, seepage
NoB	good	3 to 5% slopes, clayey
No3	good	3 to 5% slopes, clayey
PO	poor	subject to flooding
PoA	poor	subject to flooding
ReA	poor	clayey
StB	fair	moderate depth to bedrock
SoA	good	2 to 5% slopes, depth to rock
TeB	good	3 to 5% slopes, seepage
ZaB	good	3 to 5% slopes, clayey, depth to rock
ϕ	poor	shallow to bedrock, wetness

CHAPTER V

SUMMARY AND CONCLUSIONS

Soil surveys have been useful for many years in scientific investigation procedures. Highway engineers, agriculturalists, land appraisers, and spatial planning groups have long been concerned about the soil's potential for various purposes. This concern continues to grow with the ever-increasing demand placed on prime agricultural land for urbanization. Therefore, the need for wise land-use planning is evident.

To illustrate land-use planning for multiple land-uses, five sections of land on the southern end of Lake Carl Blackwell were chosen. This area is located in the northwest corner of Payne County, Oklahoma. The area was chosen because of the variety of interests in the areas use. The area soils were developed from Permian sediments under sub-humid climatic conditions with an average precipitation of 86.4 cm per year. A detailed soil survey of the area was begun in the spring of 1978 and completed in October of 1978. The soil boundaries were superimposed on aerial photographs following the criteria established in the Soil Conservation Service's Handbook on Soil Taxonomy (22). The soils mapped and described represent three soil orders in Oklahoma: Alfisols, Mollisols, and Inceptisols.

The physical and chemical soil properties had previously been determined for each soil series established in the area. Through the interpretation of these properties, soil potentials were established. These soil potentials are indications of a soil's response to specific uses. The soil potentials were determined for six engineering uses, sewage lagoons, sanitary landfills, small dwellings with basements, local roads and streets, and recreation facilities including parks. There were also potentials established for the agricultural uses of the area. These were for range sites, tame pastures, and land capability units. These potentials provide an effective resource tool for the planning of rural and non-rural communities. They also provide guidelines by which decisions might be made concerning competition for land between agricultural and non-agricultural purposes. Through the combination of economic, social, political, and natural resource information, along with proper use of these established soil potentials, the land-use decisions made for this area should be well based. Land-use planning utilizing soil survey information is an art and millions of dollars often can be saved.

Soil potential maps were established using the soils map as a base map for boundaries. These maps have provided information in locating a particular area, or areas, where the soils would have the best potential for a desired use. If there are serious limitations, alternative sites usually should be considered. However, there are procedures established by which the particular limitation may be overcome. The Payne County office of the Soil Conservation Service has additional information that might be utilized to overcome the limitations.

In conclusion it can be stated that an area can be properly utilized to its greatest potential. This is accomplished through the utilization of a detailed soil survey and careful interpretation of soil characteristics. Soil potentials for a wide range of uses should be established as guidelines for effective decision making processes. This study illustrates how this might be successfully accomplished.

LITERATURE CITED

1. Bauer, K. W. 1973. The use of soils data in regional planning. Geoderma 10:1-27.

2. Bauer, K. W. 1966. Application of soil studies in comprehensive regional planning. Soil Surveys and Land Use Planning. Soil Sci. Soc. Am. Madison, Wisc. pp. 42-59.

3. Brady, Nyle C. 1974. The Nature and Properties of Soils. New York, New York.

4. Buol, Hole, McCracen. 1973. Soil Genesis and Classification. Iowa State University Press. Ames, Iowa.

5. Gray, Fenton, and H. M. Galloway. 1959. Soils of Oklahoma. Oklahoma Agricultural Bulletin, MP-56.

6. Gray, Fenton. 1966. Productivity of key soils in Oklahoma. Oklahoma Agricultural Bulletin, B-650.

7. Grover, Williams. 1975. Soil survey of Alfalfa County, Oklahoma. Soil Conservation Service. U. S. Dept. of Agr. Washington, D. C.

8. Hayes, C. J. 1967. Engineering Classification of Geologic Materials Division Four. Oklahoma Highway Department. pp. 221-267.

9. Hausenbuiler, R. L. 1973. Soil Science Principles and Practice. Dubuque, Iowa.

10. Johnson, W. M. and L. J. Bartelli. 1974. Rural Development: Natural resource dimensions. Journal of Soil and Water Conservation 29:18-19.

11. Kaster, D. L. and O. W. Yates, Jr. 1966. The urban soils program in Prince William County, Virginia. Soil Surveys and Land Use Planning. Soil Sci. Soc. Am. Madison, Wisc. pp. 126-129.

12. Kellogg, C. E. 1966. Soil surveys for community planning. Soil Surveys and Land Use Planning. Soil Sci. Soc. Am. Madison, Wisc. pp. 1-7.

13. Klingebiel, A. A. 1958. Soil survey interpretation - capability groupings. Soil Sci. Soc. Am. Proc. 22:160-63.

14. McCormack, D. E. 1974. Soil Potential: A positive approach to urban planning. Journal of Soil and Water Conservation 29:258-262.

15. Montgomery, P. H. and F. C. Edminister. 1966. Use of soil surveys in planning for recreation. Soil Surveys and Land Use Planning. Soil Sci. Soc. Am. Madison, Wisc. pp. 104-112.

16. Peschel, D. M. 1975. The determination of agriculture and non-agriculture soil potentials for better land use in Stillwater, Oklahoma. p. 60. (Unpub. M.S. thesis, Oklahoma State University).

17. Pearson, R. W. 1966. Soil Surveys and Land Use Planning. Soil Sci. Soc. Am. Madison, Wisc. p. vii.

18. Pettry, D. E. and C. S. Coleman. 1973. Two decades of urban soil interpretations in Fairfax County, Virginia. Geoderma 10:27-35.

19. Soil Characterization Laboratory, Oklahoma State University, Stillwater, Oklahoma. 1968-1978.

20. Soil Conservation Service. 1971. Guide for Interpreting Engineering Uses of Soils. U. S. Dept. Agr. Washington, D. C.

21. Soil Conservation Service. 1966. Land Capability Classification. Ag. Handbook No. 210. U. S. Dept. Agr. Washington, D. C.

22. Soil Conservation Service. 1975. Soil Taxonomy. Agriculture Handbook No. 436. U. S. Dept. Agr. Washington, D. C.

23. Soil Science Society of America. 1973. Glossary of soil science terms. Soil Sci. Soc. Am. p. 18.

24. Soil Survey Staff. 1951. Soil Survey Manual. Handbook No. 18. U. S. Dept. Agr. Washington, D. C.

25. Trewartha. 1968. An introduction to climate. New York, New York.

26. Wilde, S. A. 1950. Crypto-mull humus: Its properties and growth effects. Soil Sci. Soc. Am. Proc. 15:360-62.

APPENDIX A

IMPORTANT SOIL PROPERTIES

TABLE XII

TABLE OF IMPORTANT SOIL PROPERTIES

Soil Series	Soil Symbols	Slope	Depth to Bedrock (cm)	Permeability (cm/hour)	Drainage Class	Shrink Swell Potential	Unified Soil Classification	Flooding
Aydelotte	AyB	3-5%	>150	<0.15	well drained	high	CH, CL	none
Broken Alluvial	Ba	0-20%	too variable to rate					
Dale	DaA	0-2%	>150	1.5-5.0	well drained	moderate	CL	rare
Darnell	DS	1-8%	36	5.1-15.2	well drained	low	SM, SC	none
Stephenville		1-8%	80	1.5-5.1	well drained	low	SC, CL	none
Grainola	GrA	1-3%	85	0.15-0.50	well drained	high	CH, CL	none
	GrB	3-5%	80	0.15-0.50	well drained	high	CH, CL	none
	Gr3		50	0.5-0.5	well drained	high	CH, CL	none
Lucien	LuA	2-5%	30	5.1-15.2	well drained	low	SM, SC, ML	none
Norge	NoB	3-5%	>204	0.5-1.5	well drained	moderate	CL	none
	No3		>204	0.5-1.5	well drained	moderate	CL	none
Port	PoA	0-3%	>150	1.5-5.1	well drained	moderate	CL, ML	occasional
Port	PO	1-3%	>150	1.5-5.1	well drained	moderate	CL, ML	occasional

TABLE XII (Continued)

Soil Series	Soil Symbols	Slope	Depth to Bedrock (cm)	Permeability (cm/hour)	Drainage Class	Shrink Swell Potential	Unified Soil Classification	Flooding
Oscar		1-3%	>150	0.15-0.5	moderately, well drained	moderate	CL	occasional
Renfrow	ReA	1-3%	>150	<0.15	well drained	high	CH, CL	none
Stephenville	StB	3-5%	58	1.5-5.1	well drained	low	SC, CL	none
Stoneburg	SoA	2-5%	80	0.5-1.5	well drained	moderate	CL, SC	none
Teller	TeB	3-5%	>203	1.5-5.1	well drained	low	CL, SC	none
Zaneis	ZaB	3-5%	118	0.5-1.5	well drained	moderate	CL, SC	none

APPENDIX B

ENGINEERING TEST DATA

TABLE XIII

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	Corrosivity Steel	Concrete
Aydelotte	A	A-4	100	98	80	72	27-37	8-14	-	-	-	High	Low
	B	A-6	100	98	85	85	33-50	12-26	9	2.03	65	High	Low
	C	A-7	99	98	87	87	37-70	15-38	11	2.01	47	High	Low
Dale	A	A-6	100	98	90	80	30-43	8-20	-	-	-	High	Low
	B	A-6	100	98	90	80	30-43	8-20	-	-	-	High	Low
	C	A-6	100	98	90	80	-	-	-	-	-	-	-
Darnell	A	A-4	95	92	65	48	<30	NP-10	-	-	-	Low	Moderate
	C	A-4	95	92	65	48	<30	NP-10	-	-	-	-	-
Grainola	A	A-6	72	67	64	62	37-50	15-25	11	1.99	49	High	Low
	B	A-7	87	86	85	84	41-70	20-40	18	1.77	54	High	Low
	C	-	50	53	52	52	41-70	20-40	-	-	-	High	Low
Lucien	A	A-4	100	99	95	51	25	5	17	1.78	8	Low	Low
	AC	A-4	100	100	99	64	26	6	17	1.78	7	Low	Low
	C	A-4	100	99	99	41	22	2	17	1.78	11	Low	Low
Norge	A	A-4	100	100	99	82	25-35	2-15	19	1.71	17	Moderate	Low
	B	A-6	100	100	99	82	33-43	12-20	13	1.90	42	Moderate	Low
	C	A-6	100	100	99	73	36	-	14	1.87	36	Moderate	Low
Oscar	A	A-4	100	97	80	75	<31	NP-10	-	-	-	High	Moderate
	B	A-6	100	97	92	89	33-43	12-20	-	-	-	High	Moderate

TABLE XIII (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	Corrosivity Steel	Corrosivity Concrete
Oscar	C	A-4	100	97	90	84	25-40	5-18	-	-	-	High	Moderate
Port	A	A-4	100	100	99	81	26	7	16	1.77	20	Moderate	Low
	C	A-4	100	100	99	52	27-43	8-20	-	-	-	Moderate	Low
Renfrow	A	A-4	100	99	98	79	28	5	-	-	-	Moderate	Low
	B	A-7	100	99	98	85	50	25	9	2.03	65	Moderate	Low
	C	A-7	100	98	97	82	42	21	11	2.01	47	High	Low
Stephen-ville	A	A-4	100	99	68	55	28	5	-	-	-	Moderage	Moderate
	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	-	-
Stoneburg	A	A-4	97	92	70	53	17-30	3-10	-	-	-	Moderate	Low
	B	A-4	97	95	80	60	25-35	8-15	-	-	-	-	-
	C	A-6	97	86	72	62	25-40	8-20	-	-	-	-	-
Teller	A	A-4	100	99	81	45	NP	NP	-	-	-	Low	Moderate
	B	A-6	100	98	88	53	29	12	13	1.88	29	Low	Moderate
	C	A-6	100	98	95	69	32	12	17	1.76	24	Low	Moderate
Zaneis	A	A-6	100	99	98	73	36	12	17	1.75	34	Low	Low
	B	A-7	100	100	99	85	46	21	12	1.94	61	Moderate	Low
	C	A-6	100	100	99	85	39	19	15	1.83	32	Moderate	Low

APPENDIX C

PHYSICAL AND CHEMICAL SOIL CHARACTERIZATION DATA

SOIL MORPHOLOGY, GENESIS, AND CLASSIFICATION LAB
DEPARTMENT OF AGRONOMY
OKLAHOMA STATE UNIVERSITY

SOIL CLASSIFICATION:

FEILD SOIL TYPE: AYDELOTTE
LOCATION: 1700' N AND 1250' E FROM SW CORNER OF SEC. 2, T10N,R2W
CLEVELAND COUNTY, OKLAHOMA
SAMPLERS: NANCE, BOURLIER, MANLEY, DOUTHIT, OLSZEWSKI, ROOZITALAB

PROFILE DESCRIPTION:

SAMPLE NUMBER	HORIZON	DEPTH (CM.)	THICKNESS (CM.)	COLOR (M)	TEXTURE	STRUCTURE	CONSISTENCE	MOTTLED COLORS
76-OK-14-24- 1	A1	0- 13	13	10YR3/2	SIL	2FSBK-GR	MFR,	
76-OK-14-24- 2	B1	13- 23	10	7.5YR3/2	SICL	2FSBK-3MGR	MFI,	
76-OK-14-24- 3	B21T	23- 53	30	5YR4/3	SIC	2MPR-2M-CBK	MVFI,	
76-OK-14-24- 4	B22T	53- 69	16	5YR4/4	SIC	1CPR-2CSBK	MVFI,	
76-OK-14-24- 5	B23TCA	69-104	35	2.5YR4/6	SIC	1CSBK	MVFI,	
76-OK-14-24- 6	B24T	104-137	33	2.5YR4/6	SIC	1CSBK-F	MVFI,	
76-OK-14-24- 7	B31CA	137-175	38	2.5YR4/6	SICL	1CSBK-F	MFI,	
76-OK-14-24- 8	B32CA	175-185	10	2.5YR4/6	SICL	1CSBK-F	MFI-MFR,	
76-OK-14-24- 9	CR	185-239	54	2.5YR4/6	SHAL			

CHEMICAL DATA: ANALYST: ROOZITALAB

	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
76-OK-14-24- 1	5.6	4.9	27.8	7.01	8.51	7.82	0.41	0.16	0.00	60.8	70.7	4.81	312.5
76-OK-14-24- 2	5.8	4.8	30.9	8.30	11.04	12.65	0.29	0.47	0.00	79.2	74.6	2.72	295.0
76-OK-14-24- 3	6.5	5.5	37.0	6.49	11.50	17.48	0.32	1.13	0.00	82.2	82.4	1.61	182.5
76-OK-14-24- 4	7.4	6.5	40.5	2.85	11.73	18.17	0.32	2.09	0.00	79.8	91.9	0.98	167.5
76-OK-14-24- 5	7.8	7.4	37.6	0.26	26.68	20.70	0.31	3.71	0.00	100.0	99.5	0.54	162.5
76-OK-14-24- 6	7.4	7.0	30.1	1.30	36.34	18.86	0.30	4.00	0.00	100.0	97.9	0.39	287.5
76-OK-14-24- 7	7.7	7.1	29.5	0.78	50.60	17.48	0.24	3.79	0.00	100.0	98.9	0.30	325.0
76-OK-14-24- 8	8.0	7.6	20.6	0.00	35.42	13.80	0.21	2.98	0.00	100.0	100.0	0.22	455.0
76-OK-14-24- 9	8.0	7.5	15.6	0.00	25.76	11.04	0.21	2.18	0.00	100.0	100.0	0.39	517.5

PHYSICAL DATA: ANALYST: ROOZITALAB

						SAND SUBFRACTIONS				
SAMPLE NUMBER	%SAND	%SILT	%CLAY	TEXTURE	%>2MM	%VCS	%CS	%MS	%FS	%VFS
76-OK-14-24- 1	16.3	56.2	27.6	SICL	0.1	0.1	0.3	0.7	3.6	11.6
76-OK-14-24- 2	10.5	59.4	30.1	SICL	0.0	0.1	0.2	0.5	2.3	7.4
76-OK-14-24- 3	8.0	48.2	43.8	SIC	0.0	0.1	0.2	0.5	1.6	5.7
76-OK-14-24- 4	8.2	48.0	43.8	SIC	0.0	0.1	0.2	0.4	1.6	5.8
76-OK-14-24- 5	6.7	45.7	47.6	SIC	0.1	0.3	0.6	0.5	1.2	4.1
76-OK-14-24- 6	4.3	49.4	46.3	SIC	0.1	0.1	0.2	0.3	0.8	2.9
76-OK-14-24- 7	4.3	53.7	42.0	SIC	0.2	0.8	0.2	0.2	0.7	2.5
76-OK-14-24- 8	4.5	59.9	35.6	SICL	1.4	0.4	0.4	0.3	0.7	2.7
76-OK-14-24- 9	1.4	64.3	33.8	SICL	0.0	0.1	0.1	0.1	0.1	1.1

SOIL MORPHOLOGY, GENESIS, AND CLASSIFICATION LAB
DEPARTMENT OF AGRONOMY
OKLAHOMA STATE UNIVERSITY

SOIL CLASSIFICATION:

FIELD SOIL TYPE: 8H DALE SILT LOAM
LOCATION: 3350' W AND 50' S OF NE CORNER SECTION 34,T2N,R1E
MURRAY COUNTY, OKLAHOMA
SAMPLERS: A. WATTERSON, E. COLE, L. KICHLER, JULY-1976

PROFILE DESCRIPTION:

SAMPLE NUMBER	HORIZON	DEPTH (CM.)	THICKNESS (CM.)	COLOR (M)	TEXTURE	STRUCTURE	CONSISTENCE	MOTTLED COLORS
77-CK-53-3C- 1	AP	0- 15	15	5YR3/3	SIL	2MGR	MFR,	
77-CK-53-30- 2	A1	15- 56	41	5YR3/2	SIL	2MGR	MFR,	
77-CK-53-3C- 3	B2	56- 97	41	5YR5/6	SICL	2MABK	FI	
77-CK-53-3C- 4	C	97-188	91	5YR5/6	SIL	M	FR,	

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
77-CK-5C-3C- 1	6.8	5.8	23.6	5.59	11.36	6.58	0.68	0.17	0.00	79.5	75.8	3.02	0.1
77-CK-5C-3C- 2	6.8	5.7	27.8	4.59	14.40	8.23	0.50	0.16	0.00	83.8	83.5	2.65	0.1
77-CK-5C-3C- 3	7.5	6.4	22.9	2.81	11.45	7.27	0.42	0.16	0.00	84.4	87.3	1.11	0.1
77-CK-50-3C- 4	8.2	7.4	13.4	0.00	39.56	7.41	0.22	0.16	0.00	100.0	10C.0	0.62	0.1

PHYSICAL DATA: ANALYST: ROOZITALAB

SAMPLE NUMBER	%SAND	%SILT	%CLAY	TEXTURE	%>2MM	SAND SUBFRACTIONS %VCS	%CS	%MS	%FS	%VFS
77-CK-5C-3C- 1	6.8	64.4	28.8	SICL	0.0	0.1	0.1	0.1	0.4	6.3
77-CK-5C-30- 2	9.0	59.7	31.3	SICL	0.0	0.1	0.1	0.1	0.4	8.4
77-CK-5C-3C- 3	9.8	48.9	41.3	SIC	0.0	0.1	0.1	0.1	0.4	9.2
77-CK-5C-3C- 4	10.7	74.9	14.4	SIL	0.0	0.1	0.1	0.1	0.2	10.3

INTERPRETIVE CALCULATIONS:

SAMPLE NUMBER:	CA/MG	CEC/CLAY	ESP	CLAY FREE PARTICLE SIZE DISTRIBUTION SILT	VCS	CS	MS	FS	VFS
77-CK-5C-30- 1	1.73	82.01	0.70	90.38	0.07	0.07	C.07	0.60	8.81
77-CK-5C-3C- 2	1.75	88.80	0.57	86.86	0.07	0.07	0.07	0.66	12.26
77-CK-5C-3C- 3	1.58	55.40	0.69	83.30	0.09	0.09	0.09	0.77	15.67
77-CK-5C-30- 4	5.34	93.18	1.17	87.47	0.06	0.06	C.06	0.26	12.09

SOIL MORPHOLOGY, GENESIS, AND CLASSIFICATION LAB
DEPARTMENT OF AGRONOMY
OKLAHOMA STATE UNIVERSITY

SOIL CLASSIFICATION:

FIELD SOIL TYPE: 1 DARNELL LOAMY FINE SAND
LOCATION: 700' E AND 50' S OF THE NW CORNER OF SEC. 32, T9N,R1W
CLEVELAND COUNTY, OKLAHOMA
SAMPLERS: BOURLIER, FRIE, HAYES, DOUTHIT MAY 1976

PROFILE DESCRIPTION:

SAMPLE NUMBER	HORIZON	DEPTH (CM.)	THICKNESS (CM.)	COLOR (M)	TEXTURE	STRUCTURE	CONSISTENCE	MOTTLED COLORS
76-OK-14-23- 1	A1	0- 13	13	7.5YR3/2	LFS	1FGR	DS,MVFR	
76-OK-14-23- 2	B2	13- 43	30	7.5YR5/4	LFS	1FGR	DS,MVFR	

CHEMICAL DATA: ANALYST: ROOZITALAB

	PH 1:1			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
76-OK-14-23- 1	6.2	5.5	4.8	0.52	3.13	1.10	0.19	0.04	0.00	92.1	89.6	1.99	230.0
76-OK-14-23- 2	6.7	5.9	1.5	0.26	0.74	0.37	0.06	0.03	0.00	81.5	82.1	0.53	135.0

SOIL MORPHOLOGY, GENESIS, AND CLASSIFICATION LAB
DEPARTMENT OF AGRONOMY
OKLAHOMA STATE UNIVERSITY

SOIL CLASSIFICATION:

IELD SOIL TYPE: GRAINOLA LOAM 6% SLOPES
OCATION: 175' E AND 2425' S OF THE NW CORNER OF SEC 32, T20N, R1E,
NOBLE COUNTY, OKLAHOMA
AMPLERS: SCOTT, NANCE DATE: 2-13-76

ROFILE DESCRIPTION:

AMPLE NUMBER	HORIZON	DEPTH (CM.)	THICKNESS (CM.)	COLOR (M)	TEXTURE	STRUCTURE	CONSISTENCE	MOTTLED COLORS
6-CK-52- 1- 1	A1	0- 15	15	7.5YR3/2	L	2FGR	MFR	
6-CK-52- 1- 2	B1	15- 28	13	5. YR3/4	L	1CSBK	MFR	
6-CK-52- 1- 3	2B21T	28- 46	18	2.5YR3/4	SIC	2FBK	MVFI	
6-CK-52- 1- 4	2B22T	46- 84	38	2.5YR4/4	SIC	1MBK	MVFI	
6-CK-52- 1- 5	2B23T	84- 99	15	2.5YR4/4	SIC	1CBK	MVFI	
6-CK-52- 1- 6	2CR	99-178	79	2.5YR4/4		SHALE		

HEMICAL DATA: ANALYST: ROOZITALAB

	PH1:1			EXCHANGEABLE CATIONS,MEQ/100 GMS						%BASE SATURATION		%	P.P.M.
AMPLE NUMBER	H2O	KCL	CEC	H	CA	MG	K	NA	AL	NAAC	SUM OF CAT.	OM	TOTAL P
6-CK-52- 1- 1	6.1	5.5	21.9	6.23	6.32	3.52	0.60	0.87	0.16	51.6	64.5	0.37	274.9
5-CK-52- 1- 2	6.4	5.5	30.3	7.53	8.55	5.98	0.43	0.87	0.10	53.5	68.3	0.31	307.6
5-CK-52- 1- 3	7.7	6.8	38.7	3.89	20.44	12.85	0.43	1.74	0.16	91.6	90.1	0.19	192.5
6-CK-52- 1- 4	8.2	7.1	36.5	1.56	23.07	15.52	0.41	2.84	0.10	100.0	96.4	0.13	202.4
5-CK-52- 1- 5	8.0	7.2	28.1	1.56	15.35	12.47	0.38	4.52	0.10	100.0	95.5	0.09	268.9
5-CK-52- 1- 6	7.9	7.1	25.6	1.56	10.39	10.22	0.44	0.45	0.16	84.0	93.2	0.07	257.0

HYSICAL DATA: ANALYST: ROOZITALAB

						SAND SUBFRACTIONS				
AMPLE NUMBER	%SAND	%SILT	%CLAY	TEXTURE	%>2MM	%VCS	%CS	%MS	%FS	%VFS
5-CK-52- 1- 1	36.1	37.6	26.3	L	0.0	0.1	0.1	0.1	9.2	26.6
5-CK-52- 1- 2	29.7	35.2	35.0	CL	0.0	0.1	0.1	0.1	7.6	21.7
5-CK-52- 1- 3	5.3	31.5	63.2	C	0.0	0.1	0.1	0.1	1.1	3.9
5-CK-52- 1- 4	2.7	27.5	69.7	C	1.3	0.4	0.4	0.5	0.6	0.9
5-CK-52- 1- 5	2.0	42.4	55.6	SIC	7.9	0.2	0.1	0.1	0.2	1.3
5-CK-52- 1- 6	1.3	44.9	53.8	SIC	0.0	0.1	0.1	0.1	0.1	1.1

NTERPRETIVE CALCULATIONS:

				CLAY FREE PARTICLE SIZE DISTRIBUTION					
AMPLE NUMBER:	CA/MG	CEC/CLAY	ESP	SILT	VCS	CS	MS	FS	VFS
5-CK-52-01- 1	1.80	83.36	3.97	51.00	0.07	0.14	0.17	12.50	36.13
5-CK-52-01- 2	1.50	86.50	2.87	54.23	0.15	0.15	0.23	11.74	33.49
5-CK-52-01- 3	1.59	61.26	4.50	85.73	0.20	0.24	0.27	2.92	10.63
6-CK-52-01- 4	1.49	52.33	7.77	90.98	1.18	1.30	1.51	2.06	2.97
6-CK-52-01- 5	1.23	50.52	16.10	95.45	0.53	0.31	0.27	0.55	2.89
6-CK-52-01- 6	1.02	47.54	1.77	97.08	0.11	0.11	0.14	0.27	2.30

SOIL MORPHOLOGY, GENESIS, AND CLASSIFICATION LAB
DEPARTMENT OF AGRONOMY
OKLAHOMA STATE UNIVERSITY

SOIL CLASSIFICATION:

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-CK-60- 2- 1	AP	0- 13	13	5.0YR3/3	SL	1FSBK-GR	DS,MFR	
73-CK-60- 2- 2	B	13- 41	28	5.0YR3/4	SL	1FSBK	DS,MFR	
73-CK-60- 2- 3	C	41- 46	5	2.5YR3/4	SS			

CHEMICAL DATA: ANALYST: WILSON

SAMPLE NUMBER	PH1:1			EXCHANGEABLE CATIONS,MEQ/100 GMS						%BASE SATURATION		%	P.P.M
	H2O	KCL	CEC	H	CA	MG	K	NA	AL	NAAC	SUM OF CAT.	OM	TOTAL
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-CK-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-CK-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					SILT SUBFRACTIONS		
						%VCS	%CS	%MS	%FS	%VFS	%CSI	%MSI	%FSI
73-CK-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-CK-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-CK-60- 2- 3	N A	N A	N A		N A	NA	NA	NA	NA	10.0	NA	NA	NA

INTERPRETIVE CALCULATIONS:

SAMPLE NUMBER:	CA/MG	CEC/CLAY	ESP	CLAY FREE PARTICLE SIZE DISTRIBUTION					
				SILT	VCS	CS	MS	FS	VFS
73-CK-60-02- 1	2.55	N A	N A	NA	N A	N A	N A	N A	N A
73-CK-60-02- 2	1.82	N A	N A	NA	N A	N A	N A	N A	N A
73-OK-60-02- 3	1.33	N A	N A	NA	N A	N A	N A	N A	N A

SOIL MORPHOLOGY, GENESIS, AND CLASSIFICATION LAB
DEPARTMENT OF AGRONOMY
OKLAHOMA STATE UNIVERSITY

. CLASSIFICATION:

.D SOIL TYPE: NCRGE LOAM,3-5% SLOPES, 6NC
.TION: 2525' E AND 1790 N OF SW CORNR, SEC 3,T19N,R1W
PAYNE COUNTY, CKLAHOMA-LAKE CARL BLACKWELL
'LERS: EARL C. NANCE,OSU   NOVEMBER 1,1976

:ILE DESCRIPTION:

'LE NUMBER	HORIZON	DEPTH (CM.)	THICKNESS (CM.)	COLOR (M)	TEXTURE	STRUCTURE	CONSISTENCE	MOTTLED COLORS
K-60-35- 1	A1	0- 25	25	5YR3/3	L	2MGR	MFR,	
K-60-35- 2	B21T	25- 43	18	5YR3/3	CL	2MSBK	MFR,	
K-60-35- 3	B22T	43- 66	23	2.5YR3/4	CL	2MPR-2FSBK	MFI	
K-60-35- 4	B23T	66-104	38	2.5YR4/4	CL	2CPR-2MSBK	MFI	
K-60-35- 5	B24T	104-152	48	2.5YR4/4	L	1CPR-1MSBK	MFR,	
K-60-35- 6	B3	152-203	51	2.5YR4/5	L	1CPR	MFR,	

ICAL CATA: ANALYST: ROOZITALAB

LE 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
K-60-35- 1	6.3	5.3	14.1	4.60	6.67	2.99	0.79	0.13	0.00	75.2	69.7	2.54	330.0
K-60-35- 2	5.8	4.7	19.2	7.62	7.68	4.51	0.65	0.13	0.00	67.7	63.0	2.09	265.0
K-60-35- 3	5.8	4.6	20.3	6.90	8.10	5.93	0.44	0.14	0.00	72.0	67.9	1.26	210.0
K-60-35- 4	5.8	4.7	15.9	5.08	6.44	5.34	0.41	0.15	0.00	77.6	70.8	0.69	.)5.0
K-60-35- 5	6.2	4.9	13.2	2.78	5.52	5.24	0.38	0.17	0.00	86.0	80.3	0.22	165.0
K-60-35- 6	6.6	5.2	10.4	1.57	4.51	4.32	0.38	0.17	0.00	90.1	85.6	0.18	152.5

ICAL DATA: ANALYST: ROOZITALAB

LE NUMBER	%SAND	%SILT	%CLAY	TEXTURE	%>2MM	SAND SUBFRACTIONS %VCS	%CS	%MS	%FS	%VFS
K-60-35- 1	31.8	43.1	25.1	L	0.0	0.1	0.1	0.3	12.3	19.1
K-60-35- 2	28.5	38.3	33.2	CL	0.0	0.1	0.1	0.1	9.7	18.5
K-60-35- 3	28.5	39.6	31.9	CL	0.0	0.1	0.1	0.1	8.0	20.3
K-60-35- 4	31.0	40.8	28.2	CL	0.0	0.1	0.1	0.1	9.0	21.8
K-60-35- 5	34.0	42.9	23.2	L	0.0	0.1	0.1	0.1	13.6	20.2
K-60-35- 6	42.7	38.5	18.8	L	0.0	0.1	0.1	0.2	16.4	26.0

?PRETIVE CALCULATIONS:

.E NUMBER:	CA/MG	CEC/CLAY	CLAY FREE PARTICLE SIZE DISTRIBUTION ESP	SILT	VCS	CS	MS	FS	VFS
K-60-35- 1	2.23	56.14	0.93	57.51	0.10	0.15	0.35	16.38	25.51
K-60-35- 2	1.70	57.82	0.68	57.35	0.07	0.11	0.22	14.53	27.70
K-60-35- 3	1.36	63.52	0.69	58.17	0.07	0.07	0.09	11.79	29.80
K-60-35- 4	1.21	56.41	0.93	56.80	0.07	0.07	0.10	12.58	30.37
K-60-35- 5	1.05	56.76	1.33	55.78	0.07	0.07	0.11	17.67	26.31
K-60-35- 6	1.04	55.39	1.68	47.37	0.08	0.08	0.20	20.24	32.04

SOIL MORPHOLOGY, GENESIS, AND CLASSIFICATION LAB
DEPARTMENT OF AGRONOMY
OKLAHOMA STATE UNIVERSITY

SOIL CLASSIFICATION:

FIELD SOIL PHASE: PORT CLAY LOAM
LOCATION: LAKE CARL BLACKWELL, 867' E, 990' S OF THE NE CORNER 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-CK-60- 5- 1	AP	0- 28	28	7.5YR2.5/2	SIL	1FGR	MFR-DH	
72-CK-60- 5- 2	B1	28- 43	15	10 YR2.5/1	SICL	2MSBK	MFI-DVH	
72-CK-60- 5- 3	B21T	43- 81	38	10 YR 3/2	SICL	2CBK	MFI-DEH	
72-CK-60- 5- 4	B22T	81-117	36	5 YR 3/4	LSIC	1MSBK	MFR-DH	

CHEMICAL DATA: ANALYST: D. BAKHTAR

	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
72-CK-60- 5- 1	6.4	5.3	9.9	5.77	4.35	2.57	0.35	0.61	0.00	79.4	57.7	2.42	284.8
72-CK-60- 5- 2	7.5	6.2	12.3	3.99	5.66	3.98	0.23	2.02	0.00	97.0	74.9	2.90	222.3
72-CK-60- 5- 3	8.2	7.0	15.4	1.89	4.87	6.86	0.36	4.98	0.00	100.0	90.0	1.79	182.6
72-CK-60- 5- 4	8.5	7.8	12.3	0.94	13.00	8.91	0.41	5.49	0.00	100.0	96.7	0.51	231.2

PHYSICAL DATA: ANALYST: D. BAKHTAR

						SAND SUBFRACTIONS				
SAMPLE NUMBER	%SAND	%SILT	%CLAY	TEXTURE	%>2MM	%VCS	%CS	%MS	%FS	%VFS
72-CK-60- 5- 1	11.0	65.2	23.8	SIL	0.0	0.1	0.1	0.1	2.8	8.0
72-CK-60- 5- 2	6.7	63.8	29.4	SICL	0.0	0.1	0.1	0.1	1.4	5.2
72-CK-60- 5- 3	8.3	54.1	37.5	SICL	0.0	0.1	0.1	0.1	2.2	6.0
72-CK-60- 5- 4	8.3	59.1	32.5	SICL	0.0	0.1	0.1	0.1	2.2	6.0

INTERPRETIVE CALCULATIONS:

			CLAY FREE PARTICLE SIZE DISTRIBUTION						
SAMPLE NUMBER:	CA/MG	CEC/CLAY	ESP	SILT	VCS	CS	MS	FS	VFS
72-CK-60-C5- 1	1.69	41.67	6.10	85.56	0.07	0.10	0.18	3.64	10.45
72-CK-60-C5- 2	1.42	41.69	16.49	90.45	0.07	0.07	0.07	2.00	7.33
72-CK-60-C5- 3	0.71	41.01	32.35	86.67	0.08	0.08	0.08	3.52	9.57
72-CK-60-C5- 4	1.46	37.82	44.56	87.66	0.07	0.07	0.07	3.26	8.86

SOIL MORPHOLOGY, GENESIS, AND CLASSIFICATION LAB
DEPARTMENT OF AGRONOMY
OKLAHOMA STATE UNIVERSITY

SOIL CLASSIFICATION:

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-CK-60- 1- 1	AP	0- 18	18	5.0YR3/3	CL	3MGR	MFR	
72-CK-60- 1- 2	B21T	18- 36	18	2.5YR3/4	CL	2MSBK	MFI	
72-CK-60- 1- 3	B22T	36- 61	25	2.5YR3/4	CL	2MBK	MFI	
72-CK-60- 1- 4	B3	61- 86	25	2.5YR3/4	C	M	MVFI	
72-CK-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	%BASE SATURATION SUM OF CAT.	% OM	P.P.M. TOTAL P
72-CK-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-CK-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-CK-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-CK-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-CK-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-CK-60- 1- 1	20.7	55.5	23.8	SIL	0.0	0.1	0.2	0.3	5.3	14.7
72-CK-60- 1- 2	1.6	58.9	39.4	SICL	0.0	0.1	0.1	0.1	0.1	1.3
72-CK-60- 1- 3	10.3	55.2	34.4	SICL	0.0	0.1	0.1	0.2	0.7	9.3
72-CK-60- 1- 4	5.1	42.3	52.5	SIC	0.0	0.1	0.1	0.1	0.6	4.2
72-CK-60- 1- 5	1.0	46.2	52.8	SIC	0.0	0.1	0.1	0.1	0.2	0.5

INTERPRETIVE CALCULATIONS:

SAMPLE NUMBER:	CA/MG	CEC/CLAY	ESP	CLAY FREE PARTICLE SIZE DISTRIBUTION SILT	VCS	CS	MS	FS	VFS
72-CK-60-C1- 1	26.21	50.32	4.32	72.85	0.20	0.26	0.39	6.93	19.37
72-CK-60-C1- 2	9.49	36.25	3.56	97.30	0.10	0.08	0.17	0.25	2.11
72-CK-60-C1- 3	9.11	59.22	2.31	84.25	0.13	0.11	0.27	1.01	14.23
72-CK-60-C1- 4	2.54	40.15	4.17	89.23	0.16	0.16	0.26	1.32	8.88
72-CK-60-C1- 5	2.07	37.47	4.95	97.96	0.16	0.16	0.27	0.42	1.03

SOIL MORPHOLOGY, GENESIS, AND CLASSIFICATION LAB
DEPARTMENT OF AGRONOMY
OKLAHOMA STATE UNIVERSITY

SOIL CLASSIFICATION:

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-CK-60- 4- 1	AP	0- 15	15	5.0YR4/3	SL	1MGR	DS,MVFR	
74-CK-60- 4- 2	A1	15- 28	13	5.0YR4/3	SL	1MGR	DS,MVFR	
74-CK-60- 4- 3	A2	28- 51	23	5.0YR4/3	LS	SG	DL,MVFR	
74-CK-60- 4- 4	B21T	51- 69	18	2.5YR3/4	SCL	2MSBK	DSH,MFR	
74-CK-60- 4- 5	B22T	69- 94	25	2.5YR3/4	SCL	2MSBK	DSH,MFR	
74-CK-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-CK-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-CK-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-CK-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-CK-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-CK-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-CK-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-CK-60- 4- 1	83.2	11.8	5.0	LS	0.0	0.1	0.1	34.4	40.4	8.2
74-CK-60- 4- 2	83.4	11.5	5.0	LS	0.0	0.1	0.1	38.7	38.8	5.8
74-CK-60- 4- 3	83.6	10.1	6.3	LS	0.1	0.1	0.1	28.2	48.7	6.5
74-CK-60- 4- 4	48.7	20.0	31.3	SCL	0.0	0.1	0.1	18.6	24.9	5.1
74-CK-60- 4- 5	49.9	22.6	27.6	SCL	0.1	0.1	0.1	2.3	37.4	10.1
74-CK-60- 4- 6	56.6	23.3	20.1	SCL	0.2	0.2	0.2	12.0	34.8	9.5

INTERPRETIVE CALCULATIONS:

SAMPLE NUMBER:	CA/MG	CEC/CLAY	ESP	CLAY FREE PARTICLE SIZE DISTRIBUTION SILT	VCS	CS	MS	FS	VFS
74-CK-60-04- 1	1.04	62.89	2.76	12.41	0.07	0.12	36.23	42.57	8.60
74-CK-60-04- 2	2.70	48.24	3.59	12.11	0.12	0.09	40.72	40.84	6.12
74-CK-60-04- 3	1.91	24.16	7.46	10.83	0.09	0.05	30.10	52.02	6.91
74-CK-60-04- 4	0.86	42.80	1.30	29.15	0.07	0.07	27.06	36.21	7.44
74-CK-60-04- 5	0.45	43.24	1.57	31.15	0.09	0.10	3.13	51.63	13.90
74-CK-60-04- 6	0.31	45.26	1.73	29.12	0.19	0.22	15.03	43.52	11.93

SOIL MORPHOLOGY, GENESIS, AND CLASSIFICATION LAB
DEPARTMENT OF AGRONOMY
OKLAHOMA STATE UNIVERSITY

SOIL CLASSIFICATION:

FIELD SOIL TYPE: STONEBURG LOAM- 3.5% SLOPES
LOCATION: 760' E AND 1750' S OF THE NW CORNER OF SEC 20, T20N, R1E,
NOBLE COUNTY, OKLAHOMA
SAMPLERS: SCOTT, NANCE 12-13-76

PROFILE DESCRIPTION:

SAMPLE NUMBER	HORIZON	DEPTH (CM.)	THICKNESS (CM.)	COLOR (M)	TEXTURE	STRUCTURE	CONSISTENCE	MOTTLED COLORS
76-OK-52- 3- 1	A1	0- 20	20	7.5YR3/3	L	1FGR	MFR	
76-OK-52- 3- 2	B1	20- 33	13	7.5YR4/4	L	2FGR	MFR	
76-OK-52- 3- 3	B21T	33- 53	20	5. YR4/6	L	1MSBK	MFR	
76-OK-52- 3- 4	B22T	53- 76	23	5. YR4/6	SCL	2MSBK	MFR	
76-OK-52- 3- 5	R	76- 79	3	7.5YR6/6		SANDSTONE		

CHEMICAL DATA: ANALYST: ROOZITALAB

	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
76-OK-52- 3- 1	5.8	5.1	13.7	4.15	6.36	1.48	0.40	0.61	0.12	64.4	68.1	1.72	262.9
76-OK-52- 3- 2	5.7	4.9	16.7	5.71	5.77	3.65	0.35	0.61	0.13	62.1	64.5	0.17	219.3
76-OK-52- 3- 3	5.7	4.9	19.2	5.97	6.40	4.66	0.31	0.61	0.13	62.3	66.8	0.35	222.3
76-OK-52- 3- 4	5.8	5.1	21.5	6.23	6.66	6.19	0.35	0.70	0.14	64.7	69.0	0.26	222.3
76-OK-52- 3- 5	6.7	5.6	3.9	1.04	1.48	0.98	1.28	0.61	0.05	100.0	80.7	0.19	39.7

PHYSICAL DATA: ANALYST: ROOZITALAB

						SAND SUBFRACTIONS				
SAMPLE NUMBER	%SAND	%SILT	%CLAY	TEXTURE	%>2MM	%VCS	%CS	%MS	%FS	%VFS
76-OK-52- 3- 1	41.5	35.9	22.5	L	0.0	0.1	0.2	0.4	16.5	24.4
76-OK-52- 3- 2	39.5	31.0	29.5	CL	0.3	0.2	0.3	0.5	15.6	23.0
76-OK-52- 3- 3	36.4	33.5	30.0	CL	0.0	0.1	0.3	0.6	13.9	21.5
76-OK-52- 3- 4	43.8	27.3	28.9	CL	0.2	0.4	0.9	1.1	19.8	21.6
76-OK-52- 3- 5	89.6	0.2	10.1	LS	12.0	0.1	0.1	0.2	69.8	19.5

INTERPRETIVE CALCULATIONS:

				CLAY FREE PARTICLE SIZE DISTRIBUTION					
SAMPLE NUMBER:	CA/MG	CEC/CLAY	ESP	SILT	VCS	CS	MS	FS	VFS
76-OK-52-03- 1	4.29	60.96	4.43	46.37	0.15	0.24	0.48	21.29	31.47
76-OK-52-03- 2	1.58	56.57	3.65	44.00	0.21	0.36	0.73	22.11	32.59
76-OK-52-03- 3	1.37	63.98	3.17	47.89	0.14	0.41	0.88	19.94	30.74
76-OK-52-03- 4	1.08	74.45	3.24	38.37	0.56	1.23	1.58	27.86	30.39
76-OK-52-03- 5	1.52	38.66	15.57	0.28	0.08	0.15	0.18	77.64	21.67

SOIL MORPHOLOGY, GENESIS, AND CLASSIFICATION LAB
DEPARTMENT OF AGRONOMY
OKLAHOMA STATE UNIVERSITY

SOIL CLASSIFICATION:

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-CK-60- 4- 1	A1	0- 28	28	5. YR4/6	L	3MGR	DH,MFI	
75-CK-60- 4- 2	B21T	28- 56	28	2.5YR4/4	CL	2MSBK	DH,MFI	
'5-OK-60- 4- 3	B22T	56- 91	35	2.5YR4/6	CL	3MABK	DH,MFI	
'5-OK-60- 4- 4	B23T	91-135	44	2.5YR4/6	CL	2MSBK	DH,MFI	
'5-OK-60- 4- 5	B3	135-152	17	2.5YR3/6	FSCL	1MSBK	DH,MFI	
5-OK-60- 4- 6	C	152-183	31	2.5YR4/6	SL	0	MVFR	

HEMICAL DATA: ANALYST: PESCHEL

	PH1:1			EXCHANGEABLE CATIONS,MEQ/100 GMS						%BASE SATURATION		%	P.P.M.
AMPLE NUMBER.	H2O	KCL	CEC	H	CA	MG	K	NA	AL	NAAC	SUM OF CAT.	OM	TOTAL P
5-CK-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
5-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
5-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
-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
-CK-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
-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

'SICAL DATA: ANALYST: PESCHEL

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

RPRETIVE CALCULATIONS:

				CLAY FREE PARTICLE SIZE DISTRIBUTION					
LE NUMBER:	CA/MG	CEC/CLAY	ESP	SILT	VCS	CS	MS	FS	VFS
K-60-04- 1	1.83	80.71	1.19	56.90	0.06	0.13	0.22	16.14	26.56
K-60-04- 2	1.99	76.43	0.73	68.40	0.07	0.11	0.27	14.08	17.07
K-60-04- 3	2.27	76.43	1.09	73.31	0.07	0.07	0.20	14.16	12.19
K-60-04- 4	3.28	69.47	1.42	66.50	0.07	0.07	0.23	13.96	19.18
-60-04- 5	3.23	75.62	1.53	54.60	0.06	0.06	0.10	15.15	30.02
-60-04- 6	2.16	81.66	4.47	20.33	0.05	0.05	0.11	41.51	[illegible]

SOIL MORPHOLOGY, GENESIS, AND CLASSIFICATION LAB
DEPARTMENT OF AGRONOMY
OKLAHOMA STATE UNIVERSITY

SOIL CLASSIFICATION:

FIELD SOIL PHASE: ZANEIS
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-CK-60- 4- 1	AP	0- 23	23	7.5YR 3/2	L	2MGR	MVFR-DSH	
72-CK-60- 4- 2	B1	23- 36	13	5YR 3/3	L	1MSBK	MFR-DH	
72-CK-60- 4- 3	B21T	36- 56	20	2.5YR 3/6	CL	2MSBK	MFR-DH	
72-CK-60- 4- 4	B22T	56- 74	18	2.5YR 3/6	CL	1FSBK	MFR-DH	
72-CK-60- 4- 5	B23T	74-132	58	2.5YR 4/6	CL	2CBK	MFI-DEH	
72-CK-60- 4- 6	B3	132-155	23	2.5YR 4/6	CL	1CSBK	MFI-DEH	

CHEMICAL DATA: ANALYST: D.BAKHTAR

	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
72-CK-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-CK-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-CK-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-CK-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-CK-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-CK-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-CK-60- 4- 1	30.9	47.8	21.3	L	0.0	0.1	0.1	0.4	12.5	18.0
72-CK-60- 4- 2	22.3	42.7	35.0	CL	0.0	0.1	0.1	0.2	8.7	13.3
72-CK-60- 4- 3	22.8	45.3	31.9	CL	0.0	0.1	0.1	0.2	9.7	13.9
72-CK-60- 4- 4	24.2	43.8	31.9	CL	0.0	0.1	0.1	0.2	9.1	14.9
72-CK-60- 4- 5	20.0	47.2	32.8	CL	0.7	0.1	0.2	0.3	7.3	12.5
72-CK-60- 4- 6	26.5	48.2	25.3	L	0.9	0.1	0.1	0.2	9.0	17.2

INTERPRETIVE CALCULATIONS:

				CLAY FREE PARTICLE SIZE DISTRIBUTION					
SAMPLE NUMBER:	CA/MG	CEC/CLAY	ESP	SILT	VCS	CS	MS	FS	VFS
72-CK-60-04- 1	1.39	61.03	1.46	60.74	0.13	0.13	0.51	15.88	22.87
72-CK-60-04- 2	0.00	63.71	1.97	65.69	0.15	0.15	0.31	13.38	20.46
72-CK-60-04- 3	1.00	69.59	3.15	66.52	0.15	0.15	0.29	14.24	20.41
72-CK-60-04- 4	0.81	52.35	9.88	64.32	0.15	0.15	0.29	13.36	21.88
72-CK-60-04- 5	0.84	57.93	16.74	70.24	0.15	0.30	0.45	10.86	18.60
72-CK-60-04- 6	0.88	67.98	16.74	64.52	0.13	0.13	0.27	12.05	23.03

VITA

Terry Allen Tindall

Candidate for the Degree of

Master of Science

Thesis: SOIL POTENTIALS IN THE PLANNING OF GOOD LAND-USE IN THE LAKE CARL BLACKWELL AREA, OKLAHOMA

Major Field: Agronomy

Biographical:

Personal Data: Born in Eugene, Oregon, June 18, 1953, the son of Mr. Richard W. Tindall and Mrs. Gean S. Brätt; married May 7, 1976, to Camille Palmer.

Education: Graduated from Coeur d'Alene High School, Coeur d'Alene, Idaho, in June, 1971; received Bachelor of Science degree in Agronomy from Brigham Young University in May, 1977; completed requirements for the Master of Science degree from Oklahoma State University in May, 1979.

Professional Experience: Served a two year mission for the Church of Jesus Christ of Latter-Day Saints in the Canada-Maritimes Mission from 1972-74; research assistant in Soil and Plant Analysis at Brigham Young University in 1976-77; teaching assistant at Oklahoma State University in Beginning Soils 1977-79.