TO TEACHERS AND STUDENTS:

BEFORE YOU PRINT

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The Handbook is designed to be printed back-to-back. However, certain special pages always fall on the right side of the booklet, making them easier to access. These are the pages bearing Table of Contents, the first page of each chapter, and the Status of Soil Surveys in NC – the final page of the Handbook.

Doing this required leaving certain pages blank (with only the page number shown at the bottom). There are fourteen such blank pages in the book.

The blank pages are:
ii, iv, x, 2,14,
36,38,56,64,
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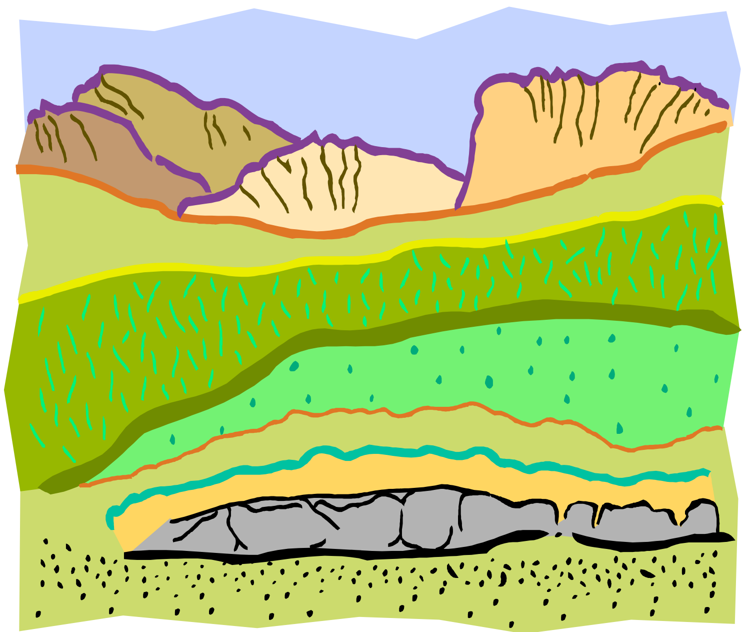
Handbook of

Land Judging



In

North Carolina

September 2009

Handbook
of
Land Judging
in North Carolina

This edition of the Handbook was prepared by Dr. George Naderman, Extension Soil Specialist, with help from those cited above and herein. It includes the progress gained through several previous editions and the input of many supporters of this highly successful FFA Career Development Program.

The Land Judging Program has always been an important educational outreach of the N.C. State University Soil Science Department. Thousands of students and their teachers have learned "hands on" about important soil properties. This has given knowledge and skills which have been important for each of them in some way in their future years.

This publication was reviewed by:

Dr. Jim Flowers, Dept. of Agricultural and Extension Education
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Additional information about the NCSU Soil Science Department and its educational programs and materials is available at: http://ces.soil.ncsu.edu/

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Land Judging in North Carolina – The Early Efforts: An Acknowledgement of the Contributions of Many

This program was officially begun in North Carolina in l955 under the name "Soil Appreciation and Land Judging School." The first contest was held near Dunn on Tuesday, April l2, and one of the sites judged was a fresh road cut where Interstate Highway 95 was being constructed. There were 47 teams of four students each in that event, and the team from Mills River in Henderson County was the winner. Beginning with the second annual meet, the name was simplified to "Land Judging Contest", and the tradition of holding the meet on Saturday was begun. The l956 event was held in the town of Farmer in Randolph County. The pits were prepared the previous day in spite of heavy rains and much mud. By judging time the next morning, sunny weather had returned. The event has always been held as scheduled, "rain or shine," and heavy rain has rarely occurred while judging was in progress.

Our land judging program was among the first few begun in the United States. As early as l953, meetings were held with teachers and Agricultural Extension Agents in Guilford and Edgecombe Counties and in l954 a trial run to check procedures was done at Snow Hill. Meanwhile the first North Carolina State University Extension Circular on land judging was also developed.

The credit for getting this program under way must be given to Mr. J. Frank Doggett, Extension Soil Conservationist at N C State University. He had discussed the educational value of the program with Mr. Edd Roberts of Oklahoma State University, one of those who had helped start a judging program for land which was patterned after the successful livestock judging programs established earlier. Mr. Doggett soon found enthusiastic supporters of the idea, including soil scientists William D. Lee of N. C. State University and Forrest Steele of the Soil Conservation Service. Mr. Lee, who attended nearly all of the first 34 annual meets, emphasized that Mr. Doggett's persistent enthusiasm convinced them to try the idea, even though these early organizers had some doubt that the program would succeed or be continued.

The Vocational Agriculture staff of the N C Department of Public Instruction (now Agricultural Education at North Carolina State University) has been instrumental since the beginning in fostering and continuing the program. From this group A. L. Teachey and A. G. Bullard helped with the l955 meet and R. J. Peeler, State Executive FFA secretary was a strong supporter for many years. The consistent help of personnel of the USDA Natural Resources Conservation Service (formerly the Soil Conservation Service) and soil scientists with the Division of Soil and Water Conservation, North Carolina Department of Environment, Health and Natural Resources throughout the state in setting up the state and federation meets is an equally essential element of this success.

The continuing strong interest and special efforts of vocational agriculture teachers have made this interesting learning experience available to many thousands of students. For many it has provided their first meaningful understanding of basic soil properties and conservation methods.

Financial support for awards and other expenses for this Career Development Event at the state level has been provided each year since the beginning by Carolina Power and Light Company, (now Progress Energy) and initially by the North Carolina Bankers Association. Since that date Duke Power Company has contributed equally in providing the support for these awards. This annual total support for awards is approximately $5,500. It is equally important to recognize the considerable financial help given individual teams by local supporters to provide incentives and cover expenses. For many years the Soil and Water Conservation Districts have provided a meal and social program for the State Meet and some also contribute to local awards. This loyal support has been a vital part of the continuing popularity and effectiveness of our land judging program. In recent years, the Soil Science Society of North Carolina has provided financial support to assist state winning teams to participate at the national level.

LOCATIONS AND WINNERS OF STATE LAND JUDGING MEETS

YEAR	***SITE***	***WINNER***
1955	Harnett County, Dunn	Mills River
1956	Randolph County, Farmer	Mills River
1957	Wake County, Apex	Piedmont
1958	Lee County, Sanford	Piedmont
1959	Sampson County, Hobbton	Clinton
1960	Rowan County, West Rowan	Piedmont
1961	Johnston County, Princeton	Deep Run
1962	Montgomery County, E. Montgomery	Norwood
1963	Greene County, Snow Hill	Deep Run
1964	Buncombe County, Clyde A. Erwin	South Stanly
1965	Wake County, Fuquay Varina	Piedmont
1966	Guilford County, NE Guilford	North Davidson
1967	Columbus Count, West Columbus	Bailey
1968	Haywood County, Tuscola	South Lenoir
1969	Vance County, Henderson	South Lenoir
1970	Chatham County, Chatham Central	Burns
1971	Nash County, Southern Nash	Southern Nash
1972	New Hanover County, John T. Hoggard	South Lenoir
1973	Macon County, Franklin	East Yancey
1974	Moore County, Union Pines	South Lenoir
1975	Anson County, Bowman	South Lenoir
1976	Robeson County, Fairmont	South Granville
1977	Yadkin County, Starmount	South Lenoir
1978	Buncombe County, Clyde Erwin	South Lenoir
1979	Beaufort County, Washington	Richlands
1980	Iredell County, North Iredell	South Lenoir
1981	Randolph County, Eastern Randolph	South Lenoir

1982	Lenoir County, South Lenoir	West Brunswick
1983	Henderson County, E. Hendersonville	East Wilkes
1984	Lee County, Lee Senior	South Lenoir
1985	Martin County, Williamston	Bartlett Yancey
1986	Yancey County, Mountain Heritage	South Lenoir
1987	Davidson County, Denton	Bartlett Yancey
1988	Wayne County, C.B. Aycock	Burns
1989	Alexander County, Alexander Central	South Lenoir
1990	Duplin County, Wallace-Rose Hill	Bear Grass
1991	Ashe County, Beaver Creek	East Wilkes
1992	Rowan County, West Rowan	East Wilkes
1993	Pitt County, Northern Pitt	East Wilkes
1994	Burke County, Freedom	Bartlett Yancey
1995	Cumberland County, Seventy First	East Wilkes
1996	Rutherford County, Chase	East Wilkes
1997	Orange County, Orange	East Wilkes
1998	Craven County, West Craven	Greene Central
1999	Buncombe County, Enka	East Wilkes
2000	Caswell County, Bartlett Yancey	East Wilkes
2001	Pasquotank County, Northeastern	South Lenoir
2002	Haywood County, Tuscola	Madison
2003	Union County, Sun Valley	Bartlett Yancey
2004	Harnett County, Western Harnett	South Lenoir
2005	Surry County, Surry Central	Lumberton
2006	Brunswick County, West Brunswick	Lumberton
2007	Granville County, South Granville	Polk County
2008	Wilkes County, East Wilkes	R.S. Central
2009	Sampson County, Clinton	South Lenoir

ABOUT THIS HANDBOOK

This is an update to the fifth edition and the continuation of a process begun in 1975 to provide a more specific and objective handbook. The major contributions of concepts, format and materials have been made by Louis E. Aull, H. Joseph Kleiss, Stanley W. Buol, Joseph A. Phillips and George C. Naderman of the Soil Science Department, N.C. State University; by J. Hall Campbell, Hubert J. Byrd, James H. Canterberry, Emmett Waller, and Ernest N. Hayhurst and Debbie Anderson of the Soil Conservation Service (now Natural Resources Conservation Service), Raleigh; and by Charles L. Keels of the Department of Public Instruction, Raleigh. George C. Naderman has served as Editor-in-Chief for this publication.

The above named individuals are indebted to Trudy Williams and Dianne Poole, N.C. State University, and to Mary Lou Thompson, Department of Public Instruction, for typing and other assistance with this handbook. Preparation of the 1988 edition of the handbook was transferred to computer format to gain greater editorial capabilities. We acknowledge the contribution of Shelley Waters and Dee Ann Cooper for the computer processing of editorial changes for the 1997 edition.

This handbook and related photographic materials ("Land Judging in North Carolina")***** are designed to be helpful in teaching about soils and conservation practices in general, as well as in preparing for contest participation. We emphasize that the concepts presented are primarily intended for use in North Carolina and some may not be appropriate under other conditions.

This publication was prepared cooperatively by:

The Cooperative Extension Office of the Soil Science Department,
North Carolina State University

USDA Natural Resources Conservation Service

Agricultural and Extension Education, North Carolina State University

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Progress Energy
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North Carolina Crop Improvement Association
Plant Food Association of North Carolina
Texasgulf Chemicals Company

The ongoing, successful Land Judging Program in North Carolina is indebted to all of these mentioned for their interest and contribution to it.

***Note: "Land Judging in North Carolina" is "a pictorial presentation to assist teachers and learners." Distributed to all teachers in the fall of 2007, it is a large document in MS PowerPoint, including separate text documents that contain only the slide footnotes. This is an educational package designed to accompany the information contained in this manual. It is provided on a CD, and is available at no charge to teachers. For more information, please contact the North Carolina FFA Association office.**

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PREFACE TO LAND JUDGING

Soil is one of our most important natural resources. North Carolina is richly endowed with soil resources and blessed with favorable rainfall and climate so essential to using these soil resources. Good crop yields are obtained when good management practices are applied. However, drought stress commonly occurs during the summer months, especially for annual crops like corn, soybeans, cotton, tobacco and peanuts. This stress is generally worsened by rather limited depth and intensity of the developing crop root system. An unusually large number of agricultural and horticultural crops are commercially grown here, thus taking advantage of the range of soil and climatic conditions and the marketing and transportation opportunities present here.

Except for floodplains and certain coastal areas, the soils of North Carolina are old and have been subjected to natural leaching and weathering for hundreds of thousands of years. In their natural state, most of our soils are infertile and acidic but respond readily to fertilizer and lime.

Land judging is an educational tool for learning about and evaluating the properties and use of soils. Soil characteristics and features studied in judging are those that can be seen and felt. These properties are very significant in making decisions about the capabilities and limitations of soils for agricultural and urban uses. Some of the important features that affect our use of soils are: slope, texture, structure, consistence, the depth to limiting layers, permeability, drainage and position on the landscape. An understanding of these properties permits some degree of evaluation of soil suitability for all uses. As students study and gain field experience in judging, they learn to identify characteristics which can be evaluated to allow logical decisions to be made. This facilitates better decisions regarding the best use and management of our soil resources.

CHAPTER I
Introductory Concepts in Land Judging

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CHAPTER I
INTRODUCTORY CONCEPTS OF LAND JUDGING

GROUPING THE MANY VARIATIONS OF SOILS

If you could thoroughly examine the entire volume of soil under an acre of land or under your own lawn or garden, you would find at least some variations in certain soil properties within this area. To use a common analogy, soil properties "do not simply occur in black and white, but in all shades of gray." Nevertheless, we group soils and give them names and a system of classification to help us recognize and make better use of their special features. Similarly, potatoes come in many different sizes, shapes and levels of quality. They are sorted and those falling within a certain range of properties - size, shape and quality - are suggested for baking potatoes; others go for mashing, potato chips and French fries. Nearly all aspects of land judging require the ability to recognize a soil characteristic or condition, place it within the proper range or grouping and determine the implications of these soil characteristics on agricultural and urban uses of the field being judged. In some cases special environmental concerns which apply to the judging site are also identified.

HOW SOILS ARE FORMED (SOIL GENESIS)

Soils are natural bodies on the surface of the earth. They are not solid (rock-like) nor are they liquid (water). They consist of unconsolidated (loose) mineral and organic particles on the earth's surface, and under natural conditions, approximately 40-60 percent of the soil volume is pore space (open space for air and water). Most soils have been subjected to all of the environmental forces present for hundreds of thousands of years. Natural changes in the physical and chemical characteristics of soils are extremely slow (involving thousands of years) unless some catastrophic event occurs (earthquake, volcano, massive land slide, etc).

Soil is the product of the combined action of five soil forming factors.

1. Parent materials

All soils have a beginning from some kind of material. This material may be mineral or vegetative (organic) or a combination of both. These classes of parent material may be very broadly grouped as follows:

a) Residual (or in-place) Parent Material This has not moved since the beginning of the formation of the soil. Included are all of the different kinds of rock that underlie soils which have formed in place. The slow breakdown and alteration of these parent materials by physical and chemical processes is called "weathering." The kinds of minerals in the rocks, their resistance to weathering, and many other factors, influence the kinds of soils present today.

b) Transported Parent Material Some soils have their beginning in unconsolidated materials (meaning loose, not like large masses or layers of solid rock) that have been deposited by water (rivers, small streams, or ocean), ice (glaciers), wind, volcanic eruptions, or gravity. The kinds of soils developed from transported material are dependent upon the composition of this material and the other soil forming factors involved.

2. Topography

Soils develop differently on a flat surface than they do on steep slopes. As the parent material weathers on sloping topography, the forces of gravity and of water tend to move the soil material down slope. As a result, a soil profile found on this slope today is shallower and has signs of being less developed. Where topography is level or nearly level the weathered products of the parent material remain in place. Soil profiles then become deeper and more advanced in development, if all other soil-forming factors are the same. Topography, in general, is partly responsible for the depth of a soil and the kinds of horizons found in soil profiles.

3. Biological Factors (vegetative and animal)

Biological activities, from the beginning of weathering of the parent material to the final stages of development of the soil profile, play an important part in the development of soils. These activities range from simple forms of plant and animal life, including bacteria, worms, insects and small animals in soil, through large forms such as trees and animal life. Present day biological factors continue to influence soil development. Soils developed under a tree vegetation are different from those developed under grass vegetation. Those developed under conifers are different from those developed under deciduous trees. Earthworms, ants, termites, and microscopic animals take part in the slow process of developing soils. Although the influence of biological factors on soil development is most noticeable between large geographic areas such as forested regions of the Southeast versus the grass plains of the Midwest, differences due to biological factors also exist at local levels. Plant and animal influence on soil development is a slow but continuing factor. Man's activities have changed many of the soil properties, especially in cultivated fields and in urbanized areas. These influences should not necessarily be considered good, bad, or even unnatural, but have to be evaluated in order to plan future soil uses.

4. Climate

The major climatic factors in soil development are those of temperature and precipitation. These factors react with soils in both physical and chemical ways. Freezing and thawing, drying and wetting affect both the physical and chemical properties of all soils. As rain falls on the surface and passes through the soil, leaching and physical movement of the mineral fractions occurs, and with long periods of time, the mature soil profile is developed. The climate in the

Southeastern United States, with warm temperatures and relatively high rainfall, is one contributing factor to the presence of soils which, without improvement, are more acid and less fertile than those soils developed under cooler or drier climates. Also, however, the nature of parent material in much of our region is such that it could not contribute high natural fertility to soils developed therein.

5. Time

The length of time that soils and parent materials remain in a place on the earth's surface and are exposed to physical and biological activities greatly influences the kinds of soil present today. Old, more mature soils are generally those that have weathered in place for millions of years, and have thoroughly developed characteristics in response to other factors of formation, especially the climate and vegetation. Young soils retain more characteristics of the parent material. One indication of greater age and moderate maturity of soil is the degree of development of a more clayey textured, "illuvial" subsurface horizon. This is common in the majority of soils in North Carolina, but it is not present in all of them. Very old, mature soils can still be highly productive with farming techniques that correct their weakness for crop production and also provide soil protection. Millions of acres of such soils are found throughout the world and are dominant in many tropical countries.

6. Combining the Factors (Soils on the Landscape)

There is no one soil forming factor responsible for all variation among soils. All five factors, interacting one with the other, determine the physical and chemical characteristics found in soil profiles. However, within a given area having similar parent material, climate and biological factors the most obvious changes in soil properties can be seen by comparing different positions on the landscape. Examples of typical soils found at different positions on the landscape are:

a) Nearly Level Upland Positions - Within a given area, soils forming on upland positions with slopes of 6% or less most clearly reflect the expected influences of climate, parent material, biological factors and time. In North Carolina, most soils in such positions have notably more clay in the subsurface layer (B horizon) than in the surface layer.

b) Soils on Steep Slopes - The surface of these soils is easily eroded by the effects of gravity and water. These kinds of soils commonly have developed a sub-surface (B horizon) showing evidence of change and alteration (such as color changes with depth in the profile) but may not have the substantial increase in clay content described under paragraph a) above. The surface layer and total profile of such soils usually are thinner than in soils on more nearly level, upland locations.

c) Soils on the Floodplain of Streams and Rivers - These soils are constantly being modified by flood waters which deposit new sediment on the surface. They commonly have less increase in clay content with depth than soils on the uplands. Frequently these soils have layers with abrupt textural changes due to repeated deposits of differing kinds of sediment during flooding events.

d) Soils Having Parent Materials Resistant to Weathering - Certain rocks are very difficult to break down and weather, as must occur in the process of soil development. Quartz, especially in the form of coarse sand grains, is very resistant to soil forming processes. Soils developing in this parent material usually have rather thick, coarse-textured surface layers and subsurface layers. In some cases the subsurface layer beginning at 20 inches depth or more (sometimes qualifying as "s" Subclasses). These soils may be old in age but are rather immature in their stage of development. Soils developing in finer textured, more easily weatherable materials will have more clayeyness in the subsurface layer and less thickness of the surface layer.

MINERAL AND ORGANIC SOILS

The foregoing discussion of the five soil forming factors implies that there are many kinds of soil. Most soils are mineral in nature since they are formed from rocks that make up the earth's crust. Yet, in some places the soil has developed principally in decaying vegetative residues of trees and shrubs. These plant residues accumulate under swampy conditions where the land surface is saturated with water nearly all of the year and the resulting soils may fit the term “organic” soil. Soils are thus regarded as "mineral" or "organic" based upon the kind of parent material from which they have formed and the content of organic material present in the surface layer today.

For the purposes of land judging, this handbook is limited to mineral soils of North Carolina. However, organic soils are mentioned here among the introductory concepts for a number of reasons:

1. Organic soils in North Carolina occur in the extreme eastern part of the state. Nevertheless, these soils are very important in forestry and agriculture, and their management and use is closely associated with fisheries and water quality concerns of our Coastal region.

2. Organic soils differ greatly from mineral soils in properties, uses and management. In general, these organic soil properties are more difficult to evaluate.

3. Although most of the world's crops are produced on mineral soils, the organic soils in other areas of the world have long provided significant amounts of certain products for our use. Notable examples are vegetables like lettuce, carrots, celery and potatoes.

UNDERSTANDING SOIL PROFILES AND HORIZONS

A vertical section of a natural soil is known as the soil profile. Soil profiles can be studied from the sides of a pit, a fresh basement excavation, or a non-vegetated road cut. Most soil profiles in North Carolina have horizontal layers called "horizons" with differences in color and texture that can easily be seen, although in some soils differences with depth require tests made with laboratory procedures.

The development of these horizons occurs over many thousands of years and follows a consistent pattern wherever similar conditions prevail. Biological and physical influences cause soluble substances and very tiny clay particles to move downward from the upper part of the profile and to accumulate just below this zone. This is one reason we frequently find that subsoil materials are more clayey than the surface soil. This makes it harder when dry and more sticky when wet.

The upper part of the soil profile is called the A horizon. For land judging this is considered the “surface layer.” The A horizon is usually at least somewhat darker brown, gray or black in color because it contains an accumulation of organic matter from many years, due to the decomposition of roots and other plant parts. In cropped areas, the A horizon has been disturbed by plowing or other tillage and for this reason it is called an Ap horizon. In many soils of North Carolina, especially on the Coastal Plain, there is a light colored layer below the Ap horizon which is known as the E horizon. The "E" implies “Eluvial,” meaning a zone from which material has been removed. By chemical reactions and water most of the iron and clay have been removed from this layer and little organic matter has accumulated in it. This layer will be discussed further in connection with "s" subclasses.

Below the A horizon many soils have a zone of accumulation. This is the B horizon (commonly known as the subsoil). The central, more typical part of the B horizon is generally considered the “subsurface layer” for land judging purposes. In most soils of North Carolina, there is a substantial increase in clay content in the B horizon as compared with the A horizon, unless serious erosion has removed most of the topsoil. In addition to having more clay, there are generally obvious differences in color and structure between the A and B horizons.

The C horizon lies below these horizons and refers to a zone of material which is technically not yet "soil," although it sometimes is loose, unconsolidated material from which soil eventually develops. It may be unconsolidated stone, gravel, or sand sediments deposited from flowing waters of streams and rivers or in the still waters of the ocean. However, this material may be hard rock (identified as a R horizon) or soft and partially weathered rock which still shows the structure of the original rock (identified as a Cr horizon). These materials will be considered a limiting layer, if within 36 inches of the soil surface. It is important to note that the C horizon may, or may not, be the actual parent material of the soil above it. In some cases surface material has been deposited over previously existing sediments. Except for the cases where the C horizon is within 36 inches of the surface we are not concerned with identifying this horizon in land judging.

It should be noted that in eroded soils any remaining A horizon will be included in the material being judged as the surface layer. It is common in cultivated and eroded fields to find that the surface six inches of the soil profile actually consists of a mixture of Ap, E and B horizons as defined above.

However, in land judging we will always refer to the soil material in the first six inches as the "surface layer". In most uses of soils for agricultural and urban needs, the surface six inches is the layer easily manipulated and intensively used by plant roots. The surface soil receives most of our management and attention including seeds, fertilizer and irrigation, weed control, bedding plants, etc. It might be called the mouth of soil. Characteristics of this six-inch zone are significant for all uses.

The subsurface layer is usually the same in concept as "subsoil." It is important to remember that the “subsurface material” designated as such in the contest is often technically not the B horizon, or at least not the entire B horizon. For example, in the contest a fairly thin transitional layer between the A and B horizons would usually be excluded from the "subsurface" sample. The subsurface layer should be the "first significant horizon below the surface layer."

There are also soils in North Carolina which differ greatly from the central ideas given above. These are:

1. Soils having an A horizon much thicker than six inches and in some cases extending to over three feet in depth. The upper horizons in such soils are technically labeled Ap and E. The Ap horizon is darker colored, reflecting the higher organic matter content of this main root zone. The E horizon is similar in texture to the Ap but usually light buff to yellowish brown in color. All soils in the "s" subclass, as well as some others, have this horizon pattern. In an "s" subclass the sandy E horizon should be recognized as part of the surface layer. If such a profile is included in a contest, the E material should be placed separately from the Ap material, but contestants should be advised to examine both samples and regard them as closely related portions of the surface layer.

Some poorly drained soils in the lower Coastal Plain also have very thick A horizons, but these have dark gray to black surfaces with high organic matter contents extending to several feet in depth. These soils do not have the pale yellowish E horizon. The subsurface layer would be taken from the deeper organic horizon unless mineral soil is encountered within three feet of depth.

2. Some soils have a B horizon which has little or no apparent increase in clay content from the A horizon. In contrast to the soils described above, the subsurface layer may be less red in color than the surface layer, even though the soil is well drained; its consistence may be more friable or less firm; its structure may be a less-defined blocky. In these soils, some differences between horizons can be readily seen in the field and other evidence is sometimes provided through laboratory methods. These soils may be described as being young in their degree of development, regardless of their age in time.

3. Other soils are very immature because the process of horizon development is constantly being interrupted. As a result, no B horizon has formed. Soils in floodplains periodically receive new surface deposits or suffer erosional losses when stream channels shift. This is apparent by a series of thin layers in these soil profiles resulting from the soil being flooded repeatedly.

4. Special B horizons which act as limiting layers also exist. Soils in certain areas of North Carolina have B horizons of cemented materials which prevent root penetration. These are soils with a "pan" layer. One type of pan is cemented with organic matter, iron, and aluminum and has the distinctive brown color of wet coffee grounds. This is usually found at between one foot and three feet below the surface. This condition is known as the "Bh" horizon and is now technically called the "spodic horizon."

A second type of pan is the "fragipan" known as the "Bx" horizon. The fragipan layer may be sandy or loamy in texture. This layer commonly occurs at a depth of about 1 to 3 feet. Both of these pan layers are very hard and brittle when dry, and the useful soil depth is limited at the upper part of this pan because roots cannot enter it. Water penetration through these pans is also greatly hampered, making the soils problematic in drainage for plant production and also for urban uses such as septic tanks and landfills.

Your evaluation of the characteristics found in the surface and subsurface layers is the first step in land judging. What you make of your findings about these characteristics - your "interpretations" about conservation treatments and land use for agricultural and urban needs - depends upon how well you have recognized and understand the importance of the soil characteristics.

The use of terms such as "A and B horizons", "topsoil", and "subsoil" should be avoided in discussions with land judging participants. For the purposes of this contest officials and teachers should closely adhere to the concepts of the surface layer and subsurface layers as outlined herein. This discussion of horizon terminology is provided to assist in relating contest procedures to the information provided in useful reference materials about soils, including textbooks and County Soil Survey reports.

SOIL SURVEY - A PRACTICAL EXAMPLE OF PROFESSIONAL LAND JUDGING

In land judging, the collective properties of an individual soil are evaluated. The individual soil represented in the “field” is defined by: the pit; the samples placed for contestants; and the slope and field border stakes used in the contest. The "set" of properties observed in judging are basically the same as those which soil scientists examine as they give names to soils, classify them and make soil maps. Among the soils of North Carolina, there are several hundred "sets" of these collective characteristics. Each of them is given a name for easy references. Thus, soil scientists use soil names like Cecil, Norfolk, etc., in discussing a soil with a specific set of properties which fit within defined ranges of these properties.

Soil maps are made to show areas that individual soil units occupy on a farm or in a county. This whole process of classification of soil based on its properties and the resulting map is a “soil survey.” In addition to the map, the soil survey report contains other information about soil behavior and the ways it is used. A section of the soil map of Granville County printed on aerial photography is shown in Figure 1. Areas on the map with the symbol VaB are Vance sandy loam, 2 to 6 percent slopes; the areas of Cecil clay loam, 6 to 10 percent slopes, eroded have the symbol CeC2. Each of the soil map units has a particular "set" of properties, suitabilities for crops, homesites, forestry and the like.

In the soil survey report are soil descriptions and information on soil management. The major sections of such a report are:

1. How the survey was made (this tells about the field methods used in surveying the soils)

2. General soil map (this section tells about broad patterns--soil associations--in the county)

Descriptions of soils (the properties of each soil series and each unit on the detailed soil map are discussed).

Figure 1 - Granville County, North Carolina

3. Use and management of the soils

- use of soils for crops and pasture
- estimated yields
- use of the soils for woodland
- use of the soils for wildlife
- engineering uses of the soils

4. Formation and classification of the soils

5. General nature of the county

The soil survey dates back to about 1900 in North Carolina. In that year, a soil map of Raleigh to New Bern by William G. Smith was published. Such reports were made and published for most counties by 1950. The early reports dealt chiefly with agricultural uses of the soil. These reports served their purpose well but are out of print and no longer available to the public.

Recent years have brought a resurgence of interest in soil surveys with a broadened view of the uses of soil. This has come about because of the wider need for facts about the nature of soil in the society of today. Soil maps are used to identify areas:

- needing conservation practices and for preparation of conservation plans
- suitable for city development as well as those with severe problems when used for such purposes
- subject to frequent flooding
- with characteristics favorable for building highways and streets
- which are important farmlands
- needing environmental impact evaluations
- needing soil productivity evaluation for purposes of taxation.

For these reasons, the soil map is a most important inventory of the lands of an area. Many public decisions are assisted by a soil survey.

Soil scientists employed by the Natural Resources Conservation Service and the North Carolina Department of Environment Natural Resources, Division of Soil and Water Conservation have been engaged in this program for many years. A map showing the counties now having modern soil survey reports and the status of the program in all counties is included at the back of this handbook. In the counties being mapped, local governments add monies to the program to accelerate the work. In addition, other public agencies, including North Carolina State University, have cooperated with NRCS in this work since the earliest days. Presently a goal of this program is to have a modern, useful soil survey completed for all counties of North Carolina. In addition, these surveys are digitized and available on web soil survey. (http://websoilsurvey.nrcs.usda.gov) This is an ambitious task of great importance for numerous purposes.

CHAPTER II
Judging Soil Characteristics

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CHAPTER II
JUDGING SOIL CHARACTERISTICS

CONTEST PROCEDURES

At each judging site separate piles of soil material labeled "surface layer" and "subsurface layer" will be provided. These soil samples should be examined to determine the texture, structure, and consistence of both of these soil layers. In addition, some information can be gained about the degree of erosion in the surface layer, drainage (by the color and presence of "redoximorphic features" such as gray or dull yellow color) and the permeability of the subsurface layer.

Although contestants are usually not permitted to enter the pit, it is very important to study the appearance of the profile from above. In this manner, one can see the depth of first occurrence of any gray and yellow colors present and the existence of any layer which limits rooting depth. In sandy soils, the total thickness of the sandy material must also be determined by observing the pit wall.

THE SURFACE LAYER

The characteristics of the surface layer are determined by examining the top six inches of the soil profile at the site. The following characteristics will be judged:

l. Texture

The three sizes of mineral particles present in soils are: sand, which is the largest and can generally be seen with the naked eye; silt, which is an intermediate-sized particle and cannot be seen with the naked eye; and clay, which is yet a much smaller particle. The soil scientist recognizes l2 "textural classes." These classes are specific combinations of sand, silt, and clay. In Land Judging <u>these l2 textural classes are grouped into just three classes</u>. These are summarized in Table II-1.

a) <u>Sandy</u> - This textural class includes sand and loamy sand. In this class are soils with at least 70 percent sand-sized particles and less than 30 percent total silt and clay-sized particles. Sandy textures are non-cohesive (when moist, particles tend to stick to the hand more than to each other) and tend to impart a gritty or rough feel when pressed or rolled between fingers. This soil cannot be pressed between the fingers to be molded into a ribbon. Instead it readily falls apart when compressed. Sandy textures generally have single grain structure and loose consistence, but if a sandy texture contains appreciable amounts of organic matter it may have granular structure. These soils behave very differently from loamy textures in that they have excessive permeability droughtiness, wind erosion hazard, and such land generally needs more frequent fertilizer applications (potassium and nitrogen, especially).

b) <u>Loamy</u> - This textural class includes loam, sandy loam, silt loam, sandy clay loam, silty clay loam, clay loam and silt. There is a wide variation in this textural class.

The sandy loams are similar to the sandy textures but are more cohesive. When these soils are moist, particles tend to stick to the soil mass more than to the hand, as in the sandy class. These soils tend to form weak aggregates. When moist, sandy loams may be molded into a loose mass which will deform slightly without rupture when pressed between fingers. Generally, these cannot be "leafed out" between the fingers, but if it can be done, the resulting "ribbon" will be less than 1/4 inch in length. **See Table II-1.** The silt loams have a smooth and floury feeling. The loams, sandy clay loams, silty clay loams, and clay loams may be pressed into thin, flat ribbons **of about 1/8 inch thickness** when moist. These ribbons tend to break at a length of 0.5 to 1.5 inches. **SeeTable II-1.** Loamy textures are granular, blocky or massive in structure, with friable or firm consistence.

In general, loamy textures are favorable for root growth, hold the most available water for crops and retain fertilizer nutrients. The soils have adequate permeability for most uses, except where the water table in the profile is kept shallow because of a location in a low portion of the landscape.

c) Clayey - This textural class includes sandy clay, silty clay, and clay. When wet, these soils will form ribbons **1/8 inch thick** at lengths of 1 to 2 inches, or more. These soils are very cohesive and may be molded to almost any form. Very distinct thumb impressions can be made on the soil mass. Clayey textures may be blocky, platy or massive in structure and are generally firm or very firm in consistence.

There are two major types of clays in our soils. Kaolinite clay (referred to as a l:l clay) is the most common in North Carolina soils. This is relatively inactive clay, is fairly stable in soils, and tends to form shorter ribbons. The other general class of clays is smectite, which includes the specific type called montmorillonite. These are very active clays (known as a 2:l clay) and form longer ribbons. Soils with major amounts of this clay will shrink when dry and swell when wet. This affects soil permeability. It is very important in using and managing them. These soils retain large amounts of available water for plant growth, but the soil is often too dense, too hard, too wet, too airtight or infertile for intensive root growth, even though water and potential rooting depth are available. Some urban uses of soils having large amounts of 2:1 clay cause severe limitations, resulting in foundation cracks and failures of septic absorption fields. The identification of soil textural classes cannot be taught in a classroom from a textbook. Field experience is essential. Students become proficient in determination of soil texture by practicing with different textural groups. If the sandy and clayey textural groups can be recognized, then all others would be in the loamy textural group.

TABLE II-1

The twelve official textural classes are placed into three textural groups for land judging. These three groups are determined in the field by "feel" and by the extent to which a thin "ribbon" can be formed with the soil. Note that a specific length of ribbon is only a guide. This is a determination which must be based on individual experience, with actual known textural samples, rather than solely by a specific length of the ribbon formed.

Texture Group In Land Judging	**Textural Classes Included**
• Sandy	l) Sand 2) Loamy Sand
• Loamy (Forms ribbon from 1/4 to 1 1/2 inches in length) **<u>Note</u>: Ribbons should be made 1/8 inch thick.**	3) Loam 4) Sandy Loam 5) Silt Loam 6) Sandy Clay Loam 7) Silty Clay Loam 8) Clay Loam 9) Silt
• Clayey (**<u>Typically</u>** forms ribbon of 1 to 2 inches, or more, in length)	10) Sandy Clay 11) Silty Clay 12) Clay

2. Structure

When the sand, silt, and clay particles in soil cling or stick together, a soil ped or aggregate is formed. This is known as soil structure and is important in water movement and root development in soils. It is judged by determining the dominant structural type in an undisturbed, natural volume of soil. Five categories are used to describe structure in the surface layer.

a) Single Grain – Each individual soil particle stands alone. The particles are totally non-coherent. It is associated only with sandy textures, although all sandy soils are not single grain. Sandy textures, when moist or wet, tend to compact and cling together when dug with shovel, post-hole digger, or backhoe, but these are not true structural aggregates. Volumes of such soil will fall apart when handled, even when moist. In single grain structure, individual sand grains can be seen with the naked eye.

b) Granular -This refers to natural soil structural aggregates that are rounded or somewhat rounded in form. They are best observed by gently breaking an undisturbed natural volume of soil and by carefully digging into a pile of loose soil. Soil disturbance such as digging with a 2-inch auger or scraping with a shovel tends to destroy natural soil structure except in strongly aggregated soils. Granular structure is normally found in loamy textures. However, it may occur in some sandy surface layers when these have good vegetative cover, and in soils having very fine-sized sand particles. Granular structure is very desirable in soils for all uses.

c) Blocky - In blocky structure, the individual soil particles cling together to form a block-like "ped." The shape of the structural aggregates is more angular than that of granular aggregates. In some cases the blocks are sharply angular, but more often the edges are somewhat rounded. In the surface layer, this structural class will generally occur only in certain severely eroded soils where the existing surface layer consists largely of loamy or clayey materials that originally were found in an underlying subsurface layer.

d) Platy - This structure is characterized by units that are flat and plate-like. They are generally oriented horizontally. This structure may impede movement of water and roots.

e) Massive – (Structureless) No peds are observable in place. This condition is the opposite of single grain structure, because in this case all soil particles form a coherent mass. Also, it may occur when the soil has not had enough time to develop other structure, as in loamy parent material or saprolite. This may also occur in floodplains. There are no true soil aggregates observable; clods tend to rupture easily when handled. Note: Some clayey soils with 2:1 clays (high shrink-swell), when moist or wet, may appear to be massive; however, these soils most likely have weak blocky structure and/or the structural units so large it is difficult to recognize the true structure. When these soils are exposed to air and begin to dry, the blocky structure usually becomes more evident.

3. Consistence

Consistence refers to the degree of cohesion and adhesion of a volume of soil and its resistance to rupture and penetration when moist, and its stickiness when wet. Consistence is determined as moist (as defined below) and wet (defined under characteristics of the subsurface layer).

The moist consistence is determined by the amount of resistance a moist volume of soil offers to rupture. Soil must feel moist to correctly make this determin- ation. It may be necessary to moisten soil slightly to evaluate its consistence. This is determined by pressing the undisturbed soil between the thumb and extended forefinger. There are three classes of consistence recognized in the surface layer.

a) Loose - The soil offers almost no resistance to crushing. This is associated with sandy textures that have single grain structure.

b) Friable - The soil deforms, crumbles, or ruptures under slight pressure. Although easily deformed, the aggregates of a friable soil rest between the fingers without collapsing. Friable consistence is usually associated with loamy textures, but some clayey textures are also friable. Any sandy textures with granular structure would be friable in consistence.

c) Firm- The soil volume deforms or crumbles only when moderate pressure is exerted with the extended forefinger and thumb. The soil volume generally does not rupture and fall between the fingers; it flattens and is deformed (applies to both loamy and clayey textures).

4. Erosion

Erosion by wind and water lowers the agricultural productivity of soils. Soils vary in their susceptibility to erosion (erodibility) because of slope, permeability, thick- ness of the surface and subsurface layers, cropping practices followed in the past, and erosion protection measures provided. Severely eroded soils are usually erodible in nature. Soils with slight to moderate erosion on sloping topography usually have received some erosion protection in the past. Non- eroded fields may or may not be erodible - and it is important to recognize the amount of conservation protection that such soils and fields require. The sediments from eroding land cause severe environ- mental problems by filling ditches, streams, rivers, reservoirs, and waterways, thereby reducing the quality and usefulness of the water. When eroding sediment, sometimes accompanie by fertilizers and pesticides, affects neighboring areas this is called “off-site” damage.

Because of erosion, most sloping upland soils have lost at least some portion of the surface layer. In many soils, this leaves the upper part of the subsurface horizon at or near the present land surface. When used for row-crop agriculture, plowing and other tillage practices have usually dipped into the subsurface layer, mixing these more clayey materials with the remainder of the surface horizon.

The degree of erosion which has occurred is revealed by examination of the soil material in the top six inches of the present profile to estimate what approximate proportion of it consists of a mixture of the surface and underlying layers.* Unfortunately, in some of our soils more than 3/4 of the upper six-inch depth consists of materials from lower horizons. To find that l/4 to 3/4 of the original surface layer has been lost is very common, especially in the Upper Coastal Plain and Piedmont regions of North Carolina. These previous erosional losses significantly influence the methods needed today to manage these soils for optimum productivity. A more complete discussion of the nature of erosion problems and treatments follows in Chapters V and VI.

The erosion class must be determined by observing the appearance of the first six inches of soil on the wall of the pit and by examining the properties of the surface layer sample. Although there are exceptions, in many soils the surface horizons are somewhat coarser in texture than the subsurface layer. Also, there are usually color differences. These differences are used to determine erosion class. In land judging, three erosion classes are recognized:

a) None to Slight – All of the top six inches (or more) of the surface layer is similar in its physical characteristics. There is little or no noticeable mixture (variations in color and/or texture) of the soil in the surface layer with soil from the horizon immediately below it*, as could occur through tillage. With little or no mixing having occurred, the upper part of the surface layer should have the characteristics of natural surface horizons, being somewhat more brownish, grayish or black due to the presence of organic matter. The upper part of the surface layer should be at least 4 l/2 inches thick in order to have none-to-slight erosion. (If less than percent of the top six inches of surface horizon remains, the erosion class cannot be "none to slight.")

b) Moderate - From 25 to 75 percent of the top six inches of the surface layer is soil from a subsurface horizon, and mixed textures and structures reflect this. There are two different possible situations of this:

1) The entire first six inches is a mixture of soil material, of which about l/4 to 3/4 came from the horizon immediately below it*. In that case, tillage has mixed the two horizons.

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*Note that the horizon "immediately below the surface horizon" will not always be the same horizon that is being judged as the subsurface layer. (Examples include: soils with thin transitional horizons; soils with E horizons; and most "s" subclass soils.)

2) Another case is that of an undisturbed lower horizon lying within l l/2 to 4 l/2 inches of the present soil surface. In fields and pastures which have not been plowed, there may be l l/2 to 4 l/2 inches of sandy or loamy textured surface over an undisturbed, finer-textured B horizon.

c) Severe - When 75 percent or more of the original topsoil has been removed by erosion, at least 3/4 of the surface layer (the top 6 inches) consists of the soil from the underlying horizon*. In this case there will generally be little or no difference in texture between the surface layer and the underlying horizon. In this case the situation should have evidence of erodibility (slopes, etc.) and the surface layer would mostly have about the same characteristics as the underlying horizon, rather than those of a natural surface horizon described previously above.

Soils that have sandy textures to a depth of at least 12 inches generally will not have suffered moderate to severe water erosion. These soils, however, commonly have wind erosion problems-if they are well drained. Severe water erosion is generally associated with soils that have loamy surface horizons and loamy or clayey subsurface horizons (having little difference between these horizons in color or texture). Although some highly erodible soils will erode when the slope is less than two percent, severe erosion is usually found where slopes are greater than two percent.

SUBSURFACE LAYER

For land judging purposes, the first significant soil horizon below the top six inches will be judged as the subsurface layer. This horizon is commonly referred to as "subsoil", but need not necessarily include all of the subsoil or B horizon. Technically, the subsurface layer judged could be part of the A horizon, a true B horizon, or it could be material from the C horizon. In any case this layer should be the most significant horizon between the 6-inch surface layer and the bottom of the land judging pit. The soil representing this layer will be placed on a separate pile and labeled "subsurface" for the purposes of land judging. Horizon characteristics of this layer have been described in the third part of Chapter I (Understanding Soil Profiles and Horizons).

There are five aspects of the subsurface to be evaluated:

l. Texture

The three textural classes of the subsoil are defined and evaluated in the same manner as those described under the surface layer (pages 15-17).

2. Structure

Any of the five types of structure described for the Surface Layer (pages 18-19) may also be used for the Subsurface Layer. The following additional information may be helpful for blocky and platy structures in subsurface layers.

a) Blocky Structure - The individual soil particles cling together to form a block-like ped. The shape of the structural aggregates is more angular than that of granular structure. Generally with block-like structure you can observe some shiny surfaces on the soil peds. If you observe an undisturbed mass of soil, these irregularly-shaped peds are easily seen. Blocky structure is found in clayey textures and in the finer grades of loamy textures. It is a desirable characteristic, aiding plant roots by supplying air and moisture. This also contributes to soil permeability in drainage systems and increases septic waste absorption capacity. Blocky structure does not occur in sandy textures. In some soils the blocky structure may be weak or very coarse, making it difficult to see true structural aggregates in undisturbed soil masses. In moist soils structure can be observed by carefully breaking aggregates apart, when these have not been mashed or otherwise disturbed by the tools used in digging the sample.

b) Platy Structure - When the soil particles cling together to form plates or sheets, the structure is platy. This type of structure cannot always be observed in the soil horizon within the pit, but platy fragments will be present in the disturbed soil mass. This is an undesirable soil structure and would retard water and air movement through a soil.

3. Consistence

In the subsurface layer, soil consistence is evaluated both when moist and when wet.

a) Moist Consistence -

Loose - Defined under characteristics of the surface layer.

Friable - Defined under characteristics of the surface layer.

Firm - Defined under characteristics of the surface layer.

Very Firm - To determine this consistence class the soil must be moist. If conditions are very dry, water must be slowly and carefully added to moisten the soil aggregates throughout, in order to test the force required to crumble them. In this case the soil strongly resists crushing. The peds generally can be broken, although maximum pressure between the thumb and extended forefinger is required.

Very firm consistence is generally associated with certain clayey textures in which the clay itself is of the more active 2:1 type (see page 16). Although there are some exceptions, most red, clayey subsurfaces do not have very firm consistence. These soils typically have the less active 1:1 clays instead.

b) Wet Consistence - It is generally necessary to add water to the soil mass to determine wet consistence. When wet, soils exhibit different characteristics than when moist or dry. A wet soil is one in which approximately 80 percent of the pores in the soil are filled with water. Wet soils are more easily crushed and deformed. There are three classes of wet consistence.

Non-Sticky - When the soil mass is wet and a ped is pressed between the fingers there is little or no adherence to the fingers by the pressed soil mass. The soil mass may stick to one of the fingers but is easily dislodged by shaking the hand. Sandy textured soils, and the sandy loams of the loamy textured group, are in this class.

Sticky - When the soil is pressed between the fingers and persists in clinging to one of the fingers, the consistence is termed sticky. The soil may be dislodged from the fingers by shaking, but it will not immediately fall from the fingers of its own accord. Loamy or clayey textured soils may be sticky; some of the clayey textures are very sticky.

Very Sticky - When the wet soil mass is pressed between the fingers it tends to hold the fingers together. The soil will stretch a little between the finger and thumb as they are moved apart. Clayey soils that contain high shrink-swell (2:1 type) clays are in this class. The presence of shrink-swell clay in subsurfaces suggests problems - especially for septic absorption fields, basements, and foundations. Also very sticky subsurface materials usually function poorly, if at all, when tile drainage is installed.

4. Permeability

Permeability refers to the rate of movement of water and air in the subsurface layer. This characteristic is inferred from your evaluation of the texture, structure, and consistence of this layer. Four classes of permeability are recognized in land judging:

a) Rapid - Rapid permeability is associated with sandy textures (an exception is when the sandy-textured subsurface has been cemented by organic matter, iron, aluminum, and silica to form a limiting layer, as described later). With rapid permeability, the rate of water movement through the subsurface layer will exceed 2.0 inches per hour. This permeability is suitable for septic tanks and septic absorption fields unless the water table is within six feet of the surface, in which case potable water supplies may be contaminated.

b) Moderate - This permeability class is associated with loamy textured soils and with blocky or granular structure. Water moves through the subsurface layer at rates of 0.6 to 2.0 inches per hour. However, a few clayey soils which have blocky structure with friable or firm (moist), or sticky (wet) consistence will have moderate permeability. Soils with very sticky consistence do not qualify.

Loamy soils with this subsurface characteristic are generally suited for conventional septic absorption fields if these systems are designed and installed with proper field size in relation to the volume of effluent. It is also necessary that the location not have high water tables during any part of the year, nor excessive slopes.

Soils with clayey subsurfaces with moderate permeability (and strong blocky structure) may be provisionally suited for septic absorption fields, if adequate area is available for the extension of absorption lines to greater lengths than normal. The normal or common absorption field area required is about one square foot per gallon of effluent capacity per day, when installed in completely suitable soils.

c) Slow - This is associated with clayey subsurfaces having blocky structure with firm (moist) and/or sticky (wet) consistence. Some loamy textures that have platy or massive structure will also have slow permeability. Water moves through the subsurface layer at rates of 0.06 to 0.6 inches per hour. Soils with subsurface layers with this absorption rate are generally unsuited for conventional septic tanks and septic absorption fields.

d) Very Slow - This permeability class is associated with clayey textured subsurface layers with massive or platy structure, and sometimes with blocky structure. When this occurs in soils with blocky structure, the consistence must be either very firm (moist) or very sticky (wet), or it may be both. This permeability class also occurs in soils with limiting layers caused by Bx and Bh horizons which block downward movement of water. The rate of water movement through these subsurfaces is less than 0.06 inches per hour. Soils with very slowly permeable subsurfaces are unsuited for conventional septic absorption systems.

5. Depth to Limiting Layer

The limiting layer in soil is a subsurface zone that seriously restricts root and water movement through it. Both organic hardpans (Bh horizons) and fragipans (Bx horizons) will be judged as limiting layers. These have been described in Chapter I (4) “Understanding Soil Profiles and Horizons.” Also, where horizons or any soil layer consists of at least 50 percent stone, gravel and rock fragments this will also be judged as a limiting layer. Solid rock (R) is obviously a limiting layer. Weathered rock (Cr horizon) will be considered as a limiting layer. Parent material or saprolite (C horizon) will not be considered limiting as roots and water will penetrate these layers.

There are four depth classes recognized in this soil characteristic. These are:

Very shallow (less than 12");
Shallow (12-24");
Moderately Deep (24-36"); and
Deep (greater than 36").

These limiting layers differ from a condition of poor drainage. Saturated zones of soil may hinder roots during wet periods but may permit roots to go through during drier periods of the year, even though water and air movement is extremely slow.

Tillage Pan - (Not a permanent, limiting layer)

In some soils, primarily sandy, light colored soil in the Coastal Plain, the depth of root growth of annual crops is often limited to about 8 to l0 inches. This condition is known as a "tillage pan" or "hard pan" and is largely a result of soil compaction by wheels and tillage equipment. This is not a permanent feature of the soil, since it can be corrected by subsoiling or deep chisel plowing. Therefore it will not be considered a limiting layer in land judging.

TOTAL SOIL CHARACTERISTICS

l. Slope

Slope is a very important characteristic when we are concerned with use and management of the soils. Slope is expressed in percentage, which simply shows the difference in elevation in feet over the horizontal distance in feet between two points. A four percent slope simply means the land surface is going up or down at the rate of four feet in every l00 feet of horizontal distance. There are six slope classes recognized in land judging:

- 0 to 2 percent - nearly level
- 2 to 6 percent - gently sloping
- 6 to l0 percent - sloping
- l0 to l5 percent - strongly sloping
- l5 to 25 percent - steep
- 25 + percent - very steep

2. Drainage

Internal soil drainage is important in soils because of its effect on development of the soil itself and upon its use and management. The internal drainage of soils is related to the level of "ground water" or "water table." This is a zone in the soil that is saturated with water for significant periods of time. How close this saturated soil zone is to the surface depends on the properties of the soil itself, as well as its elevation above nearby streams, rivers or the ocean. Seasons also have an impact. Water tables often are shallower (closer to the surface) during the winter and spring.

The water table may be of a regional nature, a saturated zone that extends over wide geographic areas; or it may be a "perched" water table, a local area in which downward movement of water is restricted by very slowly permeable strata in or beneath the soil profile. Surface runoff and the permeability of the soil also affect soil drainage. Soils having fairly fine-textured subsurface layers which are slowly permeable and nearly level, with very slow surface water removal, tend to be imperfectly drained. On the other hand, the soil may be very permeable but because of a high water table and low-lying position (without any slope), it may even be poorly drained.

Organic matter in the surface layer is also influenced by soil drainage. The well drained soils have lighter colored surface layers than those that are not well drained. In the mountains of North Carolina, however, there are a number of well drained soils that have dark-colored surfaces and higher organic matter content. This is related to the cooler average temperatures due to the higher elevation in the mountain areas.

Redox depletions, or zones of reduced iron (grey colors). and redox concentrations or zones of redox concentrations (reddish colors), and especially the presence of gray colors within 36 inches of the surface, are our primary clues to the drainage status of soils. These soil zones of dull gray colors indicate that at some period of time enough wetness existed to cause the loss of aerobic conditions. When this happens the chemical element iron (Fe), which is usually present in the soil, was converted to its "reduced" chemical state. This then changed it from the reddish-yellow color (rusty color) to gray. In this "chemically reduced form" iron is more soluble and may actually move into other soil zones (these become zones of "redox concentrations"). Sometimes these zones vary from gray to yellow or red, forming a pattern referred to as "redoximorphic features." These are zones where iron may have been depleted and others where it actually has accumulated. Then, when conditions became drier, the accumulated zones of iron changed to the oxidized condition, which produced the reddish colors again. These features are important to all urban uses and to the management of nutrients from fertilizers and waste products in agriculture. Dull gray colors (sometimes in combination with the reddish zones of redox concentrations), and the depth at which these occur, are important in several of the special environmental considerations included on the scorecard.

There are five major drainage classes recognized in land judging:

a) <u>Well</u> - With the exception of the surface layer as influenced by organic matter, these soils are usually shades of red, yellow or brown in the top 36 inches of the profile.* Within this depth there are no redox depletions (grayish or bluish colors) that would indicate reduction or removal of the iron oxides during water saturation. In some soils, fragments of parent material (gneiss, slate, schist) may be grayish in color and present throughout the subsoil, but these do not imply drainage problems. On well-drained soils mineral particles are well oxidized and the bright colors indicate the profile is not saturated with water for prolonged periods of time.

b) <u>Moderately Well</u> - With the exception of the surface layer as influenced by organic matter, the profile has no redox depletions (grayish or bluish colors) within the top 24 inches. Redox depletions are first found at 24 to 36 inches below the surface. These colors are indicative of water saturation of the soil for certain periods of time. In general, in a subsurface zone of limited drainage the more completely solid gray the soil is the longer the period of the year this soil material remains saturated with water. For crop production, moderately well-drained soils have only minor wetness problems during wet seasons and would require drainage for most intensive use. However, they present moderate to severe limitations for all urban uses.

c) <u>Somewhat Poorly</u> - With the exception of the surface layer as influenced by organic matter, the profile has no redox depletions in the upper 12 inches. However, within the range of 12 to 24 inches below the soil surface redox depletions are <u>first</u> found. Redox depletions in the l2 to 24 inch zone and may be interspersed with bright colors, or the horizon may be dominantly gray. These soils require drainage for most agricultural uses and they have severe limitations for all urban uses.

d) <u>Poorly</u> - The complete soil profile is dominantly gray or dark gray. The surface layer may be grayish in color, but is sometimes black or very dark gray. <u>If the surface horizon is black or very dark gray, then it must be less than 6 inches thick</u>. These soils require drainage for crop usage and have severe limitations for all urban uses.

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* If soil pits are not deep enough to show required subsurface depth, the drainage class will be determined by evaluating the portion of the subsurface that is exposed in the pit.

In most cases these soils are now considered to qualify as "hydric." This is one of three components; hydric soil, hydrophytic vegetation, and hydrology (saturated within 12 inches of the surface for a specified length of time) which, if all are present together, would cause an area to be designated "a wetland." (See Chapter VII, 1. Possible hydric soil). In Recommending Land Treatments drainage treatments and cropping systems are to be recommended as appropriate to land of this subclass for agricultural or forest production. In so doing we are assuming that even if the land does qualify as a wetland (or did at some previous time) it is considered as "prior converted" -- making this recommended use permissible under current rules regarding wetlands.

In evaluating the Special Environmental Concerns of the site on the scorecard the poorly drained or wetter status makes the site a probable hydric soil and this concern should be marked "True." In this case we are assuming that the site has not had previous clearing, drainage and "prior conversion." We are reminding the potential land user to check with appropriate environmental authorities before taking actions which could damage its possible functions as a wetland. Such actions could violate legal requirements.

e) Very Poorly - These soils have profiles like those of poorly drained soils, but they have surface horizons that are black to very dark gray and that are more than 6 inches thick. While these soils are most common in the Coastal Plain they may occur in both the Piedmont and mountains. They require drainage for agricultural uses and have severe limitations for all urban uses.

Note that the same comments regarding "Recommending Land Treatments" and "Special Environmental Concerns" listed above for Poorly Drained soils also apply to Very Poorly Drained soils.

3. Surface Water Removal

Surface water removal (frequently referred to as surface runoff) is the rate that water will either run off the surface of the soil or infiltrate into the soil profile. The movement of water across the surface of soils, or into the soil profile, is very significant in the use and management of soils. Rapid water movement across a soil surface is an erosion hazard and contributes to crop drought; rapid water movement into the soil indicates conditions favorable for excessive leaching and droughtiness. Very slow removal of water is associated with wetness, poor aeration, and "drowning" of crops during rainy periods. Slow surface water removal is the most favorable category and is associated with Class I land.

In evaluating surface water removal, there are two major soil characteristics to consider:

(l) The slope of the soil (with other conditions equal, the steeper the slope the higher the rate of surface water removal);

(2) The permeability of both the surface and subsurface layers.

Permeability affects surface water removal on both sloping and level soils. On sloping soils, surface water removal is more rapid where permeability of the soil profile is less. On level soils, surface water removal is more rapid if permeability of the subsurface is greater.

You may note that the combined effects of slope and permeability may also be said to influence the "infiltration rate" of the soil (the rate of water movement into the soil surface). When surface water removal is rather rapid, and the soil has at least some degree of slope, then there is little time for water to infiltrate into the soil. This leads to low infiltration rates, greater erodibility and a greater chance of crop drought stress. Also, water runs off any sloping soil faster when the profile is already wet. The effects of these soil characteristics on surface water removal may be more clearly apparent by studying Tables (II - 2 to 5) which summarize the possible combinations of soil conditions for each rate of surface water removal.

Four surface water removal classes are recognized:

a) Rapid - The soil conditions for rapid surface water removal are:

- Well-drained soils on any slopes, with sandy textures in both surface and subsurface layer.
- Soils with sandy surface layers 20 to 40 inches thick (subsurface characteristics are not important when located on slopes above 2 percent.)
- Soils with any surface or subsurface characteristics when located on slopes of greater than 6%.

b) Moderate - The soil conditions for moderate surface water removal are:

- Well-drained soils with sandy surface layers, 20 to 40 inches thick (characteristics of subsurface layer not important) when located on slopes of 0 to 2 percent.
- Soils with sandy (less than 20 inches thick) or loamy surface layers and loamy subsurface layers on slopes of 4 to 6 percent. (Drainage class is not considered).
- Soils with sandy (<20") or loamy surface, clayey subsurface at slopes of 2-6%.

- Soils with clayey surface layers (characteristics of subsurface layer not important) on slopes of 2 to 6 percent.

c) Slow - This class includes most well, moderately well and somewhat poorly drained soils on 0-4% slopes, although there are certain exceptions. The slope permitted depends upon whether the subsurface layer is clayey. Also, consistence and permeability of the subsurface layer are important in separating slow and very slow categories of surface water removal. The conditions for slow surface water removal are as follows:

  - Well, moderately well and somewhat poorly drained soils having sandy (<20") or loamy textures in the surface with loamy-textured subsurface layers on 0-4% slopes

  - Similar soils having a clayey subsurface in the slope range of 0-2%. These must not have very slow permeability with either very firm or very sticky consistence.

d) Very Slow - The soil conditions for very slow surface water removal are:

  - All soils that are poorly or very poorly drained (slope will be 0-2%).

  - Moderately well and somewhat poorly drained soils having very slow permeability, at 0 – 2% slope. These would have a clayey subsurface layer with either very firm or very sticky consistence, or both.

Table II-2 Possible Combinations of Characteristics for Each Rate of Surface Water Removal

Rapid Surface Water Removal

Factor	Possible Combinations of Characteristics			
	1	2	3	4
Surface	Sandy	Sandy (20-40")	Any	Any
Subsurface	Sandy	Not Important	Not Important	Any
Slope	Any	>2%	>6%	>2%
Drainage	Well	Not Important	Not Important	Not Important
Other	--	--	--	Very Shallow Depth to Limiting Layer (<12")

Table II-2 Possible Combinations of Characteristics for Each Rate of Surface Water Removal

Moderate Surface Water Removal

Factor	Possible Combinations of Characteristics			
	1	2	3	4
Surface	Sandy (20-40”)	Sandy (<20”) or Loamy	Sandy (<20”) or Loamy	Clayey
Subsurface	Not Important	Loamy	Clayey	Not Important
Slope	0-2%	4-6%	2-6%	2-6%
Drainage	Well	Not Important	Not Important	Not Important
Other	--	--	--	--

Table II-2 – Possible Combinations of Characteristics for Each Rate of Surface Water Removal (cont’d.)

<u>Slow Surface Water Removal</u>

Factor	**Possible Combinations of Characteristics**	
	1	2
Surface	Sandy (<20”) Loamy	Sandy (<20”) Loamy or Clayey
Subsurface	Loamy	Clayey
Slope	0-4%	0-2%
Drainage	Well, Moderately Well or Somewhat Poorly	Well, Moderately Well or Somewhat Poorly
Permeability (Of Subsurface)	Moderate or Slow	Moderate or Slow
Consistence (Of Subsurface)	Friable or Firm Non-Sticky or Sticky	Friable or Firm, Sticky

Table II-2 – Possible Combinations of Characteristics for Each Rate of Surface Water Removal (cont'd.)

<u>Very Slow Surface Water Removal</u>

Factor	**Possible Combinations of Characteristics**	
	1	2
Surface	Loamy or Clayey	Any
Subsurface	Clayey	Any
Slope	0-2%	0-2%
Drainage	Moderately Well, Somewhat Poorly	Poorly or Very Poorly
Permeability (Of subsurface)	Very Slow	--
Consistence (Of subsurface)	Either Very Firm, or Very Sticky, or both	--

4. Flooding

In evaluating soils it is important, both for agricultural use and especially for urban uses, to determine if the soil is located on a floodplain or in an area that might be subject to flooding. This characteristic can be determined by the position on the landscape and sometimes by evidence in the soil profile of several layers of materials deposited during floods.

Three flood hazard classes are recognized:

a) No Hazard - Soil is not in a stream floodplain nor located in a depressional or low lying area that would be flooded by surface runoff.

b) Potential Hazard - The soil is in a depressional or low lying area (but not in a floodplain) that would be flooded by excessive surface runoff during high intensity rains. These soils frequently have an accumulation of over-wash materials at the surface. A potential hazard of flooding, alone, will not change the class or subclass of the soil as determined by color characteristics. However, for a well-drained soil in this position, additional treatments to control the water table and/or improve surface water management will be required. This hazard also strongly influences urban uses of the soil.

c) In Floodplain - The soils are in the floodplain of a river or stream. They are subject to flooding when stream channels overflow. These soils generally are stratified, with layers ranging from less than one inch to about four inches in thickness often visible in profile. This situation may change the soil subclass, the drainage treatments required, and it strongly affects all urban uses.

CHAPTER III
Land Classification

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CHAPTER III
LAND CLASSIFICATION

1. Land Capability Classes - An Overview

Land capability is a system developed to classify soils according to their suitability and limitations for agricultural uses. All land is placed in 8 classes, designated by Roman numerals as Classes I, II, III, IV, V, VI, VII and VIII. Class I land has the widest range of uses and the fewest limitations, and requires the fewest conservation measures in its use. Class VIII land has the narrowest range of uses and the most severe limitations.

Land Classes I through IV are generally considered as classes that are suitable for agricultural crops that require tillage. Class I land is suitable for very intensive use with no conservation practices, except good management. Class IV land is suited for limited-tilled crop production with acceptable practices for soil and water conservation. Class II and III land are intermediate between Classes I and IV.

Land Classes V through VIII are generally best suited for perennial crops or forest land. This land may be used to grow perennial grass or legumes as pasture or hay or it may be best suited as forest land. Class V requires no conservation practices, but should remain in its natural condition. Examples of Class V land would be a mountain cove in native bluegrass and poplar with numerous boulder and rock outcrops, or a wet swamp subject to flooding. Because access to observe and dig pits in Class V land is usually difficult, this class will not be judged in contests. It is excluded from the scorecard. Class VIII land has no regular agricultural usefulness. These are lands which should be managed for environmental protection and for recreational and wildlife benefits. An example is the rocky and stony land of some mountain areas. Classes VI and VII are usable agricultural lands but there are several tillage restrictions on erodible land or major drainage requirements for wet lands in these classes.

Land capability classes are divided into three subclasses. The subclasses indicate the kind of conservation problem, or hazard, that limits the use of the land. Subclasses are shown by a small letter attached to the capability class. Examples are: IIe, IIIw, IVs.

2. The three subclasses:

<u>"e" Subclass</u> - Soils that have a water erosion hazard. Since water erosion is the result of water flowing across the surface of the soil, these subclasses will be related to slope, texture, infiltration and permeability. All "e" subclasses require conservation practices to control soil and water losses.

Soils that have sandy, loamy, or clayey textured surface horizons, loamy or clayey subsurfaces, that are shallow, moderately deep or deep, on slopes above 2 percent are in "e" subclasses.

"w" Subclass - Soils that require drainage as shown by dull yellow and gray soil colors, or soils that have a flooding hazard because of being located in floodplains. These soils have a water problem as their major limitation.

"s" Subclass - This subclass includes a variety of special soil conditions. These are: Well-drained soils with sandy surface layers and sandy subsurface layers, with the total depth of sandy texture extending to 20 inches or more on any slope. Well-drained soils with sandy surface layers (20-40 inches thick) and loamy subsurface layers on any slope.

Also included are:
Soils with more than 50 percent of the surface layer consisting of stony, cobbly, or gravelly materials. Also included are Very Shallow soils (limiting layer at l2 inches or less) on all slopes.

Note: Shallow or moderately deep soils of any slope class are placed in an "e" subclass according to their slope and other features.

KEY TO PLACEMENT OF SOILS INTO LAND CAPABILITY CLASS AND SUBCLASS

CLASS I SOILS (no subclasses)

The Surface Layer

Texture - Any (less than 20 inches if sandy)
Structure - Any
Consistence - Any
Erosion - None to slight

The Subsurface Layer

Texture - Loamy, Clayey
Structure - Granular, Blocky
Consistence - Friable, Firm
Non-Sticky, Sticky
Permeability - Moderate, Slow
Depth to limiting layer - Deep

Total Soil Characteristics

Slope - 0-2%
Drainage - Well
Surface Water Removal - Slow
Flooding - No hazard, Potential Hazard

CLASS IIe SOILS

The Surface Layer

Texture - Any (less than 20 inches if sandy)
Structure - Any
Consistence - Any
Erosion - None to Slight, Moderate

The Subsurface Layer

Texture - Loamy, Clayey
Structure - Granular, Blocky, Platy, Massive
*****Consistence - Friable, Firm (See Exception #1 below.)
Non-Sticky, Sticky (See Exception #1 below.)
*****Permeability - Moderate, Slow (See Exception #1 below.)
Depth to limiting layer - Deep, Moderately Deep

Total Soil Characteristics

*****Slope

- 0-2% If deep or moderately deep (Also, see both Exceptions 1 and 2 below.)
- 2-6%

*****Drainage - Well, Moderately Well, Somewhat Poorly (See Exception #2 below.)
Surface water removal - Moderate, Slow
Flooding - No hazard, Potential Hazard

***Exceptions: (Note that these apply only to 0-2% slope.)**

1. Well Drained soils with None to Slight or Moderate erosion, and having either Very Firm or Very Sticky consistence, or both, and Very Slow Permeability due to these factors, will be Class IIe soils.

2. Soil drainage is the key factor. If the field has None to Slight or Moderate erosion, with Very Firm or Very Sticky consistence, or both, and soil colors indicate anything less than Well Drained, then such soils must be class **IIIw**.

CLASS IIIe SOILS

The Surface Layer

Texture - Any (less than 20 inches if sandy)
Structure - Any
Consistence - Any
Erosion - Any

The Subsurface Layer

Texture - Loamy, Clayey
Structure - Granular, Blocky, Platy, Massive
Consistence - Friable, Firm, Very Firm
Non-Sticky, Sticky, Very Sticky
Permeability - Moderate, Slow, Very Slow
Depth to limiting layer- Shallow, Moderately Deep, Deep

Total Soil Characteristics

Slope

- 0-2% (if Shallow and/or with Severe erosion)
- 2-6% (when Severely Eroded or Shallow)
- 2-6% (when subsurface layer has either Very Firm or Very Sticky consistence, or both, and is not Severely Eroded or Shallow)
- 6-l0% (if not Severely Eroded or Shallow)

Drainage - Well, Moderately Well, Somewhat Poorly
Surface Water Removal - Rapid, Moderate, Slow
Flooding - No Hazard

CLASS IVe SOILS

The Surface Layer

Texture - Any (less than 20 inches if sandy)
Structure - Any
Consistence - Any
Erosion - Any

The Subsurface Layer

Texture - Loamy, Clayey
Structure - Granular, Blocky, Platy, Massive
Consistence - Friable, Firm, Very Firm
Non-Sticky, Sticky, Very Sticky
Permeability - Moderate, Slow, Very Slow
Depth to Limiting Layer - Shallow, Moderately Deep, Deep

Total Soil Characteristics

Slope

- 6-l0% (when Severely eroded or Shallow or Very Shallow)
- 2-6% (when Severely eroded and Shallow or Very Shallow)
- 2-6% (when Severely eroded and/or Shallow together with either Very Firm or Very Sticky consistence, or both, in subsurface layer)
- l0-l5%

Drainage - Well, Moderately Well, Somewhat Poorly
Surface Water Removal - Rapid, Moderate
Flooding - No hazard

CLASS VIe SOILS

The Surface Layer

Texture - Any (less than 20 inches if sandy)
Structure - Any
Consistence - Any
Erosion - Any

The Subsurface Layer

Texture - Loamy, Clayey
Structure - Granular, Blocky, Platy, Massive
Consistence - Friable, Firm, Very Firm
Non-Sticky, Sticky, Very Sticky
Permeability - Moderate, Slow, Very Slow
Depth to Limiting Layer - Shallow, Moderately Deep, Deep

Total Soil Characteristics

Slope

- 6-l0% (When Severely eroded and Shallow or Very Shallow)
- l0-l5% (When Severely eroded or Shallow or Very Shallow)
- l5-25%

Drainage - Well
Surface Water Removal - Rapid
Flooding - No hazard

CLASS VIIe SOILS

The Surface Layer

Texture - Any (less than 20 inches if sandy)
Structure - Any
Consistence - Any
Erosion - Any

The Subsurface Layer

Texture - Loamy, Clayey
Structure - Granular, Blocky, Platy, Massive
Consistence - Friable, Firm, Very Firm
Non-Sticky, Sticky, Very Sticky
Permeability - Moderate, Slow, Very Slow
Depth to Limiting Level - Shallow, Moderately Deep, Deep

Total Soil Characteristics

Slope

- l0-l5% (when Severely eroded and Shallow or Very Shallow)
- l5-25% (when Severely eroded or Shallow or Very Shallow)
- 25% + Slopes

Drainage - Well
Surface Water Removal - Rapid
Flooding - No hazard

CLASS IIw SOILS

The Surface Layer

Texture - Any
Structure - Any
Consistence - Any
Erosion - None to slight

The Subsurface Layer

Texture - Loamy
Structure - Granular, Blocky
Consistence - Friable, Firm
Non-Sticky, Sticky
Permeability - Moderate, Slow
Depth to Limiting Layer - Deep, Moderately Deep

Total Soil Characteristics

Slope - 0-2%
Drainage

- WD* - if in FP
- MWD, SPD (with Loamy subsurface) if not in FP

Surface Water Removal – Rapid or Moderate (if WD in FP), Slow
Flooding - No hazard, Potential Hazard, or in FP

Note: Permeability is the key to drainage subclasses - if Slow or Very Slow, with Clayey texture, it drops to IIIw. Either Very Firm or Very Sticky consistence, or both, in subsurface also drops it to class IIIw.

*Key to abbreviations for w Sub-Classes used above and on following pages:

WD - Well Drained	**PD** - Poorly Drained
MWD - Moderately Well Drained	**VPD** - Very poorly drained
SPD - Somewhat Poorly Drained	**FP** – Floodplain

CLASS IIIw SOILS

The Surface Layer

Texture - Any
Structure - Any
Consistence - Any
Erosion - None to slight

The Subsurface Layer

Texture

- Sandy (if WD and in FP)
- Loamy (if MWD or SPD and in FP)
- Sandy or Clayey (if MWD or SPD and not in FP*)
- Loamy (if PD or VPD and not in FP)

Structure - Single Grain, Granular, Blocky, Massive

Consistence - Loose, Friable, Firm, Very Firm
Non-Sticky, Sticky, Very Sticky

Permeability - Rapid, Moderate, Slow, Very Slow

Depth to Limiting Layer - Deep, Moderately Deep

Total Soil Characteristic

Slope - 0-2%
Drainage

- WD - if subsurface is Sandy and in FP
- MWD or SPD - if subsurface is Loamy and in FP
- MWD or SPD - if subsurface is either Sandy or Clayey and not in FP
- PD or VPD - if subsurface is Loamy and not in FP

Surface Water Removal - Slow, Very Slow; Moderate or Rapid (if WD with sandy surface and subsurface, nearly level and in FP)
Flooding - No Hazard, Potential Hazard or in FP*

*See the key to these abbreviations on the page for Class IIw Soils.

CLASS IVw SOILS

The Surface Layer

Texture - Any
Structure - Any
Consistence - Any
Erosion - None to slight

The Subsurface Layer

Texture

- Sandy or Clayey (if MWD, SPD, and in FP*)
- Sandy or Clayey (if PD or VPD whether in FP or with no flood hazard)
- Loamy (if PD or VPD and in FP)
- Structure - Single Grain, Granular, Blocky, Platy, Massive
- Consistence - Loose, Friable, Firm, Very Firm
  Non-Sticky, Sticky, Very Sticky

Permeability - Rapid, Moderate, Slow, Very Slow
Depth to Limiting Layer - Deep, Moderately Deep

Total Soil Characteristics

Slope - 0-2%
Drainage

- MWD or SPD (if subsurface is Sandy or Clayey and in FP)
- PD or VPD (if subsurface is Sandy or Clayey, whether in FP or with no flood hazard)
- PD or VPD (if subsurface is Loamy and in FP)

Surface Water Removal - Slow, Very Slow
Flooding - No Hazard, Potential Hazard, in FP*

*See the key to these abbreviations on the page for Class IIw Soils.

CLASS VIw and VIIw SOILS

These sub-classes will not be used for land judging. They are very wet lands that are covered with water for long periods of time. Examples of VIw and VIIw soils are fresh, brackish, or salt water marshes, and large swamp areas that cannot be readily drained. In addition to the difficulty of drainage and clearing, there are presently legal guidelines regarding drainage or modification of these areas, which generally are now considered as "wetlands." These wetlands are known to provide major benefits in protecting the natural ecology and environment in these areas.

Through large-scale dredging and drainage systems some land originally included in these subclasses has been placed into commercial agriculture in Eastern North Carolina. Drainage improvements often reduce wetness limitations sufficiently to change Class Vw, VIw or VIIw to Class IVw or IIIw. These soils are very dark colored and large areas of them are referred to as "blacklands." Some of these soils have thick, organic surface layers containing over 20% organic matter. Mineral soil layers underlie the organic surface layer at some depth. To judge these soils requires understanding several guidelines which are beyond the scope of this handbook. Therefore, although these "blacklands" of North Carolina hold promise for many future uses, we are not equipped to include these soils in our judging program.

CLASS IIs SOILS

The Surface Layer

Texture - Sandy (to 20-40 inches)
Structure - Single Grain, Granular (if high in organic matter)
Consistence - Loose, Friable
Erosion - None to slight

The Subsurface Layer

Texture – Loamy, Clayey
Structure - Granular, Blocky
Consistence - Friable, Firm
Non-Sticky, Sticky
Permeability - Moderate, Slow
Depth to Limiting Layer - Deep

Total Soil Characteristics

Slope - 0-6%
Drainage – Well, Moderately Well
Surface Water Removal - Rapid (2-6% slope)
- Moderate (0-2% slopes)
Flooding - No hazard

CLASS IIIs SOILS

The Surface Layer

Texture - Sandy to depths of 20-40 inches or 40-60 inches, depending on slope.
Structure - Single Grain, Granular (if high in organic matter)
Consistence - Loose, Friable
Erosion - None to slight

The Subsurface Layer

Texture - Loamy*
Structure - Granular or Blocky
Consistence - Friable, Firm
Permeability - Moderate, Slow
Depth to Limiting Layer - Deep

Total Soil Characteristics

Slope

- 6-l0% - if Sandy surface 20-40 inches*
- 0-6% - if Sandy surface 40-60 inches*

Drainage - Well
Surface Water Removal – Rapid (>2% slope); Moderate (0-2% slope)
Flooding - No hazard

*Soils in capability subclass IIIs have sandy surface layers from 20-60 inches thick and they must have loamy subsurface layers

CLASS IVs SOILS

The Surface Layer

Texture - Sandy (to 20+ inches, except for Very Shallow soil)
Structure - Single Grain - Granular
Blocky, if Very Shallow
Consistence - Loose, Friable
Erosion - None to slight

The Subsurface Layer

Texture - Loamy, Sandy
Structure - Blocky, Granular, Single Grain
Consistence - Firm, Friable, Loose
Permeability - Rapid, Moderate, Slow
Depth to Limiting Layer - Deep or Very Shallow

Total Soil Characteristics

Slope

- l0-l5% - with Sandy surface 20-40 inches thick and Loamy subsurface
- 6 -l0% - with Sandy surface 40-60 inches thick and Loamy subsurface
- 0-l0% - with Sandy surface and Sandy subsurface
- 0-l0% - (if Very Shallow)

Drainage - Well
Surface Water Removal - Rapid; Moderate or Slow (if Very Shallow)
Flooding - No hazard

Note: This key to Subclass IVs is prepared primarily for soils that are subject to leaching and drought conditions.

- Very shallow soils, on 0-l0% slopes, are also Class IVs land. These soils will have characteristics that are different from those listed in this key.
- Soils that have more than 50% stone, gravel, or cobble in the surface layer, on slopes of 0-l5% are also Class IVs. These soils will also have characteristics that are different from those listed in this key.

CLASS VIs

- Soils with Sandy surface - 20-40 inches thick, Loamy subsurface, on slopes above l5%.
- Soils with Sandy surface - 40 plus inches thick, and Sandy or Loamy subsurface layers, on slopes above l0%.
- Very Shallow soils on slopes of l0-l5%.
- Soils that have more than 50% of stone, gravel, or cobble in the surface layer and slopes above l5%.

CLASS VIIs

- All Very Shallow soils on slopes above l5%.
- All Very Shallow soils with severe erosion, on any slopes.

CLASS VIII

- These are recreational and wildlife areas, and will not be used in land judging.

CHAPTER IV
Understanding Erosion
and Conservation Practices

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CHAPTER IV

UNDERSTANDING EROSION AND CONSERVATION PRACTICES

Man's habitat is the surface of the earth. He can leave the land for relatively short periods - underground, on the seas, or into space - soon he must return to renew his supply of food or fuel for his engines. His body is derived from the soil, and during the span of his life the soil sustains it. Man today is successfully making many synthetic products, but he cannot live without food. The surface soil which sustains life lies in a fragile productive layer which nature has developed over the stone, clay and sand.

The continuing industrialization, urbanization, and suburban developments are causing some North Carolinians to think of the production of wealth in terms of men and machines alone. Upon the land man makes his first application of productive effort to extract from it food and fiber. The fact that proportionately few people are engaged in agriculture cannot alter the basic relationship of mankind to the soil. As we become more urbanized, our industrial process increases in size and complexity, but our social foundation still rests upon the land. Every human being, no matter how far removed from the actual working of the soil, is affected by our land and what is happening to it. We pay a high fee in soil loss and sedimentation when we fail to follow sound land use and apply needed treatments to conserve our land.

SOIL EROSION

When rain falls or water runs over bare soil it moves soil particles, organic matter, and soluble nutrients. This is soil erosion. Erosion goes on all the time. Normal or natural erosion occurs where water, wind, or other natural agents, under normal environmental conditions, wear away or wash soil or rocks from slopes without disturbance by man. This is called geologic erosion. Geologic erosion processes were wearing away our mountains, rounding off piedmont hills, building floodplains and coastal plains over the centuries before our first settlers arrived. Soil scientists tell us that the natural development of soil, protected by a cover of grass and trees, maintained the land in general equilibrium with the climate.

As settlers cut the timber and cleared away vegetation to grow crops, erosion accelerated. Activities of man that disturb and expose the soil, such as bare cropland, urban, and industrial development, result in much more rapid erosion than natural or geological. It is this accelerated or man-made erosion that is of great concern today. The goal of conservation land treatment is to hold down the rate of man-made erosion to one that permits our continuing and productive use of the land for agriculture or the many other uses of today's society.

l. **Damages of Water Erosion to Cropland** - Erosion leads to lowered infiltration, increased runoff, reduction of organic matter, and deterioration of soil structure. Erosion often results in lowered yields as it exposes successive layers of less productive soil. It does not stop at surface soil removal; on the contrary, erosion speeds up at this stage on many soils. Historically, North Carolina has been a row crop state. Tilled row crops expose land to erosion during the summer months when the majority of high-intensity rainstorms occur. Subsoils exposed by erosion or incorporated into the plow layer are generally more difficult to work than surface soils. They are likely to be puddled when wet and cloddy when dry. A crust forms easily on the surface, slowing the intake of water which increases runoff and erosion. As the degree of erosion increases, difficulty in obtaining stands of crops increases. The amount of frost damage and heaving also increases. Thus, poor physical condition of the soil, rather than loss of mineral nutrients, is the major cause of declining yields as erosion advances. Exposed subsoils are usually low in organic matter and require phosphorus and lime.

Sediment or soil washed from upland slopes may cover crops on fields below, deposit infertile materials, and impair drainage systems. Silt or sediment chokes streams, fills reservoirs, and pollutes water supplies. Flooding caused by unchecked runoff from big rains damages rural and urban property and endangers human lives. Recreational and wildlife values are reduced.

<u>The process of soil erosion by water</u> consists of three principal steps:

(a) Detachment - Soil particles are separated or loosened by the impact of raindrops or by the scouring action of runoff and water.
(b) Transportation - The detached soil particles are floated or moved by water.
(c) Deposition - The transported material is deposited at a new location and is now known as sediment. Soil particles, organic matter, and valuable mineral nutrients are carried away leaving the coarser, less fertile particles behind.

2. **Sheet and Rill Erosion** - The removal of a fairly uniform layer of soil from the land surface by raindrop action and runoff water is called sheet erosion. Sheet erosion takes place wherever muddy water moves off the land. Soil is removed more rapidly from steep slopes than from the gentle slopes. When the water moves fast enough, soil is dislodged and carried along with that splashed up by raindrops. This scouring action forms numerous small channels, or "rills," usually only a few inches or less in depth. This occurs mainly on recently cultivated or loosened soils. The combined effect of sheet and rill erosion removes enormous amounts of soil from bare land after it has been cleanly tilled. After an erosion event, tillage operations smooth the rills and mix subsoil with the surface layer. The gradual wearing away of the land surface has resulted in a surface layer of most soils today which is harder to work and less productive than the original topsoil because it has been gradually worn away through erosion. However, improved equipment design and fertilization have overcome some of this lost soil productivity. Soils vary in their susceptibility to productivity loss from erosion.

Modern day "conservation tillage" emphasizes saving crop stems and leaves after harvest of the grain or other crop product. These "crop residues" can now be left on the soil surface to protect it from erosion. To do this tillage must be avoided. In some areas, however, large acreages of land have been damaged so severely by erosion that further use for commercial row-crop agriculture is not feasible.

Continuous us of conservation tillage is possible for most crops. This allows the farmer to keep the soil surface covered most of the time, which is nature's plan. Surface cover will reduce or eliminate surface crusting. Crusting contributes to erosion and runoff increases and other production difficulties such as poor seedling emergence and reduced exchange of gasses between the atmosphere and the root zone. With the soil surface covered, the physical, chemical, and biological soil properties can be improved or maintained. This results in improved soil quality (the capacity of the soil to function) which in turn results in improved water quality, air quality, wetland and upland wildlife habitats, along with increased profits for the farmer. IMPROVED SOIL QUALITY RESULTS IN IMPROVED OVERALL ENVIRONMENTAL QUALITY.

3. **Gully Erosion** - As runoff concentrates in sufficient volume or velocity, and as rills join to make larger channels, the scouring action increases. Channels so deep they cannot be smoothed out by ordinary tillage methods are called gullies. They may range from one or two feet to over 100 feet in depth. As flowing water undercuts the head and sides of the gully, banks cave, and then collapse. Large amounts of soil are then swept downstream as sediment.

4. **Soil Loss and Sediment** - Soil loss is the quantity of soil actually removed by erosion from a given site or area. The solid material moved by erosion from its place of origin and deposited elsewhere is called "sediment." Erosion may or may not result in the complete delivery of the sediment into a stream system. Some sediment remains on the land above. Soil loss by erosion is expressed in tons per acre. Sediment yield of a watershed is the annual outflow of sediment from the drainage ways of the watershed. It is often expressed in tons per year, referenced to a given point in a stream.

MAJOR FACTORS INFLUENCING EROSION LOSSES

Since l930, controlled studies on field plots and small watersheds by state and federal research stations have supplied valuable information on the complex interrelations between those factors that cause soil and water loss and those that help to reduce such losses. More than l0,000 plot-years data regarding runoff, soil loss, associated precipitation and related information from 37 federal-state research projects located in 2l states were assembled and analyzed.

l. **Rainfall Factor** Research data shows that when factors other than rainfall are held constant, storm soil losses are directly proportional to the product value of two rainstorm characteristics:

- the total kinetic energy of the storm, multiplied by
- its maximum 30-minute intensity

Man has no control over the amount of rainfall energy or when it is received, but he can use conservation treatments to protect his land from the anticipated energy.

2. **Soil Factor** Different kinds of soil erode at different rates even when factors affecting erosion are constant. These differences, due to properties that influence erodibility by water, are those that affect the infiltration rate, permeability and total water holding capacity. Also, those that resist the dispersion, splashing, abrasion, and transporting forces of the rainfall and runoff are important.

   Some soil characteristics that influence erodibility can be modified by management while others cannot. Structure, aggregation, and porosity can be influenced by management. They affect infiltration, permeability, detachability, and transportability of soil particles, as well as the amount of runoff. The amount and kind of organic matter can be increased by using cropping practices which have a positive effect on soil structure, permeability, water holding capacity, and nutrient exchange capacity.

   Examples of factors that management does not affect are texture and the nature of the clay. As surface soil is removed by erosion or excavation, the exposed layers of different texture may be more subject to erosion than the surface materials have been.

3. **Slope** The rate of soil erosion by water is very much affected by both slope length and gradient (steepness or percent slope). Soil losses are greater on longer and steeper slopes, but the rate of erosion does not increase uniformly with increasing slope length or gradient. The relation of soil loss to gradient is influenced by density of vegetative cover and by soil particle size. These affect detachment, transportability, and runoff.

4. **Cover-Management Factor** The soil loss that would occur on a field if it were continuously in a tilled fallow (free of vegetation) condition is used as the basic loss rate for a soil. Soil loss from a cropped field is less than the loss from tilled continuous fallow. The effectiveness of a crop rotation to reduce soil loss is determined by the crop canopy, ratio of clean tilled to close-growing crops, tillage methods used, land productivity, residue use, and vegetative cover at the time of the rain.

   There is a relationship between productivity level and soil erosion. Good yields are associated with good crop stands and good root and top growth. Good vegetative growth of tops provides a better canopy over the land to cushion the raindrops during the growth season. The increased growth of roots and tops results in more residue available to return to the soil, which helps to decrease erosion losses. Management can alter the cover factor by the cropping system used on a field. Grass may be needed in the rotation cycle, or residue from the previous crop left on the surface, both resulting in significant reduction of soil loss and runoff.

5. **Practice Factor** Rarely can all surface runoff from cropland be eliminated; however, land use and treatment can affect direct runoff by:

   - changing the volume of runoff and
   - changing the peak rate of runoff

   Treatments such as grass-based rotations, residue management, fertility treatments, and conservation tillage are included in the cover-management factor. Additional practices that slow runoff are strip cropping, contour tillage, terrace systems, and stabilized waterways.

Factors which affect wind erosion loses are similar. As with water control, keeping the soil surface covered and not disturbed is a critical key to control wind erosion.

CONTROLLING EROSION ON CONSTRUCTION SITES

Erosion control, drainage and other conservation practices for cropland are presented in the Land Treatment Section of this chapter. Conservation treatment of construction sites is not included in land judging, but it warrants a brief discussion in this publication. Thousands of acres in North Carolina are being converted from agricultural use to urban use. Studies show that erosion on land going into use for highways, homes, or shopping centers is about ten times greater than on land in cultivated row crops.

The wealth of information and experience gained from soil and water conservation work on farmland can serve urban areas equally well if properly interpreted. The basic principles of soil and water conservation and resource development can be applied anywhere. Erosion and sedimentation can be controlled effectively, and at reasonable cost, if certain principles are followed in the use and treatment of land. These principles are:

1. using soils that are suited for development,
2. leaving the soil bare for the shortest time possible,
3. reducing the velocity and controlling the flow of runoff,
4. detaining runoff on the site to trap sediment, and
5. releasing runoff safely to downstream areas.

In applying these principles, various combinations of the following practices have proven effective:

- Selecting land where drainage patterns, topography, and soils are favorable for the intended use.
- Fitting the development to the site and providing for erosion control in the site development plan.
- Using for open space and recreation those areas not well suited for urban development.
- In the development of large tracts of land, the area should be divided into sufficiently small workable units on which construction can be completed rapidly so that large areas are not left bare and exposed for long periods.
- Doing the minimum of clearing and land grading and leaving vegetative cover undisturbed insofar as possible.
- Controlling runoff and conveying it to storm sewers or other outlets so it will not erode the land or cause off-site damage. Constructing sediment basins to detain runoff and trap sediment during construction.
- Protecting exposed areas during construction with mulch or temporary cover crops and with mechanical measures such as diversions and prepared outlets.
- Establishing permanent vegetation and install erosion-control structures as soon as possible.

WIND EROSION

Wind erosion is a serious problem only sporadically. Unfortunately, it is not always possible to predict when it will happen. The Sandhills and Coastal Plain regions are most likely to experience problems with wind erosion. However, almost every county in the Coastal Plain has some areas of sand and loamy sand surface textures that are susceptible to wind erosion.

Wind erosion occurs when winds blow across smooth, bare fields where the soil is loose, dry, and finely divided. As with water erosion, wind erosion first removes fine particles of silt, sand, and organic matter that are important for their ability to cycle moisture and nutrients for plant use. Sandy soils dry more rapidly and are more subject to blowing than are the finer-textured soils. In Anson County and from Halifax County eastward to the coast, over three-quarters of a million acres of sands and loamy sands are reported in the l967 North Carolina Conservation Needs Inventory. High velocity winds may occur from March to May. This is the season of bare land resulting from land preparation and planting of field and truck crops.

l. **Factors (or primary variables) that influence soil blowing are:**
   - Soil erodibility factor - Size of soil particles; soil structure.
   - Soil roughness factor - Smooth surfaces are more erosive.
   - Climatic factor - Velocity of winds and surface soil moisture
   - Unsheltered travel distance across the field in prevailing wind directions.
   - Kind, quantity, and orientation of vegetative cover (whether the soil surface is bare or covered; the height of vegetation; whether plant residue is anchored or unanchored).

2. **Damages** - Wind erosion damages our land and environment by detaching and transporting fine particles of soil and organic matter. The removal of the fine particles tends to make the soil more coarse, less fertile, and less productive. The deposition of soil particles resulting from wind erosion can cover small plants and young pasture grasses. It causes ditches and ponds to lose capacity and becomes a nuisance in homes. Blowing sand obstructs roads and creates acute road safety hazards. Reduced visibility is often a serious hazard on highways during a dust storm, sometimes causing serious traffic accidents along highways.

   The abrasive action of the blowing soil particles is similar to the mechanical process of sandblasting. Tender plants are bruised, and leaves, buds, and stems are cut off. Such plant damage can increase the incidence of diseases. Many young plants die from the loss of moisture, injury and/or disease. There are large costs to farmers who may need to replant the damaged crop areas. Injured plants grow more slowly and produce lower yields. In 1967 such damages were estimated at ten million dollars.

CHAPTER V
Recommending Land Treatments

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CHAPTER V RECOMMENDING LAND TREATMENTS

PRINCIPLES FOR CHOOSING LAND TREATMENTS

Table V-I shows the 27 land treatments included on the Land Judging Scorecard. Land treatment is divided into tillage systems, cropping systems, supporting practices, and management practices. It is assumed that good management practices are followed including lime and fertilizer application based on soil test; using winter cover crops in any cropping system when low residue producing crops are grown or the vegetation is removed. Tobacco, cotton, and vegetables are examples of low-residue crops.

Soil conserving crops are considered to be those crops that retard erosion and tend to maintain rather than deplete soil organic matter. Close seeded or close growing crops are generally regarded as soil conserving crops. Fall seeded small grains with residue left on the land following harvest would be such crops.

Soil improving crops improve or replenish soil organic matter and improve soil structure and tilth. Increased water intake, in general, increases the productivity of the soil and reduce runoff and erosion. Sod crops of grasses and legumes and long term no-till are regarded as soil improving crops. Clean-tilled crops are least effective in controlling soil erosion on cropland and sod crops are the most effective. With the variety of soil conditions and crops found in North Carolina, the choice of cropping system and tillage system is important for protecting the productivity of the land. Land judging participants are not requested to recommend the specific crops to be grown - only the general tillage and cropping systems.

Slope length on a field as well as slope gradient (percentage) are important factors. Slope length is considered under certain cases when contour farming is part of the recommendation. Where the length of slope may be a consideration this information will be given at the field site. Also, where the crops involved in the rotation may be a factor in recommending Land Treatments the “planned crops to be grown” will be placed on a sign and/or explained to contestants at the field site.

The following discussion of treatments and the Tabular Guide to Land Treatment are guides to help students, teachers, and judges select the proper use of land and the practices to meet the conservation needs of the land. The Tabular Guide will rule the contest if there is a difference between an interpretation of the following narrative discussion and the Guide. For cropland, select practice 1, 2, or 3 and a cropping system from treatments 4 through 9. The tillage and cropping system selected and the combination of soil characteristics and topographic features of the field will determine the additional treatments needed.

The scorecard may not relate perfectly to all possible site conditions. In selecting contest sites, however, officials will use the scorecard to demonstrate practical and recommended approaches for using land. Where there are debatable judgments the point distributions for scoring the respective items may reflect it.

TABLE V-I

LAND TREATMENTS INCLUDED ON LAND JUDGING SCORECARD

Tillage Systems

1. Conventional tillage, conserve crop residue
2. Conservation tillage, manage crop residue
3. Long term no-till

Cropping Systems

4. Row crop each year
5. Soil conserving crop 1 year in 4
6. Soil conserving crop 1 year in 3
7. Soil conserving crop 1 year in 2
8. Soil conserving crop 2 years in 3
9. Soil conserving crop 3 years in 4

Supporting Practices

10. Contour farming
11. Strip cropping
12. Terrace and maintain terraces
13. Construct diversion
14. Establish grassed waterway
15. Establish field border
16. Establish windbreak
17. Install water table control
18. Install surface water management
19. Stabilize sediment source areas
20. Establish recommended grass and/or legumes
21. Plant recommended trees

Management Practices

22. Remove obstructions
23. Control grazing
24. Proper pasture management
25. Improve tree stand
26. Woodland protection
27. Harvest trees using recommended method

DEFINITION AND INTERPRETATION OF LAND TREATMENTS

Tillage Systems

Treatment 1 - Conventional tillage and conserve crop residue - The seedbed is prepared by combined primary and secondary tillage operations such as plowing, disking and/or harrowing designed to disturb the entire soil surface. This system is sometimes referred to as "clean-tilled." Row crops being grown in this system may be mechanically cultivated instead of, or in addition to, the use of chemical herbicides. Crop residue from the previous crop is not burned, but is incorporated into the soil during seedbed preparation. This tillage system leaves bare soil that is vulnerable to soil detachment and transport, which cause erosion to occur.

Treatment 2 - Conservation tillage, manage crop residue - The key to this tillage system is having at least 30% ground cover from previous crop residue after planting the next crop.

A farmer practicing conservation tillage selects tillage and planting practices which keep a certain amount of the soil surface covered and protected at all times of the year and throughout the cropping system. Conservation tillage does not necessarily refer to a single tool or method; it is better understood as an objective or goal which must be achieved to a specified degree. Conservation tillage means minimizing the soil disturbance during planting and while growing a crop. Conservation tillage may include no-till or strip-till planting for one or more of the crops in the rotation.

No-till planting provides very effective erosion control. This is a form of conservation tillage in which the planting equipment places the crop seeds directly into the residue of a previous crop without any general tillage (plowing or disking). This leaves nearly all of the soil surface undisturbed by tillage, protected by the existing crop residue, and much less likely to erode.

The following are examples of conservation tillage and good crop residue management:

a. Soybeans planted by the no-till method into the residue of wheat or oats which has been harvested for grain. (In this case the soybeans are considered "double-cropped" since the grain and soybeans will be harvested in the same summer.)

b. Corn planted by the no-till method into a standing crop of vetch, clover, rye, wheat, triticale or oats which has been planted as a cover crop in the previous fall to provide winter erosion protection (often following tobacco or corn). The cover crop will be chemically killed to allow the corn to grow vigorously, and the dead residue of the grain crop protects the soil and will also conserve water for the growing crop.

c. Corn planted by the no-till method into the stubble of a soybean crop harvested the previous fall. Here the remaining soybean residue will offer soil protection. On sloping land erosion is less likely to occur if the soil has not been loosened by tillage.

d. In cropping systems which include soil-improving sod crops (such as fescue or a mixture of grass and legume), conservation tillage should be used to renovate or establish the sod crop, if feasible. This can often be done by planting corn or soybeans into a previous sod crop using a no-till planter. The old sod crop can be destroyed by herbicide. The new sod crop can then be no-till planted into the corn or soybean residue. Sod crops also may be renovated by direct no-till planting into the existing sod crop. On the other hand, there may be cases where it is necessary to mix lime and fertilizer into the soil or to control difficult perennial weeds in the pasture or hay field. Then conventional tillage should be used to plant a crop like wheat, corn or soybeans followed by the new sod crop. <u>However, in land judging it will be assumed that modern conservation systems are applicable for most cases of classes II and III “e” or “s” land</u>. Therefore, Treatment 2 will be recommended with cropping systems 8 and 9, as well as for rotations involving fewer sod crops. The exception to this is where treatment 3 (see below) is a practical and feasible method because all of the crops being grown can be successfully produced by the no-till planting method.

<u>Treatment 3</u> - <u>Long term no-till</u> - This conservation practice is done by planting all crops continuously in at least 80% plant residue from preceding crops. This practice may include the carful use of ‘strip tillage” to loosen the soil to an appropriate depth below the row zone – an area on the soil surface that is tilled, usually 6 to 12 inches wide, where the row is to be planted during strip tillage. Depth of tillage in the row zone may vary from an inch to about 16 inches – so long as the requirement of 80% residue cover maintained.

Long term no-till not only reduces soil erosion and improves water quality, but also improves soil quality. This is the only conservation practice that can be used for continuous row crops, while soil improvement takes place at the same time. The soil improvement is the result of increased organic matter and microbial activity. Through long term no-till, residue built up on the soil surface reduces the impact of raindrops, increases infiltration, and thus reduces runoff. A big advantage of long term no-till is the need for fewer structural practices such as contour farming, terraces, and in some cases grassed waterways. Research shows that long term no-till also reduces the amount of nutrients and pesticides reaching surface and ground water due to the increase in organic matter content.

After 3 years, yields from continuous no-till are normally better than for conventional tillage on most soils in North Carolina. Troublesome weeds such as Bermuda grass, trumpet creeper, horse nettle and some briars may need special control treatment after several years. Bermuda grass should preferably be eradicated before using no-till.

No-till permits more intense cropping of sloping land which would not be feasible with conventional tillage without excessive soil loss or expensive structural practices. No-till will require a high level of management.

Note carefully:

1. Treatment 3 (Long-Term No Till) will not be considered practical and generally feasible, and therefore will not be the recommended treatment where flue cured or burley tobacco or vegetable crops are being grown in the rotation. Treatment 3 will be recommended where any or all of the following crops will be grown: corn, soybeans, wheat or other "small grain crop," cotton, peanuts or grain or forage sorghum. At each field site contestants will be told which crops are planned to be grown.

2. A sign will be used to signal to participants, that although the intended crops may all be suited to Long Term No Tillage (Treatment 3), the grower prefers to use Treatments 1 or 2 as the tillage system for the field. Treatment choices for that field must meet the conservation needs by using traditional conservation practices as appropriate, such as, contour farming, terraces, etc. Information in this situation would state "In this field, the grower prefers the use of Treatment 1 or 2."

Cropping Systems

The cropping system is the sequence or rotation in which crops are grown. A cropping system may need to include a soil conserving crop. A cropping system alone does not necessarily meet the conservation needs of the field on which it is used. It may require additional supporting practices.

Treatment 4 - Row crop each year - May be used with tillage system 1, 2, or 3. Crop residue is conserved and winter cover crops grown to provide additional organic matter and land cover, if needed, following low residue producing crops.

Treatment 5 - Soil conserving crop and/or soil improving crop 1 year in 4 - This is considered satisfactory for "w" land with severe water problems.

Treatment 6 - Soil conserving and/or soil improving crop 1 year in 3 - This treatment is used for wind erosion on level to gently sloping IIIs and sloping IVs land.

Treatment 7 - Soil conserving and/or soil improving crop 1 year in 2. This is used with conservation tillage and contouring for "s" land of sloping Class III.

Treatment 8 - Soil conserving and/or soil improving crop 2 years in 3 - This is used in combination with Conservation Tillage (Treatment 2) on IIIe land with extreme hazards and on normal IVe land.

Treatment 9 - Soil conserving and/or soil improving crop 3 years in 4. This is used together with Conservation Tillage on normal IVe land with extreme hazards.

Supporting Practices

Treatment 10 - Contour farming - Conducting tillage operations on the contour with or without terraces. This practice is very important on land capability subclass “e” land. Contour farming is most effective on land of uniform topography and must be supported by terraces if slope exceeds 4% and/or if slope length exceeds 300 feet. Note, however, that terraces are not installed if the soil is shallow or severely eroded. Contour farming is not used when long term no-till is recommended.

Treatment 11 - Strip cropping - This practice is used for wind and water erosion control. It is preferred on “e” land instead of terraces when the rotation contains sufficient soil- conserving or soil-improving crops. Terraces and strip-cropping may be used in combination under conditions of extreme water erosion hazard.

Treatment 12 - Terraces - A terrace is a ridge or embankment across the slope to collect runoff and carry it away safely. This has the effect of reducing the length of slope. Terraces are not used on shallow soils (less than 24 inches total soil thickness) or on severely eroded soils. Also, terraces are normally not installed on land over 10% slope or deep sandy soils (more than 20 inches of sandy surface). Terraces must be designed and spaced according to the slopes present in order to be effective. Disregard terraces already on the land being judged.

Treatment 13 - Construct diversion - A diversion is usually designed to handle a larger flow than normal field terraces. They are used to intercept and divert runoff from a higher lying piece of land.

Treatment 14 - Establish grassed waterway - Stabilizing natural drains with perennial vegetation to safely carry runoff from rows, terraces, or diversions.

Treatment 15 - Establish field border and/or filter strip – Establishing perennial vegetation where cropland joins woodland; where cropland is adjacent to roads and/or paths, or where cropland is adjacent to ponds, streams or open drainage ditches.

Treatment 16 - Establish windbreak - Planting two or more rows of trees across the direction of prevailing winds to help control wind erosion. The practice is important on sandy fields that do not use long-term no-till when the opening along the direction of the prevailing wind exceeds 800 feet. Consider locating windbreaks along property lines, roads, or practical field divisions.

Treatment 17 - Install water table controls - To remove excess water from below the land surface to create more favorable conditions for plant growth where wetness is a factor. This includes either subsurface drains or open ditches.

Treatment 18 - Install surface water management - This practice consists of land shaping to develop a slope on flat or nearly level land. It is important where there is surface water ponding, especially where soils have slow or very slow permeability. This practice may be used to supplement water table control or be used without it.

Treatment 19 - Stabilize sediment source areas - This treatment is the stabilization of actively eroding areas by structural and/or vegetative measures. This applies to gullies or small areas of steep slope and more severe erosion which need more intensive treatment than the majority of the field under study. This treatment may be needed with any land use.

Treatment 20 - Establish recommended grass and legumes - This practice is used on land to be used for pasture and hay. Establish in strips on severely eroded or shallow soils. Disregard any sod on the field since contestants may not know if it is the recommended type or quality for the site.

Treatment 21 - Plant recommended trees - Tree planting is used to establish woodland on open land or if existing desirable trees do not occupy 60% of the site. If undesirable species occupy area, site preparation is necessary before planting.

Management Practices

Treatment 22 - Remove obstructions - The purpose is to remove stumps, trees, or large surface stones that interfere with the intensive use of the land for cropland or pasture.

Treatment 23 - Control grazing - To carry out a system of grazing that will maintain or improve desirable vegetation on pastures. This includes proper stocking and rotation grazing.

Treatment 24 - Proper pasture management - The timely application of lime and fertilizer to keep desirable plants growing actively over as long a period as possible. The control of brush, weeds, or undesirable growth by mowing or using herbicide is included in this practice. This treatment is needed on all pasture and hay land.

Treatment 25 - Improve tree stand - Remove or control undesirable trees, vines, or shrubs competing with desirable trees; also includes pre-commercial thinning of a dense stand of desirable trees. Planting is not included in this treatment.

Treatment 26 - Woodland protection - Protect woodland from uncontrolled grazing, wildfire, and insects. Approved prescribed burning for hazard reduction is permitted.

Treatment 27 - Harvest trees using recommended method - This practice is used where a stand of desirable trees is large enough for intermediate cut for pulpwood and/or saw logs. An intermediate cut provides a return to the woodland owner as well as increasing the growth and/or quality of remaining trees. A final harvest cut is made when trees are mature and have reached saw log size and a tree stand is to be reestablished.

TABULAR GUIDE TO LAND TREATMENT

Land Capability Class and Subclass	Slope Percent	Normal Minimum Treatment	Notes
I	0-2	1-4 Or 3-4	The soils in this class are nearly level and erosion hazards (wind or water) are low. They are suited for intensive cropping if soil fertility and structure are maintained. When all crops are adapted to no-till.
IIe	2-4 (0-2; if limited depth or permeability)	1-4-10 Or 3-4	These soils have similar characteristics to Class I except for erosion hazard. Terraces are needed if slope length exceeds 300 feet. Add drainage treatment if wetness is a problem. When all crops are adapted to no-till.
IIe	4-6	2-4-10-12 Or 3-4	These soils have similar characteristics to IIe above except they have more slope hazard. No drainage treatment needed because of slope. When all crops are adapted to no-till
IIIe	6-10 (2-6; if Severely eroded or Shallow; Or Very Firm/ Very Sticky, or both) (0-2, if Shallow with Severe erosion)	2-8-10-11 Or 3-4	Soils in this subclass have similar characteristics to IIe above except they have more erosion hazard. No drainage treatment would be needed because of slope (or shallow). When all crops are adapted to no-till
IIIe	2-6 (with Severely eroded or Shallow)	3-4	Long term no-till is the preferred practice. Crops grown should be selected to allow Long-Term No Till.

**Determine additional treatments needed based upon conditions of field being judged.*

Land Capability Class and Subclass	Slope Percent	Normal Minimum Treatment*	Notes
IVe	10-15	2-9-10-11 Or 3-4	Use of cultivated crops is limited as a result of steep slopes, susceptibility to erosion or past erosion. The best use is perennial hay and occasional row crops. When all crops are adapted to no-till
IVe	6-10	3-4	Severely eroded or Shallow; crops grown should be selected to allow Long-Term No-Till.
IVe	2-6	3-4	Severely eroded and Shallow; Severely eroded and/or Shallow together with either Very Firm or Very Sticky consistence; crops grown should be selected to allow Long-Term No-Till.
VIe	15-25	20-23-24	Steep. None to Slight or Moderately eroded
VIe	10	20-23-24	Strongly sloping; Severe erosion or Shallow.
VIe	6-10	20-23-24	Sloping, Severe erosion and Shallow
VIIe	10-15	20-23-24	Severe erosion and shallow
VIIe	15-25	20-23-24	Severe erosion or Shallow
VIIe	25+	21	Use for woodland w/accompanying treatments as needed.

**Determine additional treatments needed based upon conditions of field being judged.*

TABULAR GUIDE TO LAND TREATMENT

Land Capability Class and Subclass	Slope Percent	Normal Minimum Treatment	Notes
IIw	0-2	1-4-17** and/or 18	None to slight erosion, wetness limits the rooting zone – correct water problems.
		Or	
		3-4-17** and/or 18	When all crops are adapted to no till
IIIw	0-2	1-4-17** and/or 18	None to slight erosion, wetness limits the rooting zone – correct water problems.
		Or	
		3-4-17** and/or 18	When all crops are adapted to no till
IVw	0-2	1-5-17** and/or 18	None to slight erosion, excessive wetness with some continuing hazard after drainage.
		Or	
		3-4-17** and/or 18	When all crops are adapted to no till.

*Determine additional treatments needed based upon conditions of field being judged.

**Water table control (Treatment 17) is not used for well drained soils in a floodplain. Where needed, however, treatment 18 (surface water management) is used for this situation. Also, for well drained soils having a potential flood hazard, treatments 17 and/or 18 should be used where beneficial.

TABULAR GUIDE TO LAND TREATMENT

Land Capability Class and Subclass	Slope Percent	Normal Minimum Treatment*	Notes
IIs	0-6	2-4	Nearly level to gently sloping, Sandy surface 20-40 in.; subsurface Loamy. May have wind and/or water erosion hazard; add contour farming if slope is greater than 2 percent.
		Or	
		3-4	When all crops are adapted to no-till
IIIs	6-10	2-7-11	Sloping, Sandy surface 20-40 inches; subsurface Loamy, Wind and water erosion hazard.
		Or	
		3-4	When all crops are adapted to no-till.
IVs	0-10	3-4	All conditions of subclass IVs If annual crops are grown these should be selected to allow long term no till. Caution: Productivity and profit may be very low.
VIs	10-15	20-23-24	All conditions of Subclass VIs
VIs or VIIs	15+	21	Use for woodland and apply treatments as needed.

*Determine additional treatments needed based upon conditions of field being judged.

CHAPTER VI
Urban Use Considerations

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CHAPTER VI
URBAN USE CONSIDERATIONS

EVALUATING SOILS FOR URBAN USES

Evaluating or rating soils for various urban or non-agricultural uses involves comparing the soil and site characteristics to a set of criteria specific for each use. These criteria or guidelines define sets of soil characteristics including:

- those which would be most suitable, that is, pose only slight limitations,
- those that suggest caution or pose moderate limitations and
- those that require serious evaluation and costly management and thus pose severe limitations.

In judging a particular site for a given urban use, it should be clear that the site's overall rating can be no higher than the single most limiting factor. For a soil to have a slight limitation rating for basements, it cannot have a single characteristic rated moderate or severe. Likewise if any characteristic for a particular urban use is rated severe, the overall rating must be severe.

An understanding of how various soil properties affect an urban use is clearer when we take time to define each use. That is, what is involved in building a basement? What is included in a septic disposal system and its installation? If we can more clearly visualize an activity and understand its function, the soil properties of major influence become more obvious.

1. Septic Disposal Systems
This wastewater treatment and disposal technique involves the distribution of effluent from a septic tank through a system of perforated pipes buried beneath the ground surface. Soil properties and site features considered are those that affect the absorption of the effluent, those that affect the construction and installation of the system, and those that may affect public health.

Properties that affect the ground absorption of effluent are permeability, drainage (depth to seasonal high water table), depth to limiting layers and susceptibility to flooding. Excessive slope may cause lateral seepage and surfacing of effluent downslope as well as cause construction limitations. Soils that are very sandy in the subsurface pose a threat of groundwater contamination due to rapid permeability and poor purification of the waste liquid which leaves the septic tank.

2. Basements

This urban use category refers to the construction and maintenance of basements for dwellings or other small commercial buildings. It assumes an excavation of 6 to 8 feet and placement of a concrete structure on the natural soil at the base of the excavation. Ratings are based on properties affecting soil strength and settlement and those that affect excavation and construction costs. The properties affecting soil strength are the presence of high water table and flooding, as well as the shrink-swell behavior and compressibility of the soil. Features influencing the ease of excavation are flooding, drainage, slope and depth to limiting layers. Surface layer characteristics offer no limitations for basement suitability.

3. Foundations

Foundations for dwellings or small commercial buildings refer to the construction and placement of concrete footings on natural or undisturbed soil at a depth of two feet or the depth of maximum frost penetration, whichever is deeper. The soil and site characteristics affecting this use are similar to those for basements, except for properties influencing the greater depth needed for basement excavation.

4. Sanitary Landfills

A sanitary landfill is a method of disposing of solid waste by placing refuse in successive layers, spreading, compacting and covering daily with a layer of soil. When the landfill is complete, a final cover of soil material at least two feet thick is placed over the landfill area.

Properties that influence ease of excavation, risk of pollution, and re-vegetation are major considerations. Limiting layers, flooding or high water tables within the depth of excavation, present difficulty in construction as well as create potential pollution hazards. Sandy soils with rapid permeability may cause groundwater contamination. Steep slopes may cause problems in excavation as well as in finishing and stabilizing the landfill.

5. Landscaping

The main considerations for landscaping are those that affect plant growth and rooting behavior. Surface and subsurface textures that are too sandy provide low water holding capacity and result in droughty conditions. Firm clayey surface layers make plant establishment difficult. Clayey subsurface layers with very slow permeability limit root growth and survival of landscaping plants. Deep rooted trees or shrubs will be limited by shallow or very shallow soils, as well as by high water tables in soils less than well drained. Any flood hazard poses an obvious danger of destruction of a beautifully landscaped area.

The high costs associated with residential and business property often present landscapers with severe challenges where "cost is not an obstacle." Soil and "fill materials" are often brought to the site from elsewhere and extensive cutting away of original topsoil and even subsoil is done. Filling and drainage may be added. The need for these practices should be considered as an appropriate degree of "limitation" because either the higher <u>initial costs</u> or <u>the eventual costs of maintaining the site or correcting problems</u> must be paid. Also, the possibility of causing an "off site" environmental problem such as sedimentation and pollution in neighboring water bodies or property when erodible sites are cleared is an immediate concern.

The limitations for each of these Urban Uses are summarized in **Table VI-l**.

Table VI-1 Soil Limitations for Urban Uses

<u>Septic Disposal Systems</u>

Soil Characteristic	**Degree of Limitations**		
	None to Slight	*Moderate*	*Severe*
Surface Layer			
Erosion	Does Not Apply	Does Not Apply	Gullies
Subsurface Layer			
Texture	Loamy	Sandy, Clayey	Clayey (With <u>either</u> Very Firm, or Very Sticky, or both)
Permeability	Moderate	Rapid, Slow	Very Slow
Depth	Deep	Moderately Deep	Shallow, Very Shallow
Total Soil			
Slope	<10%	10-15%	>15%
Drainage	Well	Moderately Well	Somewhat Poorly, Poorly, Very Poorly
Flooding	No Hazard	Potential Hazard	In Floodplain

Basements

Soil Characteristic	**Degree of Limitations**		
	None to Slight	*Moderate*	*Severe*
Surface Layer	Does Not Apply	Does Not Apply	Does Not Apply
Subsurface Layer			
Texture	Sandy, Loamy	Clayey	Clayey (either Very Firm, Very Sticky, or both)
Depth	Deep	Does Not Apply	Moderately Deep, Shallow, Very Shallow
Total Soil			
Slope	<10%	10-15%	>15%
Drainage	Well	Does Not Apply	Moderately Well, Somewhat Poorly, Poorly, Very Poorly
Flooding	No Hazard	Does Not Apply	In Floodplain Potential Hazard

Foundations

Soil Characteristic	Degree of Limitations		
	None to Slight	*Moderate*	*Severe*
Surface Layer	Does Not Apply	Does Not Apply	Does Not Apply
Subsurface Layer			
Texture	Sandy, Loamy, Clayey	Does Not Apply	Clayey (Very Firm, Very Sticky, or both)
Permeability	Rapid, Moderate, Slow	Does Not Apply	Very Slow
Depth	Deep	Moderately Deep	Shallow, Very Shallow
Total Soil			
Slope	<10%	10-15%	>15%
Drainage	Well	Moderately Well	Somewhat Poorly, Poorly, Very Poorly
Flooding	No Hazard	Does Not Apply	In Floodplain Potential Hazard

Sanitary Landfills

Soil Characteristic	Degree of Limitations		
	None to Slight	*Moderate*	*Severe*
Surface Layer	Does Not Apply	Does Not Apply	Does Not Apply
Subsurface Layer			
Texture	Loamy, Clayey	Clayey (Very Firm, or Very Sticky, or both)	Sandy
Permeability	Does Not Apply	Does Not Apply	Rapid
Depth	Deep	Does Not Apply	Moderate, Shallow, Very Shallow
Total Soil			
Slope	0-15%	Does Not Apply	>15%
Drainage	Well	Does Not Apply	Moderately Well, Somewhat Poorly, Poorly, Very Poorly
Flooding	No Hazard	Does Not Apply	In Floodplain Potential Hazard

Landscaping

Soil Characteristic	**Degree of Limitations**		
	None to Slight	*Moderate*	*Severe*
Surface Layer			
Texture	Sandy <20”, Loamy	Sandy (>20”) Clayey (if Friable)	Clayey (if Firm)
Structure	Single Grain, Granular, Blocky, Platy	Massive	Does Not Apply
Erosion	Does Not Apply	Severe	Gullies
Subsurface Layer			
Texture	Loamy, Clayey	Sandy, Clayey (if either Very Firm or Very Sticky or both)	Does Not Apply
Permeability	Moderate, Slow	Rapid, Very Slow	Does Not Apply
Depth	Moderately Deep, Deep	Shallow	Very Shallow
Total Soil			
Slope	0-15%	Does Not Apply	>15%
Drainage	Well	Moderately Well	Somewhat Poorly, Poorly, Very Poorly
Flooding	No Hazard	Potential Hazard	In Floodplain

CHAPTER VII
SPECIAL ENVIRONMENTAL CONCERNS

INDEX

Chapter VII

Recognizing Special Environmental Concerns in Land Judging

This section of the Career Development Event offers opportunities for students to be introduced to several special environmental concerns regarding soil properties and water resource protection. For example, in Land Judging the student has already determined the slope, evidence of erosion risk and rate of surface water runoff. Here we extend the consideration to decide whether there would be a special risk if the land were cleared of all vegetation and a rainy period occurred. Would erosion cause serious "off-site" damage to waters or lower-lying land nearby? Also, the participant has already learned to identify soils where groundwater will be near the soil surface during periods of wetness, shown by the decision to give it a "w" subclass designation. And, by using the "field boundary" markers (white-tipped stakes or flags), we alert the participants to situations within or immediately adjacent to the contest field which must be considered in selecting recommended treatments. These considerations include streams, ditches, ponds, etc. If these conditions exist there may be limitations in the permitted use of certain pesticides and the application of waste products.

This part of the Event simply carries these concepts forward by determining whether or not <u>each</u> of five special environmental concerns exists at each contest field. The "special concerns" included in this section reflect actual recommendations and/or governmental regulations for the application of pesticides and wastes products in use today.

This section differs from the rest of the scorecard in that it is a "true or false" choice, rather than a multiple choice selection. Here the student is simply asked whether each of five concerns is applicable (if so it is marked "true"); if it does not apply, mark it “false.” Every site has one of these answers for each of the properties. The correct choice, and only that one, must be checked in order to receive credit for each choice.

In some of the field sites at Land Judging Events none of these concerns will apply--so all items must be correctly marked "false" in order to receive full credit. This does not diminish the learning for the participant, because each decision requires application of the principles learned about soil characteristics at this site to these additional possible environmental concerns. We would not expect all concerns to apply (be marked "true") at any site, because severe erosion risk (concern no. 5) does not occur where moderately severe wetness concerns and/or deep sandy textures also occur (concerns no. 2, 3 and 4). Wetness concerns are linked directly to soil drainage class. These will be more common in the Coastal Plain, but may also exist in low topographic positions in the Piedmont or Mountain regions.

Adjacent water bodies should be easily identified and may occur in any part of our state (concern no. 4). The participant merely needs to estimate whether the field border stakes for the site lie within 50 feet of a significant drainage way, stream, river or pond. Deep leaching and possible groundwater contamination risk are tied to sandy textures (concern no. 3), and sometimes to the combination of sandy textures and some wetness limitation (concern no. 2).

In most contests, some of these special environmental concerns are likely to apply (be checked "true") at one or more of the contest fields. Studying about and actually making these decisions is a valuable application of the knowledge gained by participation in the Land Judging program.

Specific Concepts and Guidelines for Identifying Special Environmental Concerns

1. Identifying Possible Hydric Soils

Soils which have predominantly gray, dull yellow or black colors throughout the profile are an indication that water saturation of at least the lower part of the soil profile has occurred, or may presently be occurring, during significant periods of the year. The presence of these properties, together with certain additional more complex indications, would require the soil to be described as "hydric." This soil designation plus the presence of certain "wetness loving" plants (known as hydrophytic vegetation), plus certain measurements of the water levels in the soil at various periods of the year (hydrology) are the key conditions which would make an area a "wetland." Today areas officially designated as wetlands have key importance in state and national environmental policy because of the importance of wetlands in "filtering" to protect the quality of our waters and wildlife habitat.

In Land Judging we identify the possibility of a site being a hydric soil (that is, it appears to have one of the three components required for an area to be officially designated as a wetland). However, recognizing the presence of a possible hydric soil is the first step in alerting the user of such an area that possible applicable wetlands regulations should be understood before any clearing, drainage or construction projects are undertaken.

- **The "possible hydric soil" (concern no. 1) applies to all contest field sites which you identified as Poorly Drained or Very Poorly Drained. These should be marked "true."**

2. Risk of groundwater contamination when wet (in the application of soluble nutrients and/or certain pesticides)

The goal of this decision is to identify soils where the combination of sandy texture in the upper part of the soil profile plus periods of the year when free water would be near the surface offers the risk that soluble contaminant materials could move by leaching into the shallow groundwater. There is some reasonable concern that once a long-lived and soluble contaminant is in this shallow groundwater it could be carried further along. It then could possibly reach a deeper zone of water-bearing sands or gravel which may serve as drinking water, or move through deep underground cracks or channels directly into a stream or surface water body, again possibly contaminating drinking water or wildlife habitat.

However, although the above concern is a real possibility, it is not a certainty. Even when soluble contaminating substances have entered shallow groundwater there are several means by which the substance may disappear or be safely inactivated. Most current agricultural chemicals and some fertilizer materials (especially nitrogen) may naturally decompose or be consumed and made non-toxic by microbial organisms in the soil. These contaminants also may be inactivated and made permanently harmless by adsorption to soil minerals and organic matter. Finally, if the substances remain in the groundwater they may move downward and sideways toward drainage ways and streams. In the areas surrounding streams and rivers there typically is some wetland. And, much of this area is often under perennial vegetation and forests. These are called "riparian areas." These areas are known to play an important role in absorbing, consuming, or inactivating potential contaminants to our water and environment. This is the reason for current emphasis on "buffer strips of perennial vegetation and/or forests" in critical river watersheds.

To further reduce the risk of pollution several agricultural chemicals or products have statements on the label that require the user to avoid application to areas where the soils may be wet, with a risk that the substance could be carried into the groundwater. Examples are the widely-used chemicals atrazine, metolachlor and alachlor. In some cases the label prohibits use of that product in certain areas, or under specific conditions. This may be required by policy in order to assure that such chemicals, pesticides or other products will be used with great care, or be restricted from use entirely, where the risk is believed to be intolerably high.

- **The "risk of groundwater contamination" (concern no. 2) will apply (will be marked "true") in the following conditions:**

  To those Somewhat Poorly Drained, Poorly Drained and Very Poorly Drained soils which also have:

  --sandy texture in the surface layer, and also
  --a predominance of sandy texture in the soil profile from the surface to a depth of at least 12 inches.

3. Deep leaching of soluble nutrients may restrict rates of animal or municipal waste application

This concept is similar to concern no. 2 above, except that it does not involve soil wetness. In many cases concerns no. 2 and 3 will apply together. Application of waste products is limited by possible risk of groundwater contamination, especially by nitrogen in the wastes. This may be due to excessive application rates and/or the timing of applications such that the nutrients are not properly taken up by the crops being grown on the land. Therefore, soils with a high risk of allowing leaching of soluble substances, together with a risk of low crop productivity due to drouthiness or other factors, must be used with limits and caution.

- **The Deep Leaching of soluble nutrients (concern no. 3) will apply to all "s" subclass soils.**

4. Proximity to water body may restrict application of certain pesticides or waste materials

Today we realize the importance of avoiding direct contamination of any significant body of water by nutrients found in fertilizers, or in wastes of any source or form. This is also true for any chemical, product or organism which could adversely affect water quality for any of its uses by man or nature. The label of most agricultural or household chemicals contains a requirement that the product not be applied directly to open water bodies of any kind. Some agricultural chemicals now require that the product not be applied within a certain distance of streams or other significant bodies of water.

- **This concern will apply whenever the field border stakes for a field site are within 50 feet of:**

  -- a significant drainage ditch which appears to have a depth of 3 feet or greater.

  -- an apparent creek, small stream or river; this includes meandering channels or former channels of streams which may not presently show evidence of being an active waterway. During periods of high rainfall, these channels probably will serve as overflow areas and would easily pass a contaminant into the flowing waters.

  -- Ponds or reservoirs, whether man-made or caused by nature or wildlife.

5. High risk of off-site damage from eroding sediments if vegetative cover is destroyed or removed.

This concept is simple. It applies regardless of whatever vegetative cover exists at the site. It alerts a potential user of the land that any period without vegetative cover poses an environmental risk to lower-lying areas from eroding sediments and possibly from nutrient pollutants.

- **High risk of off-site damage from erosion (concern no. 5) applies --should be marked "true"-- where the following condition exist:**

  -- On all fields with a slope of 6% or greater, regardless of erosion class.

APPENDIX I
FFA Land Judging Career Development Event
PURPOSE

To develop appreciation, understanding, and abilities to classify soil according to its physical characteristics and to use and manage soil according to its capabilities.

ELIGIBILITY

Event participation is limited to active FFA members enrolled in Agricultural Education Programs. Members of a previous state winning team are not eligible. However, all teachers and students, whether competing or not are encouraged to use the Land Judging Handbook and judging procedures in teaching and learning about soils and their use.

PROCEDURES

l. The official scorecard for all participants in North Carolina is shown as Appendix II.

2. The "Handbook for Land Judging in North Carolina" - Revised l997 - will serve as the official guide for all Land Judging Career Development Events sponsored by FFA. Official decisions and explanations should be made to conform to the concepts in this handbook as closely as possible, in the interest of fairness to students and teachers. Where professional differences of opinion are encountered, the authors would welcome your bringing the situation to their attention for possible future revisions of the Handbook.

3. Procedures for setting up FFA Land Judging Career Development Events are described in Appendix III of the Handbook.

4. Scoring and Related Items

- All "key scorecards" will be completed by officials before the Event begins.
- The judges will check to insure that all official answers conform to information in the Handbook.
- In scoring Part Three (Treatments) credit will be given only for correct treatments marked by participants within the number of blocks designated by officials starting from the left of the scorecard. Officials will not reveal the number of treatments needed for a field.

Templates are cut from official scorecards to make scoring more accurate and efficient.

5. It is suggested that judges offer a field critique to all participants immediately after the judging is completed. This explanation of the correct answers, and how students should have determined them, is very helpful in the learning process.

APPENDIX II

Land Judging Scorecard

Participant #: **Name:** **Field #:**

PART ONE - SOIL CHARACTERISTICS
(Place an X in the proper square)

The Surface Layer - (Top 6 inches)

TEXTURE
- ☐ Sandy
- ☐ Loamy
- ☐ Clayey

STRUCTURE
- ☐ Single Grain
- ☐ Granular
- ☐ Blocky
- ☐ Platy
- ☐ Massive

CONSISTENCE
- ☐ Loose
- ☐ Friable
- ☐ Firm

EROSION
- ☐ None to slight
- ☐ Moderate
- ☐ Severe

☐ *Subtotal*

The Subsurface Layer

TEXTURE
- ☐ Sandy
- ☐ Loamy
- ☐ Clayey

STRUCTURE
- ☐ Single Grain
- ☐ Granular
- ☐ Blocky
- ☐ Platy
- ☐ Massive

CONSISTENCE (MOIST)
- ☐ Loose
- ☐ Friable
- ☐ Firm
- ☐ Very Firm

CONSISTENCE (WET)
- ☐ Non-Sticky
- ☐ Sticky
- ☐ Very Sticky

PERMEABILITY
- ☐ Rapid
- ☐ Moderate
- ☐ Slow
- ☐ Very Slow

DEPTH TO LIMITING LAYER
- ☐ Very Shallow (<12")
- ☐ Shallow (12-24")
- ☐ Moderately Deep (24-36")
- ☐ Deep (>36")

☐ *Subtotal*

Total Soil Characteristics

SLOPE
- ☐ 0-2% Nearly level
- ☐ 2-6% Gently sloping
- ☐ 6-10% Sloping
- ☐ 10-15% Strongly sloping
- ☐ 15-25% Steep
- ☐ 25% + Very steep

DRAINAGE
- ☐ Well
- ☐ Moderately Well
- ☐ Somewhat Poorly
- ☐ Poorly
- ☐ Very Poorly

FLOODING
- ☐ No hazard
- ☐ Potential hazard
- ☐ In flood plain

SURFACE WATER REMOVAL
- ☐ Rapid
- ☐ Moderate
- ☐ Slow
- ☐ Very slow

☐ *Subtotal*

☐ **Score Part 1**
Max Points = 43

PART TWO - LAND CAPABILITY CLASS
(Place an X in the proper square)

☐ I ☐ IIe ☐ IIs ☐ IIw ☐ IIIe ☐ IIIs ☐ IIIw ☐ IVe ☐ IVs ☐ IVw ☐ VIe ☐ VIs ☐ VIIe ☐ VIIs ☐ VIII

☐ **Score Part 2**
Max Points = 10

PART THREE - RECOMMENDED LAND TREATMENTS
(Select treatments and write the number of each treatment in the boxes below, beginning on the left side)

Tillage Systems
1. Conventional tillage, conserve crop residue
2. Conservation tillage, manage crop residue
3. Long-Term No Till

Conservation Cropping Systems
4. Row crop each year
5. Soil conserving crop 1 year in 4
6. Soil conserving crop 1 year in 3
7. Soil conserving crop 1 year in 2
8. Soil conserving crop 2 years in 3
9. Soil conserving crop 3 years in 4

Supporting Practices
10. Contour farming
11. Strip cropping
12. Terrace and maintain terraces
13. Construct diversion
14. Establish grassed waterway
15. Establish field border
16. Establish windbreak
17. Install water table control
18. Install surface water management
19. Stabilize sediment source areas
20. Establish recommended grass and/or legumes
21. Plant recommended trees

Management Practices
22. Remove obstructions
23. Control grazing
24. Proper pasture management
25. Improve tree stand
26. Woodland protection
27. Harvest trees using recommended method

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

☐ **Score Part 3**
Max Points = 27

PART FOUR - URBAN USES
The soil characteristics judged in PART ONE determine the limitations of a soil for urban uses. Rate each site as to the soil limitations of slight, moderate and severe for each urban use listed below. (CHECK APPROPRIATE COLUMN)

☐ **Score Part 4**
Max Points = 15

	URBAN USES				
SOIL LIMITATIONS	Septic Systems	Basements	Foundations	Sanitary Landfills	Landscaping
Slight					
Moderate					
Severe					

☐ **Special Environmental Concerns**
(from back) Max Points = 5

TOTAL SCORE Max Points = 100	

Special Environmental Concerns

Check True or False for each of the following statements:

T ____	F ____	1. This appears to be a hydric soil. Check with authorities before draining and/or clearing site.
T ____	F ____	2. Risk of groundwater contamination when wet (from soluble nutrients and/or certain pesticides).
T ____	F ____	3. Deep leaching of soluble nutrients may restrict rates of animal or municipal waste application.
T ____	F ____	4. Proximity to water body may restrict application of certain pesticides and waste materials.
T ____	F ____	5. High risk of off-site damage from eroding sediments if vegetative cover is destroyed or absent.

Special Environmental Concerns Score

Max Points = 5

(Transfer this score to bottom front of scorecard)

APPENDIX III

Field Selection and Preparation for Land Judging Career Development Event

Note: This material is intended as an aid to persons setting up an event and to assist teachers in preparing a team.

The following procedures are to be followed in FFA State Land Judging Career Development Events, and it is recommended that Federation and other events also adhere to them as closely as possible.

1. Fields should be selected close enough to each other so that participants may walk from field to field in a minimum time period. Fields should be at least 200 yards from each other but never more than 800 yards apart. If it is necessary to transport participants by bus from one area to another, then two fields should be selected in each of two areas.

2. Soils and fields should be selected that are representative of the area. Profile characteristics that cannot be clearly described and evaluated using the Handbook should be avoided.

3. Field pits should be dug sufficiently deep and wide to expose clearly the surface and subsurface horizons. The width and length of the pit must permit contestants to clearly see the soil profile from the surface to the subsurface horizon. However, students are not permitted to enter the pits. If a pit contains water or mud which obscures significant soil features below, such as mottling or restrictive layers, the relevant information should be given to the students.

4. In digging pits, soil materials should be placed on two distinctly separate piles. The top six inches of the soil will be placed at the side of the pit and labeled "surface" layer. This soil material will be used by contestants to determine the characteristics of the "surface layer." The first significant horizon beneath the surface layer will be placed on a separate pile at the side of the pit and labeled "subsurface." (This is to be in accordance with the definition on page 21-- The Subsurface Layer -- of this Handbook.)

   The soil materials selected to represent the subsurface layer to be judged will normally not include all soil horizons below the surface layer. Thus any unused soil material should be placed separately to avoid confusion. (The E and transitional horizons of the profile are generally excluded from being judged as "subsurface.")

Note carefully:

However, in those cases where sandy texture extends to 12 inches or more, it is important that participants have the opportunity to carefully examine a bulk sample of the soil material beginning at the surface and extending all the way to the horizon being considered as the "subsurface layer." This applies to all cases where the field is an "s" subclass, or approaches being "s" (that is, it is almost sandy; or it is sandy texture but not all the way to a depth of 20 inches, and thus appropriately deserves careful consideration by the Event participants).

Also, keep in mind that Special Environmental Concern no. 2 requires participants to recognize situations with "predominantly sandy texture" to at least 12 depth; and especially those cases which also are Somewhat Poorly Drained, or poorer (having gray colors within the 12 to 24 inch depth, or shallower.) See pages 93 and 94.

Where the above sandy conditions exist, or where they are a reasonable consideration for participants, **officials should lay out the soil material from just below the "Surface Layer" down to the beginning of the layer being considered the "Subsurface Layer" for students to examine**. Where this “third pile” of bulk sample is provided it should have a sign labeling this material "Soil From ___ Inches to ___ Inches”. Pit supervisors should mention this special “third sample” to participants, but the students are responsible for understanding how to examine and use it in their judging interpretations.

In the case where soil conditions are extremely dry, making it unreasonably difficult for students to determine moist consistence, contest organizers should properly moisten a bulk quantity of the dry soil layer. Advise the students to use these samples for determination of soil properties. Also, in cases where sun and drying conditions quickly dry the pit face, making soil colors difficult to see, Field Supervisors should try to re-moisten the soil at the pit face, with the goal that each group of participants have equal ease of evaluating soil colors and other characteristics.

5. Signs and depth markers to be placed at each field are as follows:

   a) One sign showing field number, size of field, length of slope (where applicable). Example = Field 3 - 30 acres - 400 ft. slope.

Note that field size in acres is given to contestants, even though this usually has no specific bearing on the land treatments recommended. Officials should always give a field size large enough to contain the treatments being designated, generally at least 5 acres. Larger areas may be needed where treatments such as strip cropping or windbreaks are included.

In addition to the field sign, a measuring device (tape or board) shall be placed in each pit. This device shall be used to show the depth of the pit in six-inch increments, and is to be clearly visible to contestants.

b) Two signs, one labeled "surface" and one labeled "subsurface," used to designate the excavated soil material that contestants will examine as representative of these layers.

c) A sign labeled "Crops Planned for Field; _______, _______, _______,_______" **must be posted at each field site.** (Mention at least two to four typical crops for the situation, including pasture, hay, or even forestry, if appropriate.)

Examples:

corn, wheat, soybeans	cotton, peanuts, tobacco, hay
cotton, corn, tobacco, hay	wheat, cotton, peanuts
Burley tobacco, hay, corn	cotton, sweet potatoes, bell peppers,
corn, broccoli, tomatoes, pasture	hay, pasture, forestry

The purpose of this is to allow the possible consideration of Land Treatment nos. 3 and 4 (Long-Term No Till and Row Crop Each Year). Since the use of Treatment 3 applies to most subclasses, giving the information only for these cases would either make the choice of Land Class too obvious, or possibly would confuse some participants. For fairness, we'll offer the "Crops Planned" information at all Field Sites. Of course, in some cases the “crops planned” will only be extra information having no bearing on the practices being recommended, but participants must decide whether it is applicable.

In setting up your Official Scorecards be sure to follow closely the Tabular Guide" (pages 74-77) to be sure that you give participants a list of "crops planned" information which is in agreement with your assignment of Land Treatments. What's involved is simply that if the list of crops planned includes tobacco (flue cured or Burley) or any vegetable, then Treatment 3 (Long Term No-Till) is not presently recommended (see page 71; also 74 to 76). For certain cases judges should select only the crops which allow use of Treatment 3 (which means excluding tobacco or any vegetable crop). In those cases where the recommended treatments include cropping systems with "soil conserving crops," be sure to include hay or pasture in your list of crops planned.

d) Consider including a Field in the contest for which the “intended crops” are suited to Long-Term No Tillage (Treatment 3), but where you state that the grower prefers instead to use Treatments 1 or 2 as the tillage system. Treatment choices for that field then must meet the conservation needs by using traditional conservation practices as such as contour farming, terraces, etc. A sign for that situation will state “In this field grower prefers to use Treatments 1 or 2.”

6. At each Field the judges will clearly identify the field area to be judged with "Field Boundary" stakes.

a) Each such area to be judged will be identified by four stakes, at least 3 feet high, with an attached white ribbon, or with the upper part painted white. These stakes will be placed to designate the corners of the field area being judged. This area need not be regular, such as a square or rectangle, but the Field Boundary stakes must be visible, and if necessary, the locations may be emphasized by an official at the site.

Careful placement of Field Boundary stakes is <u>especially important</u> in offering participants the chance to understand and apply the <u>smaller-scale land treatments</u>, specifically Treatment numbers 13 (construct diversion), 14 (establish grassed waterway), 19 (stabilize sediment source area), and 22 (remove obstructions). These are some of the "Supporting Practices" and "Management Practices." The field boundaries <u>must include</u> areas for which contestants are to recommend <u>those small-scale land treatments</u> cited above. In contrast, in field situations where we recommend the large-scale treatments such as "windbreaks," "strip cropping," "improve tree stand," or "woodland protection" -- it will usually <u>be impractical and unnecessary</u> to include, <u>within the perimeter</u> defined by the white-topped Field Boundary stakes, all of the area that would justify or benefit from such large-scale land treatments.

The location of Field Boundary stakes is also important in decisions about the need for Treatment 15, "establish field border and/or filter strip." Participants need to recognize nearby drainage ditches, streams, rivers, or ponds, <u>noting whether the field area</u> defined by the white-topped stakes <u>is within 50 feet of these land features</u>, which then will require Treatment 15. Similarly, this applies in deciding whether Special Environmental Concern No. 4 should be indicated as being "true" or "false." Finally, if the <u>area being judged will be used for row crop production</u> (including the rotations offered by any of Treatments 4 through 9), and the field area <u>adjoins a woods, road or path</u> (shown by the Field Boundary stakes being placed within 50 feet of these features), then Treatment 15 will be recommended. Where realistic to do so, it is suggested that you <u>include at least one such site</u> on each Land Judging Event.

When the field area includes Special Environmental <u>Concern No. 5</u> (a risk would exist for off-site damage from eroding sediments) that possible <u>depositional area</u> does not need to lie within any specified distance of the site being judged. Therefore, <u>the area of possible deposition has no bearing</u> on setting the Field Boundary stakes. It is determined <u>solely by slope</u> of the site.

b) The slope of the field will be designated by two stakes, with an attached red ribbon, or with the upper part painted red. Slope stakes shall always be set either 50 or l00 feet apart and the contestant shall decide which it is. The purpose of these stakes is to indicate <u>where</u> the <u>slope</u> will be determined.

Contestants <u>cannot</u> assume the stakes are any standard height above the ground.

7. A "<u>pit supervisor"</u> will be stationed at each Field site. The duties there are:

   a) To <u>"dress up"</u> the soil pit so that contestants can <u>clearly see</u> the soil profile. If dry surface soil tends to tumble down the face of the pit, thus obscuring details such as color and structure, the supervisor should correct this carefully by "<u>shaving back" the pit face</u>, Also, note the above suggestion about moistening the pit face when strong drying conditions exist. For fairness to all, this assistance should be done equally between each group of participants.

   b) To relate any special instructions pertaining at that specific Field and time. An example would be to remind participants to take special care to mark scorecards legibly and protect them from getting wet, should conditions be rainy. Also, in the case that soil properties are sufficiently sandy as to be, or to approach being, an “s” subclass soil, the Pit Supervisor should consider pointing out the direction of predominant winds at the site, to allow consideration of the need of the “install windbreak” treatment -- <u>unless</u> the area being judged <u>is protected</u> from that direction by existing trees or woods. Of course, be sure to offer exactly the same information to each group of participants as they arrive.

   c) To serve as timekeeper for contestants and to perform any other duties designated by Field Director.

8. At the State Meet the time permitted for actual judging at each site will be 20 minutes. Any time limit per site at Federation Events is the option of local teachers and officials.

9. Water will be available at each field site for contestants to use in evaluating wet consistence.

10. Total signs, stakes and equipment needed for the four Fields of an Event:

SIGNS

Number
4 - SURFACE
4 - SUBSURFACE
4 - Field signs indicating
Field # ____________
_______________ acres

4 – CROPS PLANNED FOR FIELD: ______, ______, ______, ______.
1 – If applicable: SOIL FROM ______ Inches to ______ Inches

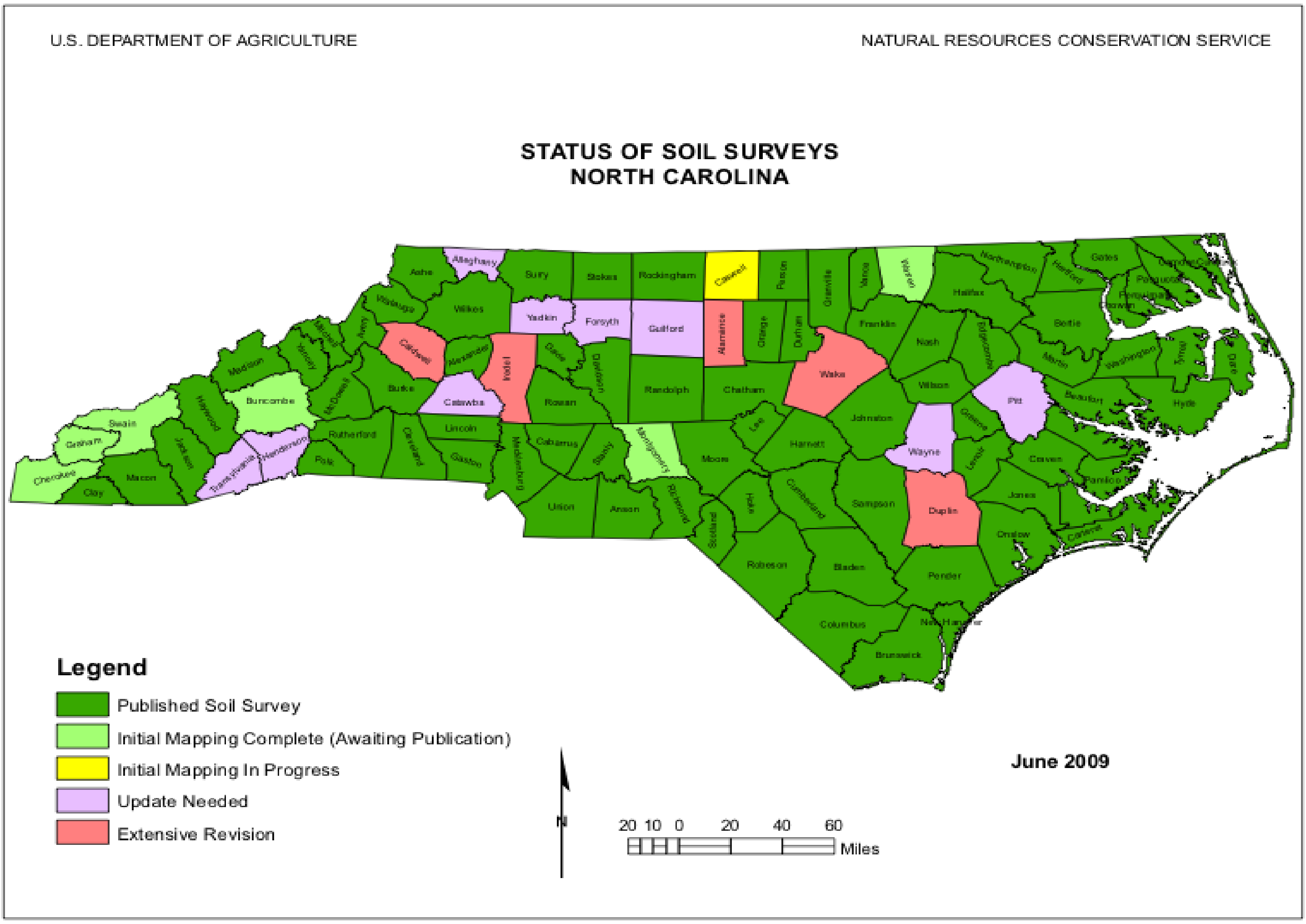
If applicable, a sign stating: "In this field, grower prefers the use of Treatments 1 or 2."

STAKES

Number
16 - Stakes at least 3 feet with white top (ribbon or painted)
8 - Stakes at least 3 feet with red top (ribbon or painted)
4 - Stakes or boards 4 to 5 feet long, marked clearly in 6-inch increments from the top down - to be placed in pits as depth markers.

EQUIPMENT

Number
1 – Survey level and rod to shoot slopes
1 – 100 foot tape to measure slope stake distance
1 - Axe or hammer to drive stakes
1 - Tacks to attach posters or hook and loop
1 - Magic marker or dry erase marker to label field #, crops planned, etc.
1 - Ball of cord, twine or survey tape to keep contestants out of pit (optional)
16 - Small or larger stakes on which to attach string surrounding pits (optional)
4 - Wash bottles or jugs of water and 1-gallon garden sprayer (one each pit) for use in moistening faces of the pits, if strong drying conditions exist
Shovels, time signal system (auto horn, etc.)


U.S. DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
STATUS OF SOIL SURVEYS
NORTH CAROLINA
Legend
Published Soil Survey
Initial Mapping Complete (Awaiting Publication)
Initial Mapping In Progress
Update Needed
Extensive Revision
June 2009
N
20 10 0 20 40 60
Miles