# LAND CAPABILITY CLASSIFICATION

A.A. Klingebiel and P.H. Montgome

# FOREWORD

Since soil surveys are based on all of the characteristics of soils that influence their use and management, interpretations are needed for each of the many uses. Among these interpretations the grouping of soils into capability units, subclasses, and classes is one of the most important. This grouping serves as an introduction of the soil map to farmers and other land users developing conservation plans.

As we have gained experience in this grouping, the definitions of the categories have improved. It is the purpose of this publication to set forth these definitions. In using the capability classification, the reader must continually recall that it is an interpretation. Like other interpretations, it depends on the probable interactions between the kind of soil and the alternative systems of management. Our management systems are continually changing. Economic conditions change. Our knowledge grows. Land users are continually being offered new things, such as new machines, chemicals, and plant varieties.

The new technology applies unevenly to the various kinds of soil. Thus the grouping of any one kind of soil does not stay the same with changes in technology. That is, new combinations of practices increase the productivity of some soils more than others, so some are going up in the scale whereas others are going down, relatively. Some of our most productive soils of today were considered poorly suited to crops a few years ago. On the other hand, some other soils that were once regarded as good for cropping are now being used more productively for growing pulpwood. These facts in no way suggest that we should not make interpretations. In fact, they become increasingly important as technology grows. But these facts do mean that soils need to be reinterpreted and regrouped after significant changes in economic conditions and technology.

Besides the capability classification explained in this publication, other important interpretations are made of soil surveys. Examples include groupings of soils according to crop-yield predictions, woodland suitability, range potentiality, wildlife habitat, suitability for special crops, and engineering behavior. Many other kinds of special groupings are used to help meet local needs.

CHARLES E. KELLOGG
Assistant Administrator for Soil Survey
Soil Conservation Service

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# LAND-CAPABILITY CLASSIFICATION

By A. A. Klingebiel and P. H. Montgomery, *soil scientists, Soil Conservation Service*

The standard soil-survey map shows the different kinds of soil that are significant and their location in relation to other features of the landscape. These maps are intended to meet the needs of users with widely different problems and, therefore, contain considerable detail to show important basic soil differences.

The information on the soil map must be explained in a way that has meaning to the user. These explanations are called interpretations. Soil maps can be interpreted by (1) the individual kinds of soil on the map, and (2) the grouping of soils that behave similarly in responses to management and treatment. Because there are many kinds of soil, there are many individual soil interpretations. Such interpretations, however, provide the user with all the information that can be obtained from a soil map. Many users of soil maps want more general information than that of the individual soil-mapping unit. Soils are grouped in different ways according to the specific needs of the map user. The kinds of soil grouped and the variation permitted within each group differ according to the use to be made of the grouping.

The capability classification is one of a number of interpretive groupings made primarily for agricultural purposes. As with all interpretive groupings the capability classification begins with the individual soil-mapping units, which are building stones of the system (table 1). In this classification the arable soils are grouped according to their potentialities and limitations for sustained production of the common cultivated crops that do not require specialized site conditioning or site treatment. Nonarable soils (soils unsuitable for longtime sustained use for cultivated crops) are grouped according to their potentialities and limitations for the production of permanent vegetation and according to their risks of soil damage if mismanaged.

The individual mapping units on soil maps show the location and extent of the different kinds of soil. One can make the greatest number of precise statements and predictions about the use and management of the individual mapping units shown on the soil map. The capability grouping of soils is designed (1) to help landowners and others use and interpret the soil maps, (2) to introduce users to the detail of the soil map itself, and (3) to make possible broad generalizations based on soil potentialities, limitations in use, and management problems.

The capability classification provides three major categories of soil groupings: (1) Capability unit, (2) capability subclass, and (3) capability class.

**TABLE 1.—Relationship of soil-mapping unit to capability classification**

| Soil-mapping unit | Capability unit | Capability subclass | Capability class |
|---|---|---|---|
| A soil mapping unit is a portion of the landscape that has similar characteristics and qualities and whose limits are fixed by precise definitions. Within the cartographic limitations and considering the purpose for which the map is made, the soil mapping unit is the unit about which the greatest number of precise statements and predictions can be made. | A capability unit is a grouping of one or more individual soil mapping units having similar potentials and continuing limitations or hazards. The soils in a capability unit are sufficiently uniform to (a) produce similar kinds of cultivated crops and pasture plants with similar management practices, (b) require similar conservation treatment and management under the same kind and condition of vegetative cover, (c) have comparable potential productivity. | Subclasses are groups of capability units which have the same major conservation problem, such as—<br>e—Erosion and runoff.<br>w—Excess water.<br>s—Root-zone limitations.<br>c—Climatic limitations. | Capability classes are groups of capability subclasses or capability units that have the same relative degree of hazard or limitation. The risks of soil damage or limitation in use become progressively greater from class I to class VIII. |
| The soil mapping units provide the most detailed soils information. The basic mapping units are the basis for all interpretive groupings of soils. They furnish the information needed for developing capability units, forest site groupings, crop suitability groupings, range site groupings, engineering groupings, and other interpretive groupings. The most specific management practices and estimated yields are related to the individual mapping unit. | The capability unit condenses and simplifies soils information for planning individual tracts of land, field by field. Capability units with the class and subclass furnish information about the degree of limitation, kind of conservation problems and the management practices needed. | The capability subclass provides information as to the kind of conservation problem or limitations involved. The class and subclass together provide the map user information about both the degree of limitation and kind of problem involved for broad program planning, conservation need studies, and similar purposes. | The capability classes are useful as a means of introducing the map user to the more detailed information on the soil map. The classes show the location, amount, and general suitability of the soils for agricultural use. Only information concerning general agricultural limitations in soil use are obtained at the capability class level. |

6. Presence of water on the surface or excess water in the soil; lack of water for adequate crop production; presence of stones; presence of soluble salts or exchangeable sodium, or both; or hazard of overflow are not considered permanent limitations to use where the removal of these limitations is feasible.[5]
7. Soils considered feasible for improvement by draining, by irrigating, by removing stones, by removing salts or exchangeable sodium, or by protecting from overflow are classified according to their continuing limitations in use, or the risks of soil damage, or both, after the improvements have been installed. Differences in initial costs of the systems installed on individual tracts of land do not influence the classification. The fact that certain wet soils are in classes II, III, and IV does not imply that they should be drained. But it does indicate the degree of their continuing limitation in use or risk of soil damage, or both, if adequately drained. Where it is considered not feasible to improve soils by drainage, irrigation, stone removal, removal of excess salts or exchangeable sodium, or both, or to protect them from overflow, they are classified according to present limitations in use.
8. Soils already drained or irrigated are grouped according to the continuing soil and climatic limitations and risks that affect their use under the present systems or feasible improvements in them.
9. The capability classification of the soils in an area may be changed when major reclamation projects are installed that permanently change the limitations in use or reduce the hazards or risks of soil or crop damage for long periods of time. Examples include establishing major drainage facilities, building levees or flood-retarding structures, providing water for irrigation, removing stones, or large-scale grading of gullied land. (Minor dams, terraces, or field conservation measures subject to change in their effectiveness in a short time are not included.)
10. Capability groupings are subject to change as new information about the behavior and responses of the soils becomes available.
11. Distance to market, kinds of roads, size and shape of the soil areas, locations within fields, skill or resources of individual operators, and other characteristics of land-ownership patterns are not criteria for capability groupings.
12. Soils with such physical limitations that common field crops can be cultivated and harvested only by hand are not placed in classes I, II, III, and IV. Some of these soils need drainage or stone removal, or both, before some kinds of machinery can be used. This does not imply that mechanical equipment cannot be used on some soils in capability classes V, VI, and VII.
13. Soils suited to cultivation are also suited to other uses such as pasture, range, forest, and wildlife. Some not suited to cultivation are suited to pasture, range, forest, or wildlife; others are suited only to pasture or

[5] Feasible as used in this context means (1) that the characteristics and qualities of the soil are such that it is possible to remove the limitation, and (2) that over [illegible] areas it is within the realm of present-day economic possibility to remove the limitation.

### Class II—Soils in class II have some limitations that reduce the choice of plants or require moderate conservation practices.

Soils in class II require careful soil management, including conservation practices, to prevent deterioration or to improve air and water relations when the soils are cultivated. The limitations are few and the practices are easy to apply. The soils may be used for cultivated crops, pasture, range, woodland, or wildlife food and cover.

Limitations of soils in class II may include singly or in combination the effects of (1) gentle slopes, (2) moderate susceptibility to wind or water erosion or moderate adverse effects of past erosion, (3) less than ideal soil depth, (4) somewhat unfavorable soil structure and workability, (5) slight to moderate salinity or sodium easily corrected but likely to recur, (6) occasional damaging overflow, (7) wetness correctable by drainage but existing permanently as a moderate limitation, and (8) slight climatic limitations on soil use and management.

The soils in this class provide the farm operator less latitude in the choice of either crops or management practices than soils in class I. They may also require special soil-conserving cropping systems, soil conservation practices, water-control devices, or tillage methods when used for cultivated crops. For example, deep soils of this class with gentle slopes subject to moderate erosion when cultivated may need one of the following practices or some combination of two or more: Terracing, stripcropping, contour tillage, crop rotations that include grasses and legumes, vegetated water-disposal areas, cover or green-manure crops, stubble mulching, fertilizers, manure, and lime. The exact combinations of practices vary from place to place, depending on the characteristics of the soil, the local climate, and the farming system.

### Class III—Soils in class III have severe limitations that reduce the choice of plants or require special conservation practices, or both.

Soils in class III have more restrictions than those in class II and when used for cultivated crops the conservation practices are usually more difficult to apply and to maintain. They may be used for cultivated crops, pasture, woodland, range, or wildlife food and cover.

Limitations of soils in class III restrict the amount of clean cultivation; timing of planting, tillage, and harvesting; choice of crops; or some combination of these limitations. The limitations may result from the effects of one or more of the following: (1) Moderately steep slopes; (2) high susceptibility to water or wind erosion or severe adverse effects of past erosion; (3) frequent overflow accompanied by some crop damage; (4) very slow permeability of the subsoil; (5) wetness or some continuing waterlogging after drainage; (6) shallow depths to bedrock, hardpan, fragipan, or claypan that limit the rooting zone and the water storage; (7) low moisture-holding capacity; (8) low fertility not easily corrected; (9) moderate salinity or sodium; or (10) moderate climatic limitations.

When cultivated, many of the wet, slowly permeable but nearly level soils in class III require drainage and a cropping system that maintains or improves the structure and tilth of the soil. To prevent puddling and to improve permeability it is commonly necessary to supply organic material to such soils and to avoid working them when they are wet. In some irrigated areas, part of the soils in class III have limited use because of high water table, slow permeability, and the hazard of salt or sodic accumulation. Each distinctive kind of soil in class III has one or more alternative combinations of use and practices required for safe use, but the number of practical alternatives for average farmers is less than that for soils in class II.

**Class IV—Soils in class IV have very severe limitations that restrict the choice of plants, require very careful management, or both.**

The restrictions in use for soils in class IV are greater than those in class III and the choice of plants is more limited. When these soils are cultivated, more careful management is required and conservation practices are more difficult to apply and maintain. Soils in class IV may be used for crops, pasture, woodland, range, or wildlife food and cover.

Soils in class IV may be well suited to only two or three of the common crops or the harvest produced may be low in relation to inputs over a long period of time. Use for cultivated crops is limited as a result of the effects of one or more permanent features such as (1) steep slopes, (2) severe susceptibility to water or wind erosion, (3) severe effects of past erosion, (4) shallow soils, (5) low moisture-holding capacity, (6) frequent overflows accompanied by severe crop damage, (7) excessive wetness with continuing hazard of waterlogging after drainage, (8) severe salinity or sodium, or (9) moderately adverse climate.

Many sloping soils in class IV in humid areas are suited to occasional but not regular cultivation. Some of the poorly drained, nearly level soils placed in class IV are not subject to erosion but are poorly suited to intertilled crops because of the time required for the soil to dry out in the spring and because of low productivity for cultivated crops. Some soils in class IV are well suited to one or more of the special crops, such as fruits and ornamental trees and shrubs, but this suitability itself is not sufficient to place a soil in class IV.

In subhumid and semiarid areas, soils in class IV may produce good yields of adapted cultivated crops during years of above average rainfall; low yields during years of average rainfall; and failures during years of below average rainfall. During the low rainfall years the soil must be protected even though there can be little or no expectancy of a marketable crop. Special treatments and practices to prevent soil blowing, conserve moisture, and maintain soil productivity are required. Sometimes crops must be planted or emergency tillage used for the primary purpose of maintaining the soil during years of low rainfall. These treatments must be applied more frequently or more intensively than on soils in class III.

## Land Limited in Use—Generally Not Suited to Cultivation [1]

**Class V—Soils in class V have little or no erosion hazard but have other limitations impractical to remove that limit their use largely to pasture, range, woodland, or wildlife food and cover.**

Soils in class V have limitations that restrict the kind of plants that can be grown and that prevent normal tillage of cultivated crops. They are nearly level but some are wet, are frequently overflowed by streams, are stony, have climatic limitations, or have some combination of these limitations. Examples of class V are (1) soils of the bottom lands subject to frequent overflow that prevents the normal production of cultivated crops, (2) nearly level soils with a growing season that prevents the normal production of cultivated crops, (3) level or nearly level stony or rocky soils, and (4) ponded areas where drainage for cultivated crops is not feasible but where soils are suitable for grasses or trees. Because of these limitations cultivation of the common crops is not feasible but pastures can be improved and benefits from proper management can be expected.

**Class VI—Soils in class VI have severe limitations that make them generally unsuited to cultivation and limit their use largely to pasture or range, woodland, or wildlife food and cover.**

Physical conditions of soils placed in class VI are such that it is practical to apply range or pasture improvements, if needed, such as seeding, liming, fertilizing, and water control with contour furrows, drainage ditches, diversions, or water spreaders. Soils in class VI have continuing limitations that cannot be corrected, such as (1) steep slope, (2) severe erosion hazard, (3) effects of past erosion, (4) stoniness, (5) shallow rooting zone, (6) excessive wetness or overflow, (7) low-moisture capacity, (8) salinity or sodium, or (9) severe climate. Because of one or more of these limitations these soils are not generally suited to cultivated crops. But they may be used for pasture, range, woodland, or wildlife cover or for some combination of these.

Some soils in class VI can be safely used for the common crops provided unusually intensive management is used. Some of the soils in this class are also adapted to special crops such as sodded orchards, blueberries, or the like, requiring soil conditions unlike those demanded by the common crops. Depending upon soil features and local climate the soils may be well or poorly suited to woodlands.

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[1] Certain soils grouped into classes V, VI, VII, and VIII may be made fit for use for crops with major earthmoving or other costly reclamation.

**Class VII—Soils in class VII have very severe limitations that make them unsuited to cultivation and that restrict their use largely to grazing, woodland, or wildlife.**

Physical conditions of soils in class VII are such that it is impractical to apply such pasture or range improvements as seeding, liming, fertilizing, and water control with contour furrows, ditches, diversions, or water spreaders. Soil restrictions are more severe than those in class VI because of one or more continuing limitations that cannot be corrected, such as (1) very steep slopes, (2) erosion, (3) shallow soil, (4) stones, (5) wet soil, (6) salts or sodium, (7) unfavorable climate, or (8) other limitations that make them unsuited to common cultivated crops. They can be used safely for grazing or woodland or wildlife food and cover or for some combination of these under proper management.

Depending upon the soil characteristics and local climate, soils in this class may be well or poorly suited to woodland. They are not suited to any of the common cultivated crops; in unusual instances, some soils in this class may be used for special crops under unusual management practices. Some areas of class VII may need seeding or planting to protect the soil and to prevent damage to adjoining areas.

**Class VIII—Soils and landforms in class VIII have limitations that preclude their use for commercial plant production and restrict their use to recreation, wildlife, or water supply or to esthetic purposes.**

Soils and landforms in class VIII cannot be expected to return significant on-site benefits from management for crops, grasses, or trees, although benefits from wildlife use, watershed protection, or recreation may be possible.

Limitations that cannot be corrected may result from the effects of one or more of the following: (1) Erosion or erosion hazard, (2) severe climate, (3) wet soil, (4) stones, (5) low-moisture capacity, and (6) salinity or sodium.

Badlands, rock outcrop, sandy beaches, river wash, mine tailings, and other nearly barren lands are included in class VIII. It may be necessary to give protection and management for plant growth to soils and landforms in class VIII in order to protect other more valuable soils, to control water, or for wildlife or esthetic reasons.

## CAPABILITY SUBCLASSES

Subclasses are groups of capability units within classes that have the same kinds of dominant limitations for agricultural use as a result of soil and climate. Some soils are subject to erosion if they are not protected, while others are naturally wet and must be drained if crops are to be grown. Some soils are shallow or droughty or have other soil deficiencies. Still other soils occur in areas where climate limits their use. The four kinds of limitations recognized at the subclass level are: Risks of erosion, designated by the symbol (e); wetness, drainage, or overflow (w); rooting-zone limitations (s); and climatic limitations (c). The subclass provides the map user information about both the degree and kind of limitation. Capability class I has no subclasses.

Subclass (e) erosion is made up of soils where the susceptibility to erosion is the dominant problem or hazard in their use. Erosion susceptibility and past erosion damage are the major soil factors for placing soils in this subclass.

Subclass (w) excess water is made up of soils where excess water is the dominant hazard or limitation in their use. Poor soil drainage, wetness, high water table, and overflow are the criteria for determining which soils belong in this subclass.

Subclass (s) soil limitations within the rooting zone includes, as the name implies, soils that have such limitations as shallowness of rooting zones, stones, low moisture-holding capacity, low fertility difficult to correct, and salinity or sodium.

Subclass (c) climatic limitation is made up of soils where the climate (temperature or lack of moisture) is the only major hazard or limitation in their use.[8]

Limitations imposed by erosion, excess water, shallow soils, stones, low moisture-holding capacity, salinity, or sodium can be modified or partially overcome and take precedence over climate in determining subclasses. The dominant kind of limitation or hazard to the use of the land determines the assignment of capability units to the (e), (w), and (s) subclasses. Capability units that have no limitation other than climate are assigned to the (c) subclass.

Where two kinds of limitations that can be modified or corrected are essentially equal, the subclasses have the following priority: e, w, s. For example, we need to group a few soils of humid areas that have both an erosion hazard and an excess water hazard; with them the e takes precedence over the w. In grouping soils having both an excess water limitation and a rooting-zone limitation the w takes precedence over the s. In grouping soils of subhumid and semiarid areas that have both an erosion hazard and a climatic limitation the e takes precedence over the c, and in grouping soils with both rooting-zone limitations and climatic limitations the s takes precedence over the c.

Where soils have two kinds of limitations, both can be indicated if needed for local use; the dominant one is shown first. Where two kinds of problems are shown for a soil group, the dominant one is used for summarizing data by subclasses.

[8] Especially among young soils such as alluvial soils, although not limited to them, climatic phases of soil series must be established for proper grouping into capability units and into other interpretive groupings. Since the effects result from interactions between soil and climate, such climatic phases are not defined the same in terms of precipitation, temperature, and so on, for contrasting kinds of soil.

## CAPABILITY UNITS

The capability units provide more specific and detailed information than the subclass for application to specific fields on a farm or ranch. A capability unit is a grouping of soils that are nearly alike in suitability for plant growth and responses to the same kinds of soil management. That is, a reasonably uniform set of alternatives can be presented for the soil, water, and plant management of the soils in a capability unit, not considering effects of past management that do not have a more or less permanent effect on the soil. Where soils have been so changed by management that permanent characteristics have been altered, they are placed in different soil series. Soils grouped into capability units respond in a similar way and require similar management although they may have soil characteristics that put them in different soil series.

Soils grouped into a capability unit should be sufficiently uniform in the combinations of soil characteristics that influence their qualities to have similar potentialities and continuing limitations or hazards. Thus the soils in a capability unit should be sufficiently uniform to (a) produce similar kinds of cultivated crops and pasture plants with similar management practices, (b) require similar conservation treatment and management under the same kind and condition of vegetative cover, and (c) have comparable potential productivity. (Estimated average yields under similar management systems should not vary more than about 25 percent among the kinds of soil included within the unit.)

## OTHER KINDS OF SOIL GROUPINGS

Other kinds of interpretive soil groupings are necessary to meet specific needs. Among these are groupings for range use, woodland use, special crops, and engineering interpretation.

The range site is a grouping of soils with a potential for producing the same kinds and amounts of native forage. The range site for rangeland is comparable to the capability unit for cultivated land. The purpose of such a grouping is to show the potential for range use and to provide the basis for which the criteria for determining range condition can be established. The soils grouped into a single range site may be expected to produce similar longtime yields and respond similarly to alternative systems of management and to such practices as seeding, pitting, and water spreading.

Soils suitable for range but not for common cultivated crops may be placed in capability classes V and VI if they are capable of returning inputs from such management practices as seeding fertilizing, or irrigating and in class VII if they are not. If these soils do not give economic returns under any kind of management when used for cultivated crops, pasture, woodland or range, they fall in class VIII.

Soil-woodland site index correlations are essential for interpreting the potential wood production of the individual soil units that are mapped.

Woodland-site indices are commonly developed for individual kinds of soils. Soil-mapping units can be placed in woodland groupings according to site indices for adapted species and other responses and limitations significant to woodland conservation. Such groupings do not necessarily parallel those for capability units or range sites; however, in some areas capability units may be grouped into range sites and woodland-suitability groups.

Rice has soil requirements unlike those of the common cultivated crops requiring well-aerated soils. Some fruits and ornamentals do not require clean cultivation. Therefore, these crops are not given weight in the capability grouping. Instead, special groupings of the soils for each of these crops are made in the areas where they are significant.

With a good basic table of yields and practices the soils can be placed in any number of suitability groups. Commonly, five groups—unsuited, fairly suited, moderately suited, well suited and very well suited—are sufficient.

Kinds of soil shown on the soil map are also grouped according to need for applying engineering measures including drainage, irrigation, land leveling, land grading; determining suitability as subgrade for roads; and constructing ponds and small dams. Such groupings may be unlike those made for other purposes.

## CRITERIA FOR PLACING SOILS IN CAPABILITY CLASSES

Soil and climatic limitations in relation to the use, management, and productivity of soils are the bases for differentiating capability classes. Classes are based on both degree and number of limitations affecting kind of use, risks of soil damage if mismanaged, needs for soil management, and risks of crop failure. To assist in making capability groupings, specific criteria for placing soils in units, subclasses, and classes are presented here. Because the effects of soil characteristics and qualities vary widely with climate, these criteria must be for broad soil areas that have similar climate.

Capability groupings are based on specific information when available—information about the responses of the individual kinds of soil to management and the combined effect of climate and soil on the crops grown. It comes from research findings, field trials, and experiences of farmers and other agricultural workers. Among the more common kinds of information obtained are soil and water losses, kinds and amounts of plants that can be grown, weather conditions as they affect plants, and the effect of different kinds and levels of management on plant response. This information is studied along with laboratory data on soil profiles. Careful analysis of this information proves useful not only in determining the capability of these individual kinds of soil but also in making predictions about the use and management of related kinds of soil.

Basic yield estimates of the adapted crops under alternative, defined systems of management are assembled in a table. Where data are few, the estimates should be reasonable when tested against available farm records and studies of the combinations of soil properties.

Where information on response of soils to management is lacking, the estimates of yields and the grouping of soils into capability units, subclasses, and classes are based on an evaluation of combinations of the following:

1. Ability of the soil to give plant response to use and management as evidenced by organic-matter content, ease of maintaining a supply of plant nutrients, percentage base saturation, cation-exchange capacity, kind of clay mineral, kind of parent material, available water-holding capacity, response to added plant nutrients, or other soil characteristics and qualities.
2. Texture and structure of the soil to the depth that influences the environment of roots and the movement of air and water.
3. Susceptibility to erosion as influenced by kind of soil (and slope) and the effect of erosion on use and management.
4. Continuous or periodic waterlogging in the soil caused by slow permeability of the underlying material, a high water table, or flooding.
5. Depth of soil material to layers inhibiting root penetration.
6. Salts toxic to plant growth.
7. Physical obstacles such as rocks, deep gullies, etc.
8. Climate (temperature and effective moisture).

This list is not intended to be complete. Although the soils of any area may differ from one another in only a few dozen characteristics, none can be taken for granted. Extreme deficiencies or excesses of trace elements, for example, can be vital. Commonly, the underlying geological strata are significant to water infiltration, water yield, and erosion hazard.

Any unfavorable fixed or recurring soil or landscape features may limit the safe and productive use of the soil. One unfavorable feature in the soil may so limit its use that extensive treatment would be required. Several minor unfavorable features collectively may become a major problem and thus limit the use of the soil. The combined effect of these in relation to the use, management, and productivity of soils is the criterion for different capability units.

Some of the criteria used to differentiate between capability classes are discussed on the following pages. The criteria and ranges in characteristics suggested assume that the effects of other soil characteristics and qualities are favorable and are not limiting factors in placing soils in capability classes.

## Arid and Semiarid, Stony, Wet, Saline-Sodic, and Overflow Soils

The capability-class designations assigned to soils subject to flooding, poorly or imperfectly drained soils, stony soils, dry soils needing supplemental water, and soils having excess soluble salts or exchangeable sodium are made on the basis of continuing limitations and hazards after removal of excess water, stones, salts, and exchangeable sodium.

When assessing the capability class of any soil the feasibility of any necessary land improvements must be considered. Feasible as used here means

(1) that the characteristics and qualities of the soil are such that it is possible to remove the limitation, and (2) that over broad areas it is within the realm of economic possibility to remove the limitation. The capability designation of these areas is determined by those practices that are practical now and in the immediate future.

The following kinds of soil are classified on the basis of their present continuing limitations and hazards: (1) Dry soils (arid and semiarid areas) now irrigated, (2) soils from which stones have been removed, (3) wet soils that have been drained, (4) soils from which excess quantities of soluble salts or exchangeable sodium have been removed, and (5) soils that have been protected from overflow.

The following kinds of soil are classified on the basis of their continuing limitations and hazards as if the correctable limitations had been removed or reduced: (1) Dry soils not now irrigated but for which irrigation is feasible and water is available, (2) stony soils for which stone removal is feasible, (3) wet soils not now drained but for which drainage is feasible, (4) soils that contain excess quantities of soluble salts or exchangeable sodium feasible to remove, and (5) soils subject to overflow but for which protection from overflow is feasible. Where desirable or helpful, the present limitation due to wetness, stoniness, etc., may be indicated.

The following kinds of soil are classified on the basis of their present continuing limitations and hazards if the limitations cannot feasibly be corrected or removed: (1) Dry soils, (2) stony soils, (3) soils with excess quantities of saline and sodic salts, (4) wet soils, or (5) soils subject to overflow.

## Climatic Limitations

Climatic limitations (temperature and moisture) affect capability. Extremely low temperatures and short growing seasons are limitations, especially in the very northern part of continental United States and at high altitudes.

Limited natural moisture supply affects capability in subhumid, semiarid, and arid climates. As the classification in any locality is derived in part from observed performance of crop plants, the effects of the interaction of climate with soil characteristics must be considered. In a subhumid climate, for example, certain sandy soils may be classified as class VI or class VII, whereas soils with similar water-holding capacity in a more humid climate are classified as class III or IV. The moisture factor must be directly considered in the classification in most semiarid and arid climates. The capability of comparable soils decreases as effective rainfall decreases.

In an arid climate the moisture from rain and snow is not enough to support crops. Arid land can be classed as suited to cultivation (class I, II, III, or IV) only if the moisture limitation is removed by irrigation. Wherever the moisture limitation is removed in this way, the soil is classified according to the effects of other permanent features and hazards that limit its use and permanence, without losing sight of the practical requirements of irrigation farming.

## Slope and Hazard of Erosion

Soil damage from erosion is significant in the use, management, and response of soil for the following reasons:

1. An adequate soil depth must be maintained for moderate to high crop production. Soil depth is critical on shallow soils over nonrenewable substrata such as hard rock. These soils tolerate less damage from erosion than soils of similar depth with a renewable substrata such as the raw loess or soft shale that can be improved through the use of special tillage, fertilizer, and beneficial cropping practices.
2. Soil loss influences crop yields. The reduction in yield following the loss of each inch of surface soil varies widely for different kinds of soil. The reduction is least on soils having little difference in texture, consistence, and fertility between the various horizons of the soil. It is greatest where there is a marked difference between surface layers and subsoils, such as among soils with claypans. For example, corn yields on soils with dense, very slowly permeable subsoils may be reduced 3 to 4 bushels per acre per year for each inch of surface soil lost. Yield reduction is normally small on deep, moderately permeable soils having similar textured surface and subsurface layers and no great accumulation of organic matter in the surface soil.
3. Nutrient loss through erosion on sloping soils is important not only because of its influence on crop yield but also because of cost of replacement to maintain crop yields. The loss of plant nutrients can be high, even with slight erosion.
4. Loss of surface soil changes the physical condition of the plow layer in soils having finer textured layers below the surface soil. Infiltration rate is reduced; erosion and runoff rates are increased; tilth is difficult to maintain; and tillage operations and seedbed preparation are more difficult.
5. Loss of surface soil by water erosion, soil blowing, or land leveling may expose highly calcareous lower strata that are difficult to make into suitable surface soil.
6. Water-control structures are damaged by sediments due to erosion. Maintenance of open drains and ponds becomes a problem and their capacity is reduced as sediment accumulates.
7. Gullies form as a result of soil loss. This kind of soil damage causes reduced yields, increased sediment damage, and physical difficulties in farming between the gullies.

The steepness of slope, length of slope, and shape of slope (convex or concave) all influence directly the soil and water losses from a field. Steepness of slope is recorded on soil maps. Length and shape of slopes are not recorded on soil maps; however, they are often characteristic of certain kinds of soil, and their effects on use and management can be evaluated as a part of the mapping unit.

Where available, research data on tons of soil loss per acre per year under given levels of management are used on sloping soils to differentiate between capability classes.

## Soil Depth

Effective depth includes the total depth of the soil profile favorable for root development. In some soils this includes the C horizon; in a few only the A horizon is included. Where the effect of depth is the limiting factor, the following ranges are commonly used: Class I, 36 inches or more; class II, 20–36 inches; class III, 10–20 inches; and class IV, less than 10 inches. These ranges in soil depth between classes vary from one section of the country to another depending on the climate. In arid and semiarid areas, irrigated soils in class I are 60 or more inches in depth. Where other unfavorable factors occur in combination with depth, the capability decreases.

## Previous Erosion

On some kinds of soil previous erosion reduces crop yields and the choice of crops materially; on others the effect is not great. The effect of past erosion limits the use of soils (1) where subsoil characteristics are unfavorable, or (2) where soil material favorable for plant growth is shallow to bedrock or material similar to bedrock. In some soils, therefore, the degree of erosion influences the capability grouping.

## Available Moisture-Holding Capacity

Water-holding capacity is an important quality of soil. Soils that have limited moisture-holding capacity are likely to be droughty and have limitations in kinds and amounts of crops that can be grown; they also present fertility and other management problems. The ranges in water-holding capacity for the soils in the capability classes vary to a limited degree with the amount and distribution of effective precipitation during the growing season. Within a capability class, the range in available moisture-holding capacity varies from one climatic region to another.

## Glossary

[illegible] **soils** Soils developing from transported and relatively recently [illegible] material (alluvium) with little or no modification of the original [illegible] by soil-forming processes. (Soils with well-developed profiles that [illegible] from alluvium are grouped with other soils having the same [illegible] profiles, not with the alluvial soils.)

[illegible] **nutrient in soils** The part of the supply of a plant nutrient in [illegible] that can be taken up by plants at rates and in amounts significant [illegible] growth.

[illegible] **water in soils** The part of the water in the soil that can be [illegible] by plants at rates significant to their growth; usable; obtainable.

[illegible] **ration** The relative degree to which soils have metallic cations [illegible] The proportion of the cation-exchange capacity that is saturated [illegible] llic cations.

[illegible] **change capacity** A measure of the total amount of exchange- [illegible] that can be held by the soil. It is expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7) or at some other stated pH value. (Formerly called base-exchange capacity.)

**Clay mineral** Naturally occurring inorganic crystalline material in soils or other earthy deposits of clay size—particles less than 0.002 mm. in diameter.

**Deep soil** Generally, a soil deeper than 40 inches to rock or other strongly contrasting material. Also, a soil with a deep black surface layer; a soil deeper than about 40 inches to the parent material or to other unconsolidated rock material not modified by soil-forming processes; or a soil in which the total depth of unconsolidated material, whether true soil or not, is 40 inches or more.

**Drainage, soil** (1) The rapidity and extent of the removal of water from the soil by runoff and flow through the soil to underground spaces. (2) As a condition of the soil, soil drainage refers to the frequency and duration of periods when the soil is free of saturation. For example, in well-drained soils, the water is removed readily, but not rapidly; in poorly drained soils, the root zone is waterlogged for long periods and the roots of ordinary crop plants cannot get enough oxygen; and in excessively drained soils, the water is removed so completely that most crop plants suffer from lack of water.

**Drought** A period of dryness, especially a long one. Usually considered to be any period of soil-moisture deficiency within the plant root zone. A period of dryness of sufficient length to deplete soil moisture to the extent that plant growth is seriously retarded.

**Erosion** The wearing away of the land surface by detachment and transport of soil and rock materials through the action of moving water, wind, or other geological agents.

**Fertility, soil** The quality of a soil that enables it to provide compounds, in adequate amounts and in proper balance, for the growth of specified plants, when other growth factors such as light, moisture, temperature, and the physical condition of the soil are favorable.

**Field capacity** The amount of moisture remaining in a soil after the free water has been allowed to drain away into drier soil material beneath; usually expressed as a percentage of the ovendry weight of soil or other convenient unit. It is the highest amount of moisture that the soil will hold under conditions of free drainage after excess water has drained away following a rain or irrigation that has wet the whole soil. For permeable soils of medium texture, this is about 2 or 3 days after a rain or thorough irrigation. Although generally similar for one kind of soil, values vary with previous treatments of the soil.

**First bottom** The normal flood plain of a stream, subject to frequent or occasional flooding.

**Parent material** The unconsolidated mass of rock material (or peat) from which the soil profile develops.

**Permeability, soil** The quality of a soil horizon that enables water or air to move through it. It can be measured quantitatively in terms of rate of flow of water through a unit cross section in unit time under specified temperature and hydraulic conditions. Values for saturated soils usually are called hydraulic conductivity. The permeability of a soil may be limited by the presence of one nearly impermeable horizon even though the others are permeable.

**Phase, soil** The subdivision of a soil type or other classificational soil unit having variations in characteristics not significant to the classification of the soil in its natural landscape but significant to the use and management of the soil. Examples of the variations recognized by phases of soil types include differences in slope, stoniness, and thickness because of accelerated erosion.

**Profile (soil)** A vertical section of the soil through all its horizons and extending into the parent material.

**Range (or rangeland)** Land that produces primarily native forage plants suitable for grazing by livestock, including land that has some forest trees.

**Runoff** The surface flow of water from an area; or the total volume of surface flow during a specified time.

**Saline soil** A soil containing enough soluble salts to impair its productivity for plants but not containing an excess of exchangeable sodium.

**Series, soil** A group of soils that have soil horizons similar in their differentiating characteristics and arrangement in the soil profile, except for the texture of the surface soil, and are formed from a particular type of parent material. Soil series is an important category in detailed soil classification. Individual series are given proper names from place names near the first recorded occurrence. Thus names like Houston, Cecil, Barnes, and Miami are names of soil series that appear on soil maps and each connotes a unique combination of many soil characteristics.

**Sodic soil (alkali)** Soil that contains sufficient sodium to interfere with the growth of most crop plants; soils for which the exchangeable-sodium-percentage is 15 or more.

**Soil** (1) The natural medium for the growth of land plants. (2) A dynamic natural body on the surface of the earth in which plants grow, composed of mineral and organic materials and living forms. (3) The collection of natural bodies occupying parts of the earth's surface that support plants and that have properties due to the integrated effect of climate and living matter acting upon parent material, as conditioned by relief, over periods of time.

A soil is an individual three-dimensional body on the surface of the earth unlike the adjoining bodies. (The area of individual soils ranges from less than ½ acre to more than 300 acres.)
A kind of soil is the collection of soils that are alike in specified combinations of characteristics. Kinds of soil are given names in the system of soil classification. The terms "the soil" and "soil" are collective terms used for all soils, equivalent to the word "vegetation" for all plants.

**Soil Characteristic** A feature of a soil that can be seen and/or measured in the field or in the laboratory on soil samples. Examples include soil slope and stoniness as well as the texture, structure, color, and chemical composition of soil horizons.

**Soil management** The preparation, manipulation, and treatment of soils for the production of plants, including crops, grasses, and trees.

**Soil quality** An attribute of a soil that cannot be seen or measured directly from the soil alone but which is inferred from soil characteristics and soil behavior under defined conditions. Fertility, productivity, and erodibility are examples of soil qualities (in contrast to soil characteristics).

**Soil survey** A general term for the systematic examination of soils in the field and in the laboratories, their description and classification, the mapping of kinds of soil, and the interpretation of soils according to their adaptability for various crops, grasses, and trees, their behavior under use or treatment for plant production or for other purposes, and their productivity under different management systems.

**Structure, soil** The arrangement of primary soil particles into compound particles or clusters that are separated from adjoining aggregates and have properties unlike those of an equal mass of unaggregated primary soil particles. The principal forms of soil structure are platy, prismatic, columnar (prisms with rounded tops), blocky (angular or subangular), and granular. Structureless soils are (1) single grain—each grain by itself, as in dune sand, or (2) massive—the particles adhering together without any regular cleavage as in many claypans and hardpans. ("Good" or "bad" tilth are terms for the general structural condition of cultivated soils according to particular plants or sequences of plants.)

**Subsoil** The B horizons of soils with distinct profiles. In soils with weak profile development, the subsoil can be defined as the soil below the plowed soil (or its equivalent of surface soil), in which roots normally grow. Although a common term, it cannot be defined accurately. It has been carried over from early days when "soil" was conceived only as the plowed soil and that under it as the "subsoil."

**Surface soil** The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, about 5 to 8 inches in thickness.

**Texture, soil** The relative proportions of the various size groups of individual soil grains in a mass of soil. Specifically, it refers to the proportions of sand, silt, and clay.

**Type, soil** A subgroup or category under the soil series based on the texture of the surface soil. A soil type is a group of soils having horizons similar in differentiating characteristics and arrangement in the soil profile and developed from a particular type of parent material. The name of a soil type consists of the name of the soil series plus the textural class name of the upper part of the soil equivalent to the surface soil. Thus Miami silt loam is the name of a soil type within the Miami series.

**Water table** The upper limit of the part of the soil or underlying rock material that is wholly saturated with water. In some places an upper, or perched, water table may be separated from a lower one by a dry zone.

**Water-holding capacity** The capacity (or ability) of soil to hold water against gravity (see **Field capacity**). The water-holding capacity of sandy soils is usually considered to be low while that of clayey soils is high. It is often expressed in inches of water per foot depth of soil.

**Waterlogged** A condition of soil in which both large and small pore spaces are filled with water. (The soil may be intermittently waterlogged because of a fluctuating water table or waterlogged for short periods after rain.)



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