Lesson 2: Using Soil Survey Manuals

Soil survey manuals provide useful information for grassland management. Soil scientists evaluate the soil for chemical and physical properties, make maps, and interpret the information for agricultural, engineering, recreational, and urban uses.

The characteristics of soils are very important when selecting plants for a grassland. Because soils provide so many vital components required by plants, it is imperative that the soil and plants of a grassland are suitable for each other and can meet the production goals and wildlife needs of the area.

Soil Surveys and Grasslands

The soil survey manual begins with a section on how to use the soil survey that provides an introduction to or review of the manual. A large map called the general soils map, which is used for land use planning, is also included. The general soils map shows the phases, or borders, of the different soil series (groups of similar soils) by means of lines that outline irregularly shaped areas and often follow contour lines.

When more detailed planning is necessary to manage a particular grassland, aerial photographs on which the phases of the soil series are drawn can be used to aid in making land use decisions. Information on the use and management of the soils is provided next, describing the land use potential and management for all areas of interest. The series are also covered in descriptions of the soils, which discusses the soil characteristics, limitations on use, land capability (uses), and suggested management practices. Finally, a section on the formation and classification of the soil is also included. It provides information on uniform systems of soil classification.

Locating Property

When trying to locate a plot of land in the manual, first find the property in the "Index to Map Sheets." Then turn to the page number of the map sheet indicated by the index and use landmarks and features and/or the U.S. standard land survey system to locate the plot. The U.S. standard land survey system is the method used for locating specific areas of land. The basis of this system is the base line (x-axis) and the principal meridians (y-axis). These two lines act as the reference points from which townships are established. Each township is a six-mile square divided into 36 sections, making each section one square mile. Most sections contain 640 acres, but the sections on the north and west sides may be larger or smaller if correlations need to be made. Sections are broken down into further subdivisions called quarters, which are identified by direction (NW, NE, SW, SE) and contain 160 acres. Each quarter can be divided into smaller components. Townships are numbered from the base line both north (N) and south (S), and the ranges from the principal meridian are numbered east (E) and west (W). See Figure 2.1 for a diagram of the system. Figure 2.2 shows divisions of a section.

Figure 2.1 – U.S. Standard Land Survey System

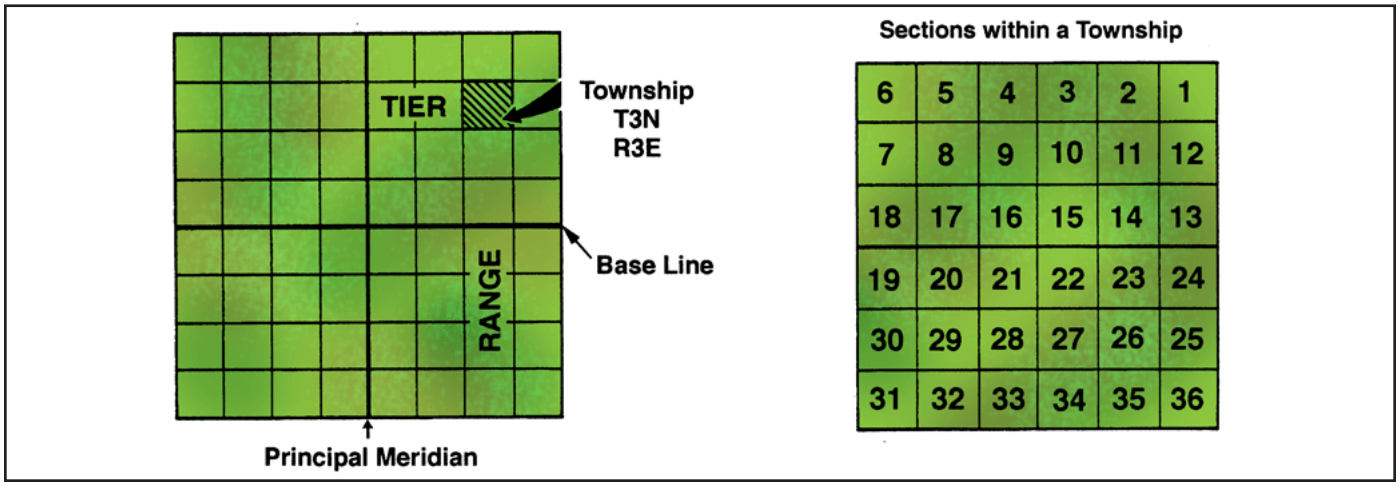
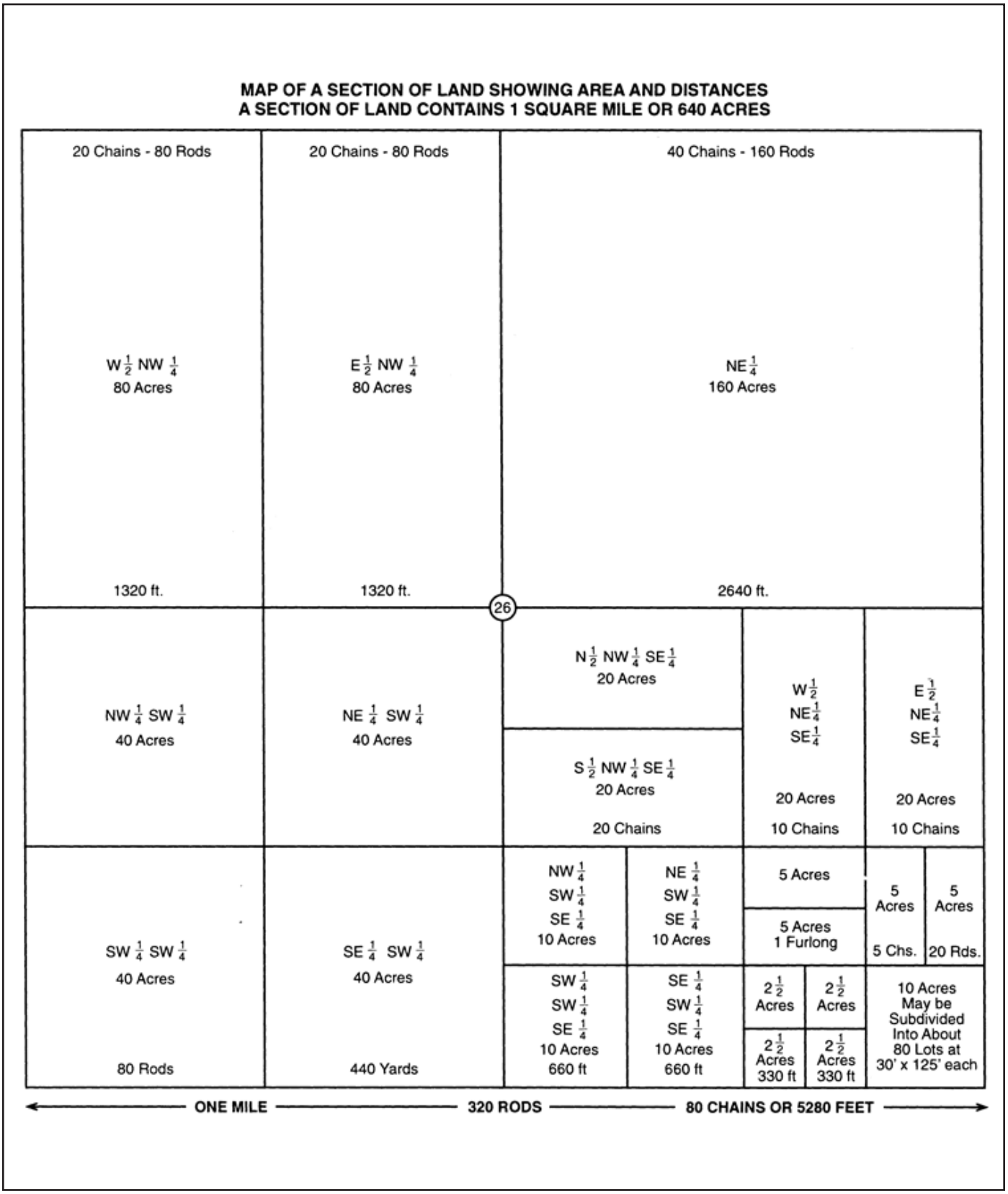


Figure 2.2 – Divisions of a Section



Soil Limitations

A soil's capability class, which indicates its uses, is determined by the limitations of an area. Limitations can be permanent or temporary. Knowledge of these limitations is of great value to the grassland manager, since it allows the management practices to be customized to the individual needs of the area.

Permanent limitations are not easy to change with conservation practices or management. Examples of permanent limitations include severe slope, soil depth, flooding, and large rocks. Some of these may be changed, although to do so would take great effort and expense, while others cannot be controlled.

Temporary limitations are problems that decrease land use potential but can be improved or removed with the implementation of conservation practices and better management. Examples of temporary limitations would include soil nutrient content, moderate slope, and minor drainage problems.

Soil Classifications

All soils are classified according to their uses and limitations. These soils are either cultivatable (able to produce crops) or noncultivatable (not able to produce crops). Each of these divisions is broken down into four different levels of cultivation, making eight soil classifications. A piece of property may have land that falls into several different soil classifications.

The cultivatable soils are Class I through Class IV.

Class I (1) – These soils have very few limitations to restrict use. No special treatment is needed for prevention of surface runoff even if the land is cultivated year after year. The land is nearly level with little risk of wind or water erosion. It has deep, well-drained soils that are easy to maintain.

Class II (2) – These soils have a few limitations that reduce the plant choices or that require moderate conservation practices to increase yields.

Class III (3) – Special conservation practices are needed for these soils because of the severe limitations that reduce the choice of plants. These conservation practices are less practical than Class II and require extra effort and costs.

Class IV (4) – Very sever limitations require careful management and/or special conservation practices on these soils to decrease the limitations that restrict the choice of plants.

Class V through Class VIII are the noncultivatable soils.

Class V (5) – This land is suitable for pasture and wildlife food and cover. It has few erosion hazards and is nearly level or gently sloping. The limitations are difficult to remove and prevent the use of standard farm equipment. The land may be wet, stony, and/or flooded by streams that may decrease the growing season.

Class VI (6) – These soils have severe limitations that reduce the uses of the area to grassland, range (if not overgrazed), and wildlife food and cover.

Class VII (7) – These soils have very severe limitations. An example would be a steep, rocky, eroded hillside.

Class VIII (8) – These areas are mountainous and suitable for wildlife, recreation, and/or water supply.

Classes II through VIII may have an additional label of E for erosion, W for wet, or S for stoniness, shallowness, or droughtiness. These labels indicate special conditions affecting the soil.

Factors Influencing Plant Selection

For plants to perform well, their needs for certain basic requirements must be met. Areas of interest when evaluating a grassland for plant selection are soil texture, soil depth, slope, erosion, surface runoff, permeability, and drainage.

Soil texture – The relative proportions of sand, silt, and clay particles in a soil determine its texture. It can vary from coarsely textured to finely textured with moderately coarse, medium, and moderately fine soils in between. Soil texture affects the amount of contact plant roots have with available water, air, and nutrients.

Soil depth – Soil depth refers to the area that plant roots have available to extend downward. Soil is divided into deep soils, which are more than 36 inches deep; moderately deep soils, which are 20-36 inches deep; shallow soils, which are 10-20 inches deep; and very shallow soils, which are less than 10 inches deep. Soil depth can limit the type of plants that can root in the soil. For example, if the soil depth is very shallow, the plant species that would prosper in that area are limited to short-rooting plans.

Slope – Slope refers to the steepness of the land's surface. It is measured as a percentage calculated by the difference in vertical elevation over a 100-foot horizontal distance. The severity of slope affects erosion and the ability to use farm machinery.

Erosion – The loss of soil by wind or water is erosion. Erosion can decrease the soil depth by removing the top-soil layer, which will decrease the quality of plant growth and limit the number of plants suitable to the area.

Surface runoff – Surface runoff refers to the rate at which water disappears from the soil surface by absorption or flowing over the soil. It can lead to erosion, the leaching of soil nutrients, and/or the washing away of seeds or nutrients.

Permeability – The movement of air and water through the soil is permeability. Root penetration, water movement in and on the soil, and nutrient leaching are all affected by the soil's permeability.

Drainage – Drainage refers to the speed at which water moves from the soil surface. Excessive or poor drainage limits plant growth. Drainage classes are discussed in greater detail in the next section.

Other factors also influence plant selection. Temperature range, rainfall, and length of season are climatic factors that affect plant growth and selection. Economic concerns also affect the selection of plants; one type of seed may cost less than another, making the first more economical, even though both may grow well in that soil.

Drainage Classes

Drainage classes are based on the frequency and duration of the periods during which the soil was saturated (voids between soil particles filled with liquid) or partially saturated when a particular soil was formed. The characteristics of the seven classes are based on the color and thickness of the subsurface soil layers.

Excessively drained soils – These soils are very porous and freely permeable for great depths.

Somewhat excessively drained soils – Water and air move freely but more slowly than excessively drained soils.

Well-drained soils – They are most often sandy or intermediately textured soils. The color is uniform except near the deep water table, where it becomes mottled or spotty.

Moderately well-drained soils – The soils have slower internal water movement. More mottling appears further up the profile (vertical section of the soil). Artificial drainage is suggested for an alfalfa crop.

Somewhat poorly drained soils – The surface is wet for many weeks throughout the year. Mottling is prominent just below the surface. Artificial drainage is almost always needed.

Poorly drained soils – These soils are wet for many months in the year. Mottling is prominent throughout the profile. Artificial drainage is required for crop growth.

Very poorly drained soils – The soils are wet almost every month of the year. They are usually gray in color with mottling on the surface. Artificial drainage may be difficult to install but is required for crop growth.

Obtaining Soil Manuals

Soil survey manuals for many Missouri counties can be obtained at no cost by Missouri residents and by all non-residents for a fee. Some counties do not have manuals. Contact a local Soil and Water Conservation district office or Natural Resources Conservation Service office to obtain copies if they are available.

Summary

Soil survey manuals are very useful for grassland managers. The maps and other information included in the manual help an individual to understand the potential uses of the soil and the conservation practices that could improve grassland production. Plant selection and growth depends a great deal on the characteristics of the soil. To select the best plants for a given area, these characteristics must be taken into account. Knowing the soil's limitations will improve management decisions made for the grassland.

Credits

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Donahue, Roy L., Raymond W. Miller, and John C. Shickluna. *Soils: An introduction to Soils and Plant Growth.* 5th ed. Englewood Cliffs, NJ: Prentice-Hall, Inc., 1983.

Donahue, Roy L., Roy Hunter Follett, and Rodney W. Tulloch. *Our Soils and Their Management.* Danville, IL: Interstate Publishers, Inc., 1990.

Minor, Paul E. *Soil Science* (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 1995.