

Introduction to Soils (selective cut/paste from [NRCS Web Soil Survey](#))

Soils 101

What is a soil survey?

One of the main tools available to help land users determine the potentials and limitations of soils is a soil survey. **Soil surveys are available through the USDA, Natural Resources Conservation Service (NRCS).** The surveys are made by NRCS in cooperation with other Federal, State, and local agencies. Our offices can provide this information, but more and more soil surveys are also available on the Internet. **Web Soil Survey** allows you to produce a customized soil survey for your own area of interest.

A soil survey generally contains soils data for one county, parish, or other geographic area, such as a major land resource area. During a soil survey, soil scientists walk over the landscapes, bore holes with soil augers, and examine cross sections of soil profiles. They determine the texture, color, structure, and reaction of the soil and the relationship and thickness of the different soil horizons. Some soils are sampled and tested at soil survey laboratories for certain soil property determinations, such as cation-exchange capacity and bulk density.

Like any tool, a soil survey is helpful only if you know what it can and can't do, and if you use it accordingly. The survey does not replace careful onsite investigation or analysis by a soil scientist

(Found in **"From the Surface Down,"** NRCS)

Who uses a soil survey?

Soil surveys available from the Natural Resources Conservation Service are intended for many different users. **They can help homebuyers or developers determine soil-related hazards or limitations that affect homesites.** They can help land use planners determine the suitability of areas for housing or onsite sewage disposal systems. They can help farmers estimate the potential crop or forage production of his land. They can be used to determine the suitability and limitations of soils for pipelines, buildings, landfills, recreation areas, and many other uses.

Many people assume that soils are all more or less alike. They are unaware that great differences in soil properties can occur within even short distances. Soils may be seasonally wet or subject to flooding. They may be shallow to bedrock. **They may be too unstable to be used as a foundation for buildings or roads.** Very clayey or wet soils are poorly suited to septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

These soil properties and many others that affect land use are given in soil surveys. Each soil survey describes the properties of soils in the county or area surveyed and shows the location of each kind of soil on detailed maps.

Information for Land Users

Homebuyers

The foundation supports the walls, the walls support the roof, and the soil holds them all. But how can you tell if the soil will be a good "home" for your house? You need to answer some important questions:

- Is the soil stable, or does it have properties that can cause the foundation or walls to crack?
- Is the soil in an area subject to flooding?
- Will storm runoff drain safely away from the house and lot? Or will it turn your yard, or basement, into a pond?
- Does the soil have a seasonal high water table that can cause a basement to flood or a septic system to fail?
- Is the soil deep enough for a basement to be dug economically? For garden and landscape plants to take root and thrive?
- Is the soil so steep that erosion may be severe?

A soil survey can help you answer these and many other questions about the soil.

Appraisers

In appraising the income potential of farmland it is essential to distinguish between income differences caused by soil properties and those caused by management. If two farms are managed in much the same way and still show differences in income, it is likely that the soils differ in inherent productivity. Likewise, two farms that have identical soil resources have the same potential productivity even if they are now managed differently.

Soil surveys available from the Natural Resources Conservation Service can help bankers, loan companies, tax assessors, farmers, and others who need to know about the productivity of farmland obtain reliable estimates of the potential productivity of soils in their area.

Developers and Builders

As a developer or builder, you probably know of construction projects on which time and money were lost because of unforeseen soil hazards. Soil surveys available from the Natural Resources Conservation Service (NRCS) can help you anticipate soil hazards at proposed construction areas, plan optimum development, and ensure adequate conservation during and after construction.

Soil surveys can help you determine whether tracts are suitable for development and avoid cost overruns caused by unforeseen soil hazards. By studying soil maps and supporting data in soil surveys, you can determine the soil conditions in areas where you plan to build and decide what additional investigations, if any, are needed. Soil surveys can help you avoid the unnecessary complications that attend failure of foundations, soil slippage, flooded basements, and other structural breakdowns caused by adverse soil properties. Special foundations, walls, and floor drains can be planned if soil hazards indicate that buildings of standard design would likely fail. Soil surveys describe soil properties in detail so that you can anticipate such problems and prepare alternative designs or select other areas for development.

Construction Engineers

Determining soil hazards

Soil surveys show the location of and describe each kind of soil in the county or area and describe the soil properties. These data can help engineers anticipate soil-related problems and plan onsite inspection. Failure to investigate adequately may lead to expensive delays in construction or **eventual structural breakdown**. *[HOT: If builders are not held financially responsible for structural breakdowns, then they have no incentive to consider soil conditions. By avoiding soil sampling, they can plead "ignorance" if sued due to resulting problems.]*

How soil surveys can help engineers

Construction engineers are particularly interested in soil properties that may require special structural measures to overcome or special maintenance once construction is completed. Soil surveys describe important soil properties that affect construction, including the following:

Shrink-swell potential: Certain kinds of clay soils expand when wet and shrink when dry, and special foundations are required to compensate for this movement. Soil surveys identify soils that have large shrink-swell potential.

Wetness: Soil surveys provide data on natural soil drainage, permeability, depth to seasonal water table, and suitability for winter grading for various kinds of soils. They can help engineers anticipate seasonal limitations on the use of heavy machinery for earthmoving and compacting and estimate the hazard of flooding or damage to underground structures caused by soil wetness.

Depth to bedrock: Soil surveys show areas where bedrock is at a depth of less than 5 or 6 feet and indicate the kind of bedrock.

Erodibility: Soil surveys provide information on how susceptible each soil is to erosion. Slope is only one factor contributing to erodibility. Other soil properties are also important, especially those properties that determine the cohesiveness of soil particles. These properties commonly vary within different layers of the same soil and cause different degrees of erodibility in different soil layers.

Flood hazard: The hazards of flooding and ponding are rated in soil surveys, and flood-prone areas are shown on soil maps. Such information does not take the place of hydrologic studies to determine the severest flood expected once in 10, 25, 50, or 100 years, but it does provide reliable estimates of areas where floods are most likely.

Slope: Slope gradient is a determining factor in establishing the final grade of a construction site and the amount of cut and fill needed to achieve the final grade. Ranges in slope are recorded in soil surveys, and areas where cuts and fills may be needed can be identified by studying soil maps. Slope particularly affects the installation of underground conduits and the construction of roads and highways.

Bearing capacity: Soil surveys give estimates of the particle size and plasticity of soils, and each soil layer is classified according to the Unified and the AASTHO systems. These classifications help in evaluating soils for shallow foundations and determining ease of compaction, ease of winter grading, trafficability, density, moisture relationships, susceptibility to frost action, and other properties.

Corrosion potential: Standard concrete deteriorates rapidly in very acid soils, and steel corrodes in soils that are highly saline or acid. The corrosion potential of each kind of soil is rated in soil surveys.

Organic layers: Muck and peat are very soft and unstable, and if drained, they subside. Areas of organic soils are shown in soil surveys, and the thickness of organic layers is indicated.

Ease of excavation: Excavating friable soils may cost half as much as excavating soils that are hard and compact. Sticky, clayey soils are difficult to spread in thin layers. Some soils are very susceptible to sloughing in trenches; others are stable. All these properties may differ from layer to layer in the same soil. Data presented in soil surveys can be used by engineers to anticipate earthmoving problems and to prepare more accurate bids for earth-moving.

Soil surveys also provide interpretations of the effect of soil properties on many kinds of land use. These interpretations and other data can be used to determine soil suitability as a source of topsoil, sand and gravel, roadfill for highway subgrade, and impermeable material. **The interpretations also show the degree and kind of limitations of soils if used for septic tank absorption fields, foundations for low buildings, underground utility lines, pipelines, highways, roads, streets, and parking lots.**

Urban Uses

Soils information helps people make many different decisions

Urban areas include developed and developing land

Developing land

As defined for Web Soil Survey, developing land is a broad category that includes transitional areas of cropland, forestland, or rangeland that may be developed in the near future.

Common questions about soils on developed and developing land

Roads, buildings, and other structures

Is my property on a flood plain?

Web Soil Survey only provides information about the susceptibility to and frequency of flooding. Consult flood maps from FEMA (see the "References and resources" section).

Is my property in an area where overland or stream flooding may cause damage?

- *Soil suitability and limitation ratings:* Playgrounds; Shallow Excavations
- *Soil property and quality ratings:* Flooding Frequency Class; Representative Slope

Is my property in an area where water may rise from below and cause damage?

- *Soil suitability and limitation ratings:* Excavated Ponds (Aquifer-fed)
- *Soil property and quality ratings:* Depth to Water Table; Representative Slope; Map Unit Hydric Rating

Why has my house settled unevenly, resulting in cracks in the walls?

- *Soil suitability and limitation ratings:* Dwellings with Basements
- *Soil property and quality ratings:* Percent Clay; Organic Matter; Flooding Frequency

Will a septic tank absorption field work on this site?

- *Soil suitability and limitation ratings:* Septic Tank Absorption Fields
- *Soil property and quality ratings:* Depth to Water Table; Representative Slope; Depth to Soil Restrictive Layer

Is construction on this land limited by erosion and sedimentation?

- *Soil suitability and limitation ratings:* Potential Erosion Hazard (Roads, Trails)
- *Soil property and quality ratings:* K Factor; Representative Slope; Hydrologic Group; Percent Clay

Our roads buckle and have many potholes. Are there other options for the soil bed or paving?

- *Soil suitability and limitation ratings:* Local Roads and Streets
- *Soil property and quality ratings:* Percent Clay; Saturated Hydraulic Conductivity (Ksat)

Is my house in danger of slipping down the slope or over the cliff?

- *Soil suitability and limitation ratings:* Shallow Excavations; Potential Erosion Hazard (Roads, Trails)

- *Soil property and quality ratings:* Depth to Soil Restrictive Layer; Saturated Hydraulic Conductivity (Ksat)

A brief guide to soils in urban areas

Understanding the suitability and limitations ratings

- Generally, there are no data recorded for map units or components called "urban land".
- If the urban land occurs as part of a complex, it is possible to view the soil information for the other components in the complex by using the advanced options for aggregation methods.
- When urban land makes up the largest percentage of the map unit, using the "dominant condition" aggregation method may obscure the information for nearby developing land and undisturbed soils. Adjusting the aggregation method to "least limiting" and leaving the component percent box unchecked (thereby opening up all components for ratings) can help to overcome this problem.
- Udorthents are an example of a more general classification category of soils. The data available for these soils commonly are limited or are displayed in the form of wide ranges. Ratings for specific uses generally are not available. Disturbed land is commonly mapped as Udorthents.
- Developing land generally was mapped as the **undisturbed soil map** unit or component. Because data or ratings for the map units of urban land and more general classifications typically are not available, it may be useful to look at the other soils in an urban land complex or at the soils in adjacent map units for clues to soil suitability or soil properties.
- As soil surveys are updated, more developed land may be captured as map units and the soil properties in some larger areas may be consistent enough to be rated for suitability.

Urban land map units

- **Urban land consists of paved areas or areas of highly disturbed land. This land may still have some of the characteristics of the soil components that existed in the area before it was disturbed. The soil survey generally describes the top 5 feet of the soil.**
- **In some rapidly developing areas, the soil has been disturbed since the soil survey mapping was completed.** Differences between the earlier mapping and the current conditions may be noticeable at the surface or when sequences of layers repeat below the surface. Typically, these areas are mapped as urban land or as a complex of urban land with an undisturbed soil.
- **Soil properties in urban areas can vary considerably over distances too small to be captured on soil survey maps.** Therefore, onsite investigations are needed before specific practices are designed.