Purdue University Extension

AY-369-W
2021

ILLINOIS SOIL Evaluation Field Book

Don Franzmeier, Gary Steinhardt, and Cathy Egler; Purdue University, Department of Agronomy
Dennis Bowman, University of Illinois, Urbana-Champaign Extension
Scott Wiesbrook, University of Illinois, Urbana-Champaign, Prairie Research Institute, Illinois Natural History Survey

Table of Contents

PREFACE

Professionals who manage soils first evaluate soil properties, then judge which practices are most suitable for that soil. Evaluate means to determine the quality of something. Judge means to form an opinion about something after careful thought.

Students use the same processes as professionals. In soil contests, students first evaluate soil and site properties, then judge those practices most suitable for that soil. They do this in competitions to make the process more interesting. It's the "after careful thought" part of the definition of "judge" that lies behind the soil contest rules described in this Field Book — with input from many agriculture science teachers.

In the first chapter, we emphasize evaluation. In the second chapter, we emphasize soil judging rules and the logic behind them. In the third chapter, we do the same for home sites.

We intend for students to take this book into the field and use it to prepare for soil judging contests.

"Illinois Soil Evaluation Field Book" will be available from the Purdue Extension Education Store, www.edustore.purdue.edu, 765-494-6795.

CHAPTER 1 - Soil Formation, Soil Properties, and Soil Evaluation

Overview of Landscapes and Soils

Soil profiles are vertical exposures of the upper 4 feet or so of the soil. You will soon learn that soils differ greatly from place to place. You will also learn that soils differ greatly as you dig deeper – you will see distinct strata, or layers, called soil horizons. This chapter provides a brief glimpse of why they differ.

Most people who read this Field Book will go outside to observe landscapes and examine soil profiles. Many Illinois landscapes include uplands, terraces, and bottomlands. Visualize a sidewalk leading to a porch with one step in between. The porch illustrates an upland, the step illustrates a terrace, and the sidewalk illustrates a bottomland (or flood plain). A more detailed discussion of landscapes follows later.

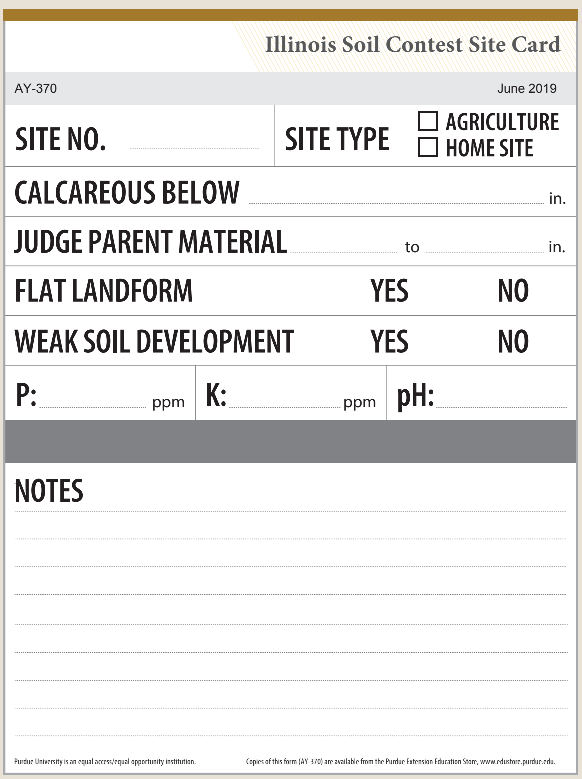
Overview of Soil Evaluation and Judging

In soil judging competitions, each student should be aware of the items discussed below.

Site Card

In soil judging contests, at each soil pit there will be a site card posted on a signboard. The site card (Figure 1 and available on page 45) provides this information:

- Site number
- The site may be judged for agriculture or home site
- Upper and lower depth at which to evaluate the parent material
- Official judges' decisions about landform and degree of soil development
- Soil fertility information: pH, K or Potassium level, P or Phosphorus level
- Optional notes


Illinois Soil Contest Site Card

AY-370 June 2019

SITE NO. ______ SITE TYPE ☐ AGRICULTURE ☐ HOME SITE

CALCAREOUS BELOW ______ in.

JUDGE PARENT MATERIAL ______ to ______ in.

FLAT LANDFORM YES NO

WEAK SOIL DEVELOPMENT YES NO

P: ______ ppm K: ______ ppm pH: ______

NOTES

Purdue University is an equal access/equal opportunity institution.

Copies of this form (AY-370) are available from the Purdue Extension Education Store, www.edustore.purdue.edu.

Figure 1. *A sample of a soil contest site card. For a full-size version of the site card, see page 45.*

Rules

Rules are key elements in soil judging and evaluation. Soil property rules summarize what a soil scientist sees in the field. Soil practice rules summarize the interpretation of what research and experience tell us about using best-suited practices on soils with certain properties. Contestants record their decisions on scorecards based on rules.

Scorecards

In this competition you will complete an agriculture scorecard.

A numbering system identifies each specific property and practice. Mark your answer clearly on the scorecard. For example, if you chose a dune landform, circle A. If your answer for No-till is Yes, then circle the A after 27 (27A). This system is compatible with electronic grading. If a contest uses electronic grading, then organizers will provide further instructions.

Time at Site

Contestants rotate among the four sites in an efficient sequence, not necessarily in numerical order. Contest officials will determine the time allotted to complete evaluation for each of the four soil pits. Contest officials will announce the time at the beginning of the contest. Time needed is usually dependent on conditions. On a pleasant, dry day contestants could be given as little as 15 minutes per pit. On a cold rainy day with small pits that are difficult to enter and exit, the time granted could be 20 minutes. It is important to be flexible due to conditions.

Critique Session

After you have completed your evaluations and all competitors have submitted their scorecards for grading, the official judges will give their answers in the pit. They will also answer questions about properties and practices. We encourage you to participate in these sessions to help you improve in future contests.

Soil Horizons

The soil profile that you see in a soil pit usually has three main sets of horizons, from the top down:

- A and E horizons (surface soil)
- B horizons (subsoil)
- C and R horizons (substratum)

A Horizons

The mineral layers near the soil surface are called **A horizons**. They contain dark humus mixed with mineral material. Humus is a kind of organic matter (material derived from plants and animals and contains carbon). For soils formed under forest vegetation, the A horizon is only a few inches thick. For soils formed under prairie grasses, or in depressions, the A horizon can be 10 to 25 or more inches thick. The A is usually the darkest of any horizon in the soil because the majority of biological activity occurs here and leaves behind organic matter.

Within the A horizon category is designation Ap, which is given to soil that has been mixed by plowing or cultivation. Ap horizons consist mostly of the A horizon, the A and E, or in eroded soils, the remaining A and part of the upper B horizons.

E Horizons

Soils developed under forests commonly have **E horizon**s a few inches below the surface. An E horizon is lighter in color, lower in organic matter, and less fertile than an A horizon. These horizons have lost clay, aluminum, iron, and some nutrients due to leaching of material from the E horizon into horizons below during the “E” eluviation process. In cultivated areas, plowing may have destroyed these horizons and mixed the material with the A horizon.

B Horizons

The mineral layers below A and E horizons are called **B horizons**. Subsoil is another name for the B horizon. B horizons have one or more of these characteristics:

- An accumulation of clay (there is more clay in the B horizon than in the A or C horizon)
- Prismatic or blocky structure (arrangement of soil material into geometric forms such as blocks)
- Weak cementation, resulting in brittle material in some cases.

C Horizons

Materials that cannot be designated as A, E, or B horizons because they lack soil development are called **C horizons**, or substratum. C horizons can be weathered rock, or they can be material that was moved by ice, water, or wind. In many soils, the C horizon is similar to the material from which the overlying horizons formed.

R Horizons

The **R horizon** is consolidated (hard) bedrock, such as limestone, sandstone, or shale. In Illinois, the depth to bedrock varies from a few inches to several hundred feet.

Degree of Soil Development

The C horizon has changed little since the material was deposited, but the A and B horizons have changed significantly. These changes are the product of soil development. One criterion used to help identify the soil parent material is the degree of soil development.

Most parent materials – till, outwash and lacustrine deposits, eolian (wind-blown) sand, loess, and weathered bedrock – have been in place for a relatively long time, and the soils formed from these parent materials have **normal soil development**, usually shown by B horizons that are much different from C horizons. In contrast, alluvium has been in place a much shorter time, and the soils formed in alluvium have **weak soil development.**

Because weak soil development grades by small changes into normal soil development, official judges will circle "Weak soil development" or "Normal soil development" on the site card to help soil judgers.

Soil Properties

Each soil evaluation scorecard will ask you for information about various soil properties, including:

- Kinds of parent material
- Slope
- Landform
- Soil color
- Previous erosion
- Soil texture
- Natural soil drainage
- Limiting layers

This book discusses each of the properties above in detail. The terms soil texture and soil color are used often in this book. Texture refers to the size of particles (sand, silt, and clay) in a soil sample, and results in the sample feeling gritty, smooth, or sticky, etc. Detailed discussion of texture is on pages 17-18. Detailed discussion of soil color is on pages 14 -15.

Parent Material

Parent material is the material from which soil horizons formed. The site card lists the depth to determine the kind of parent material.

The challenge for the soil judging participant is to recognize a certain parent material at the assigned depth. Determining parent material requires more than soil properties. Other factors can help you determine the kind of parent material:

- **Where you are in the state.** Glacial till (deposited by ice), for example, is a common parent material in the northern and central part of the state; weathered bedrock is common in the far south and in the "Driftless Region" of far northwestern Illinois and far southern Illinois. Deep loess (silt-size material deposited by wind) is common east of major rivers and becomes shallower eastward across much of the state.
- **Where you are in the local landscape.** Glacial till, loess, eolian sand, glacial outwash, lacustrine deposits and weathered bedrock are common on the highest part of the landscape – uplands. Glacial outwash (deposited by meltwater) is common on intermediate elevations – terraces or plains below terminal moraines. Alluvium is common in the lowest areas near streams – bottomlands.
- **What you see around the soil pit.** Rounded stones and boulders are typical of till. However, some rocks crushed by glacial action still have sharp edges. Box- and book-shaped stones (which are rectangular in cross-section) and boulders with sharper edges and corners are typical of bedrock.

Parent material changes greatly as it forms soil horizons. Understanding these changes will help you recognize why a certain kind of parent material looks different in different parts of a soil profile. Understanding the degree of change will also help you to identify alluvium and local overwash parent materials, as well as flood plain landforms.

The parent materials identified in soil evaluation are:

- Weathered bedrock
- Till
- Outwash and Lacustrine deposits
- Eolian sand
- Loess
- Alluvium
- Local overwash

WEATHERED BEDROCK

All parent materials weathered to some extent from bedrock. Physical, biological and chemical processes transform bedrock into **weathered bedrock**. We call the weathered bedrock residuum. For soil judging, the term "weathered bedrock" refers to materials that have stayed essentially in place (residuum) or moved downslope and collected at the base of a slope (colluvium). In many places in Illinois, the bedrock will be relatively shallow, but in others it may be deep. Weathered bedrock usually contains fragments of the original rock, such as sandstone, siltstone, shale, limestone, or chert. These fragments are usually flat but may have sharp edges and corners.

By contrast, other parent materials (such as till or outwash) were transported greater distances by glacial action, so the pebbles in them are more rounded. The transport process caused rounding of corners and edges. Also, many of the pebbles in till and outwash are from **igneous** rocks instead of **sedimentary** rocks, having been transported long distances from source areas where igneous rocks are common. The texture of weathered bedrock varies widely, depending on the size of particles in the original rock.

Other parent materials have a specific definition. If a soil does not meet the definition of the other parent materials, it is likely weathered bedrock.

▸ EVALUATING RULE
Weathered Bedrock

Weathered bedrock (including bedrock) has one or more of the following characteristics:

- More than 80 percent of the material in the diagnostic zone is so hard that roots will not grow into it (qualifies as bedrock limiting layer).
- Less than 80 percent of the material is hard, but sedimentary rock fragments are mainly angular, flat, or both.
- The parent material does not meet the definition of any other parent material.

TILL

Till is parent material that was deposited directly by glacial ice. The glacier, up to a few thousand feet thick, ground up the bedrock as it advanced. The glacier then transported that ground material and deposited it in the northern, central and southern parts of the state. In Illinois, we classically see three different periods of glaciation separated by warmer interglacial periods. The second of the three glacial events is called "Illinoian" and came as far south as Carbondale.

Till was derived mostly from nearby bedrock or previous glacial deposits, but some came from more distant sources. For example, the igneous pebbles and boulders (granite, etc.) in the till must have come mainly from Canada, because sedimentary rocks underlie most of Illinois. Glacial pebbles are more rounded than the rock fragments in weathered bedrock because they were worn down while being pushed along under (and in) the ice.

Till consists of a mixture of clay, silt, sand, and usually coarser fragments. Most tills have medium (loam) or moderately clayey (clay loam or silty clay loam) textures. In Illinois, most till was calcareous when deposited. Calcareous means that the till contains carbonate minerals, such as calcium carbonate ($CaCO_3$), also called lime. These minerals came from the limestone bedrock the glaciers ground up.

Most of the glacial tills in Illinois contained around 20 to 40 percent of carbonate minerals when deposited. When the A and B horizons formed, the carbonate minerals were dissolved, and the carbonates were leached out of the upper soil profile but remain in the C horizon.

However, not all calcareous materials are till. Other materials, such as outwash, loess, or alluvium may also be calcareous. The site card in each soil pit notes the upper depth to calcareous material. Glaciers that were hundreds of feet or even a few thousand feet thick deposited the different tills in Illinois. The weight of the ice compressed or compacted the till to a very high density in some places. Till with high bulk density (weight/volume) is called **dense till** and is considered to be a limiting layer for soil evaluation.

Most of the volume of dense till is solid particles with little pore space. Since roots grow through soil pores, soil horizons with few pores also have few roots. Quite often dense till breaks apart into a platy structure, with plates around 1/8 to 1/2 inch thick. This structure probably formed as the glacier till deposited till or freeze-thaw in a periglacial environment rather than through later soil-forming processes. In such till the vertical cracks between plates are offset (like bricks in a wall) so that after a root grows down through one vertical crack, it must grow sideways to find another downward crack. This greatly restricts root growth.

▸ EVALUATING RULE
Till

Till has all of these characteristics:

- Till is directly deposited from glaciers. It is a mixture of sand, silt, clay and coarser material. There is no stratification.
- Pebbles, if present, are mainly igneous, but in some areas there is a mixture of underlying sedimentary rocks incorporated. Pebbles usually are rounded but may be crushed, with sharp edges, by glacial action. In any case, they are randomly distributed.
- Till can be weathered (non-calcareous and not dense) or unweathered (calcareous).
- May have platy structure in unweathered till – but not in weathered till.
- Common texture and color combinations found in unweathered till:
  - Medium texture (loam or silt loam) or sometimes moderately sandy in northern Illinois and brownish color (10YR 5/4, 5/6, 5/3) **or**
  - Moderately clayey texture (clay loam, silty clay loam) and near the brownish/gray color boundary (10YR 5/3, 5/4, 5/2)

OUTWASH AND LACUSTRINE DEPOSITS

When the ice that deposited till melted, the meltwater carried away gravel, sand, silt, and clay. The meltwater flowed very rapidly when it first left the glacier, but as the streams of meltwater spread out, they slowed down. This allowed the sand and gravel to settle out as material called **outwash.**

Outwash contains very little silt and clay, and generally is stratified (layered). In some materials (especially coarse sand and gravel) the layers are so thick only one type of material may be visible in a soil pit.

In some places, meltwater streams flowed into lakes. In the still water of the lake, the fine material (silt and clay) gradually settled out. Streams that flowed into lakes also carried coarser material (sand) that immediately settled out. Thus, these lake, or **lacustrine deposits** contain much silt and clay but may also contain sand. Outwash and lacustrine deposits grade into each other and, therefore, there is no separation in Illinois high school soil judging.

According to soil evaluation guidelines, all outwash and lacustrine parent materials must be stratified except material that qualifies as a coarse sand and gravel limiting layer. "Stratified" means that material in the parent material depth consists of layers that are visibly different from each other in texture or coarse fragment content.

▸ EVALUATING RULE
Outwash and Lacustrine Deposits

Outwash and lacustrine deposits have all of these characteristics:

- Pebbles, if present, are mainly rounded and occur in layers (stratified)
- Material is either:
  - In the sandy texture group, and the sands are mainly > 0.5 mm in diameter (qualifies as a coarse sand and gravel limiting layer if it is thick enough), **or**
  - In any texture group and is stratified (consists of layers that are clearly visible)
- If official judges determine the parent material is outwash or lacustrine material, but the profile does not show clear stratification, or the material is not coarse sand and gravel, officials will give the parent material on the site card.

EOLIAN SAND

When the glaciers melted, it caused great floods on the ancient floodplains that are now terraces. During the winters, the melting slowed, resulting in the plains becoming barren flats. Wind blowing over the barren flats picked up certain particles and carried them away. The large materials (coarse sand, gravel and some medium sand) mainly stayed in place.

The very fine and medium-size sands moved by skips and jumps. Eventually this process accumulated piles of wind-transported **eolian sand** into hills called dunes. Very fine, fine and medium sands are 0.05 to 0.5 mm in diameter. The size of sand is determined by comparing the sand from a soil pit with two grits (sizes of sand particles) of sandpaper. Eolian sand is not stratified, but it often has thin bands, called lamellae, that contain slightly more clay and are redder than the surrounding material.

> ▸ **EVALUATING RULE**
> **Eolian Sand**
>
> **Eolian sand** has all of these characteristics:
>
> - Sandy or moderately sandy at the surface
> - No gravel or pebbles present in the profile
> - Sand grains are mainly very fine, fine and medium size, 0.05 to 0.5 mm in diameter (between 240-grit and 40-grit sandpaper)
> - Not stratified, but may have lamellae that are sandy, moderately sandy or moderately clayey. Some soils formed in eolian sand have moderately clayey subsoils.

LOESS

As the wind blew over the barren flats of terraces and outwash plains left by retreating glaciers, the wind picked up silt-size grains. Silt particles are smaller than sand, so the wind lifted them higher in the air and carried them further than eolian sand. Deposits of these fine grains are **loess**.

Loess settled out from the air. It was never under the weight of glacier ice, not compacted and therefore not dense. Loess-derived medium textured (silt loam) A horizons are very common in many areas of Illinois. A horizons are often medium (silt loam or silt) and can be moderately clayey (silty clay loam) in many places. B horizons are moderately clayey (silty clay loam) or fine (silty clay). In summary, loess is the only parent material found in many soils, and is the uppermost parent material of most soils in Illinois. It is not stratified. It commonly forms medium (silt loam) or moderately clayey (silty clay loam) A horizons, silty clay loam or finer in the B horizons, and silt or silt loam in the C horizons.

> ▸ **EVALUATING RULE**
> **Loess**
>
> **Loess** has all of these characteristics:
>
> - No pebbles, or if present, very few caused by animal activities or weathering processes
> - Silt, silt loam, silty clay loam or silty clay texture in surface or subsoil
> - Not stratified (in contrast to water-deposited material, which is stratified)
> - May or may not be calcareous
> - Never dense (in contrast to most unweathered till)

ALLUVIUM

Alluvium is soil material eroded relatively recently from surface soils, transported by water, and deposited on a flood plain. The material that the water carried and deposited is **sediment**. Flood plains are low in the landscape and are near streams. Soil evaluators might not be able to tell if the site is close to a stream, but they should notice if the site is low in the landscape relative to the rest of the landscape they can see.

Alluvium has one or more of these characteristics:

- The sediment's texture and organic matter content can vary depending on the kind of soil from which the material eroded. For example, one storm may have eroded mainly A horizons, so the sediment was dark. Another storm may have been severe enough to cut gullies into B and C horizons, so the sediment was lighter in color. Because of this process, darker and lighter layers can occur in the parent material of some soils formed in alluvium. Much of Illinois has very deep and dark soils, so this stratification can be very difficult to see. In those cases, emphasis should be placed on other characteristics.
- Often the sediment was calcareous, so the alluvium was calcareous to the surface. Because alluvium is very young, there was

little time to leach calcareous material out of upper layers. Calcareous material above 20 inches often indicates that the parent material is alluvium.

- Soils formed in alluvium usually have weak soil development.

> ▸ **EVALUATING RULE**
> **Alluvium**
>
> **Alluvium** has *both* of these characteristics:
>
> - The site is low in the landscape (on a flood plain).
> - The soil has at least one of the following:
>   - Distinct layers of lighter- and darker-colored soil material in the parent material zone
>   - Calcareous material above 20 inches
>   - "Weak soil development" circled "Yes" on the site card

LOCAL OVERWASH

Local overwash is similar to alluvium, except that overwash is eroded soil material from nearby hillslopes or swells, and deposited on top of soils somewhat lower in the landscape. Overwash parent material occurs in depressions on uplands, but never on floodplains.

Usually, overwash comes from the erosion of lighter colored soil horizons higher in the landscape and overlies darker colored horizons. If overwash buries a light-colored horizon, it may be difficult to distinguish the buried layer. If this is the case, official judges should give the parent material on the site card. If the overwash is 20 inches or more thick, the landform is a **filled depression** in soil evaluation.

> ▸ **EVALUATING RULE**
> **Local Overwash**
>
> **Local overwash** has all of these characteristics:
>
> - More than 20 inches thick (but the parent material identification zone may not include all 20 inches)
> - Buries a darker horizon
> - Soil horizons in and above the parent material zone have weak development
> - Not on a floodplain

OTHER PARENT MATERIALS

The far southern tip of Illinois has a special parent material found only in the area that borders the Ohio River and Mississippi River where the rivers join near Cairo. At one time, the Gulf of Mexico extended as far north as this part of southern Illinois. This feature is called the Mississippi Embayment. The parent material deposited there is stratified Coastal Sediments. It is not bedrock, nor is it related to any other geologic process that produced parent material in other parts of Illinois. It is not covered by these soil judging rules; officials will give the answer on the site card as weathered bedrock for contest purposes. If this parent material is part of a contest, be sure to take full advantage of the opportunity to see these special deposits. In many cases they are colorful and unlike anything you have ever seen.

If the material in the parent material zone does not fit any of the guidelines above, official judges will write the name of the parent material on the site card that is closest to the parent material list on the scorecard and then cover the topic in the critique.

Slopes

During soil evaluation, contestants measure the slope between two stakes near the soil pit with a slope finder (see page 34). The stakes are set from 25 to 100 feet apart where possible. There are seven slope classes designated by a letter or letters.

Mark the proper Scorecard Designation on the scorecard:

SCORECARD DESIGNATION	SLOPE (%)	DESCRIPTION
A	0-2	Nearly level
B	3-6	Gently sloping
C	7-12	Moderately sloping
D	13-18	Strongly sloping
E	19-25	Moderately steep
F	26-35	Steep
G	> 35	Very steep

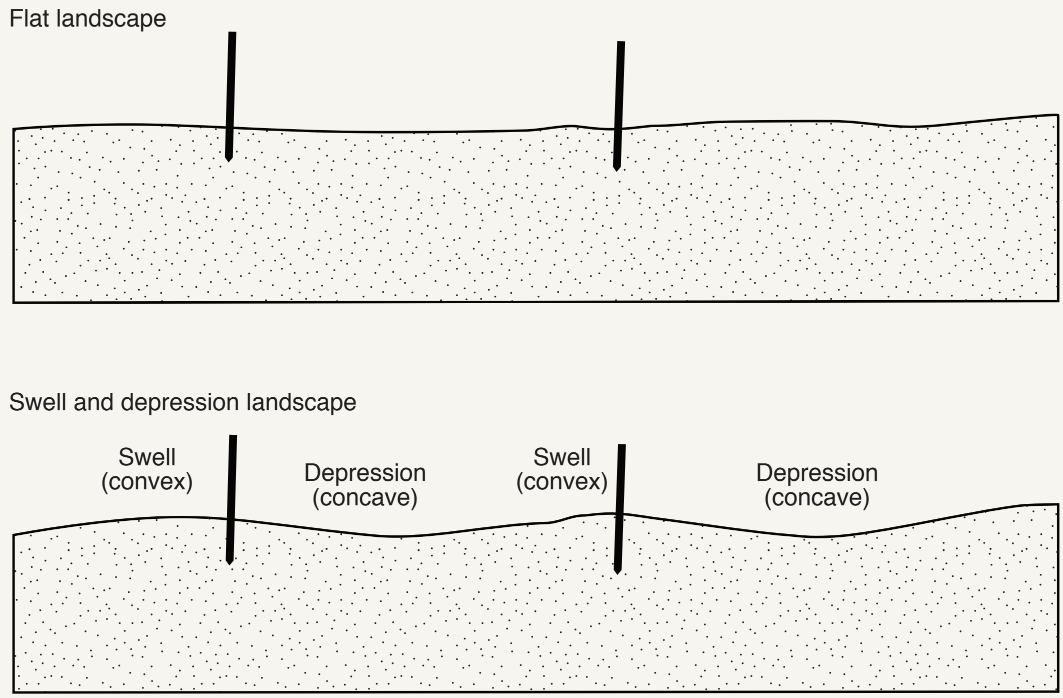


Figure 2. A cross-sections of a flat landscape and a swell-and-depression landscape. The slope stakes are set to show a depression.

Landforms

As you walk toward a soil pit observe whether the pit is on an upland or bottomland. As you will see in the definitions of the various landforms below, parent material helps determine the landform.

On uplands, the parent materials are weathered bedrock, till, outwash and lacustrine, eolian sand, and loess.

Terraces occur in Illinois, and the parent material could be outwash, but many other parent materials are possible. Outwash parent material includes not just soils on terraces but also kames, eskers, outwash plains, and similar landforms better described as upland. Lake plains also occur in Illinois with stratified parent material that is finer than outwash. Lacustrine deposits are not typically on terrace positions. For soil judging, participants should determine outwash and lacustrine deposits as parent material, but because of the complexity of the landscape, both score as uplands. In the critique of the contest, officials may point out terrace or other landforms to enhance participant understanding of the complexity of Illinois landforms.

On bottomlands (floodplains), the parent material is normally alluvium.

Local overwash (parent material) occurs in small areas on uplands and terrace landforms, but the landform is a filled depression.

SWELLS, DEPRESSIONS, AND FLATS

Much of the nearly level glaciated upland of Illinois is a rolling or undulating **till plain.** In the description that follows, convex shapes are those that bulge upward like a ball, and **concave** landforms dip downward like a bowl (Figure 2).

The convex rises of a till plain are called **upland swells**; the concave dips are called **upland depressions.** In the forested part of the state, soils on swells usually have light-colored surfaces, and soils in depressions have dark-colored surfaces. Except in sandy materials, upland swells usually have moderately well drained or somewhat poorly drained soils, and upland depressions usually have poorly drained soils.

In much of the glaciated part of central Illinois, the uplands have even less relief and lower slope percentages than the swell-and-depression topography farther west and north. Some of these uplands are so flat, in fact, that it is difficult to determine whether the surface is concave or convex. They are **upland flats**. Upland flats usually have poorly drained soils over much of the flat and somewhat poorly drained soils near the edges of the flat.

Swells, flats, and depressions are described above for till plains, but they are also found on outwash and lacustrine deposits. The difference between a landscape that has swell-depression topography and a landscape that has flat topography can be very small. Therefore, officials will circle "Yes" for "Flat landscape" on the site card if they called the landscape flat. If the officials circle "No" on the card and the slope is 2 percent or less, contestants must decide if the site is a swell or a depression. Officials will set slope stakes so that the area between them represents either a swell or a depression. Figure 2 shows the difference between a flat landscape and a swell-swale landscape. It also shows the position of stakes.

HILLSLOPES

Hillslopes are landform components that have slopes of 3 percent or greater. On 3 to 6 percent slopes, soils are usually well or moderately well drained, but such slopes may include areas of somewhat poorly drained soils. Well drained soils are usually on slopes of more than 6 percent, but such slopes can often be moderately well drained.

SOIL EVALUATION RULES FOR UPLAND LANDFORMS

Position in the landscape, parent material, and the shape and steepness of slope are the basis for determining landform in soil judging. If the landform does not meet any of the guidelines described in the Evaluation Rules below, officials will write the name of the landform on the site card.

▸ EVALUATING RULE
Upland Landforms

Upland landforms have these two characteristics:

- Parent material is weathered bedrock, till, outwash and lacustrine, or loess
- Soil has normal development
- Upland landforms are further differentiated as:
  - Upland hillslope — slope is 3 percent or more
  - Upland swell — slope is 2 percent or less and surface is convex
  - Upland flat — slope is 2 percent or less and surface is flat ("Yes" is circled for "Flat landscape" on the site card)
  - Upland depression — slope is 2 percent or less and surface is concave

▸ EVALUATING RULE
Dune

Dune has both of these characteristics:

- Parent material is eolian sand
- Slope is 3 percent or more. If the soil appears to be eolian sand parent material and has a slope less than 3 percent, it is likely outwash and lacustrine parent material and scored as upland swell, flat or depression, depending on the characteristics of the slope.

▸ EVALUATING RULE
Flood Plain

A **flood plain** has all of these characteristics:

- Parent material is alluvium
- Located low in the landscape
- Soil has weak development

> ▸ **EVALUATING RULE**
> **Filled Depression**
>
> A **filled depression** has all of these characteristics:
>
> - Parent material is local overwash that is 20 inches or more thick
> - Most nearby landforms are uplands or outwash landforms (not flood plains)
> - Soil has weak development

Soil Color

To determine a soil's color, compare a moist soil sample to a Munsell soil color chart and pick the chip on the page that matches best. All soil colors are in *three soil evaluation groups*: **gray**, **brown,** and **black**. Color designations in the Munsell Color System include determination of Hue (the page) value (how light or dark) and chroma (intensity of color). The Munsell Soil Color Charts are in a book that includes many pages of yellow to brown to red colors that covers soils of the world. In Illinois, we will use only the 10 YR page. Look at Figure 3. This concept of gray, brown and black is true for every page. Each color group contains many color chips on the 10 YR page.

While gray, brown, and black are specifically defined color groups, terms such as "light," "dark," "grayish," and "brownish" are relative. Brownish colors fall toward the right of the color chart; grayish colors to the left; light colors are to the top; dark colors are to the bottom.

COLOR GROUP OF SURFACE HORIZON

How you handle soil samples for evaluating color is important. To determine a surface horizon's color, moisten the soil (if it is dry). Then mix and mash the sample well before comparing the sample to the color chart. Record surface color results on the scorecard. The reason for mixing and mashing the surface horizon is to make sure that all the organic matter is thoroughly mixed with the mineral material to get the true color of the surface. You do not mark subsurface color on the scorecard, but you do use subsurface color to determine natural soil drainage.

> ▸ **EVALUATING RULE**
> **Determining Surface Color**
>
> Determine the **Surface soil color group** from the center of the surface horizon, unless the site card gives a specific depth. Crush (mix and mash) moist soil material between your fingers and compare it with the 10 YR Munsell soil color chart. Mark gray, brown, or black on the scorecard.

Some Illinois surface horizons have colors between 10YR 3/3 and 10YR 4/3. If the color is near this class boundary, or other boundaries, officials should provide the Munsell designation on the site card for the contestants.

COLOR OF SUBSOIL HORIZONS

An **aggregate** is a collection of many soil particles, and a ped is a soil structural unit that is composed of many aggregates that formed by natural processes. It breaks from the rest of the soil along natural surfaces. Peds separate from each other along natural planes of weakness. Peds separate easily from a soil profile.

In subsoils, the natural fabric of the sample is important, so do not mix and mash the sample. The **fabric** is the arrangement of peds and colors, like the colors of a shirt. Some shirts have a solid color and some are plaid. Select a ped that you can easily remove from the face of a soil pit, and cut through the ped with a knife or spatula. You will see that the color on the outside of the ped is often different from the inside. The outside color usually represents a *clay skin* or a *silt coat* (explained later).

The inside of the ped often consists of small areas of one color and small areas of another. Note these colors and determine which one is dominant. The dominant color of the fabric is the "matrix" color. In some pits, a face has been cut with a sharp spade, and this face shows the inside and outside of peds. In some cases, it may be necessary to hold the sample at a distance to determine if it is more gray or brown.

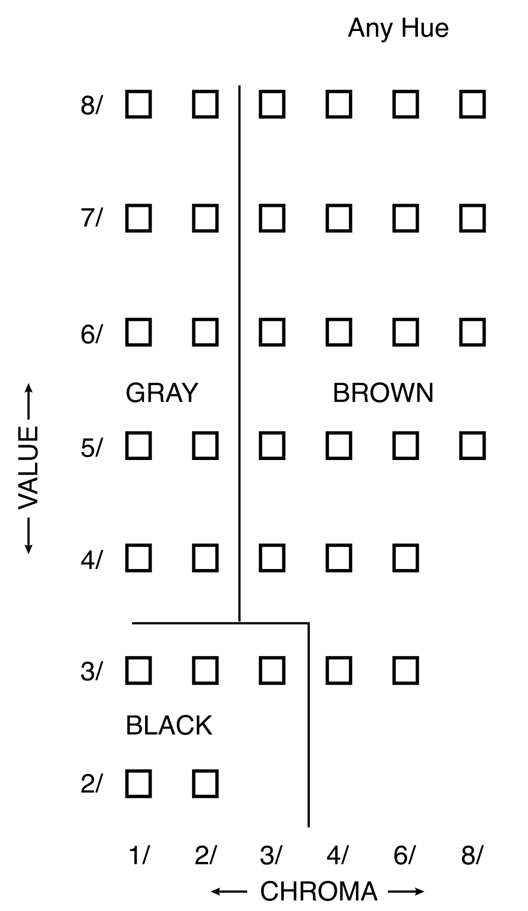


Figure 3. A sample Munsell color chart showing the definitions of soil evaluation color groups: gray, brown, and black. The grouping applies to all hues (pages in a color book). Munsell Color chart provided by X-Rite, Inc., munsell.com.

Previous Erosion

This section explains how soil scientists describe the amount of erosion that has already happened. This explanation is based on the kinds of soil horizons discussed above.

Before they were farmed, many Illinois soils had a dark-colored A horizon that varied in thickness from a few inches to a few feet. In areas formed under forests or mixed forest and grass, thinner A horizons usually had a light-colored E horizon just below the A horizon. Below the E horizon was a B horizon. In areas formed under prairie grass vegetation, the surface horizon was much thicker and darker and typically did not have the light-colored E horizon. These prairie soils had the dark surface directly overlying the B horizon.

Moldboard plowing mixed the upper horizons (A, E, or both) to create an **Ap horizon**. Where the original A horizon was thick, the Ap horizon was dark. Where the original A horizon was thin, the Ap horizon was either gray or brown.

In most soils, erosion removed some of the Ap horizon, so when the soil was plowed again, the plow cut into lower horizons, eventually reaching B horizons. Farmers plowed to about the same depth every year, often about 8 inches, so there was a clearly defined lower boundary of the Ap horizon.

As the use of moldboard plowing faded, the lower boundary of the Ap horizon became less distinct. If that is the case, the upper 8 inches is considered equivalent to the Ap horizon. As soil erosion continued, the Ap horizon included even more of B horizon soil. Meaning, *the more B horizon material and the less A and E horizon material in the A, the greater the amount of erosion*.

In many soil pits, soil scientists can observe the B horizon, but they cannot observe the original A and E horizons, because they have been lost by erosion or mixed with other horizons. We do know, however, that A and E horizons are more friable than B horizons and have less clay, so we equate “more friable material with less clay” with “A and E horizons.”

Friable soil is soil that crumbles easily. The guidelines below explain how to identify material in the Ap that is more friable than the B horizon just below the Ap.

Material that is more friable and more like topsoil has *some combination* of these traits when compared with the B horizon or subsoil:

- It crumbles more easily in your fingers
- It is darker in color (higher in organic matter)
- It provides less resistance when you poke it with a knife
- It contains more roots
- If the lower boundary of the Ap horizon is not distinct, consider the upper 8 inches to be the Ap horizon.

▸ EVALUATING RULE
Previous Erosion

Determine Previous erosion on your scorecard as follows:

- Examine top 8 inches of the soil. For soil plowed deeper than 8 inches, examine the entire plow layer
- If plow layer or top 8 inches of soil, whichever is deeper, is underlain by topsoil or a lighter color horizon, or it appears the site has never been plowed, mark previous erosion: None to Slight
- If the surface horizon is directly underlain by a B horizon or subsoil, then previous erosion depends on the percentage of topsoil material mixed in with the subsoil material in the plow layer or Ap horizon.
  - None to Slight – if plow layer or top 8 inches contains 76 to 100 percent topsoil
  - Moderate - if plow layer or top 8 inches contains 25 to 75 percent topsoil
  - Severe – if plow layer or top 8 inches contains 0 to 25 percent topsoil

Previous erosion may take on a range of different patterns. The pattern of topsoil material and subsoil material in the upper 8 inches can vary among sites. The upper part of the 8-inch zone can be composed almost entirely of topsoil material, while the lower part can be composed mostly of subsoil material (like the dark brown and white layers of a separated Oreo cookie). Or, the materials can be entirely mixed (like chocolate chips in a cookie — is the percentage of chocolate chips in the cookie more like none to slight, moderate or severe?) The estimate of erosion is based on how much of the original surface material is left with consideration of the amount of B horizon mixed in the surface layer.

Another clue that will help determine the amount of previous erosion is the depth to calcareous material on sloping sites. If this depth is much less than in other soils in the area, then the soil is likely to be severely eroded.

Soil scientists often have the opportunity to compare similar soils (one severely eroded, the other slightly eroded) and to think about the relative ability of the two soils to grow plants. This comparison will demonstrate the importance of using soil-conserving practices, as described in Chapter 2.

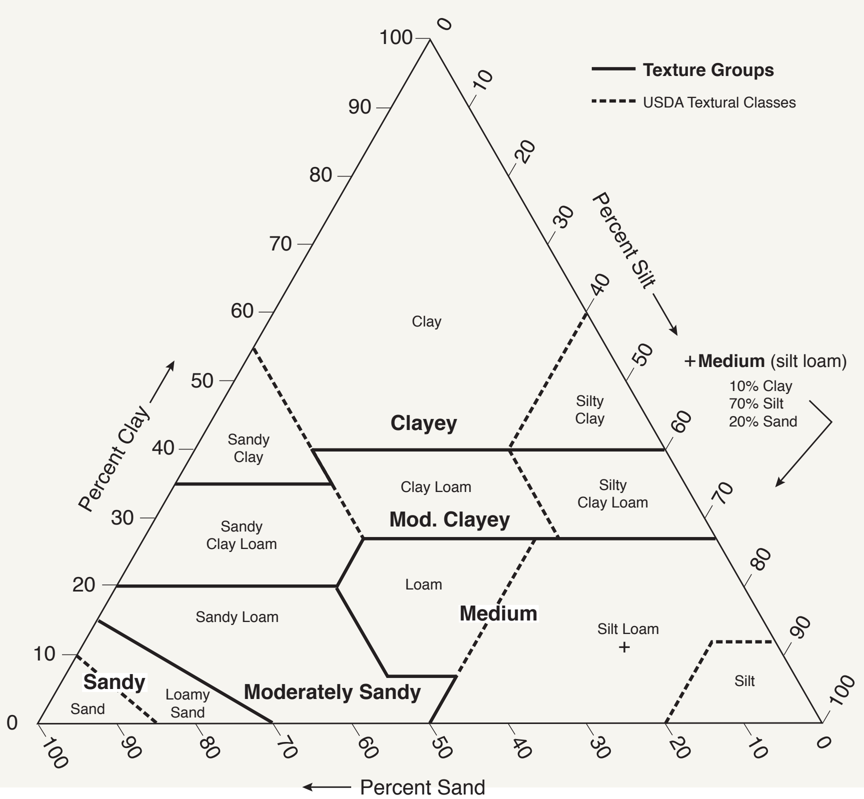


Figure 4. *This soil texture triangle shows texture classes (dashed lines) and soil evaluation texture groups (solid lines). A soil sample located at the + point on the triangle would be composed of 10 percent clay, 70 percent silt, and 20 percent sand. This soil falls in the medium texture group and the silt loam texture class.*

Soil Texture

Soil texture refers to the relative proportion of sand, silt, and clay in the soil. The texture triangle (Figure 4) shows the limits in the percentages of sand, silt, and clay for **texture classes** and **texture groups**. Specific classes (such as *silt loam*) are in lighter print. Soil evaluation groups of classes (such as *medium*) are in darker print.

Soils very high in clay are near the top of the texture triangle. Textures high in sand are in the lower-left corner, and soils high in silt are near the lower-right corner. Soils with relatively equal amounts of sand, silt, and clay are in the center of the triangle.

Texture is an important soil characteristic, because it determines or influences many other properties. Texture determines how fast water will run into or through a soil horizon, how much water the horizon will hold, and how easily the soil can be tilled. This, in turn, affects many agricultural and home site uses.

HOW TO DETERMINE TEXTURE

Estimate texture by working the soil with your hands, then feeling it with your thumb and fingers. Soils are often too dry for estimating texture, so you must moisten them first. You should carry a small water container to moisten samples — squirt-top plastic bottles are handy.

To estimate texture, take a heaping tablespoon of soil and mold it with your hand. While squeezing the soil, slowly add water until the sample mimics modeling clay and you can form it readily into different shapes.

When the sample is moist enough, squeeze it in your hand and observe the kind of cast it forms (Figure 5 A and B). Making a cast is especially helpful to identify sandy and moderately sandy textures. Soils that are finer than moderately sandy all make good casts. After you determine the kind of cast the sample makes, rub the soil between your thumb and forefinger and try to make a thin ribbon (Figure 5, C-F). Evaluate the strength of the cast, the length and rigidity of the ribbon, the smoothness and shininess of the rubbed soil ribbon, and the stickiness of the sample to determine soil texture.

Below, we describe the five basic texture groups used in soil judging. These descriptions will help you get started with determining soil textures. To develop your skills, you should work with samples of known textures and compare your results with those of experienced people or data.

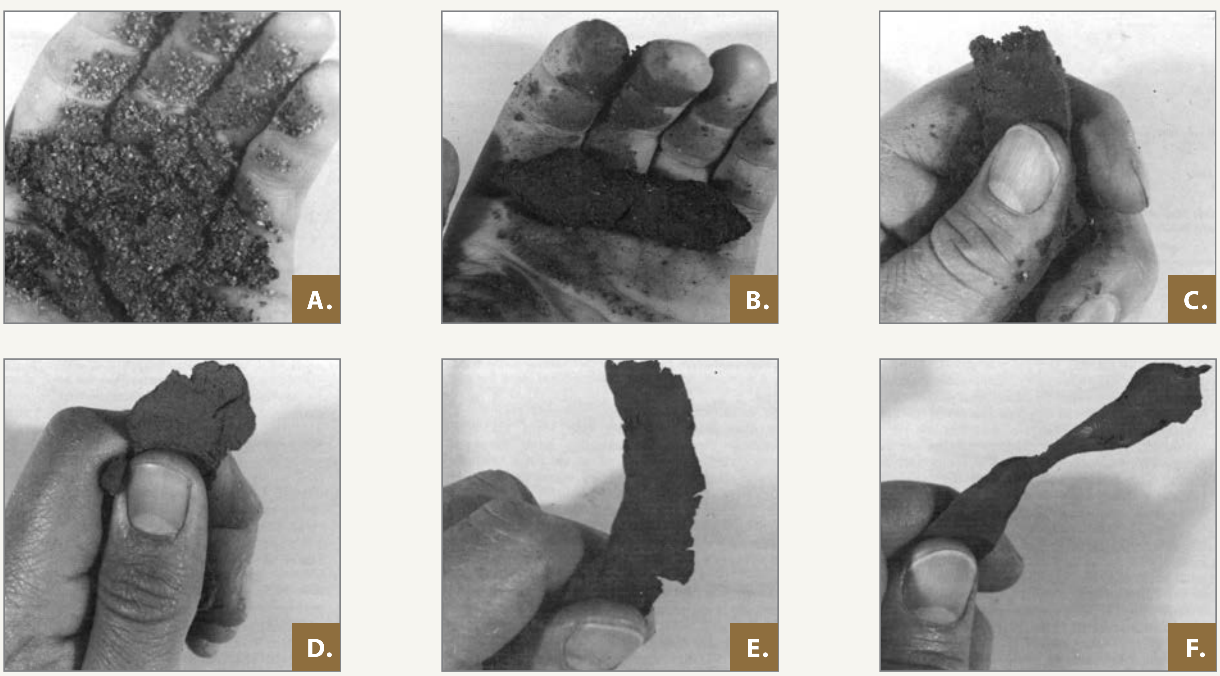


Figure 5. *The casts of different soil samples when you squeeze them in your hand to determine soil texture group. A: a sandy texture. B and C: moderately sandy. D: medium. E: moderately clayey. F. clayey.*

The **sandy** texture group includes the sand and loamy sand texture classes. Soil samples with a sandy texture do not stick together enough to form a cast (Figure 5A), or they form a weak cast that can fall apart with any but the most gentle handling. You cannot form sandy soils into a ribbon, and when you rub the surfaces, they appear very grainy. Sandy soils are not sticky.

The **moderately sandy** texture group is the same as the sandy loam class. Soil samples with a moderately sandy texture form a good cast (Figure 5B) and a weak ribbon (Figure 5C). When you rub the surfaces, samples appear grainy, but you can see the "glue" (silt and clay) that holds the sand grains together. Moderately sandy soils are not sticky.

The **medium** texture group includes the loam, silt loam, and silt classes. Soil samples with a medium texture form a good cast and a moderately weak ribbon (Figure 5D). The ribbon's strength varies from somewhat better than the ribbon shown in Figure 5C to somewhat weaker than the one shown in Figure 5E. In Illinois, many of the medium texture soils are silt loams or loams. Medium-textured soils are slightly sticky.

Moderately clayey (sandy clay loam, clay loam, and silty clay loam) soils form a fairly long ribbon because they contain moderately high amounts of clay (Figure 5E). The appearance varies from very smooth to very grainy. Moderately clayey soils are relatively sticky.

The **clayey** texture group includes the sandy clay, clay, and silty clay classes. The clay content of clayey soils varies considerably, but all clayey soils form a long ribbon that can be squeezed down very thinly and still support its own weight (Figure 5F). Rubbed surface samples usually appear very smooth and shiny or waxy, but could have some graininess. Clayey soils are very sticky.

▸ **EVALUATING RULE**
Surface Texture

For **Surface texture**, determine the texture group in the Ap horizon or the upper 8 inches of soil if the Ap is less than 8 inches thick.

▸ **EVALUATING RULE**
Subsoil Texture

For **Subsoil texture**, determine the texture of the finest layer (contains the most clay) exposed below the surface horizon.

If conditions warrant, officials may write the depth on the site card where students should sample to evaluate surface and/or subsoil texture. Alternatively, officials may put samples in a bucket or box outside the soil pit.

Natural Soil Drainage

LOCATION OF SOIL COLORS

To determine natural soil drainage, you must consider the colors of soil peds — both inside and on the surface. The inside of a ped can be seen if the ped is cut with a knife. It is also seen on the face of a soil pit that is shaved (not smeared) with a spade. The surface of a ped is seen when the profile surface is picked with a knife, and soil material falls away along natural breaks.

In the soil judging contest, remove a few peds from the wall of a pit (leave some of the peds intact to see the surfaces) and cut through some peds with a knife or spatula to observe the inside. When practicing for the contest, ask an experienced person to help examine ped interiors and ped surfaces. Estimate the percentages of gray material and brown material (Figure 3) that show on these inside exposures. This skill is an important one to develop.

Also, estimate the percentages of gray material and brown material on the clay skins if they are present. To do this, you must first distinguish clay skins from silt coats and carbonate coats on soil ped surfaces.

Clay skins coat peds like a layer of paint. They often have a somewhat shiny or waxy appearance. A clay skin can be in any of the three main color classes (gray, black, or brown), but it is usually different in color from the inside of the ped.

Silt coats and **carbonate coats** appear grainy or dusty, and they are usually light gray to white when dry on soils of all drainage classes. When water is sprayed on a thin, dry silt coat, the silt becomes practically invisible. Silt coats tend to be lighter in color (Munsell value 7 or 8) than clay skins, which are often darker gray or brownish (Munsell value 4 or 5).

Carbonate coats are calcareous, and usually coat large peds that are calcareous on the inside. Carbonate coats are typically found in dense till but may be found in lacustrine, outwash or thick loess near river bluffs.

In summary, clay skins appear to be painted on and waxy. They are usually dark gray or brownish when moist. On the other hand, silt coats and carbonate coats appear dusty or grainy. They are usually light gray when moist, and very light gray to white when dry.

SOIL DRAINAGE TERMINOLOGY

A soil that has definite brown masses and definite gray masses is called **mottled.** The brownish masses are called brown mottles, iron concentrations, or concentrations. The gray masses are called gray mottles, iron depletions, or depletions. The percentage of brown and gray mottles in a soil horizon must be determined and used with the drainage key (Figure 6). When determining the color of a subsoil horizon using the drainage key, consider the interior of peds and the clay skins on ped surfaces. Do not use the color of silt or carbonate coats.

▸ EVALUATING RULE
Natural Soil Drainage

Determine Natural soil drainage using the soil key (Figure 6). To use the soil key:

1. Measure the thickness of the surface horizon. If it is black and thicker than 10 inches, use the left side of the diagram; for all other conditions, use the right side.
2. Find the 6-inch zone (left side of diagram) or 8-inch zone (right side) to examine soil color closely.
3. Decide if the combined color of ped interiors and clay skins in that zone is predominantly gray or predominantly brown.

One coach summarized step three by asking students if the soil looked like a brown shirt with gray spots or a gray shirt with brown spots. If the zone used to determine drainage is not clear, contest officials should provide the natural soil drainage on the site card.

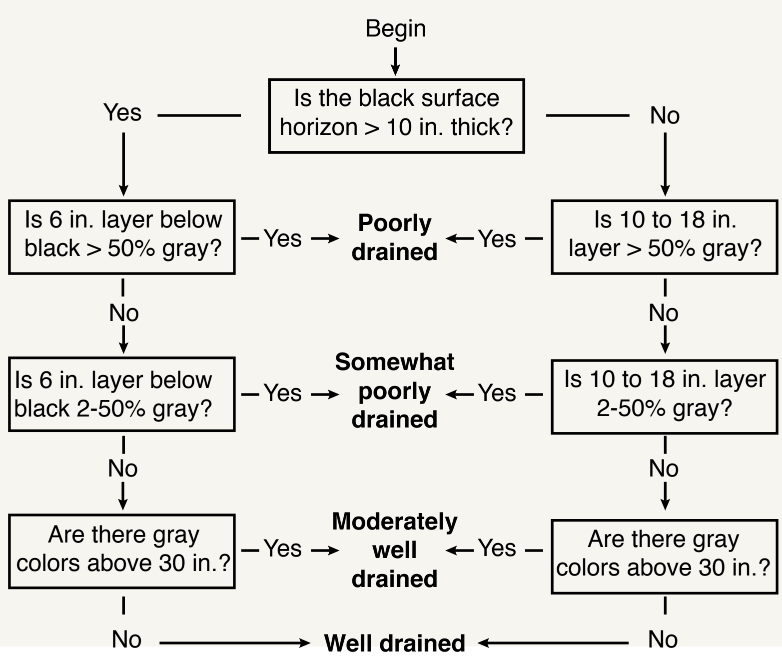


Figure 6. *This soil key is a flow diagram for determining natural soil drainage. See Figure 3 for the definition of black and gray soil evaluation color groups.*

Limiting Layers

Four kinds of limiting layers are recognized in soil judging:

- Bedrock
- Dense till
- Fragipan
- Coarse sand and gravel

To be a limiting layer, the layer must be more than 10 inches thick. If the layer or material meets the requirements below and extends to the bottom of the pit, assume it is more than 10 inches thick, and thus a limiting layer.

There are also three recognized depth zones to a limiting layer:

- 0 to 20 inches
- 21 to 40 inches
- More than 40 inches (or no limiting layer visible in soil pit)

The kind of limiting layer and the depth of the layer combine to make nine distinct soil evaluation classes, as shown on the scorecards.

Bedrock, dense till, and fragipans have little pore space, so they restrict root penetration and conduct water or sewage effluent very slowly. On the other hand, few roots grow into coarse sand and gravel, because there are big spaces between the particles and cannot hold much water. Also, coarse sand can conduct water and sewage effluent too quickly for adequate treatment.

The depth to a limiting layer is important because it determines how much soil material is available for plant roots. A shallow (thin) soil limits how much water the soil can hold for plant growth. For home sites, the depth to a limiting layer largely determines the kind of septic absorption field that is suitable for the site.

LIMITING LAYER: BEDROCK

Bedrock gradually weathers to become weathered bedrock parent material, and then continues to weather and deteriorate to become another kind of soil horizon. The evaluation rule below describes when rock material is hard enough and continuous enough to be a limiting layer.

> ▸ **EVALUATING RULE**
> **Bedrock Limiting Layer**
>
> Bedrock is a **limiting layer** if more than 80 percent of the layer is rock material that meets one or both of the following:
>
> - It cannot be dug with a spade or dug into with a knife
> - Roots cannot grow into it

LIMITING LAYER: DENSE TILL

The section about till as a parent material describes the characteristics of till. In Illinois, some tills are dense enough to be limiting and others are not.

For soil judging, however, all calcareous till is considered dense. Till that is not calcareous is not considered dense. The criteria used to identify till parent material are used to identify dense till with the understanding that dense till must be calcareous.

From a standpoint of land use, dense till limits the depth to which the roots of a crop can grow. In addition, dense till is very slowly permeable and affects the type of onsite system design recommended for home waste disposal.

> ▸ **EVALUATING RULE**
> **Dense Till Limiting Layer**
>
> **Dense till** has *all* of these characteristics:
>
> - Not all till is calcareous, but for this contest all calcareous till is considered to be dense till
> - Pebbles, if present, are mainly igneous, but in some areas there may be a mixture of underlying sedimentary rocks. They are mainly rounded, and randomly distributed, but pebbles crushed by glacial action are often present.
> - Not stratified/not layered — material is homogeneous (mixed)
> - May have platy structure from deposition and glacier weight or subsequent periglacial processes
> - Common texture and color combinations found in C horizons include:
>   - Medium texture (loam) and brownish colors (10YR 5/4, 5/6, 5/3), or
>   - Moderately clayey texture (clay loam, silty clay loam) and clayey textures (including silty clay and, rarely, clay) have colors near the brown/gray boundary (10YR 5/3, 5/4, 5/2)

LIMITING LAYER: FRAGIPANS

Fragipans are firm, brittle subsoil horizons through which water moves very slowly and roots cannot penetrate easily. A soil is brittle if a moist piece of soil (about ½ to 1 inch across) ruptures suddenly or pops when pinched between your thumb and forefinger.

Fragipans are usually medium or moderately clayey in texture and have textures that are typically silt loam, loam and silty clay loam. Where described, a fragipan's upper surface is 20 to 50 inches below the soil surface. A fragipan is typically 10 to 30 or more inches thick.

A fragipan's most recognizable characteristic is its overall appearance. Fragipans consist of large structural units called prisms, which are taller than wide. The outside face of a prism often has gray coatings that consist mainly of silt in the upper part of the fragipan and of silt and clay in the lower part. This gray material tapers like a funnel into the gray silty streaks that coat the peds. The interior of the prism is brownish mottled with gray colors. In poorly drained soils, the gray colors may be dominant. The interior material is firm and brittle when moist.

The prism coatings appear as gray vertical streaks in a soil profile. When viewed from the top, they form a polygonal pattern (something like a giraffe's hide or chicken wire, but with a less regular pattern). The prisms must be, on average, more than 4 inches across to be a fragipan. Roots grow readily down to the gray silt between the prisms, but few roots grow into the interior of the prisms. In soil judging pits, a horizontal shelf or surface through the prisms might be dug to better display the "giraffe" polygons.

Fragipan soils present special problems for farming because water cannot penetrate a fragipan very quickly, so spring rains waterlog the soil above the pan. During the growing season, roots cannot penetrate into fragipan prisms, so crop plants get very little water from fragipan horizons. In the winter, freeze-thaw cycles may heave plants with long taproots (like alfalfa) out of the soil.

▸ EVALUATING RULE
Fragipan Limiting Layer

A **Fragipan** limiting layer must have *all* of these characteristics:

- Prisms that, on average, are 4 inches or more wide, with silt coats between prisms
- The soil material inside the prisms is brittle
- The prisms contain few or no roots

LIMITING LAYER: COARSE SAND AND GRAVEL

Coarse sand and gravel is a limiting layer because it cannot supply much water to plants. Although fine sands have relatively high water-supplying abilities, the wide spaces between coarse sands hold very little water. Therefore, a limit based on sand size has been established between the sandy materials that restrict plant growth and those that do not. This limit is between the medium sands and the coarse sands.

In soil evaluation, "coarse sand and gravel" is defined as sandy material (defined in the *Texture* section) in which most of the sand particles are larger than 0.5 millimeter (the size of grains on 40-grit sandpaper). Most coarse sands also contain quite a bit of gravel, but some coarse sand does not.

Usually, if you moisten and squeeze a coarse sand, it will not form a cast, or if it does, the cast will not hold its shape when you gently toss it up and down in the air. Sandy materials that are not limiting layers include some water-deposited sandy materials and eolian sand deposits.

Thin bands of coarse sand and gravel are less of a limitation than thick deposits. Therefore, in soil evaluation, a layer of coarse sand and must be 10 or more inches thick to be considered a limiting layer. Coarse sand and gravel can be the lowest horizon in the soil pit, or it can be found between finer textured layers.

Coarse sand and gravel layers do not affect water availability if the water table is permanently within reach of the plant roots. However, most poorly and very poorly drained soils in Indiana have a fluctuating water table, which becomes low enough in summer to make the subsoil's water-holding capacity important. Therefore, in soil evaluation, coarse sand and gravel layers are considered limiting layers, regardless of drainage class.

▸ EVALUATING RULE
Coarse Sand and Gravel Limiting Layer

A **Coarse sand and gravel** limiting layer has *both* of these characteristics:

- Qualifies for the sandy texture group, and the sands are mainly > 0.5 mm in diameter (the size of 40-grit sandpaper)
- Gravel is usually present, but may be lacking

CHAPTER 2 - Agriculture Practices

In soil judging, a contestant first determines the soil properties and marks the answer on the left side of the scorecard. Then, the contestant will use the soil properties and follow rules to make interpretations about how to use the soil.

These judgments cover:

- Restoration of original vegetation
- Agricultural conservation and management

This chapter discusses both options — restoration of original vegetation, and agricultural conservation and management.

Land Use Overview

When European settlers first arrived in Illinois, much of the state was prairie on the large flat to gently sloping plains on uplands and terraces of large river floodplains, with some forests or mixed forest and prairie along narrow streams and in the uplands. Wetlands were in floodplains and in swales or depressions, glacial lake plains and flats on the uplands. Gradually, farmers cleared the forest, drained wetlands, and plowed the prairie, so very few of the original plant communities remain.

There are many woodland remnants, but most of them have had some trees removed or have been grazed. Hardly any native prairie remains. Lately, there has been significant interest in preserving remaining natural areas and converting farmland and other areas to original vegetation communities.

Restore Original Vegetation

If you recommend restoring original vegetation, then the vegetation should match the kind of vegetation that was present when settlers first cleared the land. Poorly drained soils were predominantly wetlands. Somewhat poorly drained, moderately well-drained, and well-drained soils with more than 10 inches of dark surface (black color group) should be restored to prairie. Other soils should be forest.

▶ **JUDGING RULE**
15. Restore Original Vegetation

For **Restore original vegetation** (15 on agriculture scorecard) select:

- **Wetland** if the soil is poorly drained
- **Prairie** if the soil is somewhat poorly drained, moderately well-drained or well-drained and has a black surface horizon that is more than 10 inches thick
- **Forest** if the soil does not qualify for wetland or prairie

If the area still has its original vegetation, interpret the rule as "Preserve" instead of "Restore" original vegetation.

Prime Farmland

Much of Illinois will continue to be farmed. The rest of this chapter deals with how best to farm the land while protecting the soil. In recent years, many have expressed concern about losing excellent farmland to nonagricultural uses such as highways, urban sprawl, apartments, shopping centers, industrial areas, and surface mines. To help local governments preserve soil for continued food production, the U.S. Department of Agriculture defines prime farmland as "land capable of producing good yields of adapted crops in most years." The USDA's definition relies on soil properties, many of which are evaluated in soil judging. Many local, state, and federal planning units consider prime farmland soil properties as a guide for identifying land that should remain agricultural rather than be used for urban development.

Soils that are frequently flooded, have low water-holding capacity (sandy, or shallow to a limiting layer), or are very erodible (usually on slopes steeper than 6 percent) are excluded from the definition of prime farmland.

▸ **JUDGING RULE**
16. Prime Farmland

Mark "Yes" for **Prime farmland** (16 on agriculture scorecard) if the soil has all of these properties:

- Subsoil texture is moderately sandy or finer
- More than 20 inches to a limiting layer of bedrock, fragipan or coarse sand and gravel
- Slope is 6 percent or less
- Landform is not a floodplain

Erosion and Compaction Potentials

Most Illinois soil will be used for agriculture and home sites. These uses can potentially harm the soil (on-site degradation) or pollute other areas (off-site degradation). Most sections of this chapter explain how to manage the soil for agriculture while minimizing both on-site and off-site degradation.

Erosion by Water

The potential for water erosion depends largely on the steepness and length of the hillslope. Steepness is important because runoff water carrying eroded soil particles moves down a steep slope faster than down a gradual slope. Slope length is important because the amount of runoff water increases in speed and amount the farther it travels down the hill. Slope steepness (percent) appears in several rules. Shallow soils need special care because losing even a little bit of a shallow soil will greatly affect its ability to grow plants.

▸ **JUDGING RULE**
17. High Potential for Water Erosion

Mark "Yes" for **High potential for water erosion** (17 on agriculture scorecard) if the soil has one of these properties:

- 20 inches or less to any limiting layer, and slope is more than 2 percent
- More than 20 inches to any limiting layer, and slope is more than 6 percent

Erosion by Wind

Eolian sand (as explained in the Parent Material section) is material picked up thousands of years ago by wind, carried by wind, and then deposited. Today, wind can pick up the same material in the process of wind erosion. Rule 18 identifies material readily transported by wind.

▸ **JUDGING RULE**
18. High Potential for Wind Erosion

Mark "Yes" for **High potential for wind erosion** (18 on agriculture scorecard) if the soil has a sandy or moderately sandy surface texture.

Soil Compaction

Wet soils can be compacted more readily than dry soils. Soil compaction is a significant problem in crop fields throughout Illinois. Sandy soils have few fine particles so they are not as compactable because they lack the mixture of particle sizes that leads to severe compaction.

▸ **JUDGING RULE**
19. High Potential for Soil Compaction

Mark "Yes" for **High potential for soil compaction** (19 on agriculture scorecard) if the soil has *both* of these properties:

- Natural drainage that is somewhat poor or poor
- Surface texture that is moderately sandy or finer

Buffers and Cover Crops

This section describes several farming practices that protect soil and water resources by maintaining vegetative cover. Such practices include conservation buffers and cover crops. These practices slow water runoff, trap sediment, and enhance water infiltration into the soil in the buffer. For soil contests, conservation practices are marked according to the rules below, even if the soil pit is not in a cropped field.

Grassed Waterways

Grassed waterways are strips of grass in cropland areas where water flow concentrates. Grassed waterways primarily prevent gully erosion, but when used with filter strips they help trap contaminants and sediment. Any sloping cropped fields with concentrated water flow benefit from grassed waterways.

> ▸ **JUDGING RULE**
> **20. Grassed Waterways**
>
> Mark "Yes" for Grassed waterways (20 on agriculture scorecard) if the slope is 3 to 18 percent.

Windbreaks

A windbreak is a row of trees, shrubs, or other vegetation used to reduce wind erosion, protect young crops, and control blowing snow. Windbreaks are placed near the field boundary that is perpendicular to the direction of the prevailing wind — since most prevailing winds come from the west in Illinois, most windbreaks are oriented north-south.

> ▸ **JUDGING RULE**
> **21. Windbreaks**
>
> Mark "Yes" for **Windbreaks** (21 on agriculture scorecard) if the surface texture is sandy or moderately sandy.

Filter Strips

Filter strips are long, narrow strips of dense vegetation (usually grass) planted between fields and waterways (such as streams, ditches, and drainage ways). Filter strips slow the flow of runoff from fields and trap sediment, nutrients, pesticides, and other pollutants before they reach surface waters. Filter strips also protect the soil from erosion.

Filter strips typically vary from 36 feet wide (on nearly level soils) to 117 feet wide (on sloping soils).

Filter strips are strategically established between a vulnerable waterbody and a source of sediment and runoff, such as a cropped field, along areas where water flows. These areas cannot be identified using properties determined in a soil pit. Soils on slopes more than 18 percent should not be cropped and thus do not need filter strips.

> ▸ **JUDGING RULE**
> **22. Consider Filter Strips**
>
> Mark "Yes" for **Consider filter strips** (22 on agriculture scorecard) for soils with slopes of 18 percent and less.

Cover Crops

A cover crop is grown between periods of regular crop production. Cover crops can prevent soil erosion and provide other environmental benefits by providing soil cover during the late fall, winter, and early spring. Cover crops can be grasses, legumes, or other crops. The more common cover crops include annual ryegrass, cereal rye, crimson clover, turnips, and oilseed radishes. Farmers typically seed cover crops into standing crops using high-clearance equipment or aerial seeding in late August or early September. Cover crops can be planted after harvesting the cash crop, such as corn or soybeans. Cover crops die (from cold) or are killed (with herbicides) before farmers plant the next summer crop.

Cover crops can be part of almost all tillage-management systems. Cover crops have many benefits, but their two main advantages are controlling erosion and taking up nitrogen and other nutrients before they leach through the soil into groundwater or to tile drainage water (the cover crop **scavenges** nitrogen).

Soil judgers should think about why cover crops are used. Erosion is more likely to occur on sloping soils. Scavenging is important on nearly level soils, and soils with coarse-textures where leaching is more likely to occur.

▶ **JUDGING RULE**
23. Cover Crops

Choose the most significant benefit of **Cover crops** (23 on agriculture scorecard) for this site by marking:

- **Scavenge nitrogen** if the soil has *either* of these properties:
  - Slope is 0-2 percent
  - Slope is 3-6 percent and the soil has a sandy subsoil or a coarse sand and gravel limiting layer
- **No need** if the slope is more than 18 percent (the soil is not tilled)
- **Erosion control** for all other soils

Cropping Systems

A cropping system refers to the kind of crops grown and their sequence over a period of several years. This section describes the kinds of cropping systems commonly used in Illinois. There is emphasis on how well these systems protect soil from erosion. The potential for soil erosion largely determines the kind of cropping system a farmer can use on a certain soil. Cropping systems closely relate to tillage practices. Timber stand improvement does not involve typical farm crops, but is listed with cropping systems.

Timber Stand Improvement (TSI)

TSI is a practice that improves the quality of a timber stand. Landowners allow the best trees in a stand to grow and remove other trees and vines that may hinder the growth of desirable trees. Harvested mature trees can be very profitable, and planting new trees can ensure that future generations will benefit from productive woodland.

▶ **JUDGING RULE**
24. Forestry with TSI

Mark "Yes" for **Forestry with TSI** (24 on agriculture scorecard) for all soils.

Permanent Pasture

Permanent pasture is perennial vegetation used year after year for grazing rather than for harvesting hay. A limit of 25 percent slope is used because reseeding of permanent pasture on steeper slopes has safety concerns.

▶ **JUDGING RULE**
25. Permanent Pasture

Mark "Yes" for **Permanent pasture** (25 on agriculture scorecard) for soils with slopes 25 of percent or less

Crop Rotation

Crop rotation refers to growing a sequence of different crops in a field, in contrast to continuously growing the same crop year after year. The main row crops in Illinois are corn and soybeans. Farmers often grow them in a rotation with each other.

There are many possible combinations of crops and the length of time they are grown in a crop rotation. The rotation assumed for Rule 26 provides almost continuous cover and protects the soil from erosion on slopes as steep as 18 percent. In the following discussion:

- **Forage crops** include perennial crops grown in a rotation for animal feed as hay or pasture.
- **Cover crops** fill in between periods of regular crop production, such as corn and soybeans (page 25).
- **Small grains** refer to a variety of crops. Winter wheat is the most common small grain crop in Illinois, but oats and barley are also grown.

An example rotation can be designated C-S-G-F-F-F, a six-year cycle, — where C = corn, S = soybean, G = small grain (wheat), and F = forage crop. In year one, farmers plant corn in the forage crop residue.

In year two, they plant soybean in corn residue. After soybean harvest, they plant wheat for year three. After harvesting the wheat, establish the forage crop. An example is a grass-legume mixture, which remains in place for three years. Many different rotations are available.

> **JUDGING RULE**
> **26. Crop Rotation**
>
> Mark "Yes" for **Crop rotation** (26 on agriculture scorecard) for soils with slopes of 18 percent or less.

Tillage Systems

Tillage is what farmers do to prepare land for planting. Depending on the cropping system, farmers may till the soil every year, or they may never completely till it. The more tillage used on a field, the more subject it is to erosion and compaction.

Conservation Tillage

Conservation tillage includes all tillage systems that leave at least 30 percent of the soil surface covered with live plants or crop residue at planting time. It includes no-till and strip-till. Conservation tillage has become more popular because manufacturers developed new herbicides that control weeds without plowing, and planters have been developed that can drill or slice through heavy residue cover. Controlling erosion by leaving crop residue on the surface is one of the chief benefits of conservation tillage systems.

No-till

In no-till planting, farmers plant the crop in soil that has a residue cover. The residue may be left from a previous row crop (such as soybeans or corn) or from vegetation that was recently killed with herbicides (such as a cover crop).

No-till double cropping is the practice of planting soybeans into small grain stubble immediately after harvesting the small grain crop (usually in late June). No-till planting saves fuel because it requires fewer tillage trips over the land.

STRIP-TILL

Strip-till planting is similar to no-till except that farmers clear residue from a narrow strip. They then till the strip and plant seeds in it. Usually, farmers just push the residue out of the row, leaving the same amount of total residue, but some could be buried in the operation. Strip-till has the same soil requirements as no-till and is considered the same as no-till for soil contests.

> **JUDGING RULE**
> **27. No-till**
>
> Mark "Yes" for **No-till** (27 on agriculture scorecard) for soils that have both of these properties:
>
> - 6 percent or less slope, **and**
> - Either:
>   - Well-drained or moderately well drained soils with any surface texture, **or**
>   - Poorly or somewhat poorly drained soils with moderately clayey or coarser surface texture.

Moldboard or Chisel Plowing

For years, the standard tillage method was to turn under crop residues with a moldboard plow, and then till the soil to a shallow depth with a disc harrow or other implement to prepare the seedbed. Eventually, chisel plowing, which disturbs the soil less than moldboard plowing, became more popular.

> **JUDGING RULE**
> **28. Chisel or Moldboard Plowing**
>
> Mark "Yes" **Chisel or moldboard plowing** (28 on agriculture scorecard) for soils with *all* of these properties:
>
> - Slope is 2 percent or less
> - Medium or finer surface texture
> - Poorly or somewhat poorly drained

Tillage Rules for Cover Crops

The rules above assume that cover crops *are not* used. If cover crops are used, a practice may be suitable on slopes greater than those allowed by the rule. For example, no-till might be appropriate on slopes steeper than 6 percent. Making these kinds of recommendations, however, are beyond the scope of soil contests.

Notice that soils on steep slopes have fewer options for tillage and cropping. Soils on gradual slopes have more options.

Water Management

Managing water is a critical component of farm operations. Soil judging contestants decide if it is feasible to:

- Drain wet soils
- Irrigate droughty soils
- Install structures that control water flow and soil erosion

Drainage

Plants must have water and oxygen in their root zones if they are to thrive. Poorly drained and somewhat poorly drained soils have so much water that there is little available oxygen in the root zone, essentially suffocating the plant. Before one can use wet soils for efficient crop production, the water must be removed to allow room in the pore spaces for air.

Systems that remove excess water from the soil surface and within the soil may be called *man-made drainage* or *artificial drainage* (in contrast with *natural drainage* described on page 18). In this section, all artificial systems are referred to simply as drainage. Drainage allows for timely field operations and helps crops get an early start. Another benefit of drainage is it decreases ponding in swales (low areas). In un-drained fields, water may pond in low areas long enough to kill or greatly harm crop plants.

Three drainage practices are commonly used in Illinois:

- Surface drainage, which involves grading the field to facilitate the movement of surface water off the field
- Subsurface drainage, which removes subsoil water through open ditches
- Subsurface drainage, which removes surface and subsoil water through drain (tile) lines

Current federal programs discourage draining wetlands for crop production — draining them could lead to losing federal benefits. The rule used in soil judging assumes some type of drainage has already been installed in the field.

Usually somewhat poorly drained and poorly drained soils respond to artificial drainage, so check "Yes" for drainage on these soils. The exception is somewhat poorly and poorly drained soils on flood plains. Some of these soils could benefit from drainage, but many have flooding problems that make drainage impractical.

▸ **JUDGING RULE**
29. Drainage

Mark "Yes" for **drainage** (29 on agriculture scorecard) if the soil has *both* of these characteristics:

- Natural drainage is poor or somewhat poor
- Landform is not a flood plain

Irrigation

Irrigation involves adding water to soils to help produce crops. Whether crop irrigation will be beneficial usually depends on the soil properties, crop types, the farmer's management skills, and the weather during the growing season.

Soils that hold very little water in the profile, such as sandy soils and shallow soils, will respond well to irrigation. The most common irrigation systems in Illinois are center pivot systems, travelling sprinkler systems, and sub-irrigation.

Center pivot water systems spray water from sprinklers along a horizontal pipe that rotates around a pivot at one end of the pipe. The water supply comes through the pivot from streams or a well. Wheels support the pipe as it rotates. Electric motors, gasoline, or diesel engines usually drive the unit.

Travelling sprinkler systems use a large sprinkler (big gun) that is attached to a flexible hose and rotates 360 degrees. The sprinkler is mounted on a cart that moves in a straight path through a field.

Sub-irrigation systems supply water underground. In sandy soils these systems can be combined with open ditch drainage. During the wettest part of the year, the ditches remove water from the field. When plants begin to use water, farmers block the flow of water in the ditches. During drought, farmers can pump water from streams into the ditches. In finer textured soils, farmers adjust the water level using control boxes in drainage (tile) lines.

▸ **JUDGING RULE**
30. Irrigation

Mark "Yes" for **irrigation** (30 on agriculture scorecard) if the soil has *both* sets of properties:

- Slope is 6 percent or less, **and**
- Either:
  - Subsoil is sandy or moderately sandy, **or**
  - Soil has a coarse sand and gravel limiting layer within 40 inches of the surface

Terraces

A **terrace** is an embankment or ridge constructed on sloping landscapes on the contour or at a slight angle to the contour. A terrace slows surface runoff so it can soak into the soil or flow slowly through a grass waterway or a tile outlet.

A terrace system breaks a long slope into shorter segments, which reduces soil erosion. Terraces are constructed parallel to each other and to the direction of field operations. You can minimize interfering with farming operations if you space the terraces so they are multiple widths of the planting and harvesting equipment.

Soil contests consider three kinds of terraces:

- Water and sediment control basins (WASCOBS) — these are more common in Illinois
- Graded terraces that are with the slope of the field and have variable spacing between terraces
- Parallel tile outlet (PTO) terraces

▸ **JUDGING RULE**
31. Terraces

Mark "Yes" for **Terraces** (31 on agriculture scorecard) if the soil has *all* of these properties:

- Well-drained, moderately well-drained, or somewhat poorly drained
- More than 40 inches to any limiting layer
- Slope is 3 to 12 percent
- Subsoil texture is medium or finer

Plant Nutrient Application

Most Illinois farmers use chemical fertilizers, and many use manure. When used properly, these fertilizing materials promote productivity and do little harm to the environment. In fact, high-technology agriculture might enhance the environment — if cropland is more productive, less land is needed to produce food. Using less land leaves more land for natural areas.

In soil competitions, judgers consider nitrogen (N), phosphorus (P), and potassium (K). They also consider lime, which is used to reduce soil acidity and to supply the nutrient calcium (Ca).

Nitrogen (N)

N application rate recommendations are based on soil yield potential, crop price, and cost of N fertilizer. Soil contest rules place all soils into three yield potential classes.

▸ **JUDGING RULE**
32. Nitrogen (N)

There are three application rates for **nitrogen (N)** (32 on agriculture scorecard). Select:

- **High** if the soil has *all* of these properties:
  - More than 40 inches to any limiting layer
  - Subsoil and surface soil textures are medium or moderately clayey
  - Poorly drained or somewhat poorly drained
  - Surface color is black
- **Medium** for other soils that have *all* of these properties:
  - More than 20 inches to any limiting layer
  - Subsoil and surface soil textures are moderately sandy or finer
  - Slope is 12 percent or less
- **Low** (or no nitrogen) for all other soils

Phosphorus (P) and Potassium (K)

P and K application recommendations are based on laboratory tests that determine the amount of available P and K in the soil. Soil testing laboratories report these levels in units of parts per million (ppm). For example, a test result of 1 ppm K means that the soil has 1 pound of available K in 1 million pounds of soil. In some cases, results are reported in units of pounds per acre in place of ppm. When that happens, the pounds per acre is double the ppm: thus, 1 ppm equals 2 pounds per acre.

▸ **JUDGING RULE**
33. Phosphorus (P)

Three application rates are used for **phosphorus (P)** (33 on agriculture scorecard). Select:

- Apply for buildup and maintenance if available P is less than 40 lbs/A
- Apply for maintenance only if available P is between 40-65 lbs/A
- Do not apply if available P is greater than 65 lbs/A

▸ **JUDGING RULE**
34. Potassium (K)

Three application rates are used for **Potassium (K)** (34 on agriculture scorecard). Select:

- Apply for buildup and maintenance if available K is less than 300 lbs/A
- Apply for maintenance if available K is 300-400 lbs/A
- Do not apply if available K is greater than 400 lbs/

Lime

Lime application has two main functions — it supplies calcium (Ca) and often magnesium (Mg), which are essential for plant growth, and it combats soil acidity. For soil contests, lime rate recommendations depend on soil acidity.

▸ **JUDGING RULE**
35. Lime

There are two application rates for **lime** (35 on agriculture scorecard). Select:

- Add if the soil pH is 6.2 or lower as noted on the site card
- None if the soil is higher than 6.2

Nutrient Pollution Potential

In some cases, farmers can apply too much of a nutrient, which can cause problems on and off the farm. Nutrients can move off the farm in both the solid phase and the liquid phase.

In the solid phase, nutrients move with soil particles as they are eroded from soils. Later, these nutrients move from the soil particles into the surrounding water.

In the liquid phase, dissolved nutrients can run off the soil and into surface water or leach through soils into the surface water and/or ground water. Reducing soil erosion and applying nutrients at proper rates reduce the potential for harming the environment.

Nitrogen Pollution

Nitrogen is one nutrient that especially tends to move down through the soil, into drain lines, and then into surface waters such as ditches, creeks, and rivers. Excess N (as nitrate) in water can make people ill and can even be fatal to babies.

> ▶ **JUDGING RULE**
> **36. Nitrogen (N) Pollution Potential**
>
> There are three possible ratings for **nitrogen pollution potential** (36 on agriculture scorecard):
>
> - **High for groundwater** if the soil has both of these properties:
>   - A sandy subsoil and/or a coarse sand and gravel limiting layer
>   - Soil is moderately well-drained or well-drained
> - **High for surface water** if the soil has both of these properties:
>   - Soil is poorly drained or somewhat poorly drained
>   - Soil is not on a flood plain
> - **Medium** for other soils

Phosphorus Pollution

Too much P causes excessive growth of algae in surface waters, resulting in an algal bloom. The algae can produce toxins (poisons) that get into drinking water, forcing people to drink bottled water until the water supply is cleaned up.

The algal toxins can also kill fish both directly and indirectly. Indirect fish kills are caused when algae covers the water's surface enough to prevent light from reaching the plants that grow in the water. These plants die from lack of light, and the organisms that decompose the plants use up all the oxygen in the water.

When soil fertility levels are too high, nutrients can lowered in the soil by removing/harvesting grain, hay, or other plant material from the field. Forage crops such as alfalfa remove large amounts of P and K.

> ▶ **JUDGING RULE**
> **37. Phosphorus (P) Pollution Potential**
>
> There are three possible ratings for **phosphorus pollution potential** (37 on agriculture scorecard):
>
> - **High** for soils on slopes steeper than 12 percent.
> - **Medium** for all soils on:
>   - 7-12 percent slopes
>   - 3 to 6 percent slopes in which the surface texture is medium or moderately clayey
> - **Low** for other soils

CHAPTER 3 - Home Site Practices

This section has three main parts:

- Site selection and construction practices
- Landscape and lawn practices
- On-site sewage disposal practices

Two key questions that direct the flow of soil judging are:

- Are the soils suitable for a home site?
- Are the soils suitable for a soil absorption field?

If the answer to either of these questions is "No," the judging process is short, but the determination requires great care.

> **JUDGING RULE**
> **14. Is the Soil Suitable for a Home Site?**
>
> **Is the Soil Suitable for a Home Site? Mark**:
>
> **"No" if the landform is a flood plain or a filled depression**. If you mark "No" here, then mark all subsequent home site practices "No," or "No application," or "N/A."
>
> **"Yes" if the landform is not a flood plain or filled depression** —proceed to judging rule 15.

Site Selection and Construction Practices

Sites that are subject to flooding and severe ponding are not suitable home sites. Flooding refers to areas that get covered with water from a stream. Ponding refers to areas where the water comes from nearby higher areas.

Newscasts abound with reports of houses sitting in water. Many of those houses were built on flood plains, and the flooding tragedy could have been avoided if the original builder had heeded the advice in this section.

Depressions on uplands and terraces are subject to ponding. Builders can compensate for minor ponding problems. If a depression has more than 20 inches of recent sediment over the original soil, however, the area has major problems and should not be used for a home site.

Construction Practices and Rules

Preserve and Plant Trees

Trees on home sites provide a range of environmental, social, and economic benefits that improve the quality of life. Healthy trees increase in value with age and pay big dividends by cleaning air, purifying water, reducing energy costs, and beautifying communities.

Because older trees provide more benefits, it is especially important to preserve existing trees. Most tree roots are in the upper 12 inches of the soil, so compaction caused by heavy equipment can damage them. The main area of concern is inside a tree's dripline, or the area directly under the outermost leaves of the tree. If there is construction activity on a home site, you should erect a fence around the dripline of every tree to keep out all activity.

All potential home sites that do not have trees will benefit from planting new trees, and most sites with a few trees will benefit from planting more. However, you must consider the site conditions when selecting tree species. For example, you should plant only small trees under power lines.

> ▶ **JUDGING RULE**
> **15. Preserve Existing Trees and Plant New Ones**
>
> Mark "Yes" for Preserve existing trees and plant new ones for all sites.

Stockpile Topsoil

Surface soil horizons (topsoil) provide a better medium for lawns and gardens than subsurface horizons. For this reason, after workers have protected all trees on a site, they should remove and stockpile all the topsoil on a home site.

Construction activities mix and compact the deeper soil horizons and parent materials. After construction is complete and the site has been graded to establish surface drainage, spread the stockpiled topsoil on the surface with as little compaction as possible.

Maintain Soil Cover During Construction

Construction on all sites (especially sloping sites) should try not to disturb existing vegetation. If workers must remove any vegetation, they should plant new vegetation as soon as possible to reduce erosion and off-site damage from eroded sediment. If a construction site will not be active for more than 45 days, sow seeds of a suitable grass species.

> ▶ **JUDGING RULE**
> **16. Maintain Soil Cover During Construction**
>
> Mark "Yes" for Maintain soil cover during construction if the slope is greater than 2 percent

Improve Surface Drainage

Good surface drainage is important, and in Illinois, surface drainage often needs to be improved. The state's flat and gently sloping topography has very slow surface drainage and is dominated by poorly drained and somewhat poorly drained soils. Poorly drained soils are often in depressions, and are frequently ponded.

Surface water should be channeled away from a house and on-site sewage system absorption fields. If surface water is not channeled away, it will make a high water table problem even worse.

> ▶ **JUDGING RULE**
> **17. Improve Surface Drainage**
>
> Mark "Yes" for Improve surface drainage if the soil has both of these properties:
>
> - Poorly drained or somewhat poorly drained soils
> - Slope is 0-2 percent

Suitability of Soil for Basement

Many people want basements under their houses, but some soil properties limit basements and are very difficult and expensive to overcome.

Soil properties that limit basements include:

- High water tables. Well-drained soils have a low water table and have few drainage limitations. Foundation drainage can alleviate some high water table limitations.
- Excavation problems. Bedrock is very difficult to dig.
- Steep slopes. Buildings on very steep slopes may slip downslope if not built properly.
- Swelling clays. Some kinds of clay swell when they get wet. This swelling can exert so much pressure on basement walls that they crack and buckle. Swelling clays also cause problems for on-site sewage disposal systems.

> ▶ **JUDGING RULE**
> **18. Is the Soil Suitable for a Basement?**
>
> Mark Is the soil suitable for a basement? "Yes" if the soil has all of these properties:
>
> - Soil is well-drained
> - No bedrock closer than 40 inches from the soil surface
> - Slope is 12 percent or less

Design for High-clay Subsoils

Soils with high clay contents cause special construction problems for houses. In soils with coarser textures, the friction between large particles (sand and gravel) support the weight of the structure. Clayey soils lose strength rapidly as they take up moisture. Clay particles have layers of water between them and slide easily over each other. For this reason, it is important to increase the size (width and depth) of footings on clayey subsoils.

Also, many fine-textured soils expand when they are wet and shrink when dry. If workers backfill the excavated area around basement walls with soil material, a space will develop between the wall and the soil as the soil dries out and shrinks. Soil material might fall into this space, and when the soil becomes wet again, it will swell. The added soil material will press into the building's foundation wall and could cause it to crack. Backfill the excavated area around basement walls with pea gravel to minimize swelling pressure.

> ▶ **JUDGING RULE**
> **19. Design for High-clay Subsoils**
>
> Mark "Yes" for Design for high-clay subsoils if the subsoil texture is clayey.

Potential Construction Hazards on Slopes

Soils on steep slopes cause some special problems for equipment operations. There is a great rollover hazard on slopes greater than 12 percent for both construction equipment as well as lawn maintenance equipment. Great care must be exercised when operating equipment on steep slopes. Homeowners should be aware of these problems when planning and building houses, and should discuss them with builders and contractors.

> ▶ **JUDGING RULE**
> **20. Potential Construction Hazards on Slopes**
>
> Mark "Yes" for Potential construction hazards on slopes if the slope is greater than 12 percent.

Install Diversion Structures and Interceptor Drains

To avoid soggy areas around the house and to avoid wet basements, builders must make provisions to divert surface and subsurface water away from a building. If a house is built on sloping land, the lot may receive runoff from the land above it.

Construction crews can build diversion structures that direct surface runoff away from the lot. In some soils, water also moves downslope within the soil profile. This subsurface water flow can result in wet basements or cause on-site sewage systems to fail. To intercept and divert subsurface seepage water away from the area, workers can install subsurface drain pipes called diversion drains.

> ▶ **JUDGING RULE**
> **21. Install Diversion Structures and Drains**
>
> Mark "Yes" for Install diversion structures and drains if the soil has both of these properties:
>
> Slope is greater than 2 percent
>
> Either:
>
> There is a bedrock, dense till, or fragipan limiting layer closer than 40 inches to the soil surface
>
> Subsoil texture is moderately clayey or clayey

Provide Foundation Drainage

Foundations are poured onto soils, so builders must consider soil properties when they design any building. Installing footing drains will remove subsurface water from around the base of the foundation and from underneath the basement floor.

Footing drains are made typically from plastic tubes with holes in them that workers lay next to the footings while they are building a foundation. These tubes remove water from outside the basement walls and reduce water pressure on the basement walls and floor. If a gravity outlet is not available for the footing drains or sub-floor drains, then a sump pump is needed to remove the water.

> **JUDGING RULE**
> **22. Provide Foundation Drainage**
>
> Mark "YES" for Provide Foundation Drainage for soils with these properties:
>
> - MWD, SWP, or PD, regardless of other properties or
> - WD soils that do NOT have:
>   - Sandy subsoil texture and/or
>   - Coarse sand and gravel limiting layer < 40" from the soil surface

High Risk for Cave-in During Construction

All excavations have a potential to cave in, but sandy and poorly drained soils are especially vulnerable.

> **JUDGING RULE**
> **23. High Risk for Cave-in During Construction**
>
> MARK "YES" FOR SOILS THAT HAVE ONE OR BOTH PROPERTIES:
>
> - Parent material is Eolian sand, Outwash/ Lacustrine, or Alluvium, and/or
> - Any Poorly Drained soil, regardless of landform

Landscape and Lawn Practices

Plants thrive best when they are well-suited to the soil they grow in. Once established, turf and landscape plantings need continued care, particularly fertilization. This section explains how soils are important in lawn and landscaping practices. The practices considered for soil contests involve soil acidity and the nutrient elements: nitrogen (N), phosphorus (P), potassium (K), and calcium (Ca).

Manage Soil Reaction

Some landscaping plant species (such as azaleas and rhododendrons) require very acidic (low pH) soils. Homeowners can lower soil pH in some soils by adding sulfur (S) or aluminum sulfate. For other soils, however, it is so difficult to lower the pH that it is more practical to plant species that tolerate higher pH conditions better.

> **JUDGING RULE**
> **24. Manage Soil Reaction for Acid-loving Shrubs**
>
> Mark Manage soil reaction for acid-loving shrubs:
>
> - No application if the soil pH is 5.6 or less
> - Apply sulfur if the pH is 5.7 to 7.9
> - Plant other species if the pH is 8.0 or more

> **JUDGING RULE**
> **25. Manage Soil Reaction for Lawns**
>
> Mark Manage soil reaction for lawns:
>
> - Apply lime if the pH is 5.9 or less
> - No application if the pH is 6.0 to 7.5
> - Plant other species if the pH is 7.6 or greater

Manage Soil Fertility

Lawns are fertilized mainly with N, P, and K. N application rates are based on the level of management the homeowner wants to provide. If they wish to have very green and lush lawns, they should apply high N rates. Application rates for P and K are based on soil test results, which are reported in units of Pounds per Acre (lb/A). If the soil is very acidic, apply lime to raise soil pH and supply calcium (Ca). If the soil has a high pH, choose turf species that are adapted to alkaline conditions.

P and K fertilizer recommendations are available in Turfgrass Management: Establishing a Lawn from Sod (Purdue Extension publication AY-28-W), available from the Education Store, www.edustore.purdue.edu.

> **JUDGING RULE**
> **26. Apply Phosphorus (P) to Lawn**
>
> Mark "Yes" for Apply phosphorus (P) to lawn if available P is less than 50 lb/A

> **JUDGING RULE**
> **27. Apply Potassium (K) to Lawn**
>
> Mark "Yes" for Apply potassium (K) to lawn if available K is less than 150 lb/acre

On-site Sewage Disposal and Suitability

Sewage is liquid waste generated as part of normal living. It comes from toilets, bathtubs, showers, sinks, washing machines, dishwashers, and other sources. In cities and towns, water is piped to homes through a water system, and sewage flows through sewer lines to a central treatment plant. Home sites that are not served by centralized water and sewer systems usually draw water from wells and treat sewage with on-site sewage disposal systems, which process sewage on the site where it is produced.

All on-site sewage disposal systems have two main parts:

- A septic tank, which processes the sewage and produces effluent
- A soil absorption field, which allows the soil to absorb and further treat the effluent

To save time and effort, check if the site is suitable for any kind of system.

Soil Suitability for Soil Absorption Fields

Some soils are not suitable for soil absorption fields.

> **JUDGING RULE**
> **28. Is the Soil Suitable for an Absorption Field?**
>
> Mark "No" for Is the soil suitable for an absorption field? if the soil has one or more of these properties:
>
> - Limiting layer of bedrock, fragipan, sand and gravel, or dense till closer than 20 inches to the surface
> - Slope greater than 25 percent
> - Landform is an upland depression
>
> If you mark "No", mark all on-site practices (29-36) "No" or "N/A"
>
> Mark "Yes" if the soil has none of the properties, and continue to judging rule 29
>
> If you mark "No" for this item, a house may be built on this site only if it is served by a centralized sewer system.

Septic Tank Care Practices

A septic tank is a large, watertight tank in which anaerobic (without oxygen) microbes break down sewage. Most septic tanks for single-family homes hold 1,000 to 2,000 gallons. Three layers form in septic tanks:

- Liquid effluent. Most sewage becomes liquid effluent. Eventually, effluent flows out of the septic tank through an outlet to the soil absorption field.
- Scum. Anaerobic organisms do not break down sewage completely. Some of the remaining material floats on the effluent as scum, which accumulates near the top of the tank until it is pumped out. Scum is composed mainly of fats, oils, and greases (FOG).
- Sludge. Other material not broken down by anaerobes is heavy. It sinks to the bottom of the tank as sludge and remains there until it is pumped out.

Septic Tank Care: Outlet Filter

A septic tank may have an outlet filter installed to remove the solid material that does not break down (toothpicks, hair, foil, etc.). An outlet filter is not presently required in Illinois but would be helpful to extend the life of an on-site sewage system. The filter requires periodic cleaning. The time intervals between cleanings vary based on the occupants' lifestyle choices.

Septic Tank Care: Tank Pumping

Homeowners must have scum and sludge removed from the septic tank periodically to keep the system from failing. To clean a septic tank, all scum and sludge are removed along with the entire contents. The time between tank cleanings:

- Increases with larger septic tanks — larger tanks store more sludge and scum
- Decreases if the house has a garbage disposal — much ground-up garbage from the disposal does not digest quickly, or ever, and settles out as sludge
- Decreases with more residents — each resident contributes to the accumulation of sludge and scum

Rule 29 uses this equation to calculate Pumping Interval.

$$PI = \frac{(D) \times G \text{ (Septic Tank Capacity in gallons)}/1000}{R \text{ (\# residents living in home)}}$$

JUDGING RULE

29. Septic Tank Pumping Interval

Calculate the Septic tank pumping interval using this equation:

Where:

PI = Pumping Interval (in years)

D = 7 if garbage disposal is checked "Yes" on site card

D = 10 if garbage disposal is checked "No"

G = Septic tank capacity (in gallons)

R = Number of residents in the house

Select the closest answer on the scorecard

Round your answer to the nearest whole number, and round 0.5 down to be conservative (e.g., round 3.5 years down to 3). If your calculation is 5 or more years, choose 5 years on the scorecard.

Here are some example calculations using the equation:

Example 1. Five people live in a house with a 1,000-gallon septic tank and a garbage disposal. Therefore, D = 7, G = 1,000, and R = 5.
Round to 1 year, "A" on the score card.

Example 2. Three people live in a house with a 1,500-gallon septic tank and no garbage disposal. Therefore, D = 10, G = 1,500, and R = 3.

5 years is "D" on the scorecard.

Soil Absorption Field Practices

A soil absorption field is an area of soil that further processes effluent from a septic tank. In the soil, aerobic organisms (those that require oxygen) further treat the effluent. In addition to processing effluent biologically, the soil absorbs some products (such as phosphates) chemically.

Ideally, the soil removes organic matter and harmful organisms from sewage, and the treated effluent moves down to the groundwater or aquifer. The absorption field must have at least 24 inches of aerated soil to effectively treat effluent.

The list below compares soil properties that are ideal for soil absorption fields with those properties that make the soil unsuitable for a field:

Flooding and ponding. Soils prone to flooding and ponding are unsuitable.

Soil permeability. Soils suitable for soil absorption fields have soil layers that have moderate permeability. Soil layers with very slow permeability are unsuitable, because they cannot absorb effluent as quickly as it is produced. Unsuitable layers include bedrock, dense till, and fragipan limiting layers. Also, if the permeability is too high, the effluent will flow through the soil very fast and not remain in the soil long enough for aerobic organisms to treat it. Unsuitable layers include coarse sand and gravel.

Water table. In ideal soils, the water table is deep. If the seasonally high water table is shallow, there is not enough aerated soil to treat the effluent. Subsurface drainage or alternative designs can lower the water table and improve the chances for successful systems.

Slope. In soils with gradual slopes, effluent moves downward and is processed. Several kinds of absorption fields can be used on these soils. In soils with steep slopes, effluent might seep to the surface before it is processed. Soils with slopes greater than 25% are not suitable for soil absorption fields. Soils in depressions are not suitable because surface water moves into the depression and tends to keep the water table high.

These properties are reflected in the discussion and rules that follow.

Kinds of Soil Absorption Fields and Effluent Application

Effluent from the septic tank usually moves to a distribution box. The distribution box distributes the effluent uniformly to several lines of perforated pipes (pipes with holes) buried in the soil at a level depth. These lines of pipes are called laterals, and the whole system constitutes a soil absorption field. The effluent can move to a soil absorption field by gravity or under pressure.

There are several kinds of absorption fields. In addition, secondary treatment and additional drainage can help a soil absorption field function better.

Subsurface Trench, Gravity Flow Systems

Subsurface trench, gravity flow systems are commonly used for soil absorption fields. In these systems, effluent flows by gravity from the septic tank, through a distribution box, and then to distribution lines (laterals) that are in trenches about 10 to 36 inches deep and 18 to 36 inches wide. The length of the laterals depends on how much effluent a soil can absorb in a day (called the soil loading rate) and the amount of effluent from the septic tank. In any case, a lateral must be less than 100 feet long.

Each lateral consists of a perforated plastic pipe (usually 4 inches in diameter) that is surrounded by aggregate (usually gravel) in the trench. A geotextile fabric (wide enough to cover the trench) is laid on top of the aggregate to keep soil material out. The fabric is covered with soil material.

In subsurface trench, gravity flow systems, effluent flows through the distribution box to laterals. When the effluent level in the septic tank rises above the outlet pipe, the effluent flows out of the tank by gravity. From the laterals, the effluent moves through the aggregate and the soil where aerobic microorganisms break down the organic components. The soil itself also filters out and absorbs some effluent components.

SUBSURFACE TRENCH, FLOOD DOSE SYSTEMS

Subsurface trench, flood dose systems are similar to gravity flow systems, except that flood dose systems pump effluent. Effluent flows from the septic tank into a dose tank. Once a day, the system pumps effluent from the dose tank, through the distribution box, then to the laterals.

These systems can be used where the absorption field is higher than the septic tank, or more commonly, where the soil absorption field has long laterals because the soil has a low loading rate. Compared to gravity flow systems, flood dose systems have an advantage: A large dose of effluent will fill all trenches more evenly and more of the trench will be used for absorption.

SUBSURFACE TRENCH, PRESSURE DOSE SYSTEMS

Subsurface trench, pressure dose systems pump effluent under pressure all the way to the distribution laterals. This distributes effluent more uniformly to each lateral. These systems are particularly well-suited to areas where the subsoil is fine and medium sand (such as in the eolian parent material of sand dunes). Elevated sand mounds and drip distribution systems also use pressure dosing.

JUDGING RULE

30. Subsurface trench, small size system. Mark "YES" if soil has all these properties:

- No bedrock, fragipan, coarse sand & gravel, or dense till limiting layer < 40" from soil surface
- Well-drained
- Subsoil texture is sandy or moderately sandy
- ≤ 12% slope

JUDGING RULE

31. Subsurface trench, large size system. Mark "YES" if soil has all these properties:

- No bedrock, fragipan, coarse sand & gravel, or dense till limiting layer < 40" from soil surface
- Well-drained
- Subsoil texture is medium or moderately clayey
- ≤ 12% slope

JUDGING RULE

32. Subsurface trench, very large size system. Mark "YES" if soil has all these properties:

- No bedrock, fragipan, coarse sand & gravel, or dense till limiting layer < 40" from soil surface
- Well-drained
- Subsoil texture is clayey
- ≤ 12% slope

Elevated Sand Mound Systems

When there is a limiting condition near the soil surface, an elevated sand mound is the solution. A limiting condition could be a limiting layer or a high water table. In elevated sand mound systems, installers place a layer of sand at least 12 inches thick on the soil surface, then place distribution pipes (laterals) in an aggregate (gravel) bed about 12 inches thick on top of the sand. The aggregate bed tubes are then covered with geotextile and soil fill.

The effluent flows into a dose tank, then is pumped into the mound under pressure — usually four times a day. Do not use mound systems on soils that have a slope greater than 6 percent, because effluent might seep out and pond around the mound's base.

▶ **JUDGING RULE**
33. Elevated Sand Mound System

Mark "Yes" for Elevated sand mound system if the soil has all these properties:

No bedrock, fragipan, coarse sand and gravel, or dense till limiting layer above 20 inches

Soil is well drained or moderately well drained

Slope is 6 percent or less

Drip Distribution Systems

Drip distribution systems treat sewage in a septic tank just like other systems. From the tank, effluent flows to a dose tank and then is pumped to a secondary treatment device (described later) that further cleans the effluent. This cleaner effluent is distributed under pressure to drip tubing lines. The small-diameter tubes have outlet ports spaced along the tubes. The ports open when the effluent in the tubes is under pressure and close when the pressure subsides. The tubes are placed in slots cut into surface soil horizons.

The system injects effluent into the biologically active zone of the soil, providing water and nutrients to lawns, natural areas, or crops. The topsoil and plant root system provide an excellent environment for treating effluent. Professionals can install drip distribution systems on much steeper slopes than other on-site sewage systems. If secondary treatment were not used to clean the effluent, the outlets ports would soon become clogged.

Soil Absorption Field Supplements

Supplemental practices help absorption fields function better. An explanation for each is below.

Two of the supplements, perimeter drains and interceptor drains, lower the seasonally high water table so the absorption field has sufficiently aerated soil to process effluent properly.

Perimeter drains are perforated pipes installed in soils with slopes of 2 percent or less. They completely surround soil absorption fields. They must be at least 10 feet from the outside edge of an absorption field and placed deep enough so that the seasonal high water table is more than 2 feet below the bottom of the absorption field trench. To work properly, these drains must have an outlet for the water to drain by gravity — and this requirement is often difficult to meet. For contest judging, they are used with elevated sand mounds.

Interceptor drains are installed in soils with slopes of 3 percent or more and only on the upslope side of an absorption field. These drains keep groundwater from seeping into the field. Although it is not included in soil judging rules, interceptor drains should be used with any absorption field in which water could seep through the soil profile into the absorption field. They are similar to diversion drains.

Effluent that flows out of a septic tank may appear clean, but it contains significant amounts of organic matter and other contaminants. Secondary treatment removes much of this organic matter after it leaves the septic tank and before it moves to the soil absorption field. Secondary treatment also adds oxygen to the effluent to encourage aerobic decomposition of organic matter. Some secondary treatment systems inject air into effluent. Other systems allow effluent to absorb oxygen passively as it trickles through sand or other media such as geotextile fabric. The resulting effluent is much cleaner, which extends the life of the soil absorption field. Secondary treatment systems, however, require more maintenance than conventional systems because they have pumps, valves, and other mechanical equipment that must be routinely checked and serviced by professionals. Illinois requires that outflow from secondary treatment be further treated by the soil rather than discharged onto the soil surface or into surface water. Homeowners in wooded areas often use secondary treatment so they can use a drip distribution system, which requires clearing less area than a conventional trench soil absorption field. Secondary treatment systems are also used to repair or replace a failed conventional system.

Soil judging rules are based on systems that do not use secondary treatment, except for drip distribution, which requires secondary treatment.

Rules for supplemented systems

The rules below combine ordinary absorption fields with supplements.

▶ **JUDGING RULE**
34. Elevated Sand Mound System and Perimeter Drainage

Mark "Yes" for Elevated sand mound system and perimeter drainage if the soil has all these properties:

- No bedrock, fragipan, coarse sand and gravel, or dense till limiting layer above 20 inches
- Soil is somewhat poorly drained or poorly drained
- Slope is 6 percent or less

Most poorly and somewhat poorly drained sites are on slopes of 2 percent and less. If the slope is 3 percent or greater, an interceptor drain should be installed instead of a perimeter drain.

Drip Distribution

Secondary treatment is required for drip distribution systems. It will, however, extend the life of any absorption system explained in these rules.

▶ **JUDGING RULE**
35. Drip Distribution System and Secondary Treatment

Mark "Yes" for Drip distribution system and secondary treatment if the soil has all these properties:

- No bedrock limiting layer within 20 inches
- Soil is well-drained, or moderately well-drained
- Slope is 25 percent or less

▶ **JUDGING RULE**
36. Secondary Treatment

Mark "Yes" for Secondary treatment if you marked "Yes" for at least one soil absorption field practice (judging rules 30-35).

Soil Water Cycle

Ideally, an on-site sewage system cycles water in this way:

- Homeowners pump water into the house from an aquifer (underground layer saturated with water).
- The water is used for drinking, bathing, flushing toilets, washing dishes and clothes, etc. This water use adds impurities, turning the water into sewage.
- The sewage enters the septic tank, where anaerobic microbes partially treat it to produce mainly liquid

Many new approaches to on-site sewage disposal are not covered by soil judging rules. For installers and regulators, these innovative systems are very important approaches to solve real-world problems encountered every day. Soil judging covers only the most common systems, but modern techniques include such innovations as: a plastic chamber to reduce the trench size, sand-lined technologies with large pipes for problem sites, and aerobic treatment units to digest waste more intensely prior to sending the effluent to the absorption field. All of these and more are used to great advantage on specific sites.

The point of soil judging is not to pick one approach, but rather to make the point that soil conditions are a key factor that must be considered first when designing an on-site sewage system. Many approaches can be used, but each must first consider the soil. After a design is made and approved by local health officials, it must be installed under suitable conditions, according to the design, by a qualified installer.

Then comes the most challenging part -- to maintain the on-site sewage system. On-site sewage disposal relies on four issues: Soils, Design, Installation and Maintenance. Picture a table with four legs; if one leg is missing, the table is likely to fall. With an on-site sewage system, if one element is not adequately addressed, the system is likely to fail – at great risk to the public and large expense to the homeowner.

RESOURCES - Site Card and Scorecard

PURDUE UNIVERSITY | Extension

Illinois Soil Contest Site Card

AY-370 June 2019

SITE NO.	**SITE TYPE**	☐ AGRICULTURE ☐ HOME SITE

CALCAREOUS BELOW .... in.

JUDGE PARENT MATERIAL .... to .... in.

FLAT LANDFORM	**YES**	**NO**
WEAK SOIL DEVELOPMENT	**YES**	**NO**

P: .... ppm	**K:** .... ppm	**pH:** ....

NOTES

....

....

....

....

....

....

....

....

....

Copies of this form (AY-370) are available from the Purdue Extension Education Store, www.edustore.purdue.edu.

Slope Finder

4-H-408-W
January 2017

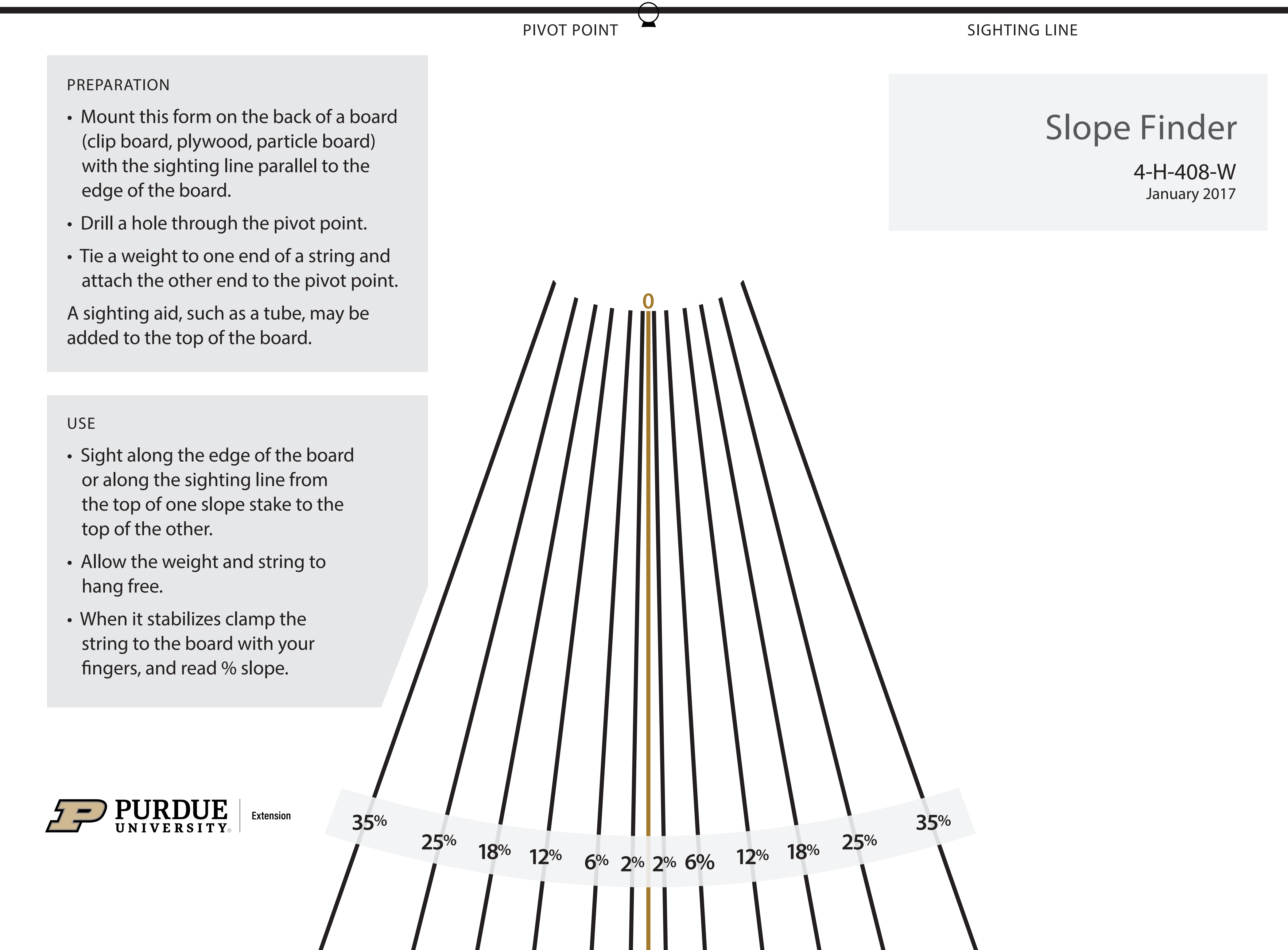
PREPARATION

- Mount this form on the back of a board (clip board, plywood, particle board) with the sighting line parallel to the edge of the board.
- Drill a hole through the pivot point.
- Tie a weight to one end of a string and attach the other end to the pivot point.

A sighting aid, such as a tube, may be added to the top of the board.

USE

- Sight along the edge of the board or along the sighting line from the top of one slope stake to the top of the other.
- Allow the weight and string to hang free.
- When it stabilizes clamp the string to the board with your fingers, and read % slope.



PURDUE UNIVERSITY Extension

PURDUE UNIVERSITY | Extension

Illinois Soil Evaluation Scorecard

AY-371

AGRICULTURE

I. SOIL PROPERTIES *(5 points each, 45 total)*

A. PARENT MATERIAL

1A Weathered bedrock
1B Till
1C Outwash/Lacustrine deposits
1D Eolian sand
1E Loess
2A Alluvium
2B Local overwash

B. SLOPE

3A 0-2%
3B 3-6%
3C 7-12%
3D 13-18%
3E 19-25%
4A 26-35%
4B >35%

C. LANDFORM

5A Upland hillslope
5B Upland swell
5C Upland flat
5D Upland depression
6A Dune
6B Flood plain
6C Filled depression

D. SURFACE SOIL COLOR GROUP

8A Gray
8B Brown
8C Black

E. PREVIOUS EROSION

9A None to slight
9B Moderate
9C Severe

F. SURFACE TEXTURE

10A Sandy
10B Moderately sandy
10C Medium
10D Moderately clayey
10E Clayey

G. SUBSOIL TEXTURE

11A Sandy
11B Moderately sandy
11C Medium
11D Moderately clayey
11E Clayey

H. NATURAL SOIL DRAINAGE

12A Poorly
12B Somewhat poorly
12C Moderately well
12D Well

I. LIMITING LAYER

13A Bedrock, 0-20 in
13B Bedrock, 21-40 in
13C Dense till, 0-20 in
13D Dense till, 21-40 in
13E Fragipan, 0-20 in
14A Fragipan, 21-40 in
14B Coarse sand & gravel, 0-20 in
14C Coarse sand & gravel, 21-40 in
14D None within 40 in

II. AGRICULTURE PRACTICES *(3 pts. each, 69 total)*

A. LAND USE OVERVIEW

15 Restore original vegetation to:
A - Wetland; **B** - Prairie; **C** - Mesic forest

Yes No
16 A B Prime farmland

B. EROSION AND COMPACTION POTENTIALS

17 A B High for erosion by water
18 A B High for erosion by wind
19 A B High for soil compaction

C. BUFFERS AND COVER CROPS

20 A B Grassed waterways
21 A B Windbreaks
22 A B Filter strips
23 Most significant benefit of cover crops:
A - Scavenge N; **B** - No need; **C** - Erosion control

D. CROPPING PRACTICES

Yes No
24 A B Timber stand improvement (TSI)
25 A B Permanent pasture
26 A B Crop rotation

E. TILLAGE PRACTICES

27 A B No till
28 A B Moldboard or chisel plowing

F. WATER MANAGEMENT

29 A B Drainage
30 A B Irrigation
31 A B Terraces

G. PLANT NUTRIENT APPLICATION

		A	B	C
32	N:	Low	Medium	High
33	P:	Add	Maintenance	None
34	K:	Add	Maintenance	None
35	Lime:	Add	None	

H. NUTRIENT POLLUTION POTENTIAL

36 Nitrogen pollution potential:
A - High, ground water; **B** - High surface water; **C** - Med.
37 Phosphorus pollution potential:
A - High; **B** - Medium; **C** - Low

Team / Contestant number: ____________

Contestant name: ____________

School / Club name: ____________

Site number: ____________

SCORE

Part I *(45 points possible)*: ____________

Part II *(69 points possible)*: ____________

Total *(114 points possible)*: ____________

PURDUE UNIVERSITY | Extension

Illinois Soil Evaluation Scorecard

AY-376

HOME SITE

I. SOIL PROPERTIES *(5 points each, 45 total)*

A. PARENT MATERIAL

1A Weathered bedrock
1B Till
1C Outwash/Lacustrine deposits
1D Eolian sand
1E Loess
2A Alluvium
2B Local overwash

B. SLOPE

3A 0-2%
3B 3-6%
3C 7-12%
3D 13-18%
3E 19-25%
4A 26-35%
4B >35%

C. LANDFORM

5A Upland hillslope
5B Upland swell
5C Upland flat
5D Upland depression
6A Dune
6B Flood plain
6C Filled depression

D. SURFACE SOIL COLOR GROUP

7A Gray
7B Brown
7C Black

E. PREVIOUS EROSION

8A None to slight
8B Moderate
8C Severe

F. SURFACE TEXTURE

9A Sandy
9B Moderately sandy
9C Medium
9D Moderately clayey
9E Clayey

G. SUBSOIL TEXTURE

10A Sandy
10B Moderately sandy
10C Medium
10D Moderately clayey
10E Clayey

H. NATURAL SOIL DRAINAGE

11A Poorly
11B Somewhat poorly
11C Moderately well
11D Well

I. LIMITING LAYER

12A Bedrock, 0-20 in
12B Bedrock, 21-40 in
12C Dense till, 0-20 in
12D Dense till, 21-40 in
12E Fragipan, 0-20 in
13A Fragipan, 21-40 in
13B Coarse sand & gravel, 0-20 in
13C Coarse sand & gravel, 21-40 in
13D None within 40 in

II. HOME SITE PRACTICES *(3 pts. each, 69 total)*

A. SITE SELECTION AND CONSTRUCTION PRACTICES

	Yes	No	
14	A	B	Is the soil available for a homesite? *If NO, mark practices 15-36 as NO, N/A, or No application.*
15	A	B	Preserve trees & plant new one
16	A	B	Maintain soil cover during construction
17	A	B	Improve surface drainage
18	A	B	Is the soil suitable for a basement?
19	A	B	Design for high-clay subsoils
20	A	B	Potential construction hazards on slopes
21	A	B	Install diversion structures and drains
22	A	B	Provide foundation drainage
23	A	B	High-risk for cave-in during construction

B. LANDSCAPE AND LAWN PRACTICES

24 Manage soil reaction for acid-loving shrubs
A - No application; **B**- Apply sulfur; **C**- Plant other species

25 Manage soil reaction for lawns
A - Apply lime; **B**- No application; **C**- Plant other species

	Yes	No	
26	A	B	Apply phosphorus (P) to lawn
27	A	B	Apply potassium (K) to lawn

C. ON-SITE SEWAGE DISPOSAL – SUITABILITY

	Yes	No	
28	A	B	Is soil suitable for an absorption field? *If NO, mark 29-36 as NO or N/A*

D. SEPTIC TANK PRACTICES

29 Septic tank pumping interval (PI, years)
A. 1-2;
B. 3;
C. 4;
D. ≥5
E. N/A

$$PI = \frac{(D \times G) / 1{,}000}{R}$$

$$PI = \frac{(\_\_ \times \_\_) / 1{,}000}{\_\_}$$

PI = ___

D-Disp. (Y=7; N=10); G=tank size, gal; R=Resid.

E. SOIL ABSORPTION FIELD PRACTICES

30 A B Subsurface trench, small size
31 A B Subsurface trench, large size
32 A B Subsurface trench, very large size
33 A B Elevated sand mound system
34 A B Elev. sand mound & subsurface drain
35 A B Drip distribution & secondary treatment
36 A B Secondary treatment

Team / Contestant number: ____________

Contestant name: ____________

Site number: ____________

SCORE

Part I *(45 points possible)*: ____________

Part II *(69 points possible)*: ____________

Total *(114 points possible)*: ____________

Notes

PURDUE UNIVERSITY | Extension

extension.purdue.edu

Find out more at
THE EDUCATION STORE
edustore.purdue.edu

August 2021