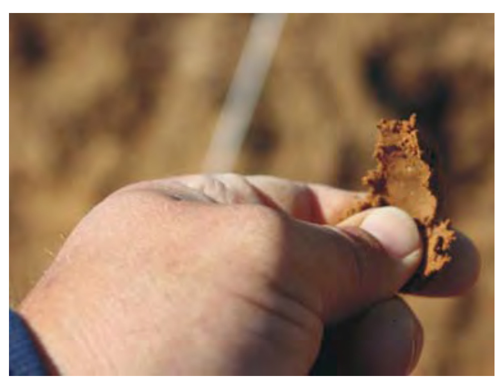
Soil Study and Land Evaluation Handbook

Wisconsin



ACKNOWLEDGMENTS

This guide was prepared by the Wisconsin Association of Agricultural Educators (WAAE) to assist with teaching students in Wisconsin about soils and their different physical characteristics. Not only is production a part of the learning process, but resource management as a whole is a very important part of educating youth.

The WAAE received assistance from UW-Platteville, USDA-Natural Resources Conservation Service and County Land Conservation Departments in developing these guidelines.

The WAAE would like to recognize Jerry Sherwin, retired Vocational Agriculture Instructor from Cuba City High School, for his commitment and dedication to land judging and helping his students understand the benefits of wise soil management. The WAAE would also like to recognize Dr. Roger Higgs, retired professor from UW-Platteville, for his 37 years of dedicated service to students all over Wisconsin and the Midwest. Roger's excellent guidance and teachings are well evidenced by the number of people that have pursued careers in resource management and production agriculture as graduates of UW-Platteville. Both Roger and Jerry have made land/soil judging the competitive "sport" that it is today.

Produced by the

in cooperation with

Wisconsin Association of Agricultural Educators

Wisconsin FFA

University of Wisconsin - Platteville

Wisconsin 4-H

County Land Conservation Committees and Departments

Produced by the U. S. Department of Agriculture, Natural Resources Conservation Service, Madison, Wisconsin. File available at http://www.wi.nrcs.usda.gov/technical/soil/soiljudging.html.   Technical contacts Rick Lange, NRCS, Wisconsin, and Ken Engelke, WAAE, Belleville.

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For more information on the Web Soil Survey go to http://websoilsurvey.nrcs.usda.gov/app/

Introduction: Know your land for good land use

As citizens of Wisconsin and the United States, we are deeply concerned with the care of our land. The health, welfare, and economic prosperity of both city and country residents are not far removed from the planet's thin layer of soil.

Fortunately, Wisconsin has many factors in our favor in our efforts to conserve soil. Topography, climate and people are the most evident. Much of Wisconsin is rolling or hilly with long slopes, and our climate provides ample rainfall. This scenic beauty we enjoy is naturally suited to dairy and livestock production with its needed hay, forage and pastures. This type of farming protects soil by keeping the soil surface covered in grass and hay crops, and often in contour strips.

Wisconsin farmers and landowners have a historic commitment to land stewardship, adopting a strong conservation ethic early in the 1900s that continues today. In addition, the state has supported conservation through innovative programs and staffing, and through cooperation with the USDA Natural Resources Conservation Service and other conservation agencies. Wisconsin is one of the first states in the nation to complete the entire initial soil survey and complete digital soil surveys for all counties. Soil surveys are now easily accessible on **Web Soil Survey** to help people make better land use decisions throughout the state.

However, some factors challenge our conservation efforts. Many soils are either poorly drained or susceptible to wind erosion. Our ample rainfall often comes in heavy, erosive downpours. Also, the dairy and forage industry in Wisconsin has been declining and cash grain operations increasing, leaving fewer acres under the protection of hay and forage crops.

Non-agricultural operations, such as highways and highway construction, urban construction and residential development, may also lead to significant erosion. USDA research shows that sediment yields from unprotected construction areas can run from 5-500 times those from typical agricultural areas.

Invasive species, both plant and animal, have recently been thrust into the natural landscape. These species have been known to harm the natural ecosystem by displacing native flora and fauna. Invasive species may cause economic damage to commercial boat traffic, agriculture and woodland production. We all must be aware and avoid any activities that introduce or spread **invasive species.**

We can maintain and improve Wisconsin's agricultural production and income, guide urban development, build necessary roads, create economic growth and at the same time conserve our precious soil if we consider the limitations and potential of the land when making land use decisions.

To use each acre appropriately, we need to know something about the soil and the characteristics that affect its use and management, such as suitability for crops, pastures, woodlands, and wildlife. If the land is not to be used for agriculture, then factors such as slopes, suitability for septic systems, and water tables need to be considered in great detail.

The first step in determining good land use is to study the site and the soils to determine capabilities. This manual discusses how to study and evaluate soils to decide their best use. It primarily applies to agriculture and related uses. However, the same principles are considered for non-agricultural land use decisions. Part V of this manual deals with non-agricultural uses.

It is the intent of the Wisconsin Association of Agriculture Educators and the USDA Natural Resources Conservation Service that this manual be used as a tool to teach students better land use by understanding factors that go into land use decisions. Whether or not the manual is used for academic competitions is up to individual instructors.

How to use this Handbook

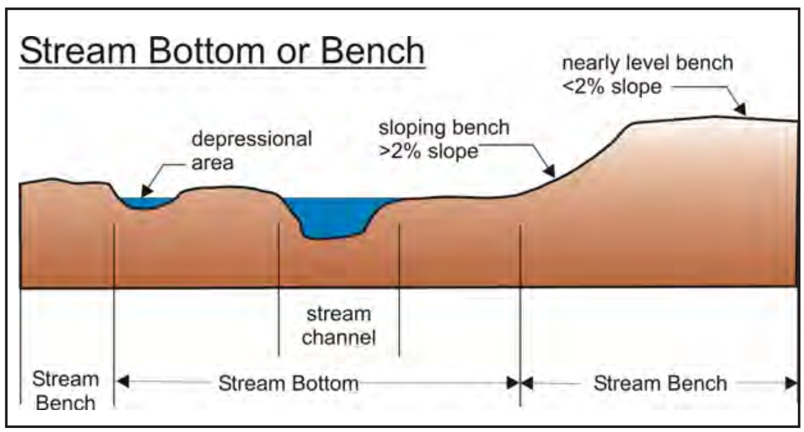
The Soil Study and Evaluation Handbook consists of five parts. Part I will assist you in studying the site and its location along with describing the characteristics of the soil profile, including fertility. Part II will assist you in determining limiting factors for crop growth and production. Part III will help you to determine the Land Capability Class of the site using the factors that you have recorded to this point. Part IV will guide you in determining what conservation practices, if any, would be required for long term resource management and conservation of the site. Part V will assist you in determining what limitation may exist, if any, for non-ag uses by bringing your attention to three common non-ag uses. After completion of the handbook, you should have a better understanding of soils, land characteristics, and their limitations along with conserving uses of natural resources.

Part I. Site

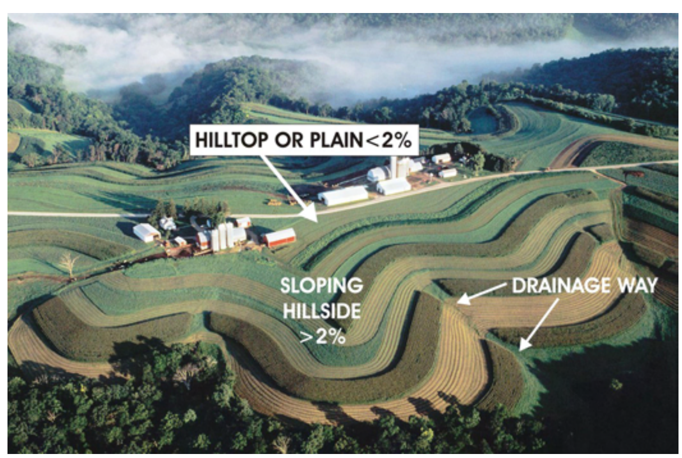
Relating soil properties to the surrounding landscape is an important part of land evaluation. This section of the study guide describes the three site considerations used in state land judging contests: 1) position in landscape; 2) slope; and 3) type and degree of erosion or deposition.

Position in Landscape

Landscape position is determined by the location of the soil pit in relation to the surrounding area, which may include areas outside the flagged site boundary. For example, a nearly level site on a stream bench would be given a different landscape position designation than a nearly level site on a hilltop, even though the areas within the flagged sited boundary may look similar. Therefore, it is important that surrounding areas are considered when evaluating landscape position.



Landscape positions are divided into two main types: 1) uplands and 2) stream bottom or bench. The first thing that should be determined when evaluating landscape position is in which of these two landscape types is the site located. The figures below show the general relationship of uplands, benches and stream bottoms. Soil often varies in a predictable manner when going from a hilltop to a depression. Upland sites are located on hilltops, plains, hillsides, depressions or drainage ways that occur in areas that are at or near the highest elevation in relation to surrounding areas. Stream bottoms or bench sites include level, sloping, and depressional areas that are often near running streams, but may sometimes be located a significant distance from the running water. An example of this would be large floodplains associated with major rivers. Stream bottoms and benches occur in areas that are significantly lower in elevation compared to surrounding areas.



Upland

Hilltop or Plain indicates the site is relatively flat (< 2% slope) and located in an upland area. In the glaciated parts of Wisconsin, this landscape position includes plains formed by glaciers (till plains) or glacial meltwater (outwash plains).

Sloping Hillside indicates gently sloping to very steeply sloping (> 2 % slope) hillsides between hilltops or plains and drainage ways, depressions, benches or stream bottoms.

Depression indicates the site is located where all adjacent areas slope upward. ***Drainage Way*** is an area that carries surface runoff. Examples of drainage ways include grassed or cultivated waterways, eroded gullies, and areas of recent deposition at the bottom of drainage ways (alluvial fans).

Stream Bottom or Bench

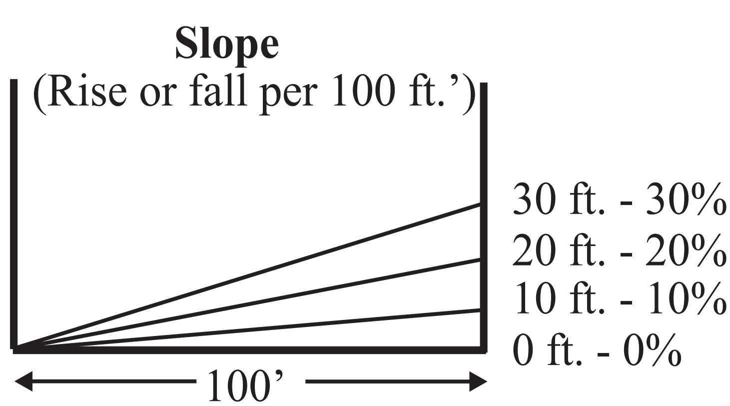
Nearly Level Stream Bottom or Bench indicates the site is relatively flat (< 2% slope) and was formed primarily by deposition from running water. These sites occur near existing rivers or streams that have annual base flow. Bed and bank areas where no annual base flow occurs is considered a drainage way.

Sloping Stream Bottom or Bench indicates gently to very steeply sloping (> 2% slope) sites between benches and/or stream bottoms. These sites are formed primarily by deposition from running water, and often occur near existing rivers and/or streams.

Depressional Stream Bottom or Bench indicates the site is located in a depressional area (all adjacent areas slope upward) that is found on a stream bottom or bench. An "oxbow" formed after a stream or river changed course is an example of a depressional stream bottom or bench position.

Slope

The Slope diagram below will help you visualize what "percent slope" means. The lines of the diagram have the actual percentage slopes indicated. Slope will be determined by the rise or fall between two designated slope stakes. Distance between the stakes will be 100 feet apart unless otherwise noted on Pit Information Card. Calculate slopes accordingly. Use the higher slope class if slope percent is a tie. For assistance in practicing slope determinations, contact your local NRCS office.

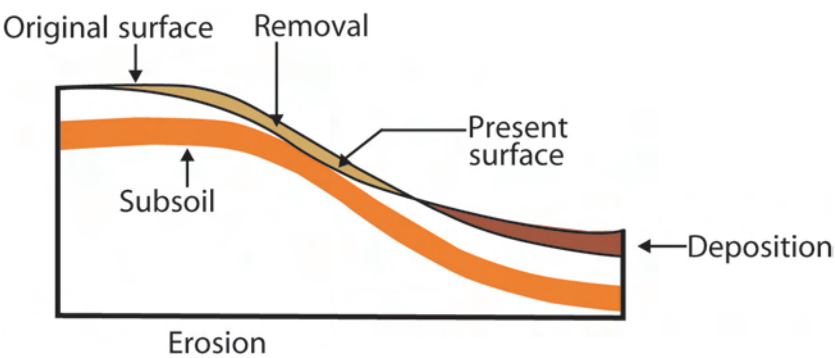


Type and Degree of Erosion or Deposition

Type and degree of erosion or deposition is computed from information obtained from the Pit Information Card. The erosion/deposition diagram below will to help you visualize the normal water erosion/deposition pattern on a hillside to a bench, bottom or drainage way. It shows the relation of degree of erosion to percent of slope, and the relative amount of surface soil and subsoil in the three different situations. In some local situations, the erosion pattern may vary from that shown here.

The pattern of soil blowing (wind erosion) is not shown, since it varies greatly from place to place. Soil profiles are vertical exposures, such as those studied at pits, where the different layers (horizons) present can be seen. A soil also has length and breadth which make it a three-dimensional body, like a thick blanket.

When we look at a soil profile (usually a two to six foot vertical exposure) in a road cut, streambank or soil judging pit, we see distinct layers of surface soil, subsoil and substratum - each with its own characteristics. You may find several horizons in some soils, but for evaluation purposes you may group them into surface soil and subsoil.



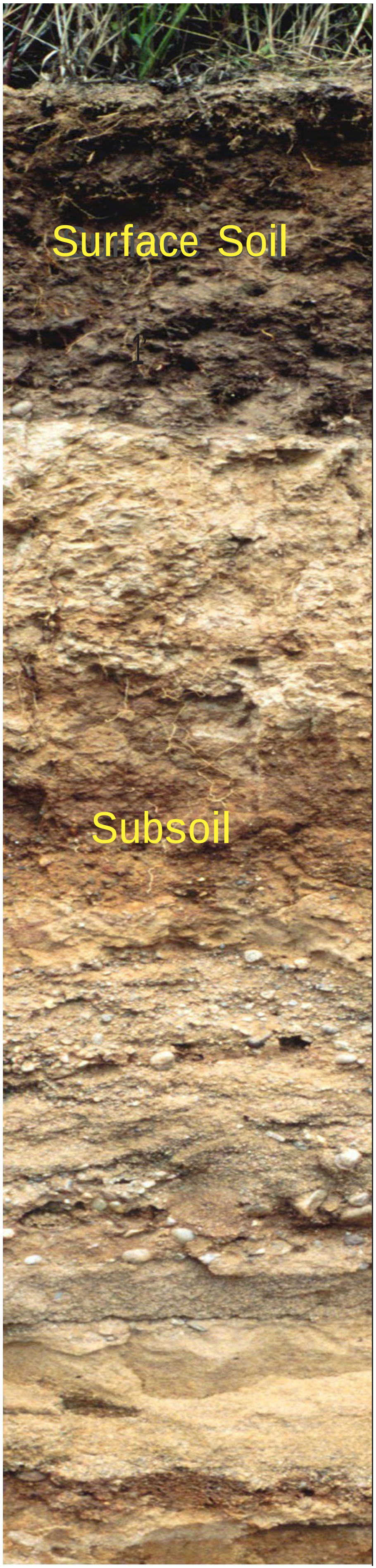
The top layer of the soil is the surface soil. Its depth varies from a few inches to a foot or more. In Wisconsin, the virgin surface soil layer varies from 2 to 12 inches deep. Where the surface soil has been plowed, it is the plow layer. This layer usually contains the greatest amount of organic matter and available plant nutrients.

Beneath the surface soil is the subsoil. It commonly contains several layers (horizons). The subsoil usually does not have much organic matter, and is more compact that the surface soil. It is usually a shade of brown or gray – or mottled or gray if it is poorly drained.

The original surface soil is buried by the light colored depositional layer. Over the years this depositional layer has been accumulating from upland erosion.

--------- *Depositional Layer*

--------- *Original Surface Soil*



Surface Soil

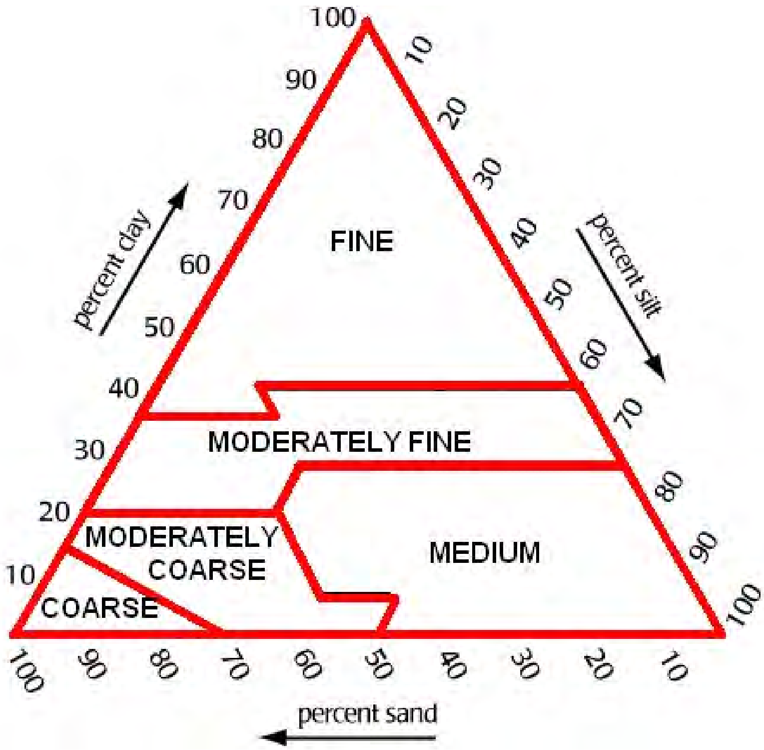
There are three important characteristics of the surface soil that we can observe. The color reveals information about the soil formation factors present during the development of the surface soil. Prairie soils and wet soils have naturally dark colors, because of previous biological activity which yielded high organic matter contents. Soils developed under forest cover generally have lighter brown or gray colors. Distinctly reddish brown soils are high in oxidized forms of iron.

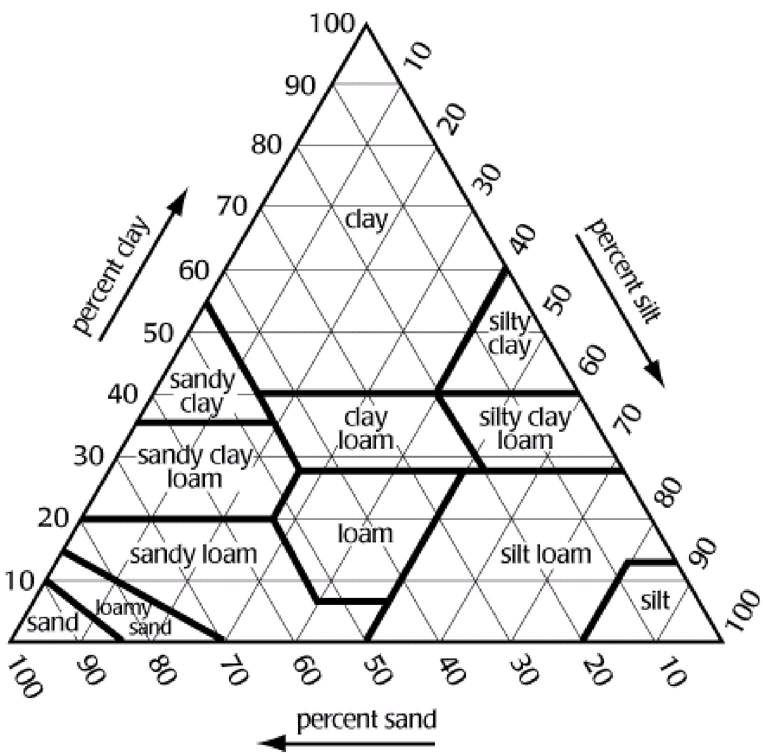
Texture

The texture of soil refers to the relative content of sand, silt and clay. The best way to become familiar with soil texture is to feel some moist soil with known textures. When you rub moist soils between your thumb and forefinger, sandy soils feel coarse and gritty; silty soils feel like moist flour; and clayey soils feel stiff and sticky like putty; they ribbon easily. Texture is an important property of soil. It influences the soils capacity to hold water and plant nutrients, its susceptibility to erosion by wind, and the ease with which a good seedbed can be prepared.

In non-cultivated areas, many Wisconsin soils have a thin dark surface soil, a brownish blocky subsoil, and a coarse, blocky or massive substratum.

Textural Triangles





The corners of the textural triangle represent 100 percent sand, clay or silt. (Gravel and organic soils are not included) The triangle is divided into 10 percent portions of clay, silt and sand. Heavy lines show the divisions between 12 basic soils textural classes. The triangle can be used only when the percentages of clay, silt and sand have been determined in the laboratory. If you know that a soil is 20 percent clay and 40 percent silt, you can follow the 20 percent line from the left hand (clay) side of the triangle to the point where it meets the 40 percent line from the right hand side (silt) side of the triangle. You will see, then, that the soil is a loam.

Structure

The structure of soil refers to the way in which sand, silt and clay particles are held together in the soil. Structure units are called aggregates. Surface soils are usually granular and subsoil layers are blocky. Sandy soils usually have weak structure or are single grained. The structure of surface soil is important, because it, along with the texture, affects infiltration which is the rate of water entry into the soil during rain. Structure also determines the ease with which seeds germinate and grow. Structure influences erosion, drainage, crop growth and yields.

Originally most Wisconsin soils had granular or fine blocky structure in the surface horizon and many still do. These are both favorable for water and air movement and plant growth. With poor management, surface soil structure may become cloddy or massive. When all structure is destroyed by working the soil when it is wet, the soil may become "puddled". Such soil may become dense and hard. Seeds do not germinate well in these "puddle" soils. Water and air enter it slowly. Stream bottoms and benches may show evidence of plates (layers) resulting from soil deposition when soils are left undisturbed.

Examples of Blocky Structure

Example of Granular Structure

Subsoil

Subsoil is more complicated to evaluate than surface soil because it may consist of several layers which differ in color, texture and/or structure. Texture and structure directly affect permeability and the resulting subsoil color is a good indicator of natural drainage. Usually one subsoil layer is outstanding because of its thickness, clays, texture, color or distinctive structure. This is the layer to consider in evaluating subsoil, since it will have the greatest effect on water movement, root growth and conservation practices needed, if any.

Texture

The texture of the soil refers to the relative content of sand, silt and clay. The subsoil generally contains more clay than surface soil. Clayey textures are therefore more common in subsoil layers. A texture containing a higher percentage of clay (fine texture) generally means more water storage capacity and slower movement of water and air. When you rub moist soils between your thumb and forefinger sandy soils feel coarse and gritty; silty soils feel like moist flour; and clayey soils feel stiff and sticky like putty; they ribbon easily.

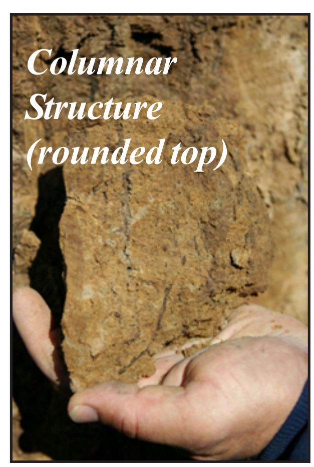

Ribbon test showing Moderately Fine Texture


Sandy Texture

Structure

The structure of soil refers to the way in which sand, silt and clay particles are held together in the soil. Structure units are called aggregates. In Wisconsin, clayey subsoils are almost always blocky in structure; however, prismatic structured aggregates are also common. Stream bottoms and benches may show evidence of plates (layers) resulting from deposition of soil when soils are left undisturbed. Some subsoils lack structure and are single grained (sands) or massive.


Platy Structure


Columnar Structure (rounded top)

Soil Profile

Natural Drainage

Texture and structure together largely control the movement of water and air through the soil. The terms permeability and aeration refer to this movement of water and air. They also affect the amount of water storage, the amount of available plant nutrients, and the ease with which roots can penetrate into the subsoil.

Color of subsoil is a very important indication of natural drainage. If the subsoil is uniform brown, yellowish-brown, or reddish-brown, the soil is well drained. If the subsoil is mottled with gray, red or rust colored spots, this soil is somewhat poorly drained. If the subsoil is almost entirely gray, it may indicate poor drainage conditions and a cold, wet soil. However, there are some soils with gray color that have moderate or higher permeability. Organic soils are naturally very poorly drained.

Gray mottle surrounded by orange mottle indicating presence of water table

The total thickness of the surface soil and subsoil, along with textures and structures of each, influence the amount of water storage, air movement, and the total available plant food nutrients. This surface soil and subsoil depth is very important, since plant roots need plenty of room in which to grow and obtain this moisture and those plant nutrients. Deep rooted crops, such as corn and alfalfa, will send roots down four or more feet in a deep soil.

Depth of Soil Favorable for Roots

One difficulty in determining depth of soil favorable for root growth is deciding just what limits root development. Some factors which almost always limit root growth are:

- thick stratified layers of sand and gravel;
- solid, widely fractured limestone or sandstone bedrock;
- permanent water table;
- stratified layered silts, clays, and dense clays;
- deposits of marl or other materials having high lime content;
- thick iron pans and dense silt pans that becomes very hard when dry.

Plow pans are rarely thick or dense enough to limit the depth of soil, even though they may often check root development to some degree.   Few soils will be totally void of roots due to nature's vast assortment of plants and their wide range of adaptability; wet, dry or other adverse conditions may be overcome by one or more plant species.

Your Scorecard has a place to record the depth of soil favorable for root growth, and below that, a list of depth-limiting factors. It is important to note that there may not be a significant depth-limiting factor. However, the lack of roots in the profile does not necessarily indicate an unfavorable condition for root growth.

Soil Test Report

Soil Fertility and Nutrient Management

Properly used, soil amendments, such as lime, fertilizer, and manure, can improve crop growth and reduce soil and nutrient loss from erosion, runoff, and leaching. Maintaining the proper pH and level of nutrients in cultivated soils promotes good vegetative cover and extensive root systems which in turn help protect the soil from erosion. However, if nutrients are applied in excess of the needs of crops, nutrient losses from runoff and/or leaching increases and can harm surface or groundwater quality. Soil fertility is the ability of the soil to supply nutrients in the proper amount and balance for optimum crop growth. Soil amendments such as lime, fertilizers, and manure are used in cultivated fields, pastures, orchards, and managed forests to improve soil fertility. Soil testing is the most widely used tool for measuring pH and nutrients available in the soil. Soil testing is needed to evaluate the potential for nutrient losses. Farmers and land managers alike must be familiar with interpreting soil test results in order to reach maximum productivity without harming the environment. Recommended rates of amendments vary not only by soil test level, but also by soil type, planned crop, previous crop, soil yield potential, and the nutrient source (fertilizer vs. manure). It is beyond the scope of this guide to detail all the potential scenarios that may be encountered in Wisconsin. Rather, this section will help you become familiar with terminology used in making fertility recommendations and learn about fertility requirements and nutrient management.

pH adjustment

Maintaining an optimal soil pH is critical for successful crop production. The pH is the relative acidity or alkalinity of a soil sample based on a scale of 1-14. If pH is too low (acidic) or too high (alkaline) nutrients become less available to crops and the soil is no longer a good medium for root growth. The optimum soil pH for crop production depends on the type of crop to be grown. Most field crops and pastures have an optimum pH that is between 6.5 and 8.0. If the soil pH is less than 6.5, the soil will have to be amended with lime or other materials to raise the pH. Alkaline soils are not common in Wisconsin, but occasionally soils with high pH do occur. Soils with a pH greater than 8 should be amended with sulfur or other materials to lower the pH. Therefore, if the pH provided on the Pit Information Card is lower than 6.5 or greater than 8.0, "pH adjustment" should be checked on the score card.

Nitrogen (N)

Crops such as corn and small grains can require relatively high amounts of N, while legume crops such as alfalfa, soybeans, and clovers require little or no N. Nitrogen recommendations for corn and small grains in Wisconsin are based primarily on the soil texture, organic matter content, and yield potential of the soil. Previous legume crops and manure applications can also reduce the amount of N recommended for a given soil. Because all of this information cannot be obtained from soil testing alone, the nitrogen level will be given as "sufficient" or "deficient" on the Pit Information Card. If "deficient" is given on the soil test information, then "Nitrogen" should be selected on the score card.

Phosphorus (P)

Phosphorus is reported in soil tests as parts per million (ppm). One part per million is roughly equal to 2 lbs. per acre in the upper 6 inches of the soil profile. Fertilizer recommendations are usually given in pounds of phosphate (P_2O_5) per acre. Most field crops do not show a positive yield response to added phosphate if the soil test level is above 30 ppm P, but potatoes and other high-demand vegetable crops may require higher P levels for maximum production. For the purposes of the contest, only select "Phosphate" on the scorecard if the soil test level is less than 30 ppm P.

Potassium (K)

Similar to phosphorus, potassium is reported in soil tests as parts per million (ppm). Fertilizer recommendations based on soil tests are given in lbs potash (K_2O) per acre. Most field crops do not show a positive yield response to added potash if the soil test level is above 150 ppm K, but some high-demand vegetable crops may require higher K levels for maximum production. For the purposes of the contest, only select "Potash" on the scorecard if the soil test level is less than 150 ppm K.

No Fertilizer or Soil Amendments needed

Check this if none are needed.

Part II. Soil Limitations

After studying a site, its characteristics, and soil test report, and describing these factors in Part I, we now look at soil limitations and decide on the best long-term use of the soil. The Soil Limitations listed below help to define soil characteristics which may affect crop growth and production and will identify the soil conservation concerns for the site. Identifying any “limitation” (1-6) will drop the site out of Class I.

On your scorecard, mark the characteristics “yes” if they are limiting, “no” if they are not.

1) *Soil subject to sheet, rill, or wind erosion* - Mark “Yes” when sheet, rill, or wind erosion is a potential concern under the most intensive long term use. Percent slope is a major factor in sheet and rill erosion by water with intensive cropping systems, overgrazing of pasture, or sparsely covered non-ag land. Sandy and/or organic soils are susceptible to wind erosion with intensive cropping systems, overgrazing of pasture, or sparsely covered non-ag land. DO NOT mark this limitation if the only concern with water erosion is from occasional overflow or flooding or stream bank erosion. Sheet and rill erosion becomes a limitation when slopes exceed 2%. Wind erosion becomes a limitation on coarse or organic surface soil textures.

2) *Subject to occasional overflow or flooding* - Mark “Yes” when occasional overflow or flooding is a potential concern for the site regardless of the most intensive long term use. Stream and river bottoms (floodplains), benches subject to overhead water (runoff), and depressions (low areas with no surface water drainage outlets) and drainage ways are subject to occasional overflow or flooding during snow melt or heavy rainfall.

3) *Surface drainage restricted* - Mark “Yes” when surface drainage is restricted regardless of most intensive long term use. Temporary or permanent standing water in depressions in uplands or depressions in bottomlands or benches are examples of places where surface drainage may be restricted. Generally these soils will show gray mottling in the surface soil indicating excessive soil moisture and drainage problems. Some of these areas may become dry.

4) *Subsoil drainage restricted from high water table* - Mark “Yes” when subsurface drainage is restricted when a high water table (seasonal or permanent) limits the growth and development of roots on a site regardless of the most intensive long term use of the land. Subsoils which are very dense, clayey, or have claypans with massive or blocky structure, and show various degrees of mottling above 36 inches generally restrict water movement resulting in limited root growth and development. Hard bedrock such as limestone or sandstone may also restrict drainage. High water tables (seasonal or permanent) limit the growth and development of root systems.

5) *Low available water capacity* - Mark “Yes” when low available water capacity limits the growth and development of roots on the site regardless of most intensive long-term use of the land. Sandy soils tend to have rapid water movement (permeability) resulting in low available water capacity. Shallow soils with solid bedrock such as limestone or sandstone at depths less than 18 inches, or soils containing 50% or greater of stones, rocks, or gravel by volume above 40 inches within the marked area of the profile lack adequate available water capacity for desirable root growth and development during periods of drought.

6) *Stoniness* - Mark “Yes” when stoniness limits or alters planting or harvesting operations regardless of most intensive long-term use. This limitation exists when 50% or more (by volume) of the top 10 inches is comprised of stones or rocks 3” or greater in any dimension. *Use the length of the entire pit face profile, on the side where the control area is marked, to a depth of 10”* to determine stoniness. Stoniness is a common limitation on glaciated or shallow soils over bedrock; these fields commonly need to have rocks picked up and removed.

7) *No major limitations* - Mark “Yes” only when no major limitations exist. Slight or moderate limitations may exist, and may have an impact on Land Capability Class.

Part III

Land Capability Classes

Land capability classification is a widely used system to classify soils for agricultural purposes. The system is based on the most intensive long term use for this land. The criteria used to classify Land Capability are: slope, texture of soil, depth of soil material, and drainage.

In this classification system, soils are grouped according to their potentials and limitations, if any, for sustained production of common crops. This classification system places all soils in eight capability classes. The higher the number, from Class I-VIII, the greater the risk of soil damage or limitations for use. With good soil conservation management, soils in Classes I, II, III, and IV, are suitable for cultivation. Soils in Classes VI and VII, with good soil conservation management, are suited for pasture, woodland and wildlife. Soils in Class VIII generally are non-productive for agricultural purposes and are recommended for wildlife habitat.

Land Suited for Cultivation

Class I

May be safely used for intensive cropping such as continous row crops, pasture, range, woodland, or wildlife food and cover. These soils are nearly level and the erosion hazard is slight. They are deep, generally well-drained, and easily worked. They hold water well and are naturally fertile or responsive to additions of fertilizer. They are not subject to damaging overflow.

Land Suited for Cultivation (continued)

Class II

Requires general soil conserving cropping systems which may require special tillage methods. Soils in this class have slight limitations and conservation practices are easy to apply. These soils may be used for cultivated crops, pasture, woodland or wildlife food and cover. The soils have one or more limitations: slight hazard of wind or water erosion; occasional damaging overflow; moderate soil depth; wetness; and gentle slopes.

Class III

Requires specific practices and conservation measures for cultivated crops. Soils in this class have moderate limitations and conservation practices are usually more difficult to apply and maintain. These soils may be used for cultivated crops, pasture, range, woodland or wildlife food and cover. The soils have one or more limitations: moderate hazard of wind or water erosion; frequent damaging overflow; wetness; moderately shallow rooting depth; moderately low moisture holding capacity; low fertility not easily corrected and moderate slopes.

Class IV

Requires intensive soil conserving systems and practices for cultivated crops. Soils in this class have severe limitations and conservation practices are more difficult to apply and maintain. These soils may be used for cultivated crops, pasture, range, woodland or wildlife food and cover. The soils have one or more of the limitations: severe hazard of wind or water erosion; frequent damaging overflow with severe crop damage; wetness; shallow rooting depth; low moisture holding capacity and have steep slopes.

Land Generally Not Suitable For Cultivation

Class V

Not used in Wisconsin

Class VI

Develop permanent pasture or timber. Use conservation practices. Soils in this class have severe limitations, making them generally unsuited to cultivation and limit their use largely to pasture, range, woodland or wildlife food and cover. These soils have one or more limitations: severe wind or water erosion; are stony or rocky, have shallow rooting depth, excessive wetness or overflow, low moisture capacity and steep slopes.

Class VII

Use very carefully for pasture. Improve for timber production. Needs careful conservation. Soils in this class have severe limitations that restrict their use to pasture, range, woodland or wildlife food and cover. The soils have one or more limitations: severe wind or water erosion, shallow soil, are stony or rocky and have very steep slopes. With proper management these soils can be used for limited pasture, woodland and wildlife production but it is seldom practical to apply pasture improvements such as seeding and fertilizing.

Class VIII

Reserve for wildlife production. Soils in this class have limitations that preclude their use for commercial plant production. Limitations that cannot be overcome consist of one or more of the following: erosion or erosion hazard; wetness; stones and rocks; and very low moisture capacity. Their use is restricted.

Includes beaches, mines, dumps, quarries, river wash rockland, etc.

Relation of Land Capability to Soil Characteristics

The land capability classification system is intended to organize land facts into a convenient form to show the broad limitations, risks and intensity of use for lands having specific soil characteristics. The chart on the next two pages shows the general relationships of soil characteristics to land capability classes.

To use the following chart, first determine the soil characteristics by using Part I of the Soil Study and Evaluation Guide. Then note these soil properties on this chart. In general, the one most limiting soil property places the soil in the numerical capability class which best describes its potentialities and limitations for sustained production of common crops. For example, if all of a soil's properties would place it in Class I – *except one*, which placed it in Class III- then the soil would have a Class III capability. (Think of a chain being only as strong as its weakest link).

For soils with no water table (mottle) within 36 inches of surface

Natural Profile Drainage of Moderately Well Drained or better

Degree of Erosion is Slight or Moderate

Percent Slope	Dominant Texture of Soil	Depth of Soil Material in Profile (inches)	Capability Class*
0-2	loamy to silty (no occasional overflow)	Over 40	**I**
0-6	loamy to silty	20-40	**II**
0-6	loamy to silty (occasional overflow)	Over 40	**II**
0-6	sandy over clayey	20-40	**II**
0-6	loamy to silty	Under 20	**III**
0-12	moderately sandy	20-40	**III**
6-12	loamy to clayey	20-40	**III**
6-12	sandy over clayey	Over 40	**III**
0-6	sandy	20-40	**IV**
6-12	loamy to clayey	Under 20	**IV**
12-20	loamy to clayey	20-40	**IV**
12-20	sandy over clayey	Over 40	**IV**
12-20	moderately sandy	20-40	**IV**
6-12	sandy	20-40	**VI**
6-20	loams and sandy loams	Under 20	**VI**
12-20	loamy to clayey	Under 20	**VI**
20-30	loamy, clayey, mod sandy	20-40	**VI**
0-20	stony soils	20-40 and over 40	**VI**
0-6	loamy to silty	20-40, on floodplains	**VI**
12-30	sandy	20-40	**VII**
20-30	loamy to clayey	Under 20	**VII**
20-30	stony soils	20-40 and over 40	**VII**
0-45	moderately sandy to clayey	20-40	**VII**
0-35	Beaches, mines, dumps, riverwash, rockland, etc.	Variable	**VIII**

*For soils that have **Severe** erosion, move one class poorer.
Example, a Class III soil with **Severe** erosion is now Class IV.
However, do not move from Class VII to Class VIII for Severe erosion

For soils with water table within 36 inches of surface

Degree of Erosion is Slight or Moderate

Natural Profile Drainage in (inches)	Percent Slope	Texture of Soil	Depth of Soil Material in profile (inches)	Capability Class	Capability Class if drained and cropped*
Somewhat Poorly (water table 12-36)	0-6	loamy	20-40	II	
		clayey	20-40	III	
		sandy	20-40	IV	
Poorly (water table 0-12)	0-6	loamy	20-40	VI	II
		clayey	20-40	VI	III
		sandy	20-40	VI	IV
Very Poorly (organics)	0-6	organic/loam	20-40	VI	II
		organic/clay	20-40	VI	III
		organic/sand	20-40	VI	IV
		organic	20-40	VI	III

Part IV. Conservation Practices for Long Term Land Use

In Part IV, we learn about some of the conservation practices which will reduce soil erosion and help to sustain the productive potential of the land for the long term. ***Be sure that you review the Pit Information Card*** for more information on conservation practices.

Conservation Practices

This part lists the most important conservation practices used in Wisconsin. These practices are described briefly with the problem(s) they help to remedy. On your Scorecard, mark all practices "yes" if needed, or "no" if not needed, for the most intensive land use unless otherwise noted on the pit card.

1) Develop a nutrient management plan

This practice is defined as managing the amount, source, placement, form and timing of the application of nutrients and soil amendments. This nutrient management plan must follow established criteria to address the application and budgeting of nutrients for plant production. All nutrient sources, including commercial fertilizer, manure, organic byproducts, legume crops, and crop residues are accounted for and properly utilized. The purpose of a nutrient management plan is to prevent nutrients from getting into surface or groundwater while maintaining and improving the physical, chemical and biological condition of the soil. This plan should cover all the lands where fertilizers, manure or soil amendments are applied during the course of a crop rotation or grass production.

2) Use residue management and/or plant cover crop

This practice refers to managing the amount, orientation, and distribution of crop and other plant residues, on the soil surface year round. This practice may be applied as part of a conservation management system to reduce wind, rill, and sheet erosion. This practice applies to all cropland, and other land where crops are grown including grass. This practice includes mulch tillage methods, commonly referred to as chiseling, subsoiling, disking, and/or no-till, row-till, slot-plant, strip-till, zero-till, or zone-till.

Planting a cover crop refers to growing grasses, legumes, forbs or other herbaceous plants established for seasonal cover and conservation purposes. This practice may be applied as part of a conservation management system to support one or more of the following purposes: reduce erosion from wind/water, increase soil organic matter, manage excess nutrients in the soil profile, promote biological nitrogen fixation, increase biodiversity, weed suppression, provide supplemental forage, and soil moisture management.

Residue management and/or planting cover crops should be recommended for all cropable soils (cropland and pasture) throughout Wisconsin.

Contour strip cropping system with waterways

3) Apply contour farming, contour buffer strips, contour strip cropping, or terraces

"Contour farming" includes tillage, planting, and other farming operations performed on or near the contour of the field slope. "Contour buffer strips" include narrow strips of permanent, herbaceous vegetative cover established across the slope and alternated down the slope with parallel, wider cropped strips. "Contour strip cropping" includes growing row crops, forages, small grains, or fallow in a systematic arrangement of equal width strips across a field. Terraces are earthen embankments, channels, or combinations of ridges and channels.

These practices may be applied as part of a conservation management system to support one or more of the following purposes: to reduce sheet and rill erosion, to reduce transport of sediment and other waterborne contaminants, and to control water runoff allowing greater infiltration.

Contour farming, contour buffer strips, contour strips or terraces should be recommended for all cropland soils with slopes 2 - 20%.

Grassed terrace

4) Maintain existing terraces

Terraces will be maintained as part of a conservation management system to support one or more of the following: reduce soil erosion, reduce sediment content in runoff water, retain runoff for moisture conservation, and improve farmability. Terraces will be maintained where soil erosion by water is problem, there is a need to conserve water, the soils and topography are such that terraces can be constructed and farmed with reasonable effort, a suitable outlet can be provided, and excess runoff is a problem. Recommend maintenance for existing terraces only.

Grassed waterway

5) Construct or maintain grassed waterways, diversions, or erosion control structures

A grassed waterway is a natural or constructed channel that is shaped or graded to required dimensions and established with suitable vegetation.

Grassed waterways may be applied as part of a conservation management system to support one or more of the following purposes: to convey runoff from terraces, diversions, or other water concentrations without causing erosion or flooding, to reduce gully erosion, or to protect water quality. Grassed waterways may be needed to control erosion resulting from concentrated runoff and may be used alone or combined with other conservation practices. This practice is not applicable if construction would destroy important woody wildlife cover or wetlands.

A diversion is a channel constructed across the slope generally with a supporting ridge on the lower side. Diversions should be recommended where the directed or controlled flow or dispersal of water is necessary.

Erosion control structure

Erosion control structures are earthen dams, rock, soil or aluminum drop structures or pipe outlets, earthen embankments. These structures typically are positioned at or near the end of a grass waterway where volume and velocity of water require an additional measure to stabilize outlet of the waterway.

6) Renovate or otherwise improve pasture

Pasture renovation includes: killing existing vegetation by chemical and/or surface or subsurface tillage; liming and fertilizing according to soils test reports; and reseeding the pasture to be used for grazing purposes to a high producing legume-grass mixture. On steeper slopes renovation can be accomplished by mulching narrow strips or bands (tillage equipment width) across the slope during successive years, to minimize water runoff or wind (blowing) erosion.

Other methods of improving pasture range from basic weed control to eliminating undesirable brush, stones, etc.

Pasture renovation or other types of pasture improvements should be recommended on pasture or grazing land where feasible.

7) Eliminate or manage grazing

Eliminate grazing means excluding livestock from an area where grazing is undesirable at all times. All woodlands to be used for commercial purposes and wildlife habitat areas should be fenced to keep livestock out. This practice helps reduce runoff and the resulting erosion, as well as enhances the natural beauty of the area.

Control grazing refers to prevention of overgrazing by excessive livestock numbers particularly during periods of drought or prolonged wetness when temporary or permanent damage to pasture land may occur. Manage grazing refers to the controlled harvest of vegetation with grazing or browsing animals, managed with the intent to achieve a specified objective. The purposes of this practice are as follows: improving the quality and quantity of forages for the benefit of the producer, livestock, wildlife, and environment, protecting water quality, improving and maintaining the health of livestock, plants, and soil, and reducing soil erosion. This practice may be applied on all lands intended to provide forage or vegetative food for grazing or browsing animals.

Eliminate or manage grazing should be recommended on all areas intended for wildlife habitation as well as on all pasture land and woodland. It is expected that all cropland already has eliminated or controlled grazing and therefore should not be considered for this practice.

8) Improve timber stand or plant adapted trees in woodland

Improving woodlands and timber stands includes removing undesirable or unwanted trees, shrubs or vines, etc. It particularly applies to woodlands where removing part of a stand will improve stand quality, recreational, wildlife, or aesthetic values. It includes protection from uncontrolled fire, insects, disease, and grazing livestock. The cutting of trees should be done in accordance to a management plan.

Planting trees adapted to a site is to establish or reinforce an existing stand of trees; conserve soil, and soil moisture infiltration; beautify an area; protect a watershed; provide wildlife habitat or to produce a woodlot crop.

Improve timber stand or plant adapted trees should be recommended where land use includes the sale of marketable lumber or woodlot products, and where aesthetic beauty of wildlife in its natural habitat is of prime concern.

When the predominant ground vegetation is grass, the site will be considered grassland. Therefore, this practice would not be applicable on these sites.

9) Establish windbreaks

Windbreaks are linear plantings of single or multiple rows of trees or shrubs or sets of linear plantings.

This practice may be applied to reduce soil erosion from wind, to protect plants from wind-related damage, to alter the microenvironment for better plant growth, to manage snow drifts, to provide shelter for structures, livestock, and recreational areas, to enhance wildlife habitat by providing travel corridors, to provide living noise screens, to provide living visual screens, to provide living barriers against airborne chemical drift, to delineate property and field boundaries, to improve irrigation efficiency, and to enhance aesthetics.

10) Protect stream banks or lakeshore

Stabilizing and/or protecting stream banks or lakeshores by vegetative or structural means prevent scour and erosion. This includes planting of grasses and legumes, as well as needed mechanical measure such as bank grade stabilization and rock riprapping. The use of selected plant species, such as willows, etc., may aid greatly in holding stream banks and/or lakeshores, reducing erodibility, as well as providing habitat for certain wildlife species.

Stream bank protection reduces sediment load resulting in less downstream damage (sedimentation). Stream banks need protection so as to prevent loss of tillable acreage; or damage to utilities, roads, bridges, fence lines and floodgates, and buildings; as well as rendering the surrounding area useless for recreation or as habitat for fish and wildlife.

Lakeshore protection reduces sedimentation along shorelines. Shorelines need protection from wave action resulting from wind and wakes from power boats, otherwise, damage to utilities, roads, etc., will occur and the surrounding area may become useless from recreation or as a habitat for fish and wildlife.

Protection of stream banks or lakeshores should be recommended when they are present within the site area. Streams will be considered streams where water is flowing.

11) Improve fish and wildlife habitat

LUNKERS structure (above) and improved streambank with LUNKERS installed in-stream.

Retaining, creating or managing wildlife on upland or wetland keeps, creates or improves habitat for desirable wildlife species. These include: upland birds, waterfowl, songbirds, fur bearers, game and non-game animals and others. These areas are commonly developed on “odd corners,” and places not readily suited for agriculture including permanent fence rows, and non-tilled areas along fence rows, but need not be confined to such areas.

Wildlife habitat development may include providing grain, grasses, legumes, upland herbaceous plants, woody plants including hardwood trees, coniferous trees and shrubs, wetland herbaceous plants, deep and shallow water areas, etc.

Opportunities exist in lakes and streams to create and improve fish habitat. Practices such as LUNKERS* fish cribs, spawning, reefs, and gravel bars are excellent fish habitat practices.

Wildlife habitat improvement should be recommended for areas not suitable for agricultural purposes (crops or pasture); “odd areas” including permanent fence rows, as well as other places normally frequented by wildlife (woodlands, etc.)

*Little Underwater Neighborhood Keeper Encompassing Rheostatic Salmonids

12) Establish/maintain riparian forest buffer or grass filter strip

Riparian forest buffers or grass filter strips are strips or small areas of grass, trees or shrubs established along streams, ditches, wetlands or other water bodies. Riparian buffers trap sediment, filter nutrients, and provide habitat and corridors for fish and wildlife.

These strips or small areas of land in permanent vegetation help control pollutants and provide other environmental benefits:

- Provide Habitat - provide habitat and corridors for aquatic and terrestrial plants and animals, increase the diversity of plant and animal species in riparian areas, provide shade to lower water temperatures and increase dissolved oxygen for better aquatic organism habitat; also provide a source of debris and woody cover for aquatic organisms.
- Reduce Flooding - permanent trees and herbaceous cover in floodplain areas subject to out-of-bank flow and/or scour erosion may reduce flood flows and mitigate flood damage.
- Protect Water quality - buffers reduce amounts of sediment, organic matter, nutrients, pesticides, and other pollutants in surface runoff and reduce the amounts of nutrients and other chemicals in shallow groundwater.

Grass filter strips should be applied to areas where conditions associated with sediment and pollutant delivery from the contributing drainage area are identified and where the installation of this practice, as part of a conservation management system, will provide a direct benefit to water quality and/or riparian stability.

Riparian Forest Buffers and Grass Filter Strips are primarily water quality practices and not forestry practices. Therefore, “planting adapted trees (# 8)” is not applicable on these sites. However, these sites provide excellent wildlife habitat as a secondary benefit. Selecting (#11) Improve Fish and Wildlife Habitat would be correct.

13) Control invasive species that are present

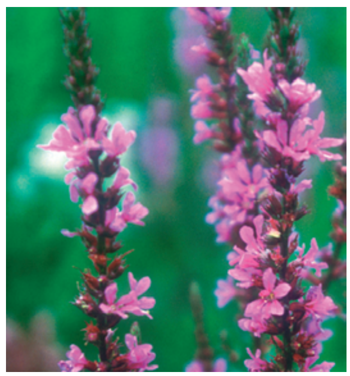
Invasive species control is the removal, reduction, or manipulation of certain herbaceous and non-herbaceous invasive plants. This practice may be applied as part of a conservation management system to accomplish one or more of the following purposes: restore natural plant community balance, create the desired plant community, reduce competition for space, moisture, and sunlight between desired and unwanted plants, restore desired vegetative cover to protect soils, control erosion, reduce sediment, improve water quality and enhance stream flow, maintain or enhance wildlife habitat including that associated with threatened and endangered species, improve forage accessibility, quality and quantity for livestock, and improve visibility and access for handling livestock.

These six and other plants, animals, and pests are invading Wisconsin lakes, rivers, forests, wetlands, and grasslands.

They displace native species, disrupt ecosystems, and affect citizens' livelihoods and quality of life. They hamper boating, swimming, fishing, hunting, hiking, and other recreation, and take an economic toll on commercial, agricultural, forestry, and aquacultural resources.

Contestant will be asked to identify the presence of any of these six (6) major invasive plants.

Garlic Mustard



Purple Loosestrife

Wild Parsnip

Multiflora Rose

Honeysuckle

Box Elder

Other references for non-native or invasive plants:

USDA NRCS Invasive and Noxious Weeds *http://plants.usda.gov/java/noxious*
DNR Invasive Species Photo Gallery *http://www.dnr.state.wi.us/invasives/photos*
UW Botany Dept *http://www.botany.wisc.edu/herbarium/*

Part V. Non-Ag Land Use Limitations

Land suitable for agricultural production may not always be suitable for other uses. Soil scientists and land managers may have to evaluate the suitability of land for uses such as building sites, construction materials, recreational areas, sanitary facilities, landfills, wastewater treatment, and water retention ponds. Specific criteria have been developed for evaluating land for these and other uses.

The tables below show the criteria for indicating if a particular site has limitations for building houses with basements, septic systems, and roads or streets. Judges should indicate on scorecards that limitations for these uses exist if site and soil characteristics meet ***any*** of defined criteria. Soil characteristics such as depth to high water table, depth to bedrock, and stoniness refer only to what is observed within the control section. Any criteria unusual to the site and soil characteristics will be indicated on the site information card (i.e. flooding frequency). Mark **Yes** if limitations are present for the following, **No** if not.

1) Houses with Basements

- Site is subject to any flooding frequency
- Depth to high water table is less than 40”
- Depth to bedrock is less than 60”
- Slope is greater than 12%
- Stones larger than 3” make up greater than 25% of the volume of the control section

2) Septic Tank Absorption Fields

- Site is subject to any flooding frequency
- Depth to high water table is less than 48”
- Depth to bedrock is less than 72”
- Slope is greater than 12%
- Stones larger than 3” make up greater than 25% of the volume of the control section
- Any texture of subsoil except sandy loam

3) Local Roads, Streets and Driveways

- Site is subject to any flooding frequency
- Depth to high water table is less than 36”
- Depth to bedrock is less than 60”
- Slope is greater than 12%
- Stones larger than 3”make up greater than 25% of the volume of the control section
- Texture of the subsoil is medium, moderately fine, fine or organic