Version 3.0

Region 3 Collegiate Soils Contest Handbook

Hosted by Purdue University

West Lafayette, IN

October 19 & 20, 2023

PREFACE

This handbook provides information about the 2023 Students in Agronomy, Soils, and Environmental Sciences (SASES), Region 3 Collegiate Soils Contest. Much of the material comes from previous Region 3 handbooks. Other references used to develop this handbook include: Chapter 3 of the *Soil Survey Manual* (Soil Survey Division Staff, 2017), *Field Book for Describing and Sampling Soils*, version 3.0 (Schoeneberger et al., 2012), *Soil Taxonomy* (Soil Survey Staff, 1999), *Keys to Soil Taxonomy* 12th Edition (Soil Survey Staff, 2014), *National Soil Survey Handbook* (Soil Survey Staff, 1996), and *Field Indicators of Hydric Soils in the United States Version 7.0, (USDA-NRCS, 2010)*

I would like to welcome the teams to west-central Indiana and hope that the contest will provide an educational, enjoyable, and rewarding experience. The contest will expose students to the soils of Tippecanoe, Benton, White, Warren, and Montgomery counties. Many thanks to those who helped with preparations and funding for this event. The contest is being hosted by the Purdue University Agronomy Department with help from the Indiana NRCS, Indiana Society of Professional Soil Classifiers, Tippecanoe Soil and Water Conservation District, and the Hoosier Chapter Soil and Water Conservation Society.

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INTRODUCTION

Collegiate soils contests are sponsored by the Students of Agronomy, Soils, and Environmental Sciences (SASES), which is an undergraduate student organization of the American Society of Agronomy (ASA), Crop Science Society of America (CSSA), and Soil Science Society of America (SSSA). Any college or university that provides a four-year curriculum in agricultural, environmental, or geosciences located in the states of Illinois, Indiana, Michigan, Ohio, or Wisconsin is eligible to compete in the contest, provided the team members are member of SASES.

EVENT SCHEDULE

The Region 3 Collegiate Soils Contest for 2023 will be held October 19-20. The location of the sites will be near West Lafayette, IN. (Tippecanoe County).

Events occurring during the week of the contest include:

1. Practice time – Tuesday and Wednesday (October 17 & 18)
2. Welcome meeting with educational presentation – Tuesday evening (October 17)
3. Coach's meeting with official judges after presentation – Tuesday (October 17)
4. Individual Competition – Thursday AM (October 19)
5. Group Competition – Friday AM (October 20)
6. Awards ceremony – Immediately after group scorecards are graded (October 20)

The practice sites will be available on Tuesday morning. Coaches' packets will be distributed on Monday evening or Tuesday morning at your motel and/or emailed to you in advance. At least 8 practice sites that are representative of soils in the contest area will be judged by contest officials. Both practice and contest sites must be evaluated by the official judge(s). Individual competition will take place on Thursday morning. The group competition will take place on Friday morning. Results and awards will be immediately after group scorecards are graded.

ROLE OF THE INSTRUCTOR (COACH)

The Region 3 Soils Contest is a co-curricular educational event that is organized under the auspices of the American Society of Agronomy (ASA), Crop Science Society of America (CSSA), and Soil Science Society of America (SSSA). Team participation in the event requires an instructor to prepare students in the fundamentals of soil morphological description, taxonomic classification, and application of the information for land use interpretations before travelling to the host region. A particularly valuable aspect of the event is the chance to visit and learn in a different soil-landscape region each year because the location changes annually. The event consists of two to three days of educational events, followed by two days with competitions. The primary educational events are sites with representative soils that have been described and studied by local experts, who provide information to visiting instructors.

It is expected therefore, that an instructor (coach) be present with the students throughout the duration of the event to teach students about the local geology, soil morphology, taxonomy, and interpretations. Furthermore, the instructor is needed for grading the competitive portion of the Contest, and the instructors of each team form the regional committee that determines the rules and sets future hosts of the Contest.

CONDUCT OF THE CONTEST

1. General

The contest will consist of two sites for group judging and four sites for individual judging with additional sites available for practice prior to the competition. At each site, a pit will be excavated exposing a profile. One or two areas will be selected in each pit and clearly designated as the control section by the contest officials. These areas will be used for measurement of horizon depths and boundaries. The selected areas will constitute the officially scored profiles and must remain undisturbed and unblocked by contestants. All measurements should be made within these designated areas. A tape measure will be attached to all contest pits control sections. Teams should bring their own tapes for practice pits. Contestants will be told which control section they are to evaluate if more than one is selected in a pit. The contestants will describe up to six horizons within a given depth. A card at each site will give the profile depth to be considered, the number of horizons to be described, the depth of a nail within the third horizon, and any required chemical data. The Region 3 site data card is included as Appendix 1. A topographic map and aerial imagery of the area with the sites located may be provided to help contestants orient themselves to the landscape. Changes to the group/individual contest schedule and the "time in and out" of pits may be made prior to the coaches meeting depending on the number of participants as well as pit and weather conditions.

All portions of the contest are closed book. No reference materials, other than those listed below, will be permitted during the contest. Any contestant found in possession of reference materials will be disqualified.

The following laminated handouts will be given to students at the individual contest (4 double sided sheets):

1) Hydric key
2) Loading rate table
3) Taxonomic key
4) Family particle size class key
5) Interpretation tables
6) Abbreviations
7) Water holding capacity, erosion potential, & surface runoff tables
8) Textural triangle

These 8 items can be found in Appendix 2.

A pit monitor will be present at each site to enforce rules, keep time limits, and clean the pit when necessary. The duties of the Site Monitor and the rotation schedule are in Appendix 3.

Contestants should provide the following for their personal use: clipboard, pencils (No. 2 suggested, pens will not work on wet papers), hand lens, tape measure, Abney level or clinometer, water bottle, acid bottle (10% HCl), knife, Munsell soil color charts, towel, 2-mm sieves and a container for soil samples. Simple calculators are permitted, programmable calculators and cell phones are <u>not</u>. No other electronics may be used (headphones, iPads, tablets…). Host university will not provide any of the materials listed above.

2. Individual Competition

The Region 3 Scorecard will be used to record all descriptions and evaluations for each site. Sixty minutes will be allowed for evaluating each of the four pits. Contestants will be assigned by team number to one of two groups at each site. One group will follow this schedule: 5 minutes in the pit, 5 minutes out, 10 minutes in, 10 minutes out, 5 minutes in the pit, 5 minutes out, and 20 minutes free-for-all (host may alter the final free-for-all time depending on number of contestants and pit size, we have gone 10, 15, or 20 minutes historically). The other group will follow the opposite in-and-out schedule. At alternating sites, the contestants will switch the in-and-out schedule. If two control sections are present in each pit and students will be designated "left" or "right". Contestants may not obtain a sample from the surface horizon while out of the pit. This is a safety precaution to prevent students from standing near pit edges and to avoid potential injury if a pit face collapses.

Individual contestants will be assigned a number that will be used to identify their scorecard and the rotation schedule.

3. Group Competition

Fifty minutes will be allowed for groups to evaluate each of the two sites. The time will be divided into 10-minute segments. 10 minutes in the pit, 10 minutes out, 10 minutes in, 10 minutes out, and 10 minutes free-for-all. Universities will be randomly assigned a group number at registration. All students from a university may participate in the group contest. During the “free-for-all” final 10 minutes at each pit, a maximum of 3 team members may be in the pit. The start time of the group contest will be announced at the coaches meeting. If two control sections are present in a pit, groups will be designated “left” or “right”.

The date, timing, and rotation schedule of both the individual and group components of the contest may be modified if warranted by weather, contestant numbers, and pit size.

4. Eligibility and Qualification for the National Collegiate Soils Contest

According to National Collegiate Soils Contest Rules (2017 revision) the following number of teams from Region 3 may qualify for the National Collegiate Soils Contest.

(a) If three or fewer teams from different institutions compete in a regional contest, all teams go to the national contest.

(b) If four to seven teams from different institutions compete in a regional contest, three teams go to the national contest.

(c) If eight to twelve teams from different institutions compete in a regional contest, four teams go to the national contest.

(d) If thirteen or more teams from different institutions compete in a regional contest, five teams go to the national contest.

If eight or more teams from different institutions compete in the Region 3 contest, the team from the host institution will automatically qualify for the National Contest and overall team score will determine other qualifying teams. If seven or fewer teams from different institutions compete in the Region 3 contest, the overall team score will solely determine qualifying teams. Additional rules on team eligibility for the National Contest can be found at:

https://www.agronomy.org/files/membership/students/2017-soil-judging-contest-rules.pdf

SCORING

1. General

All contestants will use the standard scorecard. It will consist of five sections. All boxes on the scorecard will be scored for the number of horizons required. If no entry is needed, then the contestant should enter a dash (---). Boxes left blank will be acceptable as a dash only if it is clear to the scorecard graders what the intent was. Students are STRONGLY encouraged to use a dash so there is no confusion with the graders. N is not acceptable in place of a blank or dash for redox features and efferv. A list of acceptable abbreviations can be found in Appendix 2; each contestant will receive a copy for use during the contest. Illegible entries or any abbreviations other than those listed in Appendix 2 will be marked wrong. The decisions of the contest officials will be final. If a profile has more than one parent material or diagnostic subsurface horizon, 5 points will be awarded for each correct answer. In these sections of the scorecard, negative credit (minus 5 points for each extra answer, with a minimum score of zero for any section) **will be used to discourage guessing**. More than one entry in other items of the scorecard that have one answer will be considered incorrect and will result in no credit for that item. For example, if loess and glacial till are the correct parent materials, then 5 points will be awarded for each. If a contestant checks loess (+5) and glacial outwash (0), the score would be 5; and if the contestant checked loess (+5), glacial till (+5), and glacial outwash (-5 extra answer) the score would be 5 because of the excessive answer. Omissions will not be given any points. In all other situations, points will be awarded as indicated on the scorecard.

2. Team Composition

The official team from a university will consist of three or four undergraduate students, who will be identified prior to the competition. Any number of students including those not on the official team can participate in the group portion of the contest. The team score will be the sum of the top three individual scores achieved by the official team at each pit. In this manner, all four team members may contribute to the final team score. An example of scoring:

INDIVIDUAL	SITE 1	SITE 2	SITE 3	TOTAL	
A	**232**	**241**	**254**	727	Scores for individual competition
B	**261**	**262**	**313**	836	
C	208*	**277**	251*	736	
D	**275**	234*	**289**	798	
Total	768	780	856	2404 = Score for Team	

* *Lowest score is not used to determine team score.*

The team score determined above is then added to the two pits which were done on a group basis for the overall team score. Placing in the contest to qualify for the national competition will be on the overall score.

Up to 8 individuals are eligible for individual awards from a university. Prior to the contest, coaches will notify the host who is on their A team (scores count towards team) and who is on their B team (scores do not count towards team score). Students not on the A or B teams are welcome to judge practice sites and the contest pits but will not be eligible for individual awards. A university may have as many students as they want participate in the group judging portion. If the rotation and number of participating universities allows, the host may allow additional groups from a university to compete. These additional groups are not eligible for group awards.

All aspects concerning eligibility, location, time, and procedures will be governed by provision of the most recent version of "Rules of the National Collegiate Soils Contest" by the Students of Agronomy, Soils, and Environmental Science, or a document of similar intent that replaces the above.

3. Tie Breaker – Team

In case of a tie, the percent clay content of the third horizon at site #1 will be used. The mean clay content will be calculated from the estimates provided by all members of a given team. The team with the mean estimate closest to the actual value will win. For example:

Actual clay content of tie breaker horizon = 33%

Team estimates:

TEAM #5		TEAM #7	
Individual A	= 38%	Individual E	= 33%
Individual B	= 34%	Individual F	= 29%
Individual C	= 30%	Individual G	= 22%
Individual D	= 39%	Individual H	= 30%
Mean	= 35%	Mean	= 29%
Clay Content	= 33%	Clay Content	= 33%
Difference	= 2%	Difference	= 4%

TEAM #5 wins!

If a tie still exists, the clay content of the third horizon at site #2 will be compared, followed by the third horizon at sites #3 and #4 if necessary. If this does not break the tie, the next (lower) horizon(s) will be used in the same manner and order.

4. Tie Breaker – Individual and Group

The actual clay content of the third horizon at site #1 will be compared to that estimated by each individual or group tied. If a tie still exists, the clay content of the third horizon at site #2 will be compared, followed by the third horizon at sites #3 and #4 if necessary. If this does not break the tie, the next (lower) horizon(s) will be used in the same manner and order.

5. Awards

Plaques will be awarded to the top 5 overall individuals, the top 3 universities in the group contest, and the top 3 overall teams.

6. Scorecard Instructions

The scorecard consists of five parts: I. Soil Morphology, II. Soil Profile Characteristics, III. Site Characteristics, IV. Soil Classification and V. Soil Interpretation. The points for each item are indicated on the score card. The *Soil Survey Manual* (USDA Handbook no. 18, 1993 edition) and *Keys to Soil Taxonomy* (2014), or revisions thereof, will be used as guides whenever possible. Significant deviations from these references are included below.

I. SOIL MORPHOLOGY

A. Horizonation (*Soil Survey Manual*, p. 117-134)

(1) Master

a**.** **Prefix** - In mineral soils, Arabic numerals are used as prefixes to indicate that a soil has not formed entirely in one kind of material, which is referred to as a lithologic discontinuity, or just a discontinuity. Wherever needed, the numerals precede the master or transitional horizon designation. A discontinuity is recognized by a significant change in particle-size distribution or mineralogy that indicates that the described soil genetic horizons or layers formed in two deposits that are significantly physically or mineralogically different or formed in deposits with a significant difference in age. Stratification common to soils formed in water deposited sediments are not normally designated as a discontinuity. For example, it is common to have extreme particle size and coarse fragment content differences within a single glaciofluvial deposit.

When a discontinuity of surficial material is identified, prefix numbering starts in the underlying (second) deposit. The material underlying the surficial deposit is designated by adding a prefix of "2" to all horizons and layers that formed in the second material underlying the discontinuity. There is no minimum number of horizons and layers needed in materials that underlie the surficial deposit. If another discontinuity is found below material with prefix "2", the horizons and layers formed in the third material are designated by a prefix of "3". For example, Ap, E, Bt1, 2Bt2, 2Bt3, 3BC. The number suffixes designating subdivisions of the Bt horizon continue in consecutive order across the discontinuity. A discontinuity prefix is not used to distinguish material of buried (b) horizons that formed in material like that of the overlying deposit (no discontinuity). For example, A, Bw, C, Ab, Bwb1, Bwb2. However, if the material in which a horizon of a buried soil is in a discontinuity below the overlying material, the discontinuity is designated by number prefixes and the symbol for a buried horizon is used as well, e.g., Ap, Bw, C, 2Ab, 2Bwb, 2C.

A prefix number may also be used if a discontinuity is present in human transported material (HTM) deposits.

b. **Ltr**. - in the second column is to indicate the appropriate master horizon designations (i.e., A, E, B, C, or R) and combinations of these letters (e.g., AB, E/B, etc.). The prime ('), used for horizons having otherwise identical designations, should also be included in this column after the master horizon designation. The carat (^) symbol is placed in front of the Master horizon letter to indicate that human transported materials (HTM) are present. O horizons or layers may be shown in the practice sites but will not be described in the contest soils. All depth measurements should be taken from the marker in the third horizon. R horizons should be identified in the Master column, if within the judging depth. However, they will not otherwise be described, and so mark all other columns in that row with a dash. This is also true for Cr horizons except that the C is in the master horizon and the r in the subordinate distinction.

(2) Sub. Subordinate Distinctions.

Enter lower case letters to designate specific kinds of master horizons if needed. If none, enter a dash. Students should be familiar with applications of the following subordinate distinctions: **b** (buried genetic horizon), **d** (physical root restriction), **g** (strong gleying), **h** (illuvial accumulation of organic matter), **k** (accumulation of secondary carbonates), **p** (tillage or other disturbance), **r** (weathered or soft bedrock), **s** (illuvial accumulation of sesquioxides and organic matter), **t** (illuvial accumulation of silicate clay), and **w** (development of color or structure). If used in combination, the suffixes must be written in the proper order. Some type of subordinate distinction always follows the B master horizon. **Subordinate distinctions on transitional horizons (i.e. BAt, BCtg…) will be used when needed as they communicate morphologic information. Use of subordinate distinctions on transitional horizons should be consistent between practice and contest sites.**

The suffix **b** will be used only when a buried A horizon is evident. Suffix **b** will not be used if the A horizon of the buried has been eroded prior to deposition and pedogenesis of the new geologic material. The use of the **b** is not equivalent to the definition of "buried soil" in Soil Taxonomy. The only use of **w** in this contest is with B. A B**w** is not used to indicate a transitional horizon or a horizon that would be transitional if the entire pedon were present.

Spodic materials in this contest will be identified with either a B**s** or a B**hs**. Do not use Bh alone in this contest. B**s** horizons will have matrix moist value and chroma of >3, while B**hs** will be used for horizons with spodic materials having matrix moist value and chroma of ≤3.

(3) No. - Numerical Subdivisions

Enter Arabic numerals whenever a horizon identified by the same combination of letters needs to be subdivided. If a subordinate distinction or a numerical subdivision is not used with a given master horizon, enter a dash in the appropriate space on the scorecard.

(4) Lower Depth

Up to six horizons will be described within a specified depth noted on the site card. Determine the depth (in cm) from the mineral soil surface to the lower boundary of each horizon except the last. For a Bt1 horizon with a depth between 23 and 37 cm below the soil surface enter "37." The last horizon boundary should be the specified judging depth with a "+" added. Thus, if asked to evaluate five horizons to a depth of 140 cm, the fifth depth would be "140+." An exception is when the specified depth is at a lithic or paralithic contact, then the "+" is not used.

Lithic and Paralithic contacts (R and Cr horizons)

If a lithic or paralithic contact occurs at or above the specified depth on the site card, the contact should be considered in evaluating the water retention difference, effective soil depth, and hydraulic conductivity. Otherwise, the last horizon should be assumed to extend to 150 cm for making all relevant evaluations. If a lithic or paralithic contact occurs within the specified depth, the contact should be considered as one of the horizons to be included in the description, and the appropriate horizon nomenclature should be applied (i.e., Cr or R). For Cr and R horizons the HORIZONATION AND BOUNDARY section boxes only (1^{st} six columns) should be completed. Morphological features need not be provided, and dashes should be used on the scorecard in the remaining columns. If the contestant gives morphological information for Cr or R, it will be ignored by the graders and will not count against the total score. If in doubt concerning the nature of the horizon, the contestant would be advised to provide all normal responses.

Thin and Combination Horizons

In the contest, horizons less than 8 cm thick (no matter how contrasting) will not be described, although thinner horizons may be described in the practice pits. If a horizon less than 8 cm thick occurs, combine it for depth measurement purposes with the adjoining horizon that is more similar (e.g., a thin, discontinuous E horizon might be combined with an adjoining BE). When two horizons are combined to give a total thickness of 8 cm or more, always describe the properties of the thicker horizon. If combination horizons that contain lamellae ("E and Bt" or "Bt and E") or tonguing (E/Bt or Bt/E) are present, only describe the properties of the dominant component. However, properties of the non-dominant component should be considered for classification and interpretation purposes and should be included in official practice and contest descriptions. Depth measurements should be taken from the nail. The allowed range of lower depths considered correct will depend upon the distinctness of the boundary:

Distinctness of boundary	Range for grading
Abrupt (A)	± 1 cm
Clear (C)	± 3 cm
Gradual (G)	± 8 cm
Diffuse (D)	± 15 cm

(5) <u>Dist</u>. Distinctness of Boundary

Transition range	Distinctness of boundary
< 2 cm	Abrupt (A)
2 – 5 cm	Clear (C)
5 – 15 cm	Gradual (G)
> 15 cm	Diffuse (D)

The distinctness of lower horizon boundaries is to be evaluated as per the *Soil Survey Manual* (p 133). The distinctness of the lower boundary of the last horizon is not to be determined unless it is at lithic or paralithic contact. If the lower depth to be judged is at a lithic or paralithic contact, indicate the distinctness, if there is no lithic or paralithic contact, place a dash (---) in the box. The topography or shape of the boundaries will not be recorded.

B. Texture

(1) Sand and Clay

Estimates of percent sand and clay should be made for each horizon and entered in the appropriate columns. Answers within plus or minus 5% of the actual values will be given full credit. Content of clay and sand will be determined by field methods.

(2) Coarse Fragment Modifier.

Modification of textural class is made, if needed, in the coarse fragment column, when the soil contains more than 15% by volume coarse fragments. For the purposes of this contest, the following modifiers will be used when the volume of rock fragments is between 15 and 35%.

a. Gravelly [GR]
b. Cobbly (includes stones and boulders) [CB]
c. Channery [CH]
d. Flaggy (includes stones and boulders) [FL]

If the volume of coarse fragments is between 35 and 60%, prefix the appropriate modifier with the word “very” [V]. If the volume is greater than 60%, use the prefix "extremely" [E]. Enter the correct abbreviation for the coarse fragment modifier in the **Coarse Frag.** column, not in the texture class column. Do not enter percent values for coarse fragments in this column. If coarse fragment modifiers are not appropriate, enter a dash (-) in the space on the scorecard.

(3) Sand size modifier

If sandy textural classes (S, LS, SL) contain appreciable quantities of very coarse, coarse, fine, or very fine sands, enter a sand size modifier as defined in Chapter 3 of the *Soil Survey Manual* (2017). If a sand size modifier is not appropriate, enter a dash (-) in the space on the scorecard.

(4) Class

The textural class for the less than 2 mm fraction of each horizon is to be entered in the column labeled **Class**; the only acceptable abbreviations are given in Appendix 2. Enter the abbreviation for only one class. More than one may be considered correct by the official judges, but if a contestant enters more than one class, the entire entry is wrong.

C. Color

Munsell soil color charts must be used to determine the moist color of each horizon described. Colors must be designated by Hue, Value, and Chroma. Color names such as "pale brown" will not be accepted as correct answers. Partial or full credit may be given for colors close to the official evaluation, either in hue, value, or chroma. In the case of surface horizons, color is to be determined on crushed samples. The color recorded for soil material from any other horizon, including a mottled horizon, should be the dominant, unrubbed color of the ped interior, not a ped surface or cutan. The dominant color may or may not be the matrix color.

D. Structure

Record the dominant Grade and Shape of structure as defined in the Soil Survey Manual (p. 157-163). If different kinds of structure occur in different parts of the horizon, give the shape and grade of the structure that is most common. If the most common structure is compound (one kind breaking to another), describe the one having the stronger grade. If they are of equal grade, give the one with the larger peds. Numerical notations will be utilized for grade of structure. If the soil materials are structureless, enter "0" under Grade and massive (MA) or single grain (SGR) under Shape.

Soils having structure inherited from parent material will be designated “rock-controlled fabric” (RCF) to differentiate the geologic structure from pedogenic structure. This type of structure is relatively common in thinly bedded post-settlement alluvium and some eolian deposits and some tills (appears platy) in the region. While this structure is not considered pedogenic in nature, it does impact hydraulic properties and is therefore important to recognize. Rock-controlled fabric is given a grade of 0 to indicate the lack of pedogenic structure development. This structure designation should only be used in C or C transition (AC, CA...) horizons.

E. Consistence

Determine **Moist Strength** at approximately field capacity for each horizon. We consider it impractical to use the definitions in the *1993 Soil Survey Manual* for contest purposes and therefore the following definition from the *1951 Soil Survey Manual* will be used (p. 154-156):

Consistence when moist is determined at a moisture content approximately midway between air-dry and field capacity. At this moisture content most soil materials exhibit a form of consistence characterized by (a) tendency to break into small masses rather than into powder; (b) some deformation prior to rupture; (c) absence of brittleness; and (d) ability of the material after disturbance to cohere again when pressed together. The resistance decreases with moisture content, and accuracy of field descriptions of this consistence is limited by the accuracy of estimating moisture content. To evaluate this consistence, select and attempt to crush in the hand a mass that appears slightly moist.

Abbreviation	Moist consistence	Criteria
L	Loose	non-coherent
VFR	Very friable	crushes under very gentle pressure but coheres when pressed together
FR	Friable	crushes easily under gentle to moderate pressure between thumb and forefinger, and coheres when pressed together
FI	Firm	crushes under moderate pressure between thumb and forefinger but resistance is distinctly noticeable
VFI	Very firm	crushes under strong pressure; barely crushable between thumb and forefinger
EFI	Extremely firm	Crushes only under very strong pressure; cannot be crushed between thumb and forefinger and must be broken apart bit by bit

F. Soil Features

Redox *(RMF Depletions and Concentrations)*: Soils that have impeded drainage or high-water tables during certain times of the year usually exhibit redoximorphic (redox) features (RMF) as a result of the redistribution of reduced iron and manganese. Redox features to be considered for contest purposes include redox depletions (generally seen as gray zones) and redox concentrations (generally seen as "red/orange" zones of Fe accumulation or "black" zones of Mn accumulation).

For the contest, the judges will only mark yes if ≥ 2% redox concentrations and depletions (common and many) are present. If 1% redox features are observed No (-) is the correct answer.

Depletions: If the horizon has a "g" subordinate distinction, the matrix color will be the primary redox depletion color and "**yes"** would be checked for RMF depletions. If there are depletions in the soil, even if not the dominant color, these should be indicated with a "**yes"** for RMF depletions. Specific definitions may be found in Soil Taxonomy in the Aquic Conditions section of Other Diagnostic Soil Characteristics. For determination of a seasonal high-water table, depletions of chroma 2 or less and value of 4 or more must be present.

Presence: Yes (Y) ≥ RMF 2% depletions are present.
No (---) RMF depletions are not present.

Concentrations*:* Redox concentrations may consist of zones of high chroma color, or the Fe and Mn can accumulate into masses (concretions or nodules). Colors associated with the following features will not be considered redoximorphic features: clay coatings (unless their color results from reduction/oxidation), carbonates, krotovina, rock colors, roots, or mechanical mixtures of horizons such as E or B horizon materials within an Ap horizon.

Presence: Yes (Y) ≥ 2% RMF concentrations are present.
No (---) RMF concentrations are not present.

Effervescence: Calcium carbonate effervesces (visible as bubbles or audible as fizzing) when treated with cold dilute hydrochloric acid (10% HCl). Some tills in the contest area may be calcareous. Carbonates may be visible as whitish material in the soil or they may be disseminated and not visible.

Some soils in the contest area may contain pedogenic carbonates redistributed in the soil profile during pedogenesis. Contestants must have their own acid bottles for this determination.

Abbreviation	Effervescence class	Criteria
----	No effervescence	No bubbles form
VS	Very Slightly Effervescent	Few bubbles form
SL	Slightly Effervescent	Numerous bubbles form
ST	Strongly Effervescent	Bubbles form a low foam
VE	Violently Effervescent	Bubbles form a thick foam

II. SOIL PROFILE CHARACTERISTICS

A. Hydraulic Conductivity

Estimate the saturated hydraulic conductivity of the surface horizon (Hydraulic Conductivity/ Surface) and the most limiting horizon (Hydraulic Conductivity/Limiting) within the depth specified on the site card. If a lithic or paralithic contact occurs at or above the specified depth, it should also be considered in evaluating conductivity. Although unlikely, it is possible for the surface horizon to be the limiting horizon with respect to saturated hydraulic conductivity. In this event, the surface conductivity would be indicated as both the surface and limiting layer hydraulic conductivity.

Three general **hydraulic conductivity** classes are used:

High: Greater than 86 cm/day. This class includes sands, loamy sands. Horizons containing large quantities of rock fragments with insufficient fines to fill voids between fragments are also in this class.

Moderate: Between 0.86 and 86 cm/day. This includes those materials excluded from the "low" and "high" classes.

Low: Less than 0.86 cm/day. Low hydraulic conductivity should be indicated with the following:

1) Clays, silty clays, or sandy clays that have massive, weak, or moderate structure.
2) Silty clay loams and clay loams that have weak or massive structure.
3) Cd horizons.
4) Cr or R horizons where the horizon directly above contains ≥ 2% redoximorphic depletions or a depleted matrix due to saturation and reduction (value ≥4 with chroma ≤2).

B. Loading Rate

Many rural homes in the region use septic systems. Central to septic system performance is soil hydraulic conductivity. The loading rate defines the rate wastewater enters the soil. The differences in wastewater loading rates are related to soil characteristics defining pore sizes and pore size distribution. Geology, texture, structure, and consistence each contribute to soil porosity and effluent movement. Individual states and some counties have developed loading rate tables based on soil morphologic features. In this contest we will use the criteria in Appendix 2. This table is a simplified version of the Illinois and Wisconsin state codes. To simplify things and save time we will not evaluate every horizon in this contest. We will only evaluate the loading rate for the material at 75 cm (including a Cr or R, if present, at 75 cm.) If the lower boundary of a horizon falls exactly on 75 cm, use that horizon.

Appendix 2 will be given to each contestant during the contest. It contains the soil loading rates in gallons per day per square foot (gpd/ft^2). To receive full credit, contestants must indicate the correct loading rate, and the appropriate row/column reference from the table. For example, for a sandy loam formed in till and having moderate, subangular blocky structure and friable consistence, a contestant would receive full credit if they indicated a loading rate of 0.84gpd/ft^2 and Ref. D4.

C. Effective Soil Depth

This is the depth to a restricting or contrasting layer that few or no roots penetrate. Dense till, bedrock, coarse sands and loamy coarse sands are considered restricting layers for Region 3 Soils Contests. Lithic and paralithic contacts are discussed in "Soil Taxonomy." In Region 3 Soils Contests, lithic or paralithic contacts either within or at the bottom of the described profile are limiting. Dense till and coarse sand may require more explanation. Dense till typically has massive structure but may be very coarse prismatic and/or may break into geogenic plates upon desiccation. Also dense till typically has a moist consistence of firm, very firm, or extremely firm. In such tills the vertical cracks between plates are offset, like bricks in a wall, so roots grow downward through the vertical cracks to the next plate and then grow laterally.

In some cases, coarse sand horizons can also be a root limiting layer. Horizons that are at least 25 cm thick, with a texture of coarse sand or loamy coarse sand, with or without coarse fragments, are considered restricting layers when they occur below finer horizons.

D. Water Retention Difference

Water retention difference refers to the amount of water held between 33 kPa and 1500 kPa tension. This has been referred to as plant available water. In the contest, contestants calculate the moisture that soil can hold within the upper 150 cm, or above a lithic or paralithic contact, whichever is shallower.

Four retention classes listed will be used:

Very low: < 7.5 cm
Low: 7.5 to < 15.0 cm
Moderate: 15.0 to < 22.5 cm
High: ≥ 22.5 cm

Texture is an important factor influencing moisture retention, and the following estimated relationships are used:

Water retention difference *(in cm water per cm soil)*	**Textures**
0.05	Sand, loamy coarse sand, and loamy sand
0.10	Loamy fine sand, loamy very fine sand, and coarse sandy loam
0.15	Sandy loam, fine sandy loam, sandy clay loam, sandy clay, clay, and silty clay
0.20	Very fine sandy loam, loam, silt loam, silt, silty clay loam, and clay loam

If the instructions on the site card require contestants to evaluate a profile that is less than 150 cm deep, assume that the last horizon extends to 150 cm unless it is underlain by a lithic or paralithic contact within 150 cm. In the case of lithic or paralithic contact, assume that no water retention occurs below the contact. Coarse fragments are considered to have negligible (assume zero) moisture retention, and estimates must be adjusted to reflect the coarse fragment content. Contestants should adjust the water retention difference accordingly for any horizon with 15% or more coarse fragments.

For the purposes of this contest, reductions in water retention due to the presence of coarse fragments will be made according to the following:

Coarse fragment modifier used	**Percent reduction in water retention difference**
GR, CB, CH, or FL	25%
VGR, VCB, VCH, or VFL	50%
EGR, ECB, ECH, or EFL	75%

For example, if a 30 cm thick horizon that is gravelly silt loam (GR SIL) texture, the water retention of that horizon is calculated as follows: *cm water retention = 30 cm x 0.20 x (1-0.25) = 4.5 cm*

The water retention of the other horizons within the 0-150 cm depth are calculated similarly, and summed to determine the total water retention. For Cd horizons, calculate only one-half of the normal moisture storage for that texture beginning at the top of the Cd and all underlying horizons to a depth of 1.5 m or to a lithic or paralithic contact, whichever is shallower.

F. <u>Soil Wetness Class</u>

The wetness classes utilized in this contest are those which identify redox depletions caused by saturation and reduction.

Description
Redox depletions < 25 cm
Redox depletions 25 to 49 cm
Redox depletions 50 to 99 cm
Redox depletions 100 to 150 cm
Redox depletions > 150 cm

The interpretation of wetness class is conservative because reducing conditions are seasonal and saturation may be closer to the soil surface than is indicated by the morphological features used to indicate wetness. Soils that have gray redoximorphic features immediately below a mollic epipedon should be assumed to be: “Redox depletions < 25 cm”. Mollic colors often mask redox features.

If no evidence of wetness is present above a lithic or paralithic contact, assume “Redox depletions > 150 cm”. If no evidence of wetness exists within the specified depth for judging and that depth is less than 150 cm, assume “Redox depletions > 150 cm”

III. SITE CHARACTERISTICS

A. Parent Material

Contestants must identify the parent material(s) within each profile. If more than one parent material is present, all should be recorded. Parent materials, like soils, do not always lend themselves to easy classification, so the contest officials may need to take the complexity of the situation into account in scoring alternative interpretations. The following are definitions of parent materials used in this region.

(1) **Alluvium**: Alluvium is material transported and deposited by flowing water or in ponded depressions. It includes material on flood plains, stream terraces, alluvial fans, and at the base of slopes, drainageways, and depressions where sorting indicates water as the primary mechanism of transport. Evidence of sorting by flowing water (stratification) may occur in several forms, including irregular variability of particle size with depth, especially of sand and rock fragment sizes. For example, thin strata (layers) of sandy textures alternating with silty textures, or a change from non-gravelly to extremely gravelly textures indicate irregular deposition due to variation in the velocity of flowing water. Rounded rock fragments sorted by size are also clues of movement by flowing water. In flooded areas, the soil may contain buried horizons and is coarser-textured nearest the active channel, becoming finer-textured away from the channel.

(2) **Beach deposit:** sandy material deposited near the shore of a lake, primarily by wave action.

(3) **Colluvium:** Colluvium is poorly sorted material accumulated on, and especially at the base of, hillslopes. Colluvium results from the combined forces of gravity and water in the local movement and deposition of materials. Colluvium may contain a mixture of rock fragment types with variable size and orientation within a horizon, or it may contain a mismatch between rock fragments in upper horizons with those of horizons below that retain rock-controlled structure or in-place rock fragments below. Recently transported colluvium is typically found on lower backslope, footslope or toeslope landscape positions.

(4) **Eolian sand:** primarily fine and medium sand that has accumulated through wind action, normally on dune topography.

(5) **Glacial outwash**: a type of Pleistocene age glaciofluvial deposit characteristic of heavily loaded streams with highly variable discharge that were fed by glacial meltwaters. Glacial outwash is stratified and may be highly variable in texture. Strata containing sand (medium sand or coarser) and/or gravel are often present. This feature distinguishes glacial outwash from lacustrine deposits. Glacial outwash may occur as outwash plains, stream terraces, kames, eskers, or as a relatively coarse material separating loess from till.

(6) **Human-Transported Materials** Human-transported material (HTM) is material moved and deposited by intentional human activity, usually with the aid of machinery. Common types of HTM include dredge deposits, construction debris, mine spoil, and other waste materials (ash, sludge, slag). These materials were intentionally collected and moved from one soil to another by human actions, tools, or machinery. These do not include material moved indirectly by human action, such as topsoil moved under accelerated erosion in farmland. The HTM are confirmed by the presence of artifacts, their occurrence on an evident human-constructed landform, or the evident burial of a natural soil below them on a human- constructed landform. Observed properties of HTM include disordered rock fragments, freshly fractured rock fragments with sharp or splintered edges, bridging voids between rock fragments, pockets of dissimilar materials, detached fragments of diagnostic horizons, buried artifacts, carbo-lithic materials, layers compressed by machinery, irregular distribution of organic matter, and the presence of strongly contrasting topsoil or underlying materials. The key to identification often is ruling out deposition by natural forces or processes.

(7) **Lacustrine deposit**: relatively fine-textured (typically finer than medium sand), well-sorted, materials often stratified at depth, deposited in lake or slackwater environments. Includes glacio-lacustrine materials.

(8) **Loess**: fine-grained, wind-deposited materials that are dominantly of silt size. Textures are usually silt loam, silt, or silty clay loam. Where loess mantles are thin (< 75 cm), there may be some coarser mineral particles particularly toward the base of the loess deposit. Larger particles can be incorporated into the loess through bioturbation, freeze-thaw, or through colluvial action.

(9) **Glacial till:** relatively compact, unsorted, unstratified Pleistocene-aged material, ranging in size from boulders to clay, deposited directly by ice without significant reworking by meltwater. Glacial till can be found with almost any texture. Includes all glacial diamictons.

(10) **Pedisediment:** a layer of sediment derived from the shoulder and backslope of an erosional surface, which lies on and is, or was, being transported across a more gently sloping erosional surface.

(11) **Residuum**: The unconsolidated and partially weathered mineral materials accumulated by weathering of bedrock in place.

B. Landform

Contestants should be able to identify a variety of landforms that are common to the region. Landforms and parent materials will usually be closely related. Two types of landforms are recognized: (**1) constructional** landforms and **(2) erosional** landforms. It is essential to recognize the difference between landforms produced by constructional processes and those produced by erosional processes. All landforms may be eroded, but in the use of the terms *erosion* and *construction*, a very large scale is assumed. In a situation where two parent materials are present, the landform will be selected on the basis of the process that controls the shape of the landscape. In some cases, this will be the lower parent material, but not always. For example, see till plain below. If residuum is exposed in the pit, then an erosional landform should be used. Only one landform, either constructional or erosional, is to be identified at each site. Select the one that best describes the situation. Dual or partial credit may be awarded.

(1) **Constructional landforms** are formed by deposition from colluvial, glacial, eolian, fluvial, and related processes. Such areas may be eroded with either an open or closed system drainage. Parent materials are suggested but there may be more than one parent material.

a. **Floodplain:** land bordering an active stream, built up of sediment from overflow of a stream. Although flooding may or may not occur frequently, this landform is subject to inundation when the stream is at flood stage. One or all the parent materials is alluvium regardless of where in the profile the alluvium occurs.

b. **Stream terrace**: a landform in a stream or river valley, below the upland and above the current floodplain, consisting of a nearly level surface and hillslope leading downward from that surface. Terrace materials were usually deposited by glacial meltwater. Parent materials are usually glacial outwash, alluvium, or lacustrine deposit. Some are capped with loess.

c. **Kame/esker**: a conical hill (kame) or a sinuous ridge (esker) composed of stratified sand and gravel deposited by meltwater in contact with glacial ice. The lowest parent material is glacial outwash. Kames and eskers may have a draping of debris flow glacial diamicton (till-like) over the glaciofluvial sediments.

d. **Alluvial fan:** a low, cone-shaped deposit formed by material deposited from a tributary stream of steep gradient flowing into an area with less gradient. This includes colluvial and alluvial footslopes. There is much debate amongst pedologists and geomorphologists on the name of the colluvial/alluvial hybrid material comprising alluvial fans. For this contest, we will call material making up alluvial fans, alluvium.

e. **Beach ridge**: an essentially continuous ridge of sandy material along the present or former shoreline of a lake. Parent material is beach deposit.

f. **Loess plain/hillslope**: landforms consisting of windblown silt deposits that are thick enough for an entire solum to develop in loess. Loess is the deepest parent material described.

g. **Outwash plain:** a low-relief area, when considered regionally, composed of glacio-fluvial debris spread away from glacier margins by meltwaters that were not confined to a river valley. The topography of an outwash plain can be smooth or very irregular. The deepest parent material described is glaciofluvial (outwash) and the landform is not a kame or esker.

h. **Sand dune:** a hill or ridge of wind-blown sand. The parent material is eolian sand.

i. **Lake plain:** a level landform located on the bed of a former lake or pond and underlain by stratified lacustrine sediments. The deepest parent material is lacustrine. May have alluvial, glacigenic, and/or eolian sediments above the lacustrine sediments. Includes ice-walled lake plains.

j. **<u>Till plain/drumlin/moraine</u>:** an extensive, flat to undulating area underlain by till. For our purposes till plains are considered to include ground, recessional, end or terminal moraines, and drumlins. A till plain may be covered by eolian, glaciolacustrune, and/or glaciofluvial sediments. It is possible to find outwash "smears" on till plains in the eastern portion Portage County. In these soils, if we were to dig deeper, we would find glacial till. If outwash and till are observed in the same profile, and the landscape is a ground moraine, the correct landform would be till plain/drumlin/moraine, even if the outwash is the bottom parent material.

(2) Erosional landforms, carved by running water, occur in the region. Contestants should be able to recognize the erosional landforms, which are shown schematically in Figure 1. This is a large-scale consideration. Observe how this concept is used on the practice sites. If the soil developed in transported materials, do not use erosional landforms. Erosional landforms should be used only if pedisediment, residuum, or bedrock is the lowest parent material.

a. **<u>Upland headslope</u>**: the concave portion of a slope at the head of a drainageway on which slope lengths converge downward.

b. **<u>Upland sideslope</u>**: the generally linear portion of slope along the side of a drainageway.

c. **<u>Upland noseslope</u>:** the convex portion of a slope at the open end of a drainageway on which slope lengths diverge downward.

d. **<u>Interfluve</u>:** the high area including divides between adjacent drainageways.

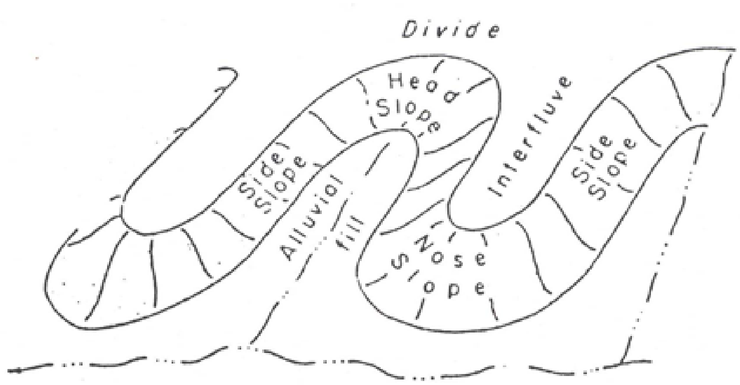


Figure 1. Erosional landforms.

C. Slope

Slope classes used in this contest are listed on the scorecard. The slope should be determined with an Abney level or clinometer between two stakes at each site. The stakes may be of unequal height. Stakes are provided to assist contestants to measure the actual slope of the land between the stakes, not the slope at the top of the stakes. The height of the stakes should be compared and the actual soil slope measured. A space is provided on the scorecard for students to write the actual slope. This will not be graded, only slope class range will be graded.

D. Slope Profile (landscape position)

The slope profile components are shown graphically by a hillslope cross-section in Figures 2 and 3. Not all profile elements may be present on a given hillslope. **A determination will be made location where the slope stakes are located.** This may or may not be the same as where the pit is located.

(1) **Summit:** a topographic high such as a hilltop or ridge top. Summits can be linear or slightly convex in shape.

(2) **Shoulder:** a slope adjacent to the summit that is convexly rounded.

(3) **Backslope:** a mostly linear surface that extends downward from a summit or shoulder position.

(4) **Footslope:** a concave slope segment at the base of a hillslope. If located in a closed depression center that is concave in shape, footslope should be marked.

(5) **Toeslope:** the lowest component that extends away from the base of the hillslope. Toeslopes are typically linear in shape. If located in a closed depression center that is linear in shape, toeslope should be marked.

(6) **None:** This designation will be used when the slope at the site is < 2% **AND** the site is not in a well-defined example of one of the slope positions given above (e.g., within a nearly level till plain, outwash plain, terrace, or floodplain).

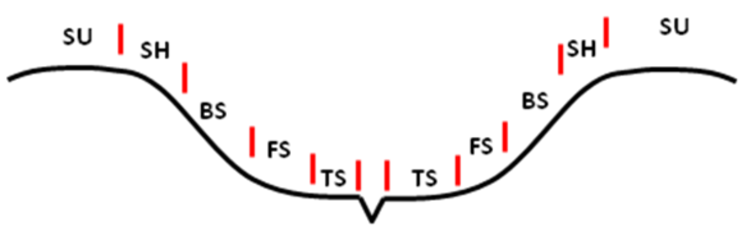


Figure 2. Landscape positions – upland drainageway example.

Figure 3. Landscape positions – closed depression example.

E. Surface Runoff

Runoff is the water that flows away from the soil over the surface without infiltrating. Soil characteristics, management practices, climatic factors (e.g., rainfall intensity), vegetative cover, and topography determine the rate and amount of runoff. The scorecard includes the six runoff classes and the combined effects of hydraulic conductivity, slope, and vegetation on runoff rate are considered. A guideline for evaluating various slopes and limiting hydraulic conductivity under cultivated conditions follows. **If the soil is located in a closed depression use the "closed depression" row in the table.**

% Slope	**Limiting hydraulic conductivity within 50 cm of the surface**		
	High	Moderate	Low
Closed depression	Ponded	Ponded	Ponded
0 - <1	Very slow	Very slow	Slow
1-<2	Very slow	Slow	Medium
2 - < 6	Slow	Medium	Rapid
6 - < 12	Medium	Rapid	Very rapid
12+	Rapid	Very rapid	Very rapid

If a site is in perennial vegetation (natural area, pasture…) determine the runoff rate as though the area was cultivated; then consider the effect of vegetation by assigning the next slower runoff class to a minimum of very slow. For example, a site with perennial vegetation, 0.5% slope, and low hydraulic conductivity within 50 cm of the surface would have a "very slow" runoff class.

F. Soil Erosion Potential

The erosion potential is dependent on the factors contributing to surface runoff, as well as organic matter content and physical properties of the surface horizon, including texture and structure. For the purposes of this contest, the following table will be used to determine soil erosion potential. The table assumes typical organic matter contents for Midwestern agricultural soils and granular structure or structureless, single-grained in the surface horizon, although there is no adjustment if that is not the case. To simplify the determination of erosion potential, no adjustments will be made on the basis of sand size. However, students should be made aware that in reality sand size can have a significant impact on erosion potential.

Surface Runoff	**Surface Horizon Texture**			
	S, LS	SCL, SC	SL, CL, C, SIC	L, SI, SIL, SICL
Ponded/Neg.	Low	Low	Low	Low
Very slow	Low	Low	Low	Medium
Slow	Low	Low	Medium	Medium
Medium	Low	Low	Medium	High
Rapid	Low	Medium	High	High
Very Rapid	Medium	High	High	High

IV. SOIL CLASSIFICATION

Soil Taxonomy, USDA-NRCS Agricultural Handbook 436, 2nd Edition (1999) and the most current edition of *Keys to Soil Taxonomy* should be referred to for details on soil classification. Only the diagnostic horizons, features, orders, suborders, great groups, particle size control section, and family particle size class that are possible for mineral soils in the contest area are included on the scorecard.

Contestants should list only the diagnostic horizons of the soil to be classified. In the case of buried soils, only the diagnostic horizons (or lack thereof) present above the buried soil should be selected on the scorecard and used to determine taxonomic classification. For example, if a soil contained a horizon sequence of Ap (ochric)-C1-C2-Ab-Btb(argillic) and the Ab and Btb horizons met the definition of a buried soil, the correct answers would be "ochric" under epipedon and "none" under subsurface diagnostic feature. If argillic was selected under diagnostic horizons, it would be incorrect. Laboratory data will be provided, if necessary, for each soil. This information will be used to determine the correct epipedon, subsurface horizon or feature, order, suborder, and great group for each soil. In the absence of chemical data, contestants should always assume the typical values for the area suggested in the practice sites. For taxonomic decisions, assume that the last horizon extends to 2 m or more unless it is directly underlain by a lithic or paralithic contact, or unless additional information is provided on the site card. A simplified taxonomic key to the family particle size class key can be found in Appendix 2.

To simplify taxonomic decisions for identifying Aquolls in the Keys to Soil Taxonomy (2014). Rules IB, Aquoll criteria 1, 2, 3, 4 & 6 remain as described in Keys. Rule 5 is simplified to:

5. Gleyed, depleted, or reduced matrix immediately under mollic epipedon.

To simplify taxonomic decisions for identifying Spodosols, the following criteria are used to identify spodic horizons in Region III:

1. Family particle-size class; sandy or coarse loamy.
2. Thickness is greater than 2.5 cm and extends below 12 cm from the surface.
3. A pH value in water (1:1) of 5.9 or less and an organic carbon content of 0.6 percent or more.
4. Hues are redder than 10YR and the value and chroma, moist, are generally 4/4, 3/2, 2/1, 3/3, or 3/4.
5. Often, but not always, underlies an albic diagnostic horizon.

V. SOIL INTERPRETATION

Contestants will be expected to recognize soil limitations relative to homes with basements, traditional septic system absorption fields, and local roads and streets. The tables in Appendix 3 have been developed from the National Soils Handbook and are guides to making soil interpretations for these uses. A copy will be provided to each contestant. When utilizing the following tables, the overall degree of limitation is determined by the most restrictive soil property which is determined first when reading the table from top to bottom. Contestants will print the number corresponding to the first reason in the table used for the suitability rating selected on the score card. If all the evaluations are "slight" or "good" then print "none" as the reason on the scorecard. There may be some instances where the pit does not extend to the necessary depth needed to make the interpretation. In these cases, contestants must assume the lowest horizon if the pit extends to the interpretative depth unless a lithic or paralithic contact occurs within the depth to be judged.

Special considerations for soil/site interpretations:

- Cd (dense till) are **<u>not</u>** considered a cemented pan for interpretations for local roads and streets.
- When rating shrink-swell suitability for Houses with basements, consider the continuous thickness of clay textures (SC, SIC, and C). For example, if a profile has an 8cm thick horizon of SIC overlying a 15 cm horizon of C, the continuous thickness of clay is 23 cm, and the site should be rated severe for reason #7, Shrink swell.
- Unless average texture is specified, consider the texture of the most restrictive horizon within the profile or depth specified. This applies to interpretations for Septic Tank Absorption Fields (permeability) and Local Roads and Streets (frost action)
- When average texture is specified (Local Roads and Streets-strength), use the weighted average texture based on sand and clay contents of horizons within the depth specified.
- The depth to high water table is defined by the depth to low chroma (≤2) depletions.

In this contest students will also be asked to determine if a soil is hydric or not using a simplified version (Appendix 2) of the most current edition of the *Field Indicators of Hydric Soils in the United States*. Determine if the soil is hydric or not and print the first indicator in Appendix 2 that determined the soil to be hydric. If the soil is not hydric print “none” in the indicator line of the scorecard.

APPENDIX 1

REGION 3 – SOIL JUDGING CONTEST SITE CARD

SITE NO. __________

Describe _____________ horizons to a depth of ____________ cm

Marker is in the third horizon at ___________ cm

Horizon	pH	% Base Sat.	% Organic C	% $CaCO_3$	% Resistant minerals
1.					
2.					
3.					
4.					
5.					
6.					

Note – Not all data may be given at all sites.

APPENDIX 2
REGION 3 – SOIL JUDGING CONTEST ACCEPTED ABBREVIATIONS

Distinctness of Boundary: Abrupt = A Clear = C Gradual = G Diffuse = D

Texture:

Sandy clay loam	=	SCL	Sand	=	S
Loam	=	L	Clay Loam	=	CL
Silt	=	SI	Silt loam	=	SIL
Loamy sand	=	LS	Silty clay loam	=	SICL
Silty clay	=	SIC	Sandy clay	=	SC
Clay	=	C	Sandy loam	=	SL

Coarse fragment modifiers:

Gravelly	=	GR	Channery	=	CH
Very gravelly	=	VGR	Very channery	=	VCH
Extremely gravelly	=	EGR	Extremely channery	=	ECH
Cobbly	=	CB	Flaggy	=	FL
Very cobbly	=	VCB	Very flaggy	=	VFL
Extremely cobbly	=	ECB	Extremely flaggy	=	EFL

Sand modifiers:

Very Fine	=	VF
Fine	=	F
Coarse	=	CO

Structure, Grade:

Structureless	=	0	Moderate	=	2
Weak	=	1	Strong	=	3

Structure, Shape:

Granular	=	GR	Angular blocky	=	ABK
Platy	=	PL	Subangular blocky	=	SBK
Prismatic	=	PR	Single grain	=	SGR
Columnar	=	COL	Massive	=	MA
Rock-controlled fabric	=	RCF			

Consistence:

Loose	=	L	Firm	=	FI
Very friable	=	VFR	Very firm	=	VFI
Friable	=	FR	Extremely firm	=	EFI

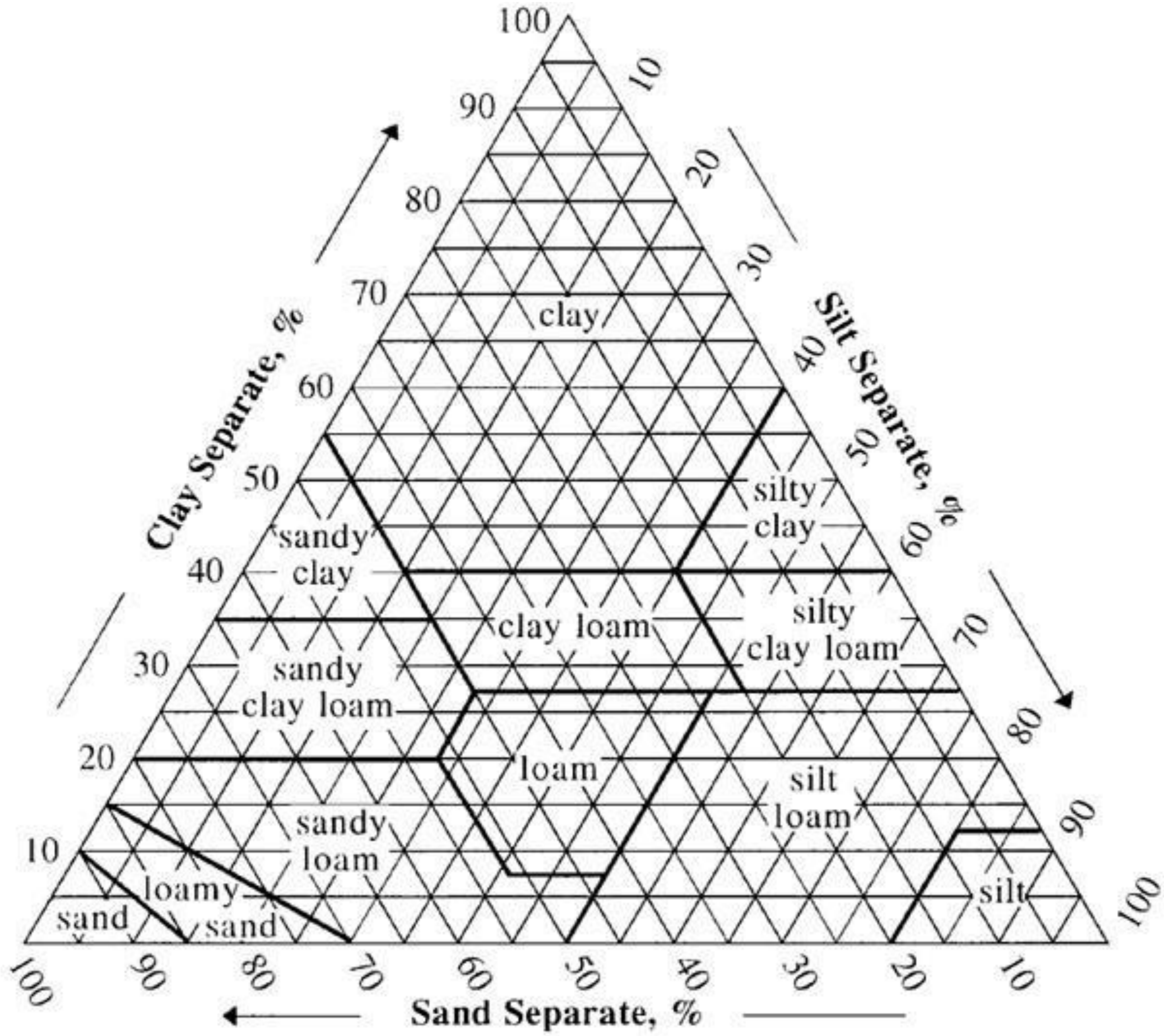
Mottles:

Concentrations			**Depletions**		
Yes	=	Y	Yes	=	Y
No	=	---	No	=	---

Effervescence:

None	=	---	Strongly	=	ST
Very slightly	=	VS	Violently	=	VE
Slightly	=	SL			

USDA Soil Textural Triangle



Rating Guide for Houses with Basements

Reason #	Property	Slight	Moderate	Severe
1	Flooding (floodplain landform)	none	------	any
2	Ponding (closed depression)	no	-------	yes
3	Depth to high water table	> 180 cm	75 to 180 cm	< 75 cm
4	Depth to bedrock	> 180 cm	100 to 180 cm	< 100 cm
5	Depth to cemented pan	>150 cm	100 to 150 cm	< 100 cm
6	Slope	< 8%	8 to 15%	> 15%
7	Shrink swell	< 8 cm clay	8 to 16 cm clay	> 16 cm clay
8	% > 8 cm stones, 0 to 100 cm	< 25%	25 to 50%	> 50%

Rating Guide for Septic Tank Absorption Fields

Reason #	Property	Slight	Moderate	Severe
1	Flooding	none	------	any
2	Depth to bedrock	> 180 cm	100 to 180 cm	< 100 cm
3	Depth to cemented pan	> 180 cm	100 to 180 cm	< 100 cm
4	Ponding	no	-------	yes
5	Depth to high water table	> 180 cm	120 to 180 cm	< 120 cm
6	Slow perm. 60 to 150 cm	S, LS, SL	SCL, L, SIL, SI	all other textures, Cd & Bx horizons
7	High perm. 60 to 150 cm	all others	------	S, LS
8	Slope	< 8%	8 to 15%	> 15%
9	% > 8 cm stones, 0 to 40 cm	< 25%	25 to 50%	> 50%

Rating Guide for Local Roads and Streets

Reason #	Property	Good	Fair	Poor
1	Depth to bedrock	> 150 cm	100 to150 cm	< 100 cm
2	Depth to cemented pan	> 150 cm	100 to 150 cm	< 100 cm
3	Shrink swell	< 8 cm clay	8 to 16 cm clay	> 16 cm clay
4	Strength (avg. 25 to 100 cm)	S, LS, SL	L, SCL	all others
5	Ponding	no	------	yes
6	Depth to high water table	> 90 cm	30 to 90 cm	< 30 cm
7	Slope	< 15%	15 to 25%	> 25%
8	Flooding (floodplain landform)	none	------	any
9	Frost action	S, LS	all others	SI, SIL, SICL
10	% > 8 cm stones, 0 to 40 cm	< 25%	25 to 50%	> 50%

SIMPLIFIED FIELD INDICATORS OF HYDRIC SOILS

Use the list as a flowchart starting at the top. Once an indicator is met, the soil is hydric and that indicator letter and number should be written on the scorecard. For purposes of this contest, consider a depleted or gleyed matrix as any horizon fitting the criteria of having a "g" subordinate distinction. If color value and/or chroma is specified in within a depleted or gleyed matrix, then these criteria must be met in addition to having the "g" subordinate distinction.

A – Used for all soils

A4. Hydrogen Sulfide. A hydrogen sulfide odor (rotten egg smell) within 30 cm of the surface.

A11. Depleted Below Dark Surface. A layer with a depleted or gleyed matrix that has chroma 2 or less starting within 30 cm of the soil surface that has a minimum thickness of 15 cm.

- Loamy/clayey/silty material above the depleted or gleyed matrix must have value 3 or less and chroma 2 or less.
- Sandy material above the depleted or gleyed matrix must have value 3 or less, chroma 1 or less.

A12. Thick Dark Surface. A layer at least 15 cm thick with a depleted or gleyed matrix that has chroma 2 or less starting below 30 cm of the surface. The layer(s) above the depleted or gleyed matrix have a value 2.5 or less and chroma 1 or less to a depth of 30 cm and value 3 or less and chroma 1 or less in any remaining layer above the depleted or gleyed matrix.

S = Sandy soils only

S4. Sandy Gleyed Matrix. A gleyed matrix within 15 cm of the soil surface.

S5. Sandy Redox. A layer starting within 15 cm of the soil surface that is at least 10 cm thick and has a matrix chroma 2 or less with 2% or more distinct or prominent redox concentrations.

S6. Stripped Matrix. A layer within 15 cm of the surface in which iron/manganese oxides and/or organic matter have been stripped from the matrix exposing the primary base color of soil materials. The stripped areas and the translocated oxides and/or organic matter form a faint, diffuse splotchy pattern of two or more colors. The stripped zones are 10% or more of the volume and rounded and 1.2 to 2.5 cm in diameter.

F = Non-sandy soils

F2. Loamy Gleyed Matrix. A gleyed matrix occurs within 30 cm of the surface.

F3. Depleted Matrix. A layer that has a depleted matrix with 60% or more chroma 2 or less and that has a minimum thickness of either:

a. 5 cm if it is entirely within the upper 15 cm of the soil, or
b. 15 cm starting within 25 cm of the soil surface

F6. Redox Dark Surface. A layer at least 10 cm thick entirely within the upper 30 cm of the mineral soil that has:

a. matrix value 3 or less and chroma 1 or less and 2% or more distinct or prominent redox concentrations as soft masses or pore linings,
or
b. matrix value 3 or less and chroma 2 or less and 5% or more distinct or prominent redox concentrations as soft masses or pore linings.

F7. Depleted Dark Surface. Redox depletions, with value 5 or more and chroma 2 or less, in a layer at least 10 cm thick entirely within the upper 30 cm of the mineral soil and has:

a. matrix value 3 or less and chroma 1 or less and 10% or more redox depletions, **or**
b. matrix value 3 or less and chroma 2 or less and 20% or more redox depletions.

F8. Redox Depressions. In closed depressions subject to ponding, 5% or more distinct or prominent redox concentrations occurring as soft masses or pore linings in a layer that is 5 cm or more thick and is entirely within the upper 15 cm of the soil.

Onsite Wastewater Loading Rates at 75 cm *(gal/day/ft²)*

Structure shape →		SGR PL RCF	GR, SBK, ABK, PR				MA (Massive)		
Structure grade →		any	Weak *(Grade 1)*		Moderate or Strong *(Grade 2 or 3)*		None (Grade = 0)		
Moist consistence →		any	VFR FR	FI VFI EFI	VFR FR	FI VFI EFI	VFR	FR	FI VFI EFI
Row Reference ↓	**Column Reference →**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
	Texture ↓								
A	Dense till Fragipan Cr horizon R horizon > 35% CF	NR = *not recommended or not applicable*							
B	S COS VCOS LCOS LS	1	1	NR	NR	NR	1	NR	NR
C	FS LFS COSL	0.84	0.91	NR	NR	NR	0.91	0.84	NR
D	SL FSL	0.75	0.75	NR	0.84	NR	0.84	0.75	0.69
E	L SIL VFSL SCL SI VFS LVFS	0.62	0.69	0.62	0.75	0.52	0.62	0.52	0.45
F	SICL *(≤ 35% clay)* CL *(≤ 35% clay)*	0.52	0.52	0.45	0.62	0.52	0.52	0.45	0.27
G	SICL *(> 35% clay)* CL *(> 35% clay)*	NR	NR	0.4	0.45	0.4	NR	0.2	NR
H	SC SIC C	NR	NR	NR	NR	0.2	NR	NR	NR

Water Retention

Water retention difference *(in cm water per cm soil)*	Textures
0.05	All sands, loamy coarse sand, and loamy sand
0.10	Loamy fine sand, loamy very fine sand, and coarse sandy loam
0.15	Sandy loam, fine sandy loam, sandy clay loam, sandy clay, clay, and silty clay
0.20	Very fine sandy loam, loam, silt loam, silt, silty clay loam, and clay loam

Surface Runoff

% Slope	Limiting hydraulic conductivity within 50 cm of the surface		
	High	Moderate	Low
Closed depression	Ponded	Ponded	Ponded
0 - <1	Very slow	Very slow	Slow
1-<2	Very slow	Slow	Medium
2 - < 6	Slow	Medium	Rapid
6 - < 12	Medium	Rapid	Very rapid
12+	Rapid	Very rapid	Very rapid

Erosion Potential

Surface Runoff	Surface Horizon Texture			
	S, LS	SCL, SC	SL, CL, C, SIC	L, SI, SIL, SICL
Ponded/Neg.	Low	Low	Low	Low
Very slow	Low	Low	Low	Medium
Slow	Low	Low	Medium	Medium
Medium	Low	Low	Medium	High
Rapid	Low	Medium	High	High
Very Rapid	Medium	High	High	High

Simplified Key to Great Groups – Wisconsin - 2019

1) Mollisol – Mollic epipedon **AND** BS > 50% in all horizons above a RLL, 180 cm, or 125 cm below the top of an argillic, whichever is shallowest

- **a) Alboll -** Albic horizon with redox concentrations **AND** argillic horizon **AND** gleyed matrix within 100 cm
  - ► **Argialboll**
- **b) Aquoll** – gleyed matrix < 50 cm or immediately below mollic
  - ► **Calciaquoll** – calcic horizon begins within 40 cm of surface and no argillic present unless buried
  - ► **Argiaquoll** – argillic horizon present
  - ► **Epiaquoll** – episaturation, gleyed horizons over non-gleyed horizons within judging depth
  - ► **Endoaquoll** – other Aquolls
- **c) Udoll –** other Mollisols
  - ► **Paleudoll** – 1) no RLL within 150 cm **AND**
    2) no clay decrease of 20% or more from clay maximum in argillic **AND**
    3) argillic hue 7.5YR or redder and chroma ≥ 5 in > ½ of argillic
  - ► **Argiudoll** – argillic horizon present
  - ► **Hapludoll** – other Udolls

2) Spodosol – Spodic present

- **a) Aquod –** redoximorphic features within albic or spodic and within 50 cm of soil surface
  - ► **Epiaquod** – episaturation, gleyed horizons over non-gleyed horizons within judging depth
  - ► **Endoaquod** – other Aquods
- **b) Orthod** – other Spodosols
  - ► **Haplorthod –** other Orthods

3) Alfisol – Argillic present

- **a) Aqualf** – redox features in all horizons between Ap or 25 cm (whichever is deeper) and 40 cm **AND** gleyed matrix in the upper 12.5 cm of argillic (Btg)
  - ► **Albaqualf** – albic horizon present **AND** clay % abruptly doubles from Albic into upper 7.5 cm of Argillic.
  - ► **Glossaqualf** – glossic horizon present
  - ► **Epiaqualf -** episaturation, gleyed horizons over non-gleyed horizons within judging depth
  - ► **Endoaquaf** – other Aqualfs
- **b) Udalf** – other Alfisols
  - ► **Paleudalf** – 1) no RLL within 150 cm **AND** 2) no clay decrease of 20% or more from clay maximum in argillic **AND** 3) argillic hue 7.5YR or redder and chroma ≥ 5 in > ½ of argillic
  - ► **Glossudalf** – glossic horizon present
  - ► **Hapludalf** – other Udalfs

4) Inceptisol – Cambic and/or Mollic or Umbric present

- **a) Aquept** – gleyed matrix < 50 cm
  - ► **Epiaquept -** episaturation, gleyed horizons over non-gleyed horizons within judging depth
  - ► **Endoaquept –** other Aquepts
- **b) Udept** – other Inceptisols
  - ► **Eutrudept –** free carbonates present **OR** BS ≥ 60% in at least one horizon between 25 and 75 cm or directly above RLL if shallower
  - ► **Dystrudept** – other Udepts

5) Entisol – no diagnostic subsurface horizon present

- **a) Aquent** – gleyed matrix < 50 cm
  - ► **Psammaquent** - texture of loamy fine sand or coarser in all layers within particle size control section (sandy loam lamellae are permitted)
  - ► **Fluvaquent** - 0.2% OC at 125 cm **OR** irregular decrease in OC with depth
  - ► **Epiaquent -** episaturation, gleyed horizons over non-gleyed horizons within judging depth
  - ► **Endoaquent –** other Aquents
- **b) Psamment** – all horizons in control section S and/or LS textures
  - ► **Quartzipsamment** - > 90% resistant minerals (i.e. quartz)
  - ► **Udipsamment –** other Psamments
- **c) Fluvent –** 0.2% OC at 125 cm **OR** irregular decrease in OC with depth
  - ► **Udifluvent**
- **d) Orthent –** other Entisols
  - ► **Udorthent**

In this key, gleyed means matrix colors have value ≥ 4 and chroma ≤ 2 because of saturation and reduction. (Bg, Btg, Cg, Eg…). This includes reduced, depleted, and gleyed matrix.

Simplified Family Particle Size Class & Control Section Criteria

CONTROL SECTION DEPTH

1) Soils < 36 cm to RLL (lithic, paralithic, densic)
    - a. 0 to RLL

2) Argillic horizon present
    - a. Strongly contrasting particle size classes within 100 cm of surface
        - i. Deepest of
            - 1. Upper 50 cm of argillic ***<u>OR</u>***
            - 2. Top of argillic to 100 cm (or RLL if shallower)

    - b. Upper 50 cm of argillic **<u>OR</u>** whole argillic if < 50 cm thick

3) All other soils
    - a. 25 or lower depth of Ap, whichever is deeper to 100 cm or RLL if RLL < 100 cm below surface

FAMILY PARTICLE SIZE CLASS

Control section weighted average contains:

1) > 90% coarse fragments
    - a. ***Fragmental***
2) > 35% coarse fragments
    - a. Sand and loamy sand textures
        - ***i. Sandy skeletal***
    - b. < 35% clay
        - ***i. Loamy skeletal***
    - c. ≥ 35% clay
        - ***i. Clayey skeletal***
3) Sand or loamy sand textures
    - a. ***Sandy***
4) RLL (lithic, paralithic, or densic) contact < 50 cm
    - a. < 35% clay
        - ***i. Loamy***
    - b. ≥ 35% clay
        - ***i. Clayey***
5) < 35% clay AND ≥ 15% sand and rock fragments < 7.6 cm
    - a. < 18% clay
        - ***i. Coarse loamy***
    - b. 18 to < 35% clay
        - ***i. Fine loamy***
6) < 35% clay AND < 15% sand and rock fragments < 7.6 cm
    - a. < 18% clay
        - ***i. Coarse silty***
    - b. 18 to < 35% clay
        - ***i. Fine silty***
7) 35 - 60% clay
    - a. ***Fine (***replace with ***Clayey*** if strongly contrasting***)***
8) > 60% clay
    - a. ***Very fine (***replace with ***Clayey*** if strongly contrasting***)***

APPENDIX 3
REGION 3 SITE MONITOR DUTIES

1. Each contestant will have a set of score cards issued before the contest.

2. Remind contestants to check the contestant number on score card and the color of the card to be judged at your site.

3. Announce the number of horizons to be judged, the total depth of the pit to be considered, and depth of nail in the third horizon. Point out the site card, topo map or other relevant information provided, and the slope stakes. If more than one no-pick zone is provided, remind all contestants to evaluate the proper profile: Either A or B and the sequence of odd or even teams in and out of the pit.

4. Split Judgers into 2 groups based on team number: **First two digits of contestant number is the team number.**
   *At Sites 1 & 3 Odd Team Numbers enter pit first.
   *At Sites 2 & 4 Even Team Numbers enter pit first.

   Each 60-minute judging period will be divided into 7 periods as shown in the table below. The schedule is the same for Sites 1 & 3 and opposite for Sites 2 and 4.

	Sites 1 & 3	**Sites 2 & 4**
Period 1 (0-5 min)	Odd teams in pit, even teams out	Even teams in pit, odd teams out
Period 2 (5-10 min)	Evens in pit, Odds out	Odds in pit, Evens out
Period 3 (10-20 min)	Odds in pit, Evens out	Evens in pit, Odds out
Period 4 (20-30 min)	Evens in pit, odds out	Odds in pit, Evens out
Period 3 (30-35 min)	Odds in pit, Evens out	Evens in pit, Odds out
Period 4 (35-40 min)	Evens in pit, odds out	Odds in pit, Evens out
Period 7 (40-60 min)	Free time, anyone in pit	Free time, anyone in pit

   Each pit monitor must have a watch and announce to the contestants when the periods change. You must enforce this timing and keep the pit available only to the group that is scheduled for each period.

5. Start judging at long horn blast. Be sure that group A is on the A profile and group B on B profile and that appropriate teams are in or out.

6. At the end of the 60-minute judging period you will hear two horn blasts. Collect all score cards, check for the contestant number, and give them to the score card runner.

7. Site monitors will point out the next judging site. They will have approximately 10 minutes to travel to the next site and get ready before the next horn blast signals the beginning of the next 60-minute judging period. Additional time may be needed for travel between sites. A longer break will be taken between the second and third judging periods.

8. There will be a marked "no pick" zone, approximately 2 feet wide, which will extend from the surface of the pit to the bottom. <u>No one</u> is to work in this area, they can only measure depth of horizons and look–no knives, picking or digging allowed. This is to preserve the judged site so all have an equal opportunity to see the officially judged area. You may periodically spray this area to keep the soil moist.

9. You will need to clean the soil away from the bottom of the pit so that all judgers can have easy access to the lower depth to which the pit is to be judged. This is done during the 10-minute travel time or if a contestant requests it be done.

10. Check the depth to the marker in the third horizon to make sure it hasn't been moved. Adjust the height, if necessary, but only after consulting with the contest superintendent.

11. There is to be no talking prior to, or during, the 60-minute judging period. Cell phone use is strictly prohibited and will result in immediate disqualification.

    Contestants are not allowed to use notes or help guides of any kind, other than the list of abbreviations, loading rate table, hydraulic soils rating guide, and suitability ratings tables. Each judger can have a clipboard, Munsell Soil Color Book with color pages only, and other basic equipment–no other written material is to be in their Color Book. Three approved sheets will be distributed with abbreviations and rating tables. Contestants will be allowed to share Color Books and Abney levels/clinometers, if necessary, but they may not work together.

12. If available, there will be a topographic map on display for contestants to look at. No one is to mark on it.