100

2010 California Envirothon - DRAFT
Soils Station Test
Total = 100 points
Suggested time is 35 minutes

Introduction: "Water, water, everywhere, nor any drop to drink". So goes a line from "The Rime of the Ancient Mariner". Imagine, if you can, standing where you are today with the temperature hovering around the 100 degree mark. (You might be surprised to find you don't have to stand here more than a few weeks to experience that!) While it is highly unlikely that you will ever see an ocean of water in front of you at this location, unless, of course, you are experiencing a mirage, imagine if all the water available to you was unfit to drink. Now that scenario, is a far more likely and realistic one. Groundwater can be easily contaminated by human activity, but not nearly so easily decontaminated. Groundwater can, however, be protected by careful urban, agricultural and environmental planning. Since much of the water that we use or discard must run through the soil at one time or another on its return to the groundwater, it makes good sense to understand soil properties and characteristics before we plan any activities that could adversely affect the quality of our groundwater. Let's examine our soil and see what we can learn to maintain the purity of our groundwater.

All Questions are worth **3 POINTS** unless marked otherwise.

Describe Soil Properties

Answer the following questions by making observations in the soil pit. **Write MULTIPLE CHOICE answers in the box on the left.**

1. What is the thickness of the surface layer?
   - A. 0 to 4 centimeters
   - B. 4 to 8 centimeters
   - C. 8 to 15 centimeters
   - D. 15 to 30 centimeters

2. What is the MOIST color of the surface layer? HINT: look on the 10YR and 2.5Y pages
   - A. olive brown or dark olive brown
   - B. dark yellowish brown
   - C. dark grayish brown or very dark grayish brown
   - D. brown or dark brown
   - E. gray or grayish brown

3. What is the texture of the surface layer?
   - A. sand or loamy sand
   - B. sandy loam or fine sandy loam
   - C. loam or silt loam
   - D. clay loam or sandy clay loam

4. What is the saturated hydraulic conductivity (permeability) of the surface layer?
   - A. extremely slow or very slow
   - B. slow or moderately slow
   - C. moderate or moderately rapid
   - D. rapid or very rapid

5. Other than soil texture what other soil property influences hydraulic conductivity? Name the property and describe the visual evidence (if any) from the surface layer of the soil pit.

6. What is the dominant structure of the surface layer?

A. massive or no structure
B. subangular blocky or blocky
C. prismatic
D. granular or crumb
E. platy

7. How thick is the subsoil?

A. less than 10 centimeters
B. between 10 and 20 centimeters
C. between 20 and 40 centimeters
D. between 40 and 80 centimeters
E. more than 80 centimeters

8. What is the MOIST color of the subsoil? HINT: look on the 10YR and 2.5Y pages

A. olive brown or dark olive brown
B. dark yellowish brown
C. light yellowish brown or yellowish brown
D. pale brown or brown
E. light olive brown

9. What is the texture of the subsoil?

A. sand or loamy sand
B. sandy loam or fine sandy loam
C. loam or silt loam
D. clay loam or sandy clay loam

10. What is the dominant structure of the subsoil?

A. massive or no structure
B. subangular blocky or blocky
C. prismatic
D. granular or crumb
E. platy

11. Based on your observations in the pit what differences do you think there would be in the saturated hydraulic conductivity (permeability) of the surface layer and subsoil?

A. subsoil more rapid than surface layer
B. surface layer more rapid than subsoil
C. no difference
D. more information needed to determine

12. Is there a root or water restrictive layer evident in the pit? Write down the depth at which it is observable. If no restrictive layer is evident, what type of restrictive layer would you expect to find if we dug deeper? Don't be afraid to be specific! **(5 points)**

13. What is the type of parent material the soil at the pit location formed in?

[ ]
- A. residuum (from the underlying soft or hard bedrock)
- B. eolian (brought by wind)
- C. colluvium (brought by gravity) and alluvium
- D. alluvium (brought by water)
- E. alluvium and eolian

Describe Site Properties

Answer the following questions by making observations of the visible area surrounding the soil pit and soils station. **Write MULTIPLE CHOICE answers in the box on the left.**

14. Using the provided **clinometer**, measure the percent slope of the land between the marked stakes. Percent slope is the vertical feet of rise or fall for every 100 feet of horizontal run divided by 100.

[ ]
- A. 0 to 2 percent
- B. 2 to 4 percent
- C. 4 to 8 percent
- D. 8 to 15 percent
- E. 15 to 25 percent
- F. 25 to 50 percent

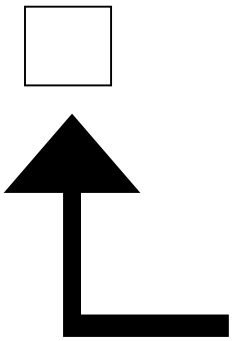
15. What is your assessment of the type and severity of erosion that has occurred in the area surrounding the soil pit?

[ ]
- A. no erosion apparent (less than 1 centimeter)
- B. slight erosion (1 to 3 centimeters), mostly sheet erosion
- C. slight erosion (1 to 3 centimeters, mostly rills
- D. moderate erosion (3 to 10 centimeters), mostly sheet erosion
- E. moderate erosion (3 to 10 centimeters), mostly rills
- F. severe erosion (more than 10 centimeters), mostly rills with some gullies

16. There is no evidence indicating the presence of a water table in the soil pit. Here, in the desert, water tables can be as deep as 200 meters (more than 600 feet). However, if there were a water table present what evidence would you expect to see somewhere in the soil profile?

[ ]
- A. the soil would just need to be wet
- B. there would have to be grey colors and the soil would be wet
- C. there would be orange or red colored mottles and maybe gray colors
- D. there would be orange or red colored mottles and maybe gray colors, the soil would be wet

17. Rate the soil in the pit using the USDA Land Capability Classification System, the answers you obtained from your observations above, and the following information. Use the following table to assign a Land Capability Class to the soil. Choose the Land Capability Class for the single most limiting item. Limitations increase as you move from the top to the bottom of the table. Write your answer in the box to the left. **(7 points)**



Effective rooting depth:	answers from Questions 7 and 12
Surface layer texture:	answer from Question 3
Permeability:	answers from Questions 4 and 11
Depth to water table:	greater than 10 feet
Available water capacity:	use texture from Question 9 and info following
Slope:	answer from Question 14
Erosion hazard:	answer from Question 15

Your answer here

Class	Effective soil depth[1] (inches)	Surface layer texture[2]	Permeability	Drainage Class[3]	Available water capacity[4] (inches)	Slope (%)	Erosion Hazard
I	≥40	Sandy loam to clay loam (0 to 15%)	Moderate	Well or moderately well >60	≥7.5	< 2	None or slight
II	≥40	Loamy sand through clay (0 to 15%)	Rapid through slow	Somewhat poorly to somewhat excessively >36	≥5.0	< 5	None to moderate
III	≥20	Sandy loam to clay (0 to 35%)	Rapid through slow	Poorly to excessively >20	≥3.5	< 15	None to severe
IV	≥10	Loamy sand to clay (0 to 60%)	Any	Poorly to excessively >20	≥2.5	< 25	Any
V	≥20	Any	Any	Any	≥3.0	< 2	None or slight
VI	≥10	Any	Any	Any	≥2.0	< 50	Any
VII	Any	Any	Any	Any	1.0	< 75	Any
VIII	Any	Any	Any	Any	Any	Any	Any

[1] Clay pans with slow permeability will be treated as limiting the effective depth.
[2] Percentage of gravel and rock fragments on the surface within 10,000 ft^2 area.
[3] Depth to water table during the growing season.
[4] Available moisture between field capacity and wilting point.

Representative values of soil bulk density, total porosity, and available soil water for various generalized soil textures.

Soil Texture	Bulk Density (g/cm^3)	Porosity (%)	Available Soil Water (inches/foot of soil depth)	
			Range	Average
Coarse				
Sand	1.65	38	0.5-0.8	0.7
Fine Sand	1.60	40	0.6-1.0	0.8
Loamy Sand	1.60	40	0.7-1.1	0.9
Gravel/Cobble in Coarse Texture	—	—	0.6-0.8	0.7
Moderately Coarse				
Loamy Fine Sand	1.55	42	1.0-1.3	1.2
Sandy Loam	1.50	43	1.2-1.6	1.4
Fine Sandy Loam	1.50	43	1.2-1.7	1.5
Medium				
Gravel/Cobble in Medium Texture	—	—	1.1-1.3	1.2
Very Fine Sandy Loam	1.45	45	1.6-2.2	1.9
Loam	1.40	47	1.6-2.3	2.0
Moderately Fine				
Sandy Clay Loam	1.35	49	1.7-2.4	2.1
Silt Loam	1.35	49	1.8-2.5	2.2
Clay Loam	1.35	49	1.8-2.5	2.2
Fine				
Sandy Clay	1.30	51	1.9-2.5	2.3
Silty Clay	1.25	53	1.9-2.5	2.3
Clay	1.20	55	2.0-2.5	2.3
Peats and Mucks	—	—	2.0-3.0	2.5

Don't forget you may have to make a conversion from feet to inches!!

18. Placing soils in a Land Capability Class is most often done for agricultural purposes. There doesn't appear to be much agriculture here. Often a subclass is attached to a LCC rating to indicate additional limitations. Which of the following limitations do you think might be most appropriate to attach to your rating from Question 17 above? **(4 points)**

A. Subclass 'e' for erosion susceptibility or past erosion damage
B. Subclass 'w' for poor soil drainage or wetness
C. Subclass 's' for soils with root zone limitations (shallowness, stones, low moisture-holding capacity, salt problems, or low fertility that is hard to correct)
D. Subclass 'c' for soils where climate is limiting (temperature or lack of moisture)

Interpreting Soil and Site Properties

Write your answer in the space provided or, for **MULTIPLE CHOICE in the box on the left.**

19. Hydrologic Soil Groups are often used to help determine a given soil's likelihood to produce runoff from rainfall events. Which of the following four Hydrologic Soil Groups would the soil at the pit fall into? Use the most limiting layer and the data below to make your decision. **(4 points)**

A. Group A
B. Group B
C. Group C
D. Group D

Group A—Soils in this group have low runoff potential when thoroughly wet. Water is transmitted freely through the soil. Group A soils typically have less than 10 percent clay and more than 90 percent sand or gravel and have gravel or sand textures. The depth to any water impermeable layer is greater than 50 centimeters [20 inches]. The depth to the water table is greater than 60 centimeters [24 inches].
Group B—Soils in this group have moderately low runoff potential when thoroughly wet. Water transmission through the soil is unimpeded. Group B soils typically have between 10 percent and 20 percent clay and 50 percent to 90 percent sand and have loamy sand or sandy loam textures. The depth to any water impermeable layer is greater than 50 centimeters [20 inches]. The depth to the water table is greater than 60 centimeters [24 inches].
Group C—Soils in this group have moderately high runoff potential when thoroughly wet. Water transmission through the soil is somewhat restricted. Group C soils typically have between 20 percent and 40 percent clay and less than 50 percent sand and have loam, silt loam, sandy clay loam, clay loam, and silty clay loam textures. The depth to any water impermeable layer is greater than 50 centimeters [20 inches]. The depth to the water table is greater than 60 centimeters [24 inches].
Group D—Soils in this group have high runoff potential when thoroughly wet. Water movement through the soil is restricted or very restricted. Group D soils typically have greater than 40 percent clay, less than 50 percent sand, and have clayey textures. All soils with a depth to a water impermeable layer less than 50 centimeters [20 inches] and all soils with a water table within 60 centimeters [24 inches] of the surface are in this group.

20. What likely reason would you give for the variability in color between the surface soil and the subsoil?

A. Very little difference, no significant processes at work in either layer
B. Hotter, more evaporation at surface but more organic matter production as well
C. Temperature is hotter at surface, promotes darker color
D. Formed in different parent materials, weather into different colors
E. Cooler, lower evaporation in the subsoil produces color change

21. Which of the following would pose the greatest threat to groundwater quality in this area (the desert)?

A. Salts
B. Fertilizers
C. Sedimentation
D. Pesticides
E. Nitrogen accumulation

22. By which pathway would you expect the groundwater (aquifers) to be recharged in the desert? **(4 points)**

A. faults in the bedrock
B. through the large drainageways (the usually dry river/stream beds)
C. probably little to no recharge
D. through the (usually dry) playas or lakebeds
E. C and D
F. A and B
G. A and D

USE THE SCENARIO BELOW TO ANSWER THE FOLLOWING THREE QUESTIONS

Although the desert is most often dry, it does receive a large portion of its rather limited rainfall in the form of thunderstorms. These storms often bring significant precipitation to a localized area in a short amount of time. Runoff can be a problem.

23. Describe how the soil at the pit location will react to receiving a significant amount of runoff from upslope in a short period of time. Be specific and think about the soil properties you have observed. **(5 points)**

24. Describe the runoff condition at the pit site after a large local thunderstorm if the upslope area was (1) under natural vegetation or (2) cleared of vegetation. Be specific as to your reasons for any perceived differences and assume the upslope soil is the same as at the soils station. **(6 points)**

25. As the town council of a small town built on a slope and receiving periodic upslope runoff from thunderstorms (hey that sounds just like the towns of Yucca Valley and Joshua Tree!), what are some things you could do to avoid having erosion or runoff issues affecting your town. Think of structures one could construct, measures you could take, or rules or ordinances you could enact to control the water before it becomes a problem. Some of the specific areas that might be affected by runoff and erosion are: roads and streets, buildings and homes, septic systems, open land or private property. Assume the soil at the pit location and use all the soil and site characteristics you observed to answer. Remember you are a small town with a small budget…what you suggest has to be practical and doable. **(7 points)**

26. Choose the correct statement or statements concerning SOIL TEXTURE. If soil texture is known:

A. one can infer soil organic matter content
B. a qualitative estimate of a soil's potential fertility can be made
C. the likelihood of erosion (by wind or water) can be determined
D. an estimate of a soil's water holding capacity can be estimated
E. B and D
F. A and C

27. Now explain your chosen answer or answers to the previous question about soil texture. In other words…If soil texture is known how would this knowledge allow you to infer, estimate or determine "your chosen answer"? (Ahh…just when you thought the test was over too, I had to ask a stretcher!) **(4 points)**