

Soil Science  
Professional Practice Exam  
Performance Objectives

Soil Science Society of America's  
Council of Soil Science Examiners

Effective December 2009

## **CSSE PROFESSIONAL PRACTICE PERFORMANCE OBJECTIVES**

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## FOREWARD

This booklet represents the Performance Objectives (POs) for the Soil Science Professional Practice Examination. The POs presented are the minimal professional competencies needed by the professional soil scientists. These competencies are given as a list of POs. To be considered a minimally qualified professional, an individual must also be knowledgeable of the fundamental performance objectives.

The development of the POs began in 1994 when the Soil Science Society of America (SSSA) asked the practicing soil consultants, state licensing boards, government officials and academicians to collectively develop a nationally applicable set of standards fundamental to the rigorous solution of environmental and agronomic problems. Subsequently, this group evolved into the Council of Soil Science Examiners (CSSE) which refined that original list of standards and continues to refine the list on a systematic basis leading to the most recent 2010 edition. The POs have been developed to assist the student in studying for the Professional Practice Exam. The CSSE is also charged with the development of the examinations required for certification and licensure. The examinations are the product of the balanced application of the POs and can best be studied for by developing a technical understanding of each PO.

The goal of the POs, the examinations and the CSSE is to protect the health and welfare of the public by insuring only competent soil scientists are certified and /or licensed. In doing so, the CSSE repeatedly scrutinized the POs to insure we are testing the most pertinent soils knowledge. In this right, a subcommittee of the CSSE is formed along with an end user group to review and revise the POs on a routine basis culminating in this document.

Soil Science is a dynamic field where new discoveries and approaches continue to occur at a rapid pace. The CSSE encourages comments and suggestions concerning possible modifications to the 2010 edition of the POs. Comments should be sent to: SSSA CSSE, 677 South Segoe Road, Madison, WI 53711.

The SSSA and CSSE would like to thank the many volunteers who contributed to the continuing refinement of this document. It would not be possible without their dedication to the profession of soil science.

## **I. SOIL CHEMISTRY AND MINERALOGY**

### **COMPETENCY AREA 1. ADVANCED SOIL CHEMISTRY CONCEPTS**

1. Define ionic strength in relation to the soil solution.

### **COMPETENCY AREA 2. SOLID PHASE**

2. Explain organo-clay complex formation.
3. Differentiate surface charge characteristics for phyllosilicate and hydrous metal oxides:
  - a. relationship to shrink-swell properties.
  - b. suitability for in design of physical structures.
4. Estimate cation exchange capacity in relationship to soil organic matter content, clay content and mineralogy.

### **COMPETENCY AREA 3. MINERAL WEATHERING**

5. Know relative weathering rates of primary minerals.
6. Explain climate affects on the progression of weathering in a soil profile relative to:
  - a. soil pH.
  - b. organic matter.
  - c. profile depth.
  - d. salt accumulation.
  - e. carbonate accumulation.
  - f. leaching of anions and cations.
7. Explain weathering impacts on clay content, distribution, and mineralogy in a soil profile.

### **COMPETENCY AREA 4. SORPTION AND PRECIPITATION REACTIONS**

8. Relate electronegativity to binding strength between ions in solution with colloid surfaces.
9. Describe how differences in sorption strengths of lead, cadmium, chromium, arsenic, and selenium affect their movement through soils.
10. Explain how the following impact inorganic and organic compounds in soils:
  - a.  $K_{OC}$ .
  - b. half life.

- c. solubility.
- d. vapor pressure.
- e. ionic form.
- f.  $K_d$ .

11. List soil factors that influence the corrosion of concrete and iron containing materials placed in soils.

### **COMPETENCY AREA 5. ACIDITY**

12. Know the effect of soil pH on speciation of:

- a. Aluminum.
- b. Iron.
- c. Chromium.
- d. Copper.
- e. Zinc.
- f. Lead.
- g. Phosphorus.
- h. Carbonate.
- i. Arsenic.

13. Explain the relationship between  $SO_{2(g)}$ ,  $CO_{2(g)}$ , and  $NO_{2(g)}$  and soil acidity.

### **COMPETENCY AREA 6. OXIDATION AND REDUCTION**

14. Explain the effect of oxidation-reduction reactions on solubility of:

- a. iron.
- b. manganese.
- c. arsenic.
- d. lead.

15. Interpret the relationship between pe and Eh.

16. Interpret the relationship between pH and Eh.

17. Explain the relationship between microbial activity and Eh.

## **II. SOIL FERTILITY**

### **COMPETENCY AREA 1. ROLES OF NUTRIENTS IN PLANTS AND THEIR AVAILABILITY IN SOILS**

1. Explain how chelates (organometallic complexes) are used to increase bioavailability of plant nutrients.
2. Identify the relative mobility of nutrients in the soil.

### **COMPETENCY AREA 2. pH**

3. Explain effect on soil pH upon drainage of an acid sulfate soils.
4. Describe the relationship between plant root growth, soil pH and aluminum solubility.
5. Analyze the role of pH in solubility of bioavailable nutrients.

### **COMPETENCY AREA 3. ACIDIFYING AND LIMING OF SOIL**

6. Explain the effect of adding pyrite containing material on soil pH.
7. Explain the effects of gypsum and soil organic matter on soil:
  - a. pH.
  - b. aluminum bioavailability.

### **COMPETENCY AREA 4. SALT AFFECTED SOILS**

8. Calculate the leaching requirement to ameliorate salt affected soils when provided with water quality and soil salinity data.
9. Prescribe management strategies to mitigate salt accumulation in plant root zones.
10. Describe the effects of gypsum, sulfur and sulfuric acid on chemical and physical properties when remediating saline-sodic or sodic soils.

### **COMPETENCY AREA 5. NUTRIENT SOURCES**

11. Calculate the quantity of bioavailable nutrients when provided the with nutrient concentration of organic and inorganic nutrient sources.
12. Identify appropriate physiological, climatic and environmental timing for application of nutrient sources.



## **COMPETENCY AREA 6. NUTRIENT MANAGEMENT**

13. Describe impact of tillage practices, crop species selection, and cropping sequence on nutrient cycling.
14. Appraise how soil disturbances affect nutrient cycling.
15. Explain how plant removal affects nutrient cycling.
16. Identify the key requirements of a nutrient management plan.

## **COMPETENCY AREA 7. SOIL AND PLANT ANALYSES AND INTERPRETATIONS**

17. Describe how to use plant tissue analyses in a soil fertility program.
18. Describe the procedure by which a soil test method is properly developed and tested.

### **III.SOIL PHYSICS**

#### **COMPETENCY AREA 1. PHYSICAL PROPERTIES**

1. Explain how to mitigate physical limitations of sodic, saline, and saline-sodic soils.
2. Formulate the relationship between the following soil physical properties:
  - a. bulk density.
  - b. particle density.
  - c. porosity.
  - d. mass wetness.
  - e. volume wetness.
3. Analyze how the following soil physical properties, both individually or in groups, affect soil productivity:
  - a. particle size distribution.
  - b. specific surface.
  - c. soil structure
    - i. crusting.
    - ii. aggregate characteristics (size, distribution, stability).
  - d. bulk density.
  - e. porosity.
  - f. mass wetness.
  - g. volume wetness.
  - h. hydrophobicity.

#### **COMPETENCY AREA 2. SOIL-WATER RELATIONSHIPS**

4. Calculate a soil water balance given the pertinent information.
5. Given a soil moisture characteristic curve, analyze and evaluate the soil for different uses.
6. Describe how water input affects water table geometry under a land application system.
7. Compare and contrast the following soil water potentials:
  - a. total soil-water potential.
  - b. gravitational potential.
  - c. pressure potential.
  - d. matric potential.
  - e. osmotic potential.
8. Propose the most appropriate field procedure for measuring soil water potential under given conditions.

9. Diagram the water potential profile of a soil with an active root zone.
10. Identify and estimate the following components of the hydrologic cycle:
  - a. stemflow.
  - b. throughflow.
  - c. interception.
11. Describe the effects of the following conditions on evapotranspiration potential:
  - a. soil moisture regimes.
  - b. ground cover.
  - c. vegetative characteristics.
  - d. climate/microclimate.

### **COMPETENCY AREA 3. WATER MOVEMENT AND TRANSPORT PROCESSES**

12. Compare and contrast the rate and pattern of water flow in saturated and unsaturated soils.
13. Review stratified flow.
14. Analyze flow using Darcy's equation.
15. Identify appropriate conditions for using Darcy's Law.
16. Evaluate flow rate and/or direction given soil water potentials.
17. Compare and contrast field and lab methods to measure saturated hydraulic conductivity.
18. Describe the effects of soil texture, structure and suction on the following:
  - a. hydraulic conductivity.
  - b. soil water movement.
  - c. plant available water.
  - d. water holding capacity.
19. Describe how preferential flow affects groundwater quality.
20. Differentiate between an aquifer, aquitard, and aquiclude.
21. Explain how land use affects water movement, retention and availability.
22. Distinguish between infiltration, percolation rate and saturated hydraulic conductivity.
23. Assess surface characteristics and their effect on infiltration rate.

24. Explain how the following affect infiltration rate:
- a. time from the beginning of rain or irrigation.
  - b. hydraulic conductivity.
  - c. antecedent soil moisture.
  - d. depth of soil profile.
  - e. layered soil profile.
  - f. crusted soil.
  - g. instability of wetting fronts.

#### **COMPETENCY AREA 4. SOIL TEMPERATURE**

25. Describe how thermal properties of soil are modified by:
- a. water content.
  - b. organic matter.
  - c. air filled porosity.
  - d. soil texture.
  - e. surface residue.
  - f. albedo.

26. Understand the soil thermal regime and its relationship to the soil system as a whole.

#### **COMPETENCY AREA 5. SOIL GASES**

27. Appraise the composition of soil air with respect to the following gases under different circumstances:
- a. oxygen.
  - b. carbon dioxide.
  - c. methane.
  - d. hydrogen sulfide.
  - e. relative humidity.
28. Differentiate and explain why soil respiration differs:
- a. in vegetated versus fallow areas.
  - b. during different seasons of the year.
  - c. throughout different times of the day.
  - d. with varying degrees of microbial activity.
  - e. with varying degrees of soil moisture content.

29. Compare and contrast movement of soil gases under conditions of convection and diffusion.

#### **COMPETENCY AREA 6. ENGINEERING PROPERTIES**

30. Compare and contrast the following particle size classification systems:
- a. United States Department of Agriculture (USDA).

- b. American Society for Testing and Materials Unified Soil Classification System (USCS).
- c. American Association of State Highway and Transportation Officials (AASHTO).

31. Describe shear strength and its relation to soil cohesion and friction forces.
32. Compare and contrast shear strength of coarse grained sandy soils with that of clay.
33. Describe the Proctor Test and its use.
34. Evaluate factors affecting slope stability and soil mass movement hazards.
35. Assess soil compaction under different land use practices, soil texture and moisture conditions.
36. Provide BMPs to minimize soil compaction.

## **IV. SOIL GENESIS, MORPHOLOGY, AND CLASSIFICATION**

### **COMPETENCY AREA 1. SOIL FORMING FACTORS**

1. Evaluate the five soil forming factors influence on soil properties.
2. Relate soil properties to the following parent materials:
  - a. alluvium.
  - b. colluvium.
  - c. till.
  - d. eolian sand.
  - e. loess.
  - f. marine sediments.
  - g. residuum.
  - h. glacial outwash.
  - i. coastal sediments.
  - j. lacustrine sediments.

### **COMPETENCY AREA 2. HORIZON FORMING PROCESSES**

3. Describe the soil forming processes given morphologic, hydrologic, and landscape information.
4. Explain the pedogenic processes for a given soil profile description.
5. Identify the soil forming processes leading to development of diagnostic horizons.

### **COMPETENCY AREA 3. SOIL PROFILE DESCRIPTIONS AND LAND USE MANAGEMENT**

6. Evaluate soil morphologic properties for land use decisions.
7. Interpret soil genetic processes utilizing morphologic information.
8. Identify the seasonal high water table location using soil morphology.
9. Utilize soil profile descriptions to evaluate and make land use decisions.

### **COMPETENCY AREA 4. SOIL CLASSIFICATION CONCEPTS**

10. Distinguish between endosaturation and episaturation for land use decisions.
11. Integrate soil taxonomic information with soil morphology, genesis, landscapes, and land use decision making.

## **COMPETENCY AREA 5. SOIL MAPPING AND GEOSPATIAL INFORMATION**

12. Utilize information found in a modern National Cooperative Soil Survey Report to evaluate a site for potential uses.
13. Identify scale limitations of soil surveys.
14. Describe how to acquire, transform, and interpret the following:
  - a. soil maps.
  - b. topographic maps.
  - c. wetlands inventory maps.
  - d. aerial imagery.
  - e. remote sensing & satellite data.
  - f. bedrock and surficial geology maps.
  - g. watershed maps.
  - h. land cover inventories.
  - i. hydrology maps.
  - j. hydrogeology maps.
  - k. cultural resources information.
15. Utilize geospatial information to develop best management practices (BMP's) for:
  - a. soil testing.
  - b. nutrient recommendations.
  - c. erosion control practices.
  - d. cropping practices.

## **COMPETENCY AREA 6. GEOMORPHOLOGY**

16. Use soil morphology and geologic information to predict soil properties.
17. Describe pedologic and hydrologic properties of the following hillslope positions:
  - a. summit.
  - b. shoulder.
  - c. backslope.
  - d. footslope.
  - e. toeslope.
18. Differentiate convex, concave, and linear landscape segments and describe their impact on soil and hydrologic properties for land use decisions.
19. Distinguish convergent and divergent flow.
20. Utilize topographic information in order to evaluate how a landscape partitions water.
21. Define and delineate the components of a watershed.

## **COMPETENCY AREA 7. SOILS IN LANDSCAPES**

22. Identify how morphological, chemical and physical soil properties vary in the following landscapes:
  - a. forest.
  - b. desert.
  - c. prairie.
  - d. arctic and alpine.
  - e. wetlands.
  - f. agriculture.

## **COMPETENCY AREA 8. SOIL VARIABILITY**

23. Differentiate between natural variability and anthropogenic variability.
24. Define pedo-transfer functions and utilize them in characterizing soil variability.
25. Evaluate and design sampling schemes to assess soil variability across scales.
26. Describe the influence of the following human activities on soil:
  - a. mining.
  - b. drainage.
  - c. industry.
  - d. construction.
  - e. landfills.
  - f. agriculture.



## V. SOIL BIOLOGY AND BIOCHEMISTRY

### COMPETENCY AREA 1. SOIL ECOLOGY

1. Describe how a change in soil moisture, temperature, aeration, pH and organic carbon levels will impact populations and activities of key groups of organisms in soil such as:
  - a. aerobic organisms.
  - b. heterotrophic bacteria and fungi.
  - c. autotrophic bacteria involved in the nitrogen and sulfur cycles.
  - d. earthworms.
2. Describe how the following compete with microorganisms for inorganic nutrients:
  - a. soil texture.
  - b. organic matter content.
  - c. plant roots.
3. Explain why microorganisms are in constant competition for energy and nutrients in the soil.
4. Contrast how soil bacteria and soil fungi form stable aggregates in soil.
5. Discuss the dynamic nature of the rhizosphere with reference to:
  - a. microbial populations.
  - b. nutrient transformation.
  - c. phytoremediation.
  - d. aggregate development and stability.
6. Compare soil microbial populations and activities after disturbance by the following:
  - a. intensive tillage.
  - b. flooding.
  - c. compaction.
7. Discuss the conditions under which one should consider the use of inoculants for leguminous crops.
8. Discuss how mycorrhizal and rhizobial symbioses are affected by soil:
  - a. moisture.
  - b. aeration.
  - c. fertilizer additions.
  - d. pH.

## COMPETENCY AREA 2. BIOLOGICAL AND BIOCHEMICAL ACTIVITIES

9. Describe how microbial activities can affect the oxidation status and/or chemical form of the following elements;
  - a. arsenic.
  - b. iron.
  - c. manganese.
  - d. mercury.
  - e. nitrogen.
  - f. selenium.
  - g. sulfur.
  - h. chromium.
  
10. Describe how the following soil factors affect the decomposition of organic materials in soil:
  - a. pH.
  - b. moisture.
  - c. temperature.
  - d. aeration.
  - e. oxidation-reduction potential.
  - f. inorganic nutrients.
  - g. clay type and amount.
  - h. tillage.
  
11. Given data on organic material composition and efficiency of microbial decomposition, calculate the following:
  - a. quantity of organic carbon produced.
  - b. nitrogen mineralization or immobilization.
  - c. phosphorus mineralization or immobilization.
  
12. Describe how the nitrification and denitrification processes are affected by soil:
  - a. pH.
  - b. moisture.
  - c. temperature.
  - d. aeration.
  - e. available carbon.
  
13. Discuss how the denitrification process is affected by soil:
  - a. moisture.
  - b. temperature.
  - c. aeration.
  - d. available carbon.
  
14. Discuss the conditions under which inorganic nitrogen can be lost from the soil in the nitrogen cycle.

### **COMPETENCY AREA 3. SOIL ORGANIC MATTER**

15. Discuss how the exchange capacity of stable soil organic matter is affected by soil acidity.
16. Describe the mechanism of retention of organic matter for nutrients, organic pollutants, and inorganic pollutants.
17. Explain how soil pH affects the retention of organic matter for nutrients, organic pollutants, and inorganic pollutants.
18. Discuss the mechanisms by which soil organic matter interacts with the following:
  - a. acidity ( $H^+$  or  $H_3O^+$ ).
  - b. aluminum.
  - c. cations (e.g.,  $Ca^{2+}$ ,  $Cd^{2+}$ ,  $Na^+$ ,  $Pb^{2+}$ , etc...).
  - d. polar and non-polar pesticides.
  - e. organic xenobiotics.
19. Describe how plant materials of differing age and chemical composition influence the rate of decomposition and stable organic matter formation.

### **COMPETENCY AREA 4. ENVIRONMENTAL AND AGRICULTURAL APPLICATIONS**

20. Compare and contrast concepts of environmental modification, bioaugmentation and bioremediation.
21. Describe how to encourage microbial degradation of an organic pollutant during the bioremediation of a contaminated soil.
22. Describe how to encourage microbial transformations of an inorganic pollutant during the bioremediation of a contaminated soil.
23. Calculate how much nitrogen to add to an organic material to avoid nitrogen immobilization given the C:N ratio of the organic material.

### **COMPETENCY AREA 5. CLIMATE CHANGE**

24. Examine the soil carbon source-sink relationship between contrasting soil management practices.
25. Define the short- and long-term potential for soil to sequester carbon.

## **VI. LAND USE MANAGEMENT**

### **COMPETENCY AREA 1. EROSION AND SEDIMENT CONTROL**

1. For a given site recommend best management practices (BMP's) for erosion and sediment control.
2. Evaluate a site to select appropriate values to use in the RUSLE2.
3. Assess site vulnerability to soil erosion.
4. Appraise limitations of highly erodible land (HEL).
5. Evaluate and provide appropriate BMPs that mitigate:
  - a. creep.
  - b. saltation.
  - c. suspension.
6. Identify co-contaminants associated with suspended soil particulates in the air.
7. Develop a conservation land use plan.
8. Describe the effects of grazing management on the hydrologic cycle and soil erosion.

### **COMPETENCY AREA 2. WETLANDS AND HYDRIC SOILS**

9. Differentiate criteria used to delineate a jurisdictional wetland.
10. Describe characteristics of wetland environments.
11. Describe how to identify hydric soils.
12. Given morphologic information, distinguish hydric soils from non hydric soils.
13. Formulate methods to measure recharge, discharge and saturation in wetlands.
14. Evaluate methods used to avoid, minimize, or mitigate adverse effects to wetlands.
15. Contrast constructed versus restored wetlands for wetland mitigation.

### **COMPETENCY AREA 3. SOIL QUALITY AND MANAGEMENT**

16. Calculate the quantity of carbon sequestered in soil given land management practices and the amount of carbon in the soil amendment.

17. Use bulk density, organic carbon concentration, and soil thickness to calculate the quantity of organic carbon in a soil.
18. Given C:N:P:S ratio, estimate the quantity of P, N, and S sequestered per ton of carbon.
19. Explain the use of clay minerals to form organo-clay complexes:
  - a. removing organic constituents.
  - b. to reduce transport of organic constituents within soil profiles.
  - c. for remediation of polluted soil or water.

#### **COMPETENCY AREA 4. WASTE MANAGEMENT**

20. Describe methods and management for the beneficial use of biosolids, animal wastes, and effluents.
21. Understand contaminants regulated by EPA guidelines commonly found in municipal biosolids, industrial wastes, and effluents.
22. List the dominant contaminants in municipal biosolids and industrial wastes.
23. Calculate soil amendment rates given appropriate information such as:
  - a. biomass requirements.
  - b. regulatory requirements.
  - c. soil test data.
  - d. amendment analysis.
  - e. biomass removal.
24. Use  $\text{CaCO}_3$  equivalent to adjust lime application rate to meet biosolid application recommendations.
25. Calculate application rates of biosolids, effluents, and industrial wastes based on yearly and cumulative identified loading rates.
26. Given site information and soil properties, determine suitability and size of an on-site waste disposal system.
27. Identify best management practices (BMP's) for managing soils contaminated with:
  - a. cadmium.
  - b. chromium.
  - c. lead.
  - d. zinc.
  - e. nickel.
  - f. arsenic.
  - g. selenium.
  - h. mercury.

28. Describe the fate of human and animal pathogens and waste products introduced into the soil environment.

29. Evaluate capacity of a wetlands to mitigate outflow contaminants.

#### **COMPETENCY AREA 5. CROPLAND, RANGELAND AND FIELD MANAGEMENT**

30. Appraise soil physical, chemical and biological properties as affected by soil tillage and residue management.

31. Describe effects of grazing and overgrazing on rangeland soils.

32. Given information and data, design a nutrient management plan for a confined animal feeding operation (CAFO).

#### **COMPETENCY AREA 6. WATER QUALITY AND MANAGEMENT**

33. Explain the impact of land application of organic amendments on the biological oxygen demand (BOD) on surface and groundwater.

34. Evaluate the use of soil systems for treating contaminated water.

35. Describe how suspended soil particulates in air or water affect water quality and human health.

36. Evaluate the impact on surface and groundwater quality of the following land use practices:

- a. agricultural production – crops, animal agriculture feedlot, range.
- b. construction.
- c. waste disposal and remediation.
- d. forestry.
- e. natural habitats.
- f. mine reclamation.
- g. residential development.

37. List techniques for remediation of soils contaminated by chemical leaks and spills.

#### **COMPETENCY AREA 7. REGULATORY AND RESOURCE AGENCIES**

38. Know aspects related to soil science or materials impacted by soils in Federal Programs pertaining to:

- a. National Pollution Discharge Elimination Systems (NPDES).
- b. Confined Animal Feeding Operations/Animal Feeding Operations (CAFOs/AFOs).
- c. Total Maximum Daily Loads (TMDLs).

- d. Coastal Zone Act.
  - e. Clean Water Act.
  - f. National Environmental Policy Act (NEPA).
  - g. Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).
  - h. Resource Conservation and Recovery Act (RCRA).
39. Compare and contrast the responsibilities of federal agencies with respect to the programs:
- a. National Pollution Discharge Elimination Systems (NPDES).
  - b. Confined Animal Feeding Operations/Animal Feeding Operations (CAFOs/AFOs).
  - c. Total Maximum Daily Loads (TMDLs).
  - d. Coastal Zone Act.
  - e. Clean Water Act.
  - f. National Environmental Policy Act (NEPA).
  - g. Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).
  - h. Resource Conservation and Recovery Act (RCRA).

#### **COMPETENCY AREA 8. SURFACE MINE AND MINE SPOIL RECLAMATION**

40. Define the following surface mine and mine spoil reclamation terms:
- a. acid/base accounting.
  - b. top soil substitute.
  - c. acid forming materials.
  - d. toxic forming materials.
  - e. acid mine drainage.
  - f. sodicity and salinity forming materials.
41. Calculate the lime requirement based upon the acid/base account.
42. List criteria for selecting topsoil substitute material instead of native soil.
43. Describe the role of a soil scientist in a surface mine reclamation plan.
44. Describe methods of soil restoration in surface mine reclamation.
45. List sources of acid in acid mine drainage.

#### **COMPETENCY AREA 9. URBAN AND DISTURBED SOILS**

46. Identify common physical and chemical properties and concerns associated with the following fill materials:
- a. fly ash.
  - b. bottom ash.

- c. foundry sand.
  - d. railroad ties.
  - e. concrete.
  - f. asphalt.
  - g. construction debris.
  - h. biosolids.
  - i. demolition debris.
47. Compare and contrast characteristics and properties of the following:
- a. native soils.
  - b. urban soils.
  - c. disturbed soils.
48. Identify common physical properties and chemical concerns associated with the following:
- a. organic solvents.
  - b. heavy metals.
  - c. petroleum waste products.
  - d. household waste.
49. Construct a plan to assess soils on a brownfield site.
50. Identify soil and environmental characteristics associated with brownfields.
51. Describe procedures to ameliorate site compaction.
52. Distinguish cut and fill and compacted site materials from native soils.
53. Evaluate substrate materials for suitability as a topsoil substitute.

## **COMPETENCY AREA 10. FOREST SOILS**

54. Explain the effect of compaction on a forest soil.
55. Explain how soil erosion differs for the following forest areas:
- a. logging roads.
  - b. landings.
  - c. skid trails.
  - d. harvested areas.
  - e. undisturbed forest.
56. Explain how infiltration differs for the following forest areas:
- a. logging roads.
  - b. landings.
  - c. skid trails.



- d. harvested areas.
- e. undisturbed forest.

57. Describe nutrient cycling and losses in the following forest management scenarios:

- a. clear cut harvesting.
- b. prescribed burn.
- c. wildfire.
- d. plantation forestry.
- e. undisturbed forest.

58. Explain the effect of forest fires on the soil physical, chemical and biological properties such as:

- a. hydrophobicity.
- b. nutrient transformations.
- c. organic horizons.
- d. soil surface.
- e. nitrogen losses.
- f. carbon losses.

59. Explain the effect of prescribed burns on the soil physical, chemical and biological properties such as:

- a. hydrophobicity.
- b. nutrient transformations.
- c. organic horizons.
- d. soil surface.
- e. nitrogen losses.
- f. carbon losses.

## VII. FIELD AND LABORATORY TECHNIQUES

1. Analyze and evaluate applicable field measurement strategies for measuring soil physical, chemical and biological properties.
2. Analyze and evaluate applicable lab measurement strategies for measuring soil physical, chemical and biological properties.
3. Compare and contrast field versus lab measurements of soil physical, chemical and biological properties.
4. Describe how to collect a representative sample of the solid, liquid and gas phases in soil.
5. Design and justify a soil sampling strategy for:
  - a. disturbed sites.
  - b. nutrient management.
  - c. reclamation sites.
  - d. contaminated sites.
  - e. soil mapping.
  - f. wetland delineation.
6. Evaluate sampling schemes based on available equipment and properties to be sampled.
7. Evaluate conditions for proper collection and measurement of field samples with the following common instruments:
  - a. tTensiometer.
  - b. constant head permeameter.
  - c. piezometer.
  - d. core sampler.
  - e. infiltrometer.
  - f. penetrometer.
  - g. pressure transducer.
  - h. ground penetrating radar.
  - i. TDR.
  - j. neutron probe.
  - k. wells.
  - l. pH meter.
  - m. electrical conductivity.
8. Synthesize and interpret laboratory and field measurements for data analysis.
9. Understand the application and limitations of data based on analytical methodology.
10. Synthesize analytical data for sources of error and variability.

11. Evaluate sources of error, variability, and potential contamination for soil sample collection.
12. Understand standard QA/QC protocols for field and laboratory techniques.

## **VIII. ETHICS**

1. Explain the obligations a professional soil scientist has to the soil science profession.
2. Describe obligations a professional soil scientist has to a client and the interests of the client.
3. Describe a professional soil scientist obligation to protect the confidence of a client.
4. Understand and apply the professional soil scientist's responsibility to maintain professional integrity.
5. Resolve professional and personal conflicts of interest.
6. Explain the role of the professional soil scientist in the protection of the public's health, safety and welfare, and the environment.