BASIC WASTEWATER MATH FORMULAS

(Conversion Factors) Revised 01/12/2012

Common Symbols or Acronyms Used

Foot/Feet (') or (ft.)	Gallon per Minute (GPM)	Pounds per Square Inch Gauge (PSIG)	Diameter (D)
Inches (") or (in.)	Gallon per Day (GPD)	Milligrams per Liter (mg/L)	Depth (d)
Square Feet (ft^2)	Million Gallons per Day (MGD)	Hour (hr)	Length (L)
Cubic Feet (ft^3)	Cubic Feet per Second (CFS)	Pounds (lbs.)	Width (W)

1. 1 acre = 43,560 ft^2
2. 1 yard = 3 feet
3. 1 yd^3 = 27 ft^3 (3' x 3' x 3')
4. Inches ÷ 12 inches per foot = tenth(s) of foot (ex. 6"÷ 12 = 0.5 ft.)
5. Tenth(s) of foot x 12 inches per foot = inches (0.5 x 12= 6")
6. π (Pi) = 3.14 (Approximate)
7. 1 horse power (hp) = 746 watts (W) or 0.746 kilowatts (kW)
8. 1 milli (gram, liter, etc.) = 1/1000 or 0.001 (gram, liter, etc.)
9. 1 gram, liter, etc. = 1,000 milli (grams, liters, etc.)
10. 1 kilo (gram, liter, etc.) = 1000 (grams, liters, etc.)
11. 1 percent (%) = 10,000 mg/L
12. 1 in. = 25.4 millimeters (mm)
13. 1 ft. = 12 inches or 0.305 meters
14. 1 mile = 5,280 ft. or 1,609 kilometers
15. 1 lb. = 453.6 grams (Approximate)
16. 1 kilogram (kg) = 2.2 lbs.
17. 1 ounce (oz) = 28.35 grams
18. 1 quart = 0.946 liters
19. 1 gallon = 3.785 Liters
20. 231 in^3 = 1 gallon of water
21. 1 ft^3 = 7.48 gallons
22. 1 ft^3 of water weights = 62.4 lbs.
23. 1 gallon of water = 8.34 lbs.
24. 3960 gallons of water to weigh = 33,000 lbs.
25. CFS = GPM x 0.00223
26. CFS = MGD x 1.547
27. GPM = CFS x 450
28. GPD = GPM x 1440
29. MGD = CFS x 0.646
30. 1 MGD = 694.4 GPM
31. 1 PSIG = 2.31 ft. or 27.72 inches of water, or 2.04 inches of Hg
32. 1 ft. of water = 0.43 PSIG or 0.88 inches of Mercury (Hg)
33. To change ft. of water to PSIG, multiply ft. of water times 0.43.
34. To change PSIG to ft. of water, multiply the PSIG times 2.31.
35. Area, ft^2 of a rectangle = L x W
36. Area, ft^2 of a circle = πr^2
37. Area, ft^2 of a circle = 0.785 x D^2
38. Area, ft^2 of a pond = 43,560 ft^2 x number of acres
39. Volume, ft^3 of a rectangle= Length x Width x Depth
40. Volume, ft^3 of a cylinder = $\pi r^2 d$
41. Volume, ft^3 of a cylinder = 0.785 x D^2 X d
42. Volume, ft^3 of a pond = 43,560 x acres x depth
43. Volume, gallons = ft^3 x 7.48
44. Velocity, ft/sec = $\dfrac{\text{Distance traveled, ft.}}{\text{Time, sec.}}$
45. Volume in gallons = $\dfrac{\text{L in. x W in. x D in.}}{231\ \text{in}^3/\text{gallon}}$
46. Cubic Feet to Cubic Yards = $\dfrac{\text{L ft. x W ft. x D ft.}}{27\ \text{ft}^3/\text{yd}^3}$

NOTE: Standard Rounding Procedure is to round to the nearest hundredth.

glossary

ABC soil. A soil having an A, a B, and a C horizon.

AC soil. A soil having only an A and a C horizon. Commonly such soil formed in recent alluvium or on steep rocky slopes.

Aeration, soil. The exchange of air in soil with air from the atmosphere. The air in a well aerated soil is similar to that in the atmosphere; the air in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Area reclaim (in tables). An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Association, soil. A group of soils geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as—

	Inches
Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	9 to 12
Very high	More than 12

Base saturation. The degree to which material having cation exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, K), expressed as a percentage of the total cation exchange capacity.

Bedding planes. Fine stratifications, less than 5 millimeters thick, in unconsolidated alluvial, eolian, lacustrine, or marine sediments.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Bisequum. Two sequences of soil horizons, each of which consists of an illuvial horizon and the overlying eluvial horizons.

Bottom land. The normal flood plain of a stream, subject to flooding.

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

Cation. An ion carrying a positive charge of electricity. The common soil cations are calcium, potassium, magnesium, sodium, and hydrogen.

Cation-exchange capacity. The total amount of exchangeable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. The term, as applied to soils, is synonymous with base-exchange capacity, but is more precise in meaning.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Coarse fragments. If round, mineral or rock particles 2 millimeters to 25 centimeters (10 inches) in diameter; if flat, mineral or rock particles (flagstone) 15.2 to 38.1 centimeters (6 to 15 inches) long.

Coarse textured soil. Sand or loamy sand.

Colluvium. Soil material, rock fragments, or both moved by creep, slide, or local wash and deposited at the base of steep slopes.

Complex slope. Irregular or variable slope. Planning or constructing terraces, diversions, and other water controls on such slopes is difficult.

Complex, soil. A map unit of two or more kinds of soil in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils are somewhat similar in all areas.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—
Loose.—Noncoherent when dry or moist; does not hold together in a mass.
Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.
Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.
Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.
Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.
Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.
Soft.—When dry, breaks into powder or individual grains under very slight pressure.
Cemented.—Hard; little affected by moistening.

Control section. The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

Corrosive. High risk of corrosion to uncoated steel or deterioration of concrete.

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Depth to rock (in tables). Bedrock is too near the surface for the specified use.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:
Excessively drained.—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.
Somewhat excessively drained.—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.
Well drained.—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.
Moderately well drained.—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically they are wet long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum, or periodically receive high rainfall, or both.
Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.
Poorly drained.—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.
Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients.

Drainage, surface. Runoff, or surface flow of water, from an area.

Eluviation. The movement of material in true solution or colloidal suspension from one place to another within the soil. Soil horizons that have lost material through eluviation are eluvial; those that have received material are illuvial.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.
Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of the activities of man or other animals or of a catastrophe in nature, for example, fire, that exposes the surface.

Excess fines (in tables). Excess silt and clay in the soil. The soil does not provide a source of gravel or sand for construction purposes.

Fast intake (in tables). The rapid movement of water into the soil.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the ovendry weight, after the gravitational, or free, water has drained away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity, normal moisture capacity,* or *capillary capacity.*

Fine textured soil. Sandy clay, silty clay, and clay.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Foot slope. The inclined surface at the base of a hill.

Fragipan. A loamy, brittle subsurface horizon low in porosity and content of organic matter and low or moderate in clay but high in silt or very fine sand. A fragipan appears cemented and restricts roots. When dry, it is hard or very hard and has a higher bulk density than the horizon or horizons above. When moist, it tends to rupture suddenly under pressure rather than to deform slowly.

Gleyed soil. Soil that formed under poor drainage, resulting in the reduction of iron and other elements in the profile and in gray colors and mottles.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rock up to 3 inches (2 millimeters to 7.5 centimeters) in diameter. An individual piece is a pebble.

Gravelly soil material. Material that is 15 to 50 percent, by volume, rounded or angular rock fragments, not prominently flattened, up to 3 inches (7.5 centimeters) in diameter.

Ground water (geology). Water filling all the unblocked pores of underlying material below the water table.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an upper case letter represents the major horizons. Numbers or lower case letters that follow represent subdivisions of the major horizons. An explanation of the subdivisions is given in the *Soil Survey Manual.* The major horizons of mineral soil are as follows:

O horizon.—An organic layer of fresh and decaying plant residue at the surface of a mineral soil.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon, most of which was originally part of a B horizon.

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of transition from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) prismatic or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these. The combined A and B horizons are generally called the solum, or true soil. If a soil does not have a B horizon, the A horizon alone is the solum.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the A or B horizon. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, the Roman numeral II precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock commonly underlies a C horizon, but can be directly below an A or a B horizon.

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

Illuviation. The movement of soil material from one horizon to another in the soil profile. Generally, material is removed from an upper horizon and deposited in a lower horizon.

Impervious soil. A soil through which water, air, or roots penetrate slowly or not at all. No soil is absolutely impervious to air and water all the time.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Intake rate. The average rate of water entering the soil under irrigation. Most soils have a fast initial rate; the rate decreases with application time. Therefore, intake rate for design purposes is not a constant but is a variable depending on the net irrigation application. The rate of water intake in inches per hour is expressed as follows:

Less than 0.2	very low
0.2 to 0.4	low
0.4 to 0.75	moderately low
0.75 to 1.25	moderate
1.25 to 1.75	moderately high
1.75 to 2.5	high
More than 2.5	very high

Large stones (in tables). Rock fragments 3 inches (7.5 centimeters) or more across. Large stones adversely affect the specified use of the soil.

Leaching. The removal of soluble material from soil or other material by percolating water.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Loess. Fine grained material, dominantly of silt-sized particles, deposited by wind.

Low strength. The soil is not strong enough to support loads.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Moderately coarse textured soil. Sandy loam and fine sandy loam.

Moderately fine textured soil. Clay loam, sandy clay loam, and silty clay loam.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—*few, common,* and *many*; size—*fine, medium,* and *coarse*; and contrast—*faint, distinct,* and *prominent*. The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium*, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse*, more than 15 millimeters (about 0.6 inch).

Munsell notation. A designation of color by degrees of the three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color of 10YR hue, value of 6, and chroma of 4.

Neutral soil. A soil having a pH value between 6.6 and 7.3. (See Reaction, soil.)

Nutrient, plant. Any element taken in by a plant essential to its growth. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

Organic matter. Plant and animal residue in the soil in various stages of decomposition.

Pan. A compact, dense layer in a soil that impedes the movement of water and the growth of roots. For example, *hardpan, fragipan, claypan, plowpan,* and *traffic pan*.

Parent material. The unconsolidated organic and mineral material in which soil forms.

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation. The downward movement of water through the soil.

Percs slowly (in tables). The slow movement of water through the soil adversely affecting the specified use.

Permeability. The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

Very slow	less than 0.06 inch
Slow	0.06 to 0.20 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

Phase, soil. A subdivision of a soil series based on features that affect its use and management. For example, slope, stoniness, and thickness.

pH value. A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Piping (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

Ponding. Standing water on soils in closed depressions. The water can be removed only by percolation or evapotranspiration.

Poorly graded. Refers to a coarse grained soil or soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles, density can be increased only slightly by compaction.

Productivity, soil. The capability of a soil for producing a specified plant or sequence of plants under specific management.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as—

	pH
Extremely acid	Below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Regolith. The unconsolidated mantle of weathered rock and soil material on the earth's surface; the loose earth material above the solid rock.

Residuum (residual soil material). Unconsolidated, weathered, or partly weathered mineral material that accumulated as consolidated rock disintegrated in place.

Rock fragments. Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

Rooting depth (in tables). Shallow root zone. The soil is shallow over a layer that greatly restricts roots.

Root zone. The part of the soil that can be penetrated by plant roots.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sandstone. Sedimentary rock containing dominantly sand-size particles.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Sequum. A sequence consisting of an illuvial horizon and the overlying eluvial horizon. (See Eluviation.)

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the underlying material. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Shale. Sedimentary rock formed by the hardening of a clay deposit.

Shrink-swell. The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Siltstone. Sedimentary rock made up of dominantly silt-sized particles.

Site index. A designation of the quality of a forest site based on the height of the dominant stand at an arbitrarily chosen age. For example, if the average height attained by dominant and codominant trees in a fully stocked stand at the age of 50 years is 75 feet, the site index is 75 feet.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

Slow refill (in tables). The slow filling of ponds, resulting from restricted permeability in the soil.

Small stones (in tables). Rock fragments less than 3 inches (7.5 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

Soil. A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles less than 2 mm in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows:

	Millimeters
Very coarse sand	2.0 to 1.0
Coarse sand	1.0 to 0.5
Medium sand	0.5 to 0.25
Fine sand	0.25 to 0.10
Very fine sand	0.10 to 0.05
Silt	0.05 to 0.002
Clay	less than 0.002

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and plant and animal activities are largely confined to the solum.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter.

Stony. Soil contains stones in quantity that interferes with or prevents tillage.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular. Structureless* soils are either *single grained* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Substratum. The part of the soil below the solum.

Subsurface layer. Technically, the A2 horizon. Generally refers to a leached horizon lighter in color and lower in content of organic matter than the overlying surface layer.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Taxadjuncts. Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use and behavior.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer (in tables). Otherwise suitable soil material too thin for the specified use.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Toe slope. The outermost inclined surface at the base of a hill; part of a foot slope.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Valley fill. In glaciated regions, material deposited in stream valleys by glacial melt water. In nonglaciated regions, alluvium deposited by heavily loaded streams.

Variant, soil. A soil having properties sufficiently different from those of other known soils to justify a new series name, but occurring in such a limited geographic area that creation of a new series is not justified.

Weathering. All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

Well graded. Refers to soil material consisting of coarse grained particles that are well distributed over a wide range in size or diameter. Such soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

Wilting point (or permanent wilting point). The moisture content of soil, on an ovendry basis, at which a plant (specifically sunflower) wilts so much that it does not recover when placed in a humid, dark chamber.

Keys to Soil Taxonomy

By Soil Survey Staff

United States Department of Agriculture
Natural Resources Conservation Service

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3. Redoximorphic features associated with wetness result from alternating periods of reduction and oxidation of iron and manganese compounds in the soil. Reduction occurs during saturation with water, and oxidation occurs when the soil is not saturated. The reduced iron and manganese ions are mobile and may be transported by water as it moves through the soil. Certain redox patterns occur as a function of the patterns in which the ion-carrying water moves through the soil and as a function of the location of aerated zones in the soil. Redox patterns are also affected by the fact that manganese is reduced more rapidly than iron, while iron oxidizes more rapidly upon aeration. Characteristic color patterns are created by these processes. The reduced iron and manganese ions may be removed from a soil if vertical or lateral fluxes of water occur, in which case there is no iron or manganese precipitation in that soil. Wherever the iron and manganese are oxidized and precipitated, they form either soft masses or hard concretions or nodules. Movement of iron and manganese as a result of redox processes in a soil may result in redoximorphic features that are defined as follows:

a. *Redox concentrations.*—These are zones of apparent accumulation of Fe-Mn oxides, including:

(1) Nodules and concretions, which are cemented bodies that can be removed from the soil intact. Concretions are distinguished from nodules on the basis of internal organization. A concretion typically has concentric layers that are visible to the naked eye. Nodules do not have visible organized internal structure. Boundaries commonly are diffuse if formed *in situ* and sharp after pedoturbation. Sharp boundaries may be relict features in some soils; *and*

(2) Masses, which are noncemented concentrations of substances within the soil matrix; *and*

(3) Pore linings, i.e., zones of accumulation along pores that may be either coatings on pore surfaces or impregnations from the matrix adjacent to the pores.

b. *Redox depletions.*—These are zones of low chroma (chromas less than those in the matrix) where either Fe-Mn oxides alone or both Fe-Mn oxides and clay have been stripped out, including:

(1) Iron depletions, i.e., zones that contain low amounts of Fe and Mn oxides but have a clay content similar to that of the adjacent matrix (often referred to as albans or neoalbans); *and*

(2) Clay depletions, i.e., zones that contain low amounts of Fe, Mn, and clay (often referred to as silt coatings or skeletans).

c. *Reduced matrix.*—This is a soil matrix that has low chroma *in situ* but undergoes a change in hue or chroma within 30 minutes after the soil material has been exposed to air.

d. In soils that have no visible redoximorphic features, a reaction to an alpha,alpha-dipyridyl solution satisfies the requirement for redoximorphic features.

Field experience indicates that it is not possible to define a specific set of redoximorphic features that is uniquely characteristic of all of the taxa in one particular category. Therefore, color patterns that are unique to specific taxa are referenced in the keys.

Anthraquic conditions are a variant of episaturation and are associated with controlled flooding (for such crops as wetland rice and cranberries), which causes reduction processes in the saturated, puddled surface soil and oxidation of reduced and mobilized iron and manganese in the unsaturated subsoil.

REDOXIMORPHIC FEATURES

Redoximorphic features are soil features that are produced by the processes of reduction and oxidation of Fe and Mn. The following are categories of redoximorphic features:

I. ***Reduced Matrices*** - Soil matrices of low chroma because of the presence of Fe(II). The color increase in hue and/or chroma within 30 minutes after exposure to air.

II. ***Redox Depletions*** - Bodies of low chroma where Fe and Mn or Fe, Mn and clay have been reduced and removed.

1. Iron Depletions - Grayish bodies lower in Fe & Mn, but not in clay, than the matrix. These bodies have been called "grey mottles," "albans" or "neoalbans"

2. Clay Depletions - Grayish bodies lower in Fe, Mn, and clay than the matrix. They have been called "silt coatings" or "skeletans"

III. ***Redox Concentrations*** - Bodies of Fe - Mn accumulations

1. Nodules and concretions - Firm bodies of Fe-Mn accumulations. Nodules have a uniform internal fabric and concretions have concentric layers.

2. Masses - Soft bodies which are frequently within the matrix. The term includes, among other things, features previously called reddish mottles.

3. Pore linings - Accumulations of Fe-Mn along pores, either as coatings or impregnations of the matrix adjacent to the pores. Fe along rice root pores is a notable example.

SEASONAL WATER TABLE (SWT) CLASSES

The depth to seasonal water tables (SWTs) of three durations can be estimated from the following guides. The guides are interpretations of redoximorphic features, a type of soil morphology which results from reduction-oxidation processes. All colors are for moist conditions. Place each horizon in the most limiting class in which it will fit.

Soil horizons that have chroma and value of ≤3 due to high organic matter contents (A horizons) present problems for SWT interpretations. Also, uncoated grains which result from prolonged leaching with organic acids (E horizons) are not considered to be an indication of a SWT. These horizons (A & E) shall be considered to contain SWTs only if they also contain high or low chroma colors. A plowed horizon (Ap) which has chroma of 2 or 3 or less shall not be considered to contain a SWT unless the first underlying horizon contains a SWT. The duration of the SWT in plowed horizon (Ap) with chroma ≤3 and in A & E horizons with chroma ≤3 and high or low chroma colors shall be the same as in the first underlying horizon.

The placing of soil horizons into SWT classes based on redoximorphic features is an interpretation and requires some understanding of soil development processes. Redoximorphic features are not expected to occur unless the horizon has been both saturated and reduced. Reduction is not expected to occur until after the horizon has been saturated for some period of time.

HORIZONS WITH DISSIMILAR COLOR PATTERNS N PED SURFACES AND PED INTERIORS.

Long: Soil horizons which have SWTs of long duration contain:

1. Chroma ≤ 2 on ≥ 70% of ped surfaces or
2. Chroma ≤ 2 on ≥ 50% of ped surfaces with some chroma ≤ 2 in ped interiors or
3. ≥ 50% clay.[1]

Moderate: Soil horizons which have SWTs of moderate duration contain:

1. Some chroma ≤ 2 on ped surface or
2. ≥ 50% chroma 3 on ped surfaces or
3. 35 to 49% clay.[1]

Brief: Soil horizons which have SWTs of brief duration contain:

1. Concentrations or depletions on ped surfaces with chroma ≥ 3 or
2. Mn masses on ≥ 2% of ped surface or
3. Fe-Mn nodules or concretions ≥ 2 mm in diameter.

HORIZONS WITH SIMILAR COLOR PATTERNS ON PED SURFACES AND PED INTERIORS AND HORIZONS WITHOUT PEDS.

Long: Soil horizons which have SWTs of long duration contain:

1. Chroma ≤ 2 in $\geq 50\%$ of the mass or
2. $\geq 50\%$ clay.[1]

Moderate: Soil horizons which have SWTs of moderate duration contain:

1. Chroma ≤ 2 in $< 50\%$ of the mass or
2. Chroma 3 in $> 20\%$ of the mass or
3. 35 to 49% clay.[1]

Brief: Soil horizons which have SWTs of brief duration contain:

1. Concentrations or depletions with chroma ≥ 3 or
2. Fe-Mn nodules or concretions ≥ 2 mm in diameter.

Soil horizons that do not meet any of the above criteria are considered not to have a SWT for design purposes of filter fields.

[1] The occurrence of redoximorphic features is not a perfect indicator of loading rates. Therefore clay content is included as a backup. When horizons are placed in moderate or long SWT classes due to clay content, this means that the soil should be "loaded as if a SWT" occurred. (added 2/98)

Some soil horizons with 35% or more clay, normally horizons with low or moderate shrink-swell, may have higher hydraulic conductivities and SWTs of shorter duration than indicated by the guides. The Program Administrator of Environmental Program Services of the Arkansas Department of Health shall, in conjunction with representatives of the National Cooperative Soil Survey, maintain a list of such horizons.

[2] Mn masses should be classified as "Mn masses" rather than by their chroma.

HYDRAULIC CONDUCTIVITY (H.C.) CLASSES

The H.D. class may be estimated using the following guide:

HIGH H.C.: Natural soil horizons which have not been compacted by the activities of man/woman, especially vehicle traffic and tillage operations, and are in the following particle size classes.

Sandy - The texture of the fine earth is sand or loamy sand but not loamy very fine sand or very fine sand; rock fragments make up <35 percent by volume.

Fragmental - Stones, cobbles, gravel, and very coarse sand particles; too little fine earth to fill some of the interstices larger than 1 mm in diameter.

Sandy-skeletal - Rock fragments 2 mm in diameter or larger make up 35 percent or more by volume; enough fine earth to fill interstices larger than 1mm; the fraction finer than 2 mm is sandy as defined for the sandy particle-size class.

MODERATE H.C.: Natural soil horizons which clearly have some soil structure other than platy, which have not been compacted by the activities of man/woman, especially vehicle traffic and tillage operations, and which are in one of the following particle size classes.

Loamy - The texture of the fine earth is loamy very fine sand, very fine sand, or finer, but the amount of clay is <35 percent; rock fragments are <35 percent by volume.

Loamy-skeletal - Rock fragments make up 35 percent or more by volume; enough fine earth to fill interstices larger than 2 mm; the fraction finer than 2 mm is loamy as defined for the loamy particle size class.

LOW H.C.: Included are all soil horizons which have platy structure, or (clearly) fragipan horizons or horizons which have been compacted by the activities of man/woman, especially vehicle traffic and tillage operations. Also included are horizons with the following particle size classes.

Clayey - The fine earth contains 35 percent or more clay by weight, and rock fragments are <35 percent volume.[1]

Clayey-skeletal - Rock fragments make up 35 percent or more by volume; enough fine earth to fill interstices larger than 1 mm; the fraction finer than 2 mm is clayey as defined for the clayey particle size class.[1]

[1] Some soil horizons with 35 percent or more clay, normally horizons with low or moderate shrink-swell, may have higher hydraulic conductivities and SWT's of less duration than indicated by the guides. The Program Administrator of Environmental Program Services of the Arkansas Department of Health shall, in conjunction with representatives of the National Cooperative Soil Survey, maintain a list of such soil horizons.

The above particle size classes are as defined in Soil Taxonomy.[2]

UNASSIGNED: Soil horizons which do not have soil structure, which do not have high H.C., and which have not been compacted by the activities of man/woman are not assigned to H.C. classes. The H.C. of these horizons must be assigned on a horizon by horizon basis. The decision should be based primarily on the amount of rooting, amount of biopores, particle size, and shrink-swell. Small horizon (thin strata) should not be overlooked.

The H.C. of horizons containing seasonal water tables does not need to be rated unless tile (curtain) drains are going to be utilized.

Hydraulic conductivity (H.C.) as used herein is saturated H.C. It refers to the rate of water movement under unit gradient in a specific soil horizon after the soil is saturated and swollen. The three classes used are defined in the Soil Survey Manual.[3]

	Rate of water movement		
Class	um/s	cm/day	in/day
High	>10	>86	>34
Moderate	0.1-10	.86-86	.34-34
Low	<0.1	<.86	<.34

H.C. depends on pore size distribution and geometry which is related to particle size, structure, biological activity (biopores), organic matter, mineralogy (shrink-swell), and other factors.

[2] Soil Survey Staff. 1994. Keys to Soil Taxonomy, Sixth Edition. USDA, Soil Conservation Service, Washington, DC.

[3] Soil Survey Division Staff. 1993. Soil Survey Manual. USDA Handbook No. 18. U.S. Gov't. Printing Office. Washington, DC.

SOIL DESCRIPTION GUIDE

I. **Soil:** II. County: III. Pedon No. IV. Location: (general & legal)
V. Physiography & Elevation & Slope: VI. Plant Material: VII. Use or Vegetation:
VIII. Described & Sampled by: IX. Classification: X. Pedon Description:
1. Horizon nomenclature 2. Depth 3. Color (matrix) 4. Texture
5. Redoximorphic Features (RMF):

Abundance		Size		Contrast	Color
Few	< 2%	fine	< 5mm	faint	
Common	2-20%	medium	5-15mm	distinct	
Many	> 20%	coarse	> 15mm	prominant	

Redox Depletion	Redox Concentration	Boundary	Location
iron depletion	nodules & concretions	sharp	
clay depletion	masses	clear	
	pore linings	diffuse	

(Boundary mainly for nodules; concretions & masses)

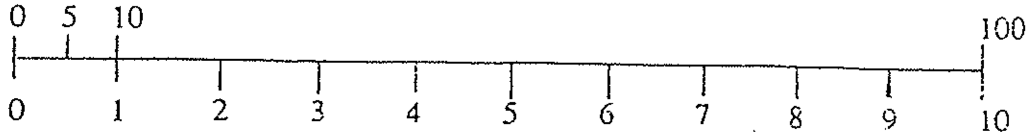
6.

Structure	Size	Shape		
Grade		Platy & Granular	Blocky	Prismatic & Columnar
			(mm)	
Structureless (massive or single grain)	very fine	< 1	< 5	< 10
Weak	fine	1-2	5-10	10-20
Moderate	medium	2-5	10-20	20-50
Strong	coarse	5-10	20-50	50-100
	very coarse	> 10	> 50	> 100

Do not use "structureless" as term. Use massive or single grain.

7. Consistence: Rupture resistance classes for blocklike specimens - slightly dry and wetter: Loose - non-coherent; Very friable - fails...very slight force; friable - fails...slight force; firm - fails...moderate force; very firm - fails...strong force; extremely firm - fails...both hands, very extremely firm - fails...underfoot; rigid - fails...3J blow; very rigid - not fail...3J blow. Also, use slightly brittle, brittle, and very brittle as needed.

8. Surface features: Clay films, clay bridges, slickensides, etc. Note color, kind and location (vertical or horizontal faces). Give amount as % of total surface area.



Amount		Distinctness	
very few	<5%	faint	w/ 10X
few	5-25%	distinct	w/o & w/ 10X
common	25-50%	prominent	w/o 10X
many	>50%		

9. Concentrations: nodules and concretions (not RMF), carious salts, masses, ironstone, etc.

Describe, as needed, abundance, size, shape, consistency, color, location, and boundary. Use abundance and boundary as given under Redoximorphic Features. Size:

fine	<2mm	coarse	5-20mm	extremely	
medium	2-5mm	very coarse	20-76mm	coarse >76mm	

10. Roots: Describe if needed: quantity, size and location: Quantity and Size per dm^2

	Very fine <0.5 mm	Fine 0.5 - 2 mm	Medium 2 - 5 mm	Coarse 5 - 10 mm
Few	<100	<100	<1	<1
Common	100 - 500	100 - 500	1 - 5	1 - 5
Many	>500	>500	>5	>5

11. Pores: Describe (if needed): quantity, size and location: Quantity and Size per dm^2

	Very fine <0.5mm	Fine 0.5 - 2mm	Medium 2 - 5mm	Coarse 5 - 10mm
Few	<100	<100	<1	<1
Common	100 - 500	100 - 500	1 - 5	1 - 5
Many	>500	>500	>5	>5

Continuity: discontinuous, constricted, continuous. Orientation: vertical, horizontal, random, oblique. Shape: vesicular, irregular, tubular. Distribution: inped, exped. (Usually describe only inped). Describe earthworm, etc. holes separately with the same criteria.

12. Mottles: Color of features of unknown origin.

13. Coarse Fragments: shape, size, kind, and % by volume.

14. Other Features:

15. Reaction: pH

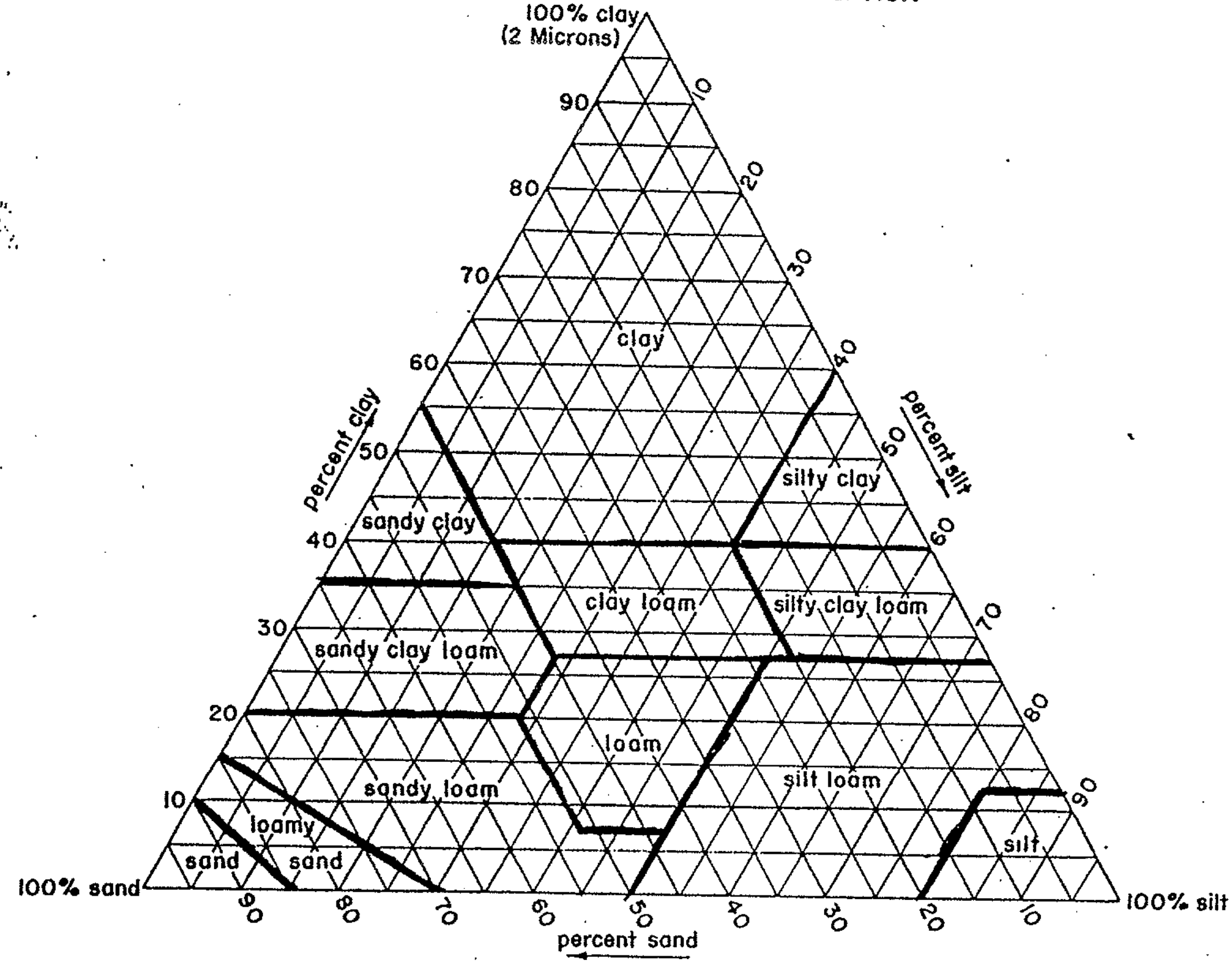
16. Boundary: Describe: distinctness and topography
Distinctness: abrupt, <2cm; clear, 2-5cm; gradual, 5-15cm; diffuse, >15cm.
Topography: smooth, nearly a plane; wavy, pocket width > depth; irregular, pocket depth > width: broken, is discontinuous.

XI. Remarks: Moisture status, etc.

Note: All features may not be described in all cases. Judgement must be exercised in deciding which attributes are important enough to describe and which attributes merely complicate a description without adding useful information.

From: Schoeneberger, P.J., Wysocki, D.A., Benham, E.C., and Broderson, W.D. 1998 Field book for describing and sampling soils. Natural Resources Conservation Service, USDA, National Soil Survey Center, Lincoln, NE.

GUIDE FOR TEXTURAL CLASSIFICATION



U.S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE
USDA-SCS-FORT WORTH, TEX. 1969

Determining Soil Texture by the "Feel Method"

Texture Classification
C = Coarse
MC = Moderately Coarse
M = Medium
F = Fine

Start

Place approximately one tablespoon of soil in palm. Add water a drop at a time and knead the soil to break down all aggregates. Soil is at the proper consistency when plastic and mobile, like moist putty.

Does soil remain in a ball when squeezed?
- NO → Is the soil to dry?
  - YES → Place approximately one tablespoon of soil in palm...
  - NO → Is the soil too wet?
    - YES → Add dry soil to soak up water. → Place approximately one tablespoon of soil in palm...
    - NO (0 -10% **) → SAND C*
- YES ↓

Place ball of soil between thumb and forefinger, gently pushing the soil with the thumb, working it upward into a ribbon. Form a ribbon of uniform thickness and width. Allow the ribbon to emerge and extend over the forefinger, breaking from its own weight.

Does the soil form a ribbon?
- NO (0 -15% **) → LOAMY SAND C*
- YES ↓

Does the soil make a weak ribbon less than 1" long before breaking?
- NO → Does the soil make a medium ribbon 1" to 2" long before breaking?
  - NO → Does the soil make a strong ribbon 2" or longer before breaking?

Weak ribbon — YES: Excessively wet a small pinch of soil in palm of hand and rub with forefinger.
- Does the soil feel very gritty? YES (0-20%) → Sandy Loam MC
- NO → Does the soil feel very smooth? YES (0-27%) → Silt or Silt Loam M
- NO → Neither grittiness nor smoothness predominates. YES (7-27%) → Loam M

Medium ribbon — YES: Excessively wet a small pinch of soil in palm of hand and rub with forefinger.
- Does the soil feel very gritty? YES (20-35%) → Sandy Clay Loam MC
- NO → Does the soil feel very smooth? YES (27-40%) → Silty Clay Loam F
- NO → Neither grittiness nor smoothness predominates YES (27-40%) → Clay Loam F

Strong ribbon — YES: Excessively wet a small pinch of soil in palm of hand and rub with forefinger.
- Does the soil feel very gritty? YES (35-55%) → Sandy Clay MC
- NO → Does the soil feel very smooth? YES (40-60%) → Silty Clay F
- NO → Neither grittiness nor smoothness predominates YES (40-100%) → Clay F

* Sand Particle size should be estimated (very fine, fine, medium, coarse) for these textures. Individual grains of very fine sand are not visible without magnification and there is a gritty feeling to a very small sample ground between the teeth. Some fine sand particles may be just visible. Medium sand particles are easily visible. Examples of sand size descriptions where one size is predominant are; very fine sand, fine sandy loam, loamy coarse sand.

** Cay percentage range.

Modified from: Thien, Steven J., Kansas state University, 1979 Jour. Agronomy education.

Determining Soil Loading Rates

When a seasonal water table (SWT) of more than one duration is present in a soil, the loading rate is determined as follows:

1) Determine the depth to each seasonal water table observed.

2) Adjusting the moderate SWT.
   - Subtract the depth of the observed brief SWT from the observed moderate SWT and divide by 3. (18 days storage divided by 6 days storage)
   - Subtract this number from the observed moderate SWT to obtain the adjusted moderate SWT.

3) Adjusting for a long SWT.
   - Subtract the adjusted moderate SWT from the observed long SWT and divide by 2. (36 days storage divided by 18 days storage)
   - Subtract this number from the observed long SWT to obtain the adjusted long SWT.

4) For brief and long SWT only.
   - Subtract the observed depth of the brief SWT from the observed depth of the long SWT and divide by 6. (36 days storage divided by 6 days storage)
   - Subtract this number from the observed long SWT to obtain the adjusted long SWT.

5) Compare the loading rates for the brief SWT, adjusted moderate SWT, and the adjusted long SWT.

6) Use the lowest or most restrictive loading rate to determine the size of the absorption area.

Adjusting Seasonal Water Tables (SWT)

(Examples are for 8 foot trench-spacing in a moderate hydraulic conductivity soil.)

Brief and Moderate SWT only

Brief SWT observed at 22 inches. Loading rate is 0.75 G/ft^2D.
Moderate SWT observed at 27 inches. Loading rate is 0.60.
27 - 22 = 5/3 = 1.6
27 - 2 = 25 inch adjusted Moderate SWT. Loading rate is 0.52 G/ft^2D.
0.52 is most restrictive and is the loading rate actually used.

Moderate and Long SWT only

Moderate SWT observed at 25 inches. Loading rate is 0.52 G/ft^2D.
Long SWT observed at 37 inches. Loading rate is 0.49 G/ft^2D.
37 - 25 = 12/2 = 6
37 - 6 = 31 inch adjusted Long SWT. Loading rate is 0.37 G/ft^2D.
0.37 G/ft D is most restrictive and is the long rate actually used.

Brief SWT and Long SWT only

Brief SWT observed at 19 inches. Loading rate is 0.75 G/ft^2D.
Long SWT observed at 39 inches. Loading rate is 0.53 G/ft^2D.
39 - 19 = 20/6 = 3.3
39 - 3 = 36 inches adjusted Long SWT. Loading rate is 0.47 G/ft^2D.
0.47 G/ft^2D is most restrictive and the loading rate actually used.

Brief, Moderate and Long SWT present

Brief SWT observed at 21 inches. Loading rate is 0.75 G/ft^2D.
Moderate SWT observed at 28 inches. Loading rate is 0.64 G/ft^2D.
Long SWT observed at 40 inches. Loading rate is 0.0.55 G/ft^2D.

Adjusting the Moderate SWT

28 - 21 = 7/3 = 2.3
28 - 2 = 26 inches adjusted Moderate SWT. Loading rate is 0.57 G/ft^2D.

Adjusting Long SWT

40 - 26 (adjusted moderate SWT) = 14/2 = 7
40 - 7 = 33 inches adjusted long SWT. Loading rate is 0.41 G/ft^2D.
0.41 G/ft^2D loading rate is most restrictive and is the one actually used.

LOADING RATES FOR RESIDENCES AND COMMERCIAL ESTABLISHMENTS

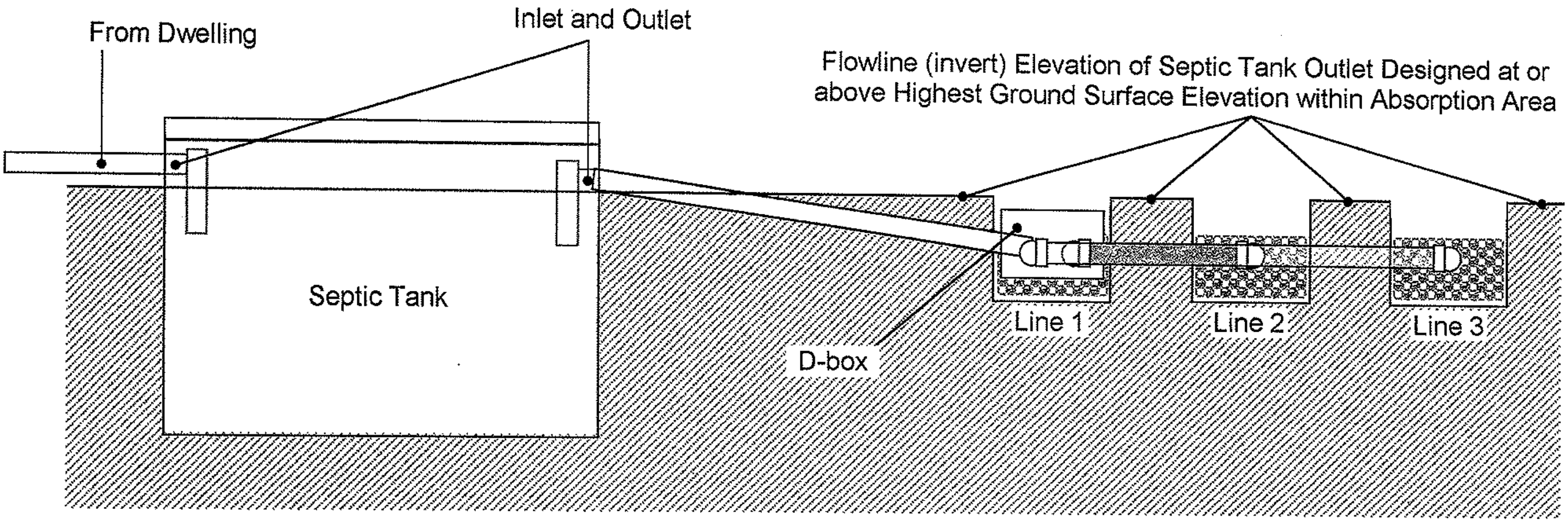
A. SOILS WITH A MODERATE HYDRAULIC CONDUCTIVITY

SEASONAL WATER TABLE (SWT) DEPTH	BRIEF SWT GPD/Sq. Ft.		MODERATE SWT GPD/Sq.Ft.		LONG SWT GPD/Sq. Ft.	
Inches	8 Ft. Centers	10 Ft. Centers	8 Ft. Centers	10 Ft. Centers	8 Ft. Centers	10 Ft. Centers
13	0.22	0.22				
14	0.29	0.29				
15	0.40	0.40				
16	0.51	0.51				
17	0.62	0.63				
18	0.73	0.75	0.24	0.26		
19	0.75	0.75	0.28	0.30		
20	0.75	0.75	0.32	0.35		
21	0.75	0.75	0.36	0.40		
22	0.75	0.75	0.40	0.44		
23	0.75	0.75	0.44	0.49		
24	0.75	0.75	0.48	0.54		
25	0.75	0.75	0.52	0.59	0.26	0.30
26	0.75	0.75	0.57	0.64	0.28	0.32
27	0.75	0.75	0.60	0.68	0.30	0.34
28	0.75	0.75	0.64	0.73	0.32	0.36
29	0.75	0.75	0.67	0.75	0.34	0.39
30	0.75	0.75	0.71	0.75	0.35	0.41
31	0.75	0.75	0.75	0.75	0.37	0.43
32	0.75	0.75	0.75	0.75	0.39	0.46
33	0.75	0.75	0.75	0.75	0.41	0.48
34	0.75	0.75	0.75	0.75	0.43	0.50
35	0.75	0.75	0.75	0.75	0.45	0.53
36	0.75	0.75	0.75	0.75	0.47	0.55
37	0.75	0.75	0.75	0.75	0.49	0.58
38	0.75	0.75	0.75	0.75	0.51	0.60
39	0.75	0.75	0.75	0.75	0.53	0.63
40	0.75	0.75	0.75	0.75	0.55	0.65
41	0.75	0.75	0.75	0.75	0.57	0.68
42	0.75	0.75	0.75	0.75	0.59	0.70
43	0.75	0.75	0.75	0.75	0.61	0.73
44	0.75	0.75	0.75	0.75	0.63	0.75
45	0.75	0.75	0.75	0.75	0.65	0.75
46	0.75	0.75	0.75	0.75	0.68	0.75
47	0.75	0.75	0.75	0.75	0.70	0.75
48	0.75	0.75	0.75	0.75	0.72	0.75
49	0.75	0.75	0.75	0.75	0.75	0.75

B. SOILS WITH HIGH HYDRAULIC CONDUCTIVITY

SEASONAL WATER TABLE (SWT) DEPTH	BRIEF SWT GPD/Sq. Ft.		MODERATE SWT GPD/Sq.Ft.		LONG SWT GPD/Sq. Ft.	
Inches	8 Ft. Centers	10 Ft. Centers	8 Ft. Centers	10 Ft. Centers	8 Ft. Centers	10 Ft. Centers
13	0.33	0.34				
14	0.42	0.46				
15	0.54	0.60				
16	0.66	0.75				
17	0.79	0.90				
18	0.91	1.05	0.30	0.35		
19	1.04	1.21	0.35	0.40		
20	1.17	1.25	0.39	0.46		
21	1.25	1.25	0.44	0.51		
22	1.25	1.25	0.48	0.56		
23	1.25	1.25	0.53	0.62		
24	1.25	1.25	0.58	0.68		
25	1.25	1.25	0.62	0.74	0.31	0.37
26	1.25	1.25	0.67	0.80	0.34	0.40
27	1.25	1.25	0.72	0.85	0.36	0.43
28	1.25	1.25	0.76	0.91	0.38	0.45
29	1.25	1.25	0.81	0.96	.040	0.48
30	1.25	1.25	0.85	1.02	0.43	0.51
31	1.25	1.25	0.90	1.08	0.45	0.54
32	1.25	1.25	0.95	1.14	0.47	0.57
33	1.25	1.25	1.00	1.20	0.50	0.60
34	1.25	1.25	1.05	1.25	0.52	0.63
35	1.25	1.25	1.10	1.25	0.55	0.66
36	1.25	1.25	1.15	1.25	0.57	0.69
37	1.25	1.25	1.20	1.25	0.60	0.73
38	1.25	1.25	1.25	1.25	0.63	0.76
39	1.25	1.25	1.25	1.25	0.65	0.79
40	1.25	1.25	1.25	1.25	0.68	0.83
41	1.25	1.25	1.25	1.25	0.71	0.86
42	1.25	1.25	1.25	1.25	0.74	0.90
43	1.25	1.25	1.25	1.25	0.76	0.93
44	1.25	1.25	1.25	1.25	0.79	0.97
45	1.25	1.25	1.25	1.25	0.82	1.01
46	1.25	1.25	1.25	1.25	0.85	1.04
47	1.25	1.25	1.25	1.25	0.88	1.08
48	1.25	1.25	1.25	1.25	0.91	1.12
49	1.25	1.25	1.25	1.25	0.95	1.16
50	1.25	1.25	1.25	1.25	0.98	1.20
51	1.25	1.25	1.25	1.25	1.01	1.24
52	1.25	1.25	1.25	1.25	1.04	1.25
53	1.25	1.25	1.25	1.25	1.08	1.25
54	1.25	1.25	1.25	1.25	1.11	1.25
55	1.25	1.25	1.25	1.25	1.14	1.25
56	1.25	1.25	1.25	1.25	1.18	1.25
57	1.25	1.25	1.25	1.25	1.21	1.25
58	1.25	1.25	1.25	1.25	1.25	1.25

Maximum Storage on Level Ground



When ground surface elevations differ less than 6 inches across the absorption field, the flowline (invert) elevation of the septic tank outlet must be greater than or equal to the ground surface elevation of the down slope side of the uppermost absorption trench.

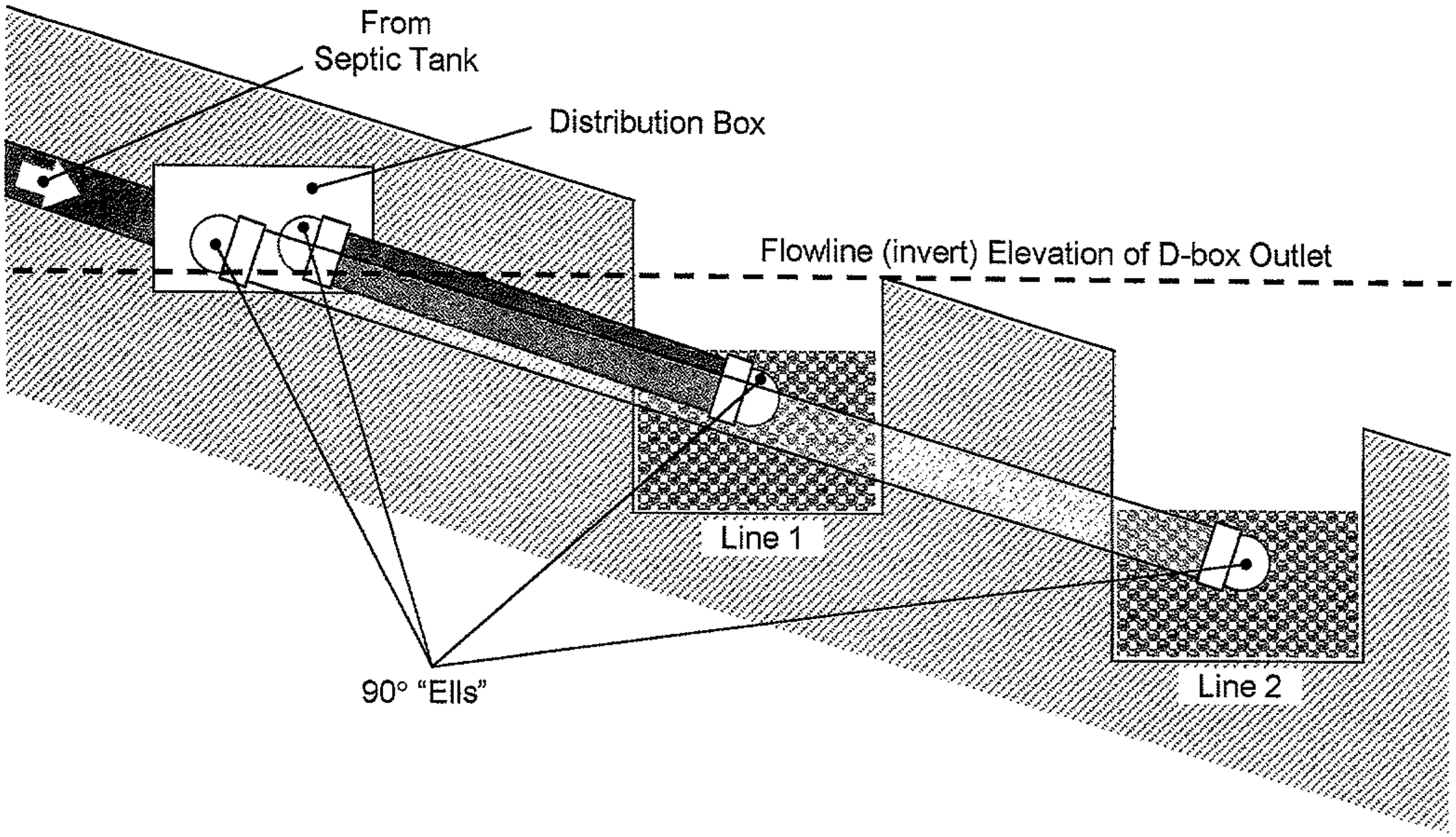
Example: Down slope ground surface elevation of the uppermost trench = 105.00' ; Septic tank outlet flowline (invert) elevation must be $\geq$ 105.00'

If rod readings are used instead of elevations, the flowline (invert) rod reading of the septic tank outlet must be less than or equal to the ground surface rod reading of the down slope side of the uppermost absorption trench.

Example: Down slope ground surface rod reading of the uppermost trench = 6.25' ; Septic tank outlet flowline (invert) elevation must be $\leq$ 6.25'

jnr:diagram MSL

Maximum Storage on Sloping Ground



When ground surface elevations differ $\geq$ 6 inches across the absorption field, the flowline (invert) elevation of the distribution box outlet must be greater than or equal to the ground surface elevation of the down slope side of the uppermost absorption trench.

Example: Down slope ground surface elevation of the uppermost trench = 102.50'; D-box outlet flowline (invert) elevation must be ≥ 102.50'

If rod readings are used instead of elevations, the flowline (invert) rod reading of the distribution box outlet must be less than or equal to the ground surface rod reading of the down slope side of the uppermost absorption trench.

Example: Down slope ground surface rod reading of the uppermost trench = 6.25'; D-box outlet flowline (invert) elevation must be ≤ 6.25'

jnr:diagram MSS

Designated Representative Exam
Soils Test

(100 pts.)

Name ______________________________ **Time In** ________

Time Out ________

Indicate the following for each of the 2 soil pits. Give the soils characteristics (concentration, depletions, chroma, etc.) that determine the depths to each SWT if they are observed. Calculate the loading rate, or indicate "no load" for each pit based on the most limiting SWT.
EVALUATE PITS BETWEEN THE FLAGS ON THE SIDE OF PIT
EVALUATE EACH PIT TO A DEPTH OF 48 INCHES.
DISREGARD CLAY CONTENT IN DETERMINING SWT's

	Pit # ______	**Pit #** ______
REDOX FEATURES (7 pts)	________________	________________
	________________	________________
	________________	________________
Depth to Brief SWT (10 pts)	________"	________"
REDOX FEATURES (7 pts)	________________	________________
	________________	________________
	________________	________________
Depth to Moderate SWT (10 pts)	________"	________"
REDOX FEATURES (2 pts)	________________	________________
	________________	________________
	________________	________________
Depth to Long SWT (3 pts)	________"	________"
Depth to bedrock (1 pt. each)	________"	________"
Loading rate. Use 10' centers (Show calculations) (5 pts. each)	________	________

Name ______________________________ **Date** ____________________

Answer the following questions using the provided soil samples. Be sure to include the sample number (Sand and silt percentages are for determining textural class only):

	Sample # __________	**Sample #** __________
Sand percentage (0 pts. each)	____________%	____________%
Silt percentage (0 pts. each)	____________%	____________%
Clay percentage (3 pts. each)	____________%	____________%
Soil Texture (1 pt. each) (from textural triangle)	______________	______________
Hydraulic conductivity (1 pt. each)	______________	______________

SYSTEM LAYOUT AND DRAWING
(100 points total)

NAME ______________________ **LOT NO.** ________

Using the soils information from the pits, design a gravity flow pipe & gravel wastewater system with a distribution box for a 1200 ft^2 one level house on a well. **Use 370 GPD**

SECTION 1 **20 POINTS** **60 MINUTES**

a. Flag and label the bench mark. **(1 pt.)**
b. Flag and label the stub-out. **(1 pt.)**
c. Flag and label the inlet & outlet of the septic tank. **(1 pt.)**
d. Flag and label the distribution box. **(1 pt.)**
e. Layout primary absorption area on contour. **(8 pt.)**
f. Flag and label the beginning, middle and end of each line in the primary area. **(3 pt.)**
g. Layout the four corners of the alternate absorption area on contour. **(4 pt.)**
h. Flag and label the 4 house corners. **(1 pt.)**

SECTION 2 **50 POINTS** **150 MINUTES**

Use attached elevation/flowline form . Turn in this sheet before beginning Section 3.

SECTION 3 **30 POINTS** **60 MINUTES**

Indicate the following items on a scale drawing using the following criteria:

1. Use a 1 inch = 20 feet or 1 inch = 30 feet scale. Indicate scale. **(2 pt.)**
2. House with dimensions. **(1 pt.)**
3. Location of all septic system components. **(2 pt.)**
4. Indicate North. **(1 pt.)**
5. Property lines with dimensions. **(1 pt.)**
6. Location of utility/service lines. **(1 pt.)**
7. Driveway and dimensions. **(1 pt.)**
8. Location and elevation of water well. **(2 pt.)**
9. All septic system setbacks. **(6 pt.)**
10. Contour lines or arrows indicating the direction and percent of slope in the primary and secondary absorption locations. **(2 pt.)**
11. Bench mark location. **(1 pt.)**
12. Volume of septic tank. **(1 pt.)**
13. Pipe specifications for all parts of the system. **(2 pt.)**
14. Correct size for primary and secondary areas in ft^2 of absorption lines. **(4 pt.)**
15. Absorption trench depth. **(1 pt.)**
16. Identify and locate each soil pit **(2 pt.)**

Section 2 of the Layout Exam Time Limit: 2 ½ hours 50 points

All shots are Rod Readings unless otherwise noted

PRIMARY SITE	Ground Elevation			Flowline Elevation		
Stub Out						
Septic tank IN						
Septic tank OUT						
D-Box IN						
D-Box OUT						
	Begin	Mid	End	Begin	Mid	End
Ln 1						
Ln 2						
Ln 3						
Ln 4						
Second area		XXXXXXX				
Second area		XXXXXXX				
Well				Benchmark		

Cover over tank/ht. above grade	
Cover over D box/ht. above grade	

Pressure Manifold Design

Step 1—Calculate Dose Volume

Step 2—Calculate Minimum Flow Rate for System

Step 3—Calculate Total Dynamic Head (TDH) @ Minimum Flow Rate

Step 4—Selecting the Pump

Step 5—Calculate Operating Capacity of Selected Pump

Step 6—Setting the Pump Timers

Step 7—Calculate Draw Down for Demand Dosing

Step 1---Calculate Dose volume

Need to Know:

#1—Number of Orifices

- Number of field lines---6 Lines

#2—Dose Volume

- Given or Selected

Step 1--Calculations

Common dose rate is 0.10 to 0.25 of the daily flow in gallons (GPD). This is usually a given value.

(a) select dose rate of .25 of the daily flow

(b) 370 GPD x .25 = **92.5 gal dose**

Step 2—Calculate Minimum Flow Rate for the System

Need to Know:

#1--Orifice sizes----3/8 inch

(Given or Selected)

#2--Residual Head (Squirt Height)----5 ft.

(Given or Selected)

Step 2----Calculations

- A 3/**8 in.** orifice with a **5 ft.** squirt height (residual head) has a flow rate of 3.893 gal per orifice. This will be 3.893 gallons per line with one orifice per absorption line. (Refer to chart provided on next slide)

- 3.893 gallons per orifice x 6 total orifices = 23.358 gpm (gal per minute).   You may round to 23 gpm

- To meet the 5 ft. residual head, the pump must be able to pump 23.358 (or 23) gpm against the Total Dynamic Head (TDH)

Table 1

Orifice Discharge Rate Chart (gpm)

Drill Size (in)

	1\8	3\16	1\4	5\16	3\8	7\16	1\2
Head (ft)							
3	0.335	0.754	1.34	2.094	3.015	4.104	5.361
4	0.387	0.871	1.548	2.418	3.482	4.739	6.19
5	0.4326	0.973	1.73	2.703	3.893	5.299	6.921
6	0.474	1.066	1.895	2.961	4.264	5.804	7.581
7	0.512	1.152	2.047	3.199	4.606	6.27	8.189
8	0.547	1.231	2.189	3.42	4.924	6.702	8.754
9	0.58	1.306	2.321	3.627	5.223	7.109	9.285
10	0.612	1.376	2.447	3.823	5.505	7.493	9.787

Table 2

TABLE II

HEADLOSS IN 100 Feet of SCHEDULE 40 PVC PIPE

FLOW RATE GPM	1"	1¼"	1½"	2"	3"
5	1.3	0.5	0.2	0.1	0.01
10	4.8	1.8	0.9	0.3	0.04
15	10.2	3.9	1.8	0.5	0.08
20	17.3	6.7	3.1	0.9	0.14
25	26.2	10.1	4.7	1.4	0.2
30	36.7	14.1	6.7	2.0	0.3
35	48.8	18.7	8.8	2.6	0.4
40	62.5	24.0	11.3	3.4	0.5
45	77.7	29.9	14.1	4.2	0.6
50	94.4	36.3	17.1	5.1	0.7
55	112.7	43.3	20.4	6.1	0.9
60	132.3	50.9	24.0	7.1	1.0
65		59.0	27.8	8.2	1.2
70		67.7	31.9	9.5	1.4
75		76.9	36.3	10.7	1.6
80		86.7	40.9	12.1	1.8

Step 3---Calculate Total Dynamic Head

Need to Know:

#1-- Minimum Flow Rate (step 2)—23gpm

#2-- Elevation Head—12.5 ft.

(Difference in elevation between the pump off {105.0 ft} and the discharge assembly {92.5.0 ft} or manifold)

#3-- Friction Head

a. Length of force main---120 ft.

b. Pipe size of force main--- 1.5 in. Sch. 40 PVC

c. Fitting and connections--- 20% of total friction loss

Step 3---Calculations

- 1.5 in. Sch. 40 pvc has a friction loss of 4.7 ft. per 100 ft. @ 25 gpm (Refer to chart on next slide)
- 120 ft. of pipe (1.2 x 4.7) = **5.64 ft** of head loss for force main
- Fittings loss = 5.64 **ft.** x 0.2 (20%)=**1.13 ft.**
- **Total friction loss** = 5.64+1.13=**6.77 ft.**

Step 3—Total Dynamic Head (TDH)

Total Dynamic Head=

Elevation Head--12.5 ft.
\+ Friction Head----6.77 ft.
\+ Residual Head----5 ft.

24.27 **ft.**

The pump must be able to pump 23 gpm against 24.27 ft. of Total Dynamic Head

Calculations

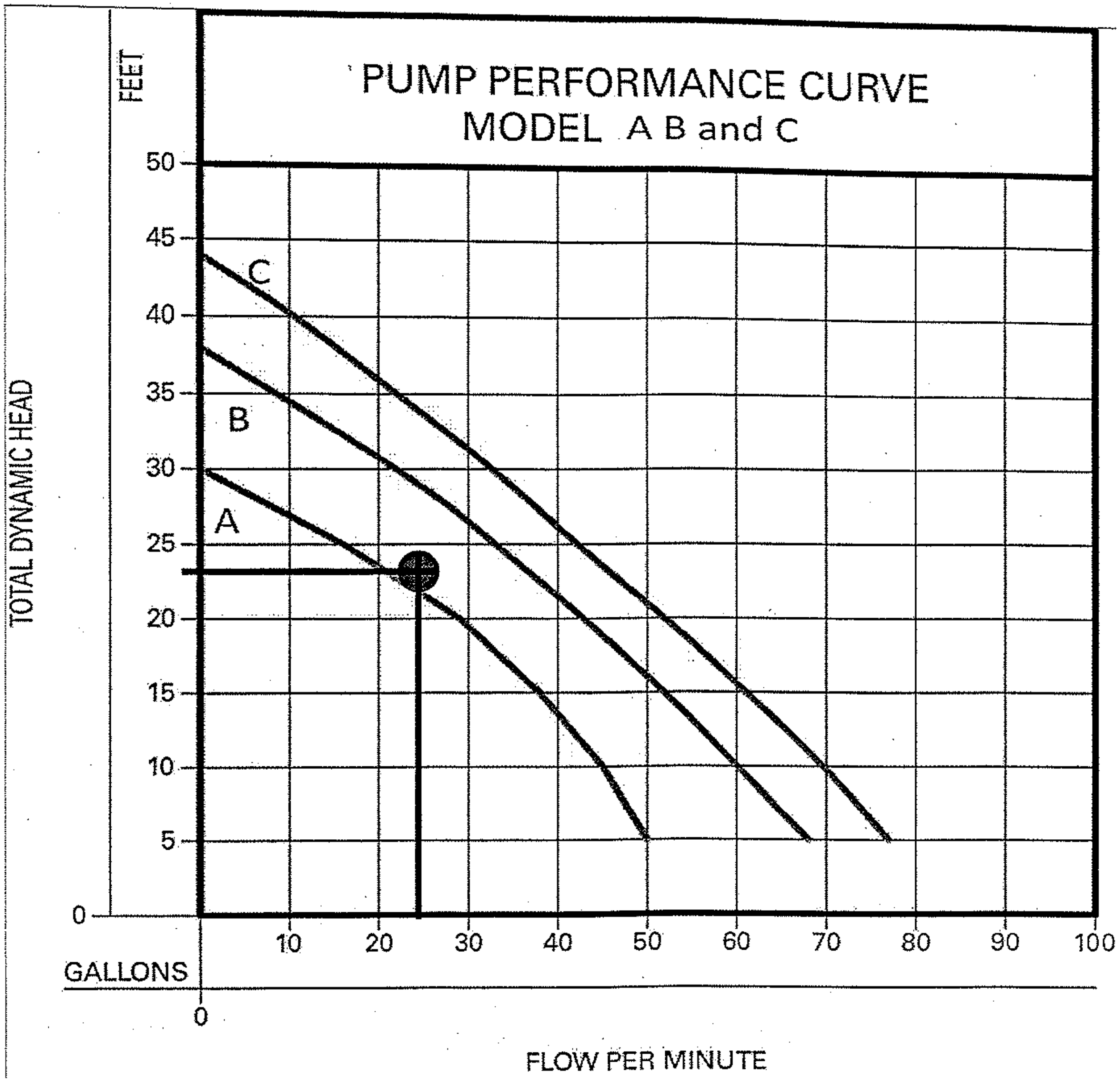
GPM	H_e	H_f	H_r Chart 1	TDH
23	12.5 ft	6.77 ft	5.0 ft	24.27ft

Step 4---Selecting the Pump

#1. Plot the point where 23 GPM intersects 24.27 ft. TDH on the pump curve(s) chart

#2. The point must be below the pump curve.

#3. Select the pump best suited for the job.


PUMP PERFORMANCE CURVE
MODEL A B and C
TOTAL DYNAMIC HEAD
FEET
50
45
40
35
30
25
20
15
10
5
0
C
B
A
GALLONS
0
10
20
30
40
50
60
70
80
90
100
FLOW PER MINUTE

Step 5---Calculate Operating Point of Selected Pump

- Pump A does not meet the requirements of the system because the pump curve is below the plotted point of the system.
- Pump B and C both meet the system requirements, but pump B is best pump to meet the minimum needs of the system.
- Now that a Pump has been selected, re-calculate the TDH at a flow rate above the pump curve for pump B.

Table 1

Orifice Discharge Rate Chart (gpm)

	Drill Size (in)						
	1\8	3\16	1\4	5\16	3\8	7\16	1\2
Head (ft)							
3	0.335	0.754	1.34	2.094	3.015	4.104	5.361
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7	0.512	1.152	2.047	3.199	4.606	6.27	8.189
8	0.547	1.231	2.189	3.42	4.924	6.702	8.754
9	0.58	1.306	2.321	3.627	5.223	7.109	9.285
10	0.612	1.376	2.447	3.823	5.505	7.493	9.787

Use a higher residual head to find a new flow rate above the pump curve.

Table 1 states a 3/8 in. orifice with a residual head of ten feet will have a flow rate of 5.505 gpm

6orifices at 5.505gpm=33gpm

This is the new flow rate above the pump curve

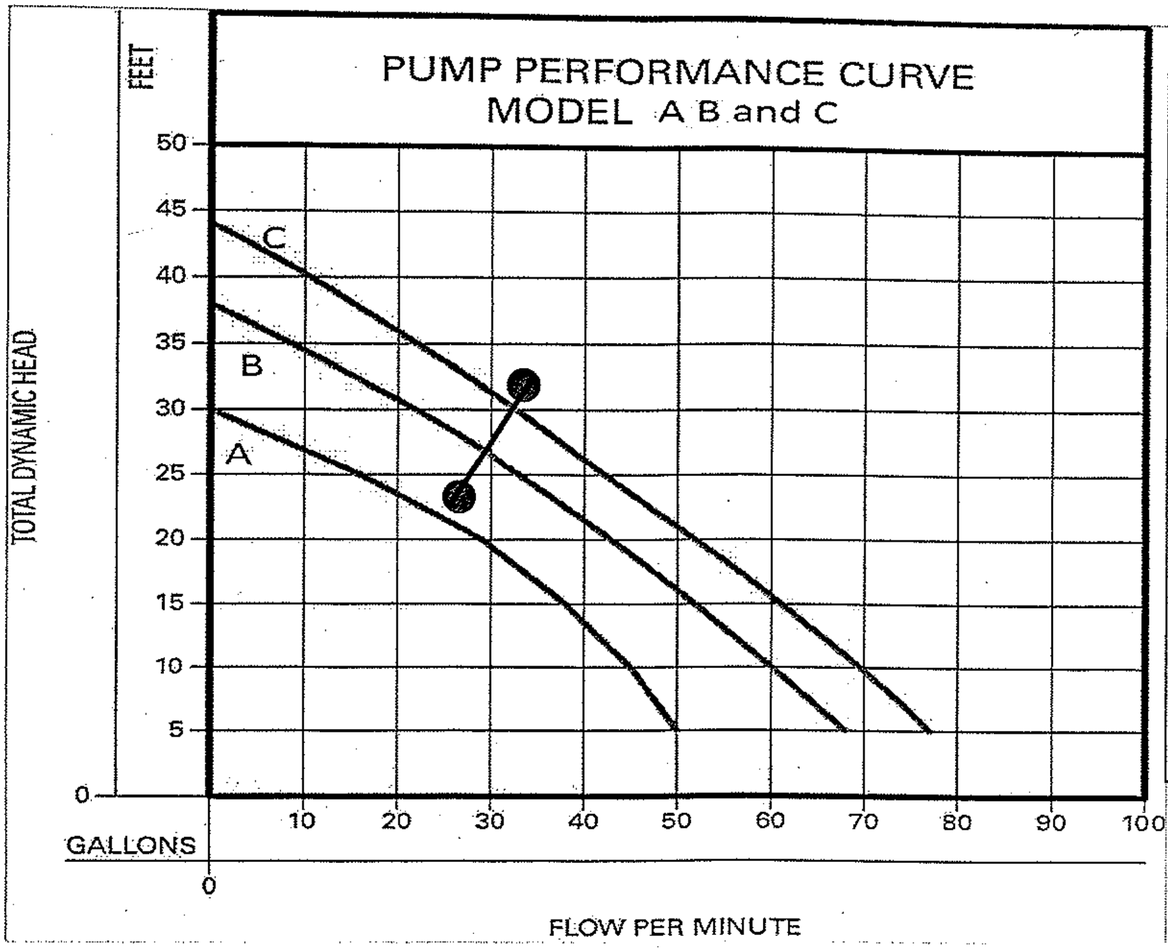
Step 5---Calculate Operating Point of Selected Pump

GPM	H_e	H_f	H_r Chart 1	TDH
23	12.5 ft	6.77 ft	5.0 ft	24.27ft
33	12.5 ft	8.8 X 1.2=10.56 + 20% 10.56 ft	10 ft	33.06ft

➢ Step 5---Calculate Operating Point of Selected Pump

- Plot the points (gpm/tdh) on pump curve B
- Connect both points with a line to find the system curve
- Where the system curve intersects the pump curve is the operating point for the pump.

Pump B operating point



System curve crosses pump curve at 30GPM. This will be the pump operating point for Pump B.

Step 6---Setting the Pump Timers

Need to Know:

#1. Dose Volume (step 1) --- 92.5 gal

#2. Number of Doses per Day--- 4

(Assume 370 gpd for daily flow)

370 gpd÷92.5gal = 4 doses per day

#3. Dose Interval

Calculating Dose Interval

- 60 min. per hour x 24 hrs= **1440** min. per day
- Dose Interval is Pump On + Pump Off
- 1440 min.per day÷ 4 doses per day= 360 minutes between doses (Dose Interval)
- Pump On= 92.5 gal per dose / 30 gpm (pump operating point from step 5) = 3.08 or 3.1 minutes or 186 seconds
- Timer is set for the pump to run for 3.1 minutes **and be off for 356.9 minutes**

Step 7---Calculate the Draw Down

Need to Know:

#1. Dimensions of Tank
100 in. long
60 in. wide
50 in. to the bottom of the outlet

#2. 1 gallon of water = 231 cubic inches

Step 7---Calculate the Draw Down

Volume= LxWxH*

*The height is normally calculated to the inlet flow line since that is the typical working liquid volume level

V=100 in. x 60 in. x 50 in.=300,000 in^3

300,000 in^3 ÷231 in^3 =1294 gallons

1294 gallons ÷ 50 inches* = 25.8 gal/in.

92.5 gallons ÷ 25.8 gal/in= 3.59 inch draw down for a 92.5 gallon dose

Step 8---Tank Reserve

To set a reserve capacity in the tank to prevent floating and pulling solids off the bottom, select a reserve volume (300 gal)

300 gal ÷ 25.8 gal/in= 11.6 inches of liquid required below the pump shut off.

Arkansas Department of Health
Environmental Health Protection

Receipt Number

Individual Onsite Wastewater System Permit Application

Permit Type ☐ New Installation ☐ Alteration / Repair

DR Environmental ID #

Fee Schedule for Structures		√
Structures 1500 sq ft or less	$ 30.00	☐
Structures more than 1500 sq ft and up to 2000 sq ft	$ 45.00	☐
Structures more than 2000 sq ft and up to 3000 sq ft	$ 90.00	☐
Structures more than 3000 sq ft and up to 4000 sq ft	$120.00	☐
Structures more than 4000 sq ft	$150.00	☐
Alteration and Repair	$ 30.00	☐

Part 1 Application

Treatment Type (check one)

☐ STD = Standard Septic Tank
☐ ISF = Intermittent Sand Filter
☐ PMF = Proprietary Media Filter
☐ OTH = Other (Describe)
☐ ATU = Aerobic Treatment Plant
☐ RSF = Re-circulating Sand Filter
☐ RGF = Re-circulating Gravel Filter
☐ HLD = Holding Tank

Disposal Method (check one)

☐ STD = Standard Absorption Field
☐ SUR = Surface Discharge
☐ CPF = Capping Fill
☐ OTH = Other
☐ LPD = Low Pressure Distribution
☐ HLD = Holding Tank
☐ SRL = Serial Distribution
☐ DRP = Drip Irrigation

1. Owner's/Applicant's Name
2. Phone Number
3. Mailing Address
4. County
5. Address of Proposed System (If a 911 address is not available, attach detailed directions or map)
6. Subdivision Name
7. Approval Date
8. Date Recorded
9. Lot Number
10. Lot Dimensions
11. Total Area (Acres)
12. # Bedrooms # People
13. Daily Flow (GPD)
14. Brief Legal Description of Property (Attach a separate sheet of paper, if necessary)
15. Water Supply (Specify supplier, if Public Water)
16. GPS Coordinates

17. Loading Rates	(gpd/ft²)	18. System Specifications						
Primary Area		a. Size of Septic Tank		gal	f. Trench Depth		inches	
Secondary Area		b. Size of Dose Tank		gal	g. Trench Spacing		feet	
Percolation Test	(min/in)	c. Absorption Area		ft²	h. Trench Media (List Below)		i.Trench Width	
Primary Area Avg		d. Number of Field Lines						in
Secondary Area		e. Length of Field Lines		ft				in

TO THE OWNER
The permit for construction may be deemed invalid by the local Environmental Health Specialist before the start of construction, if the site and/or soil conditions have changed after approval of this permit, or if the information within this permit is inaccurate or has been found to be misrepresented. Approval for operation does not constitute a guarantee that the system will function properly. The approval states that the system was designed and installed according to the Arkansas Department of Health, Rules and Regulations Pertaining to Onsite Wastewater Systems, unless there are exceptions or deviations noted in the comments. A Permit for Construction is valid for one (1) year from the date of approval. The authorized agent must revalidate a permit more than one (1) year old prior to the start of any construction.

19. Utilization Verification
I hereby attest that item 12, the number of bedrooms (number of persons for commercial) and square footage of the structure that will utilize the designed individual onsite wastewater system in this permit application, is accurate. I have reviewed the permit application and understand the layout, installation, maintenance, operation and expense(s) that may be associated with this system.

Owner/Applicant Signature____________________ Date __________

20. I certify that I have conducted the above tests and that the above listed information is in accordance with the latest requirements of the Arkansas Department of Health Rules and Regulations Pertaining to Onsite Wastewater Systems.

Soil Certified ☐ Yes ☐ No

Designated Representative Signature Title

Print Name Date Phone Number

21. Approval of Health Authority
The information and specifications in the application has been reviewed and found to meet the requirements of the Arkansas Department of Health Rules and Regulations Pertaining To Onsite Wastewater Systems. A PERMIT FOR CONSTRUCTION is hereby issued.

Environmental Specialist Signature EHS Number Date

Individual Onsite Wastewater System Permit Application

Receipt Number

Continue Part 1

22. Soil Criteria (Primary Area)	Indicate the depth to items a-f, if observed in the soil (designate in inches)						
a. Bedrock	b. BSWT	c. MSWT	d. LSWT	e. Adj. MSWT	f. Adj. LSWT	g. H.C./Depth	h. Loading Rate (gpd/ft²)

23. Soil Criteria (Secondary Area)	Indicate the depth to items a-f, if observed in the soil (designate inches)						
a. Bedrock	b. BSWT	c. MSWT	d. LSWT	e. Adj. MSWT	f. Adj. LSWT	g. H.C./Depth	h. Loading Rate (gpd/ft²)

24. Seasonal Water Table (SWT) Classes Detail		
Primary Area		List Redoximorphic Features and/or Clay Content Restrictions
Brief	in	
Moderate	in	
Long	in	
Secondary Area		List Redoximorphic Features and/or Clay Content Restrictions
Brief	in	
Moderate	in	
Long	in	
Comments		

Part 2 Installation Inspection

Septic tank manufacturer	Pump information
Septic tank material	Trench media and width
Dose tank manufacturer	Depth of interceptor drain
Dose tank material	Depth of settled fill
Name of Installer	License Number

Installation Inspected by ☐ Environmental Health Specialist ☐ Designated Representative
(check one or installer signs System Installation Verification below)

Signature ____________ EHS / License Number ____________ Date ____________

System Installation Verification
I have installed this system as designed and in compliance with all Rules and Regulations Pertaining to Onsite Wastewater Systems.

Installer Signature ____________ License Number ____________ Date ____________

Part 3 Permit for Operation

The information contained in Part 1 and 2 of this form has been reviewed and found to meet the requirements of the Arkansas Department of Health. THE PERMIT FOR OPERATION of this system is hereby issued.

Environmental Health Specialist ____________ Signature ____________ EHS Number ____________ Date

Comments

Site Revalidation conducted by ☐ Environmental Health Specialist ☐ Designated Representative
(check one)

Signature ____________ EHS / License Number ____________ Date ____________

* Optional System Utilization Verification Form

Arkansas Department of Health
Environmental Health Protection

Receipt Number

Individual Onsite Wastewater System Permit Application

Permit Type
☐ New Installation
☐ Alteration / Repair

DR Environmental ID #

☐ Homeowner

☐ Builder/Developer

Fee Schedule for Structures	√
Structures 1500 sq ft or less $ 30.00	☐
Structures more than 1500 sq ft and up to 2000 sq ft $ 45.00	☐
Structures more than 2000 sq ft and up to 3000 sq ft $ 90.00	☐
Structures more than 3000 sq ft and up to 4000 sq ft $120.00	☐
Structures more than 4000 sq ft $150.00	☐
Alteration and Repair $ 30.00	☐

TO THE PROPERTY OWNER

Onsite Wastewater System Utilization Verification

Property location:____
(*Address of Proposed System, City, State, Zip*)

I hereby attest there are ____ bedrooms (____ number of persons for commercial) and the square footage of the structure that will utilize the designed onsite wastewater system in this permit application is accurate. I have reviewed the permit application and understand the layout, installation, maintenance, operation and expense(s) that may be associated with this system.

As Developer/Builder, I hereby attest that the above information is correct and prior to the sale of the property, I will convey, to the buyer, all information associated with this system.

Owner/Applicant Signature____

Date ________________________

This document must be submitted with the permit application, if the Owner/Applicant Signature Section (number 19 on the EHP-19) is not signed.

ONSITE WASTEWATER SOIL EVALUATION

Applicant Name ______________________ Permit Number ______________ Soil Pit ______________

Site Location ______________________ County ______________ Date of Evaluation ________

GPS Coordinates ______________________ Evaluated by ______________________

Depth (inches)	Matrix Color	Redox Features (abundance, size, color, & kind)	Structure	Texture & % Clay	% Coarse Fragments	Boundary	Hydraulic Conductivity
							High Moderate Low
							High Moderate Low
							High Moderate Low
							High Moderate Low
							High Moderate Low
							High Moderate Low
							High Moderate Low
							High Moderate Low

Redox Abundance
0-2% = few (f)
2-20% = common (c)
>20% = many (m)

Redox Size
<2mm = fine (f)
2-5mm = medium (m)
5-20mm = coarse (c)
20-76mm = very coarse (vc)
>76mm = Extremely coarse (xc)

Depth to Seasonal Water Table

Brief duration ________

Moderate duration ________ Adjusted moderate ________

Long duration ________ Adjusted long ________

Depth to Bedrock ________ Percent Slope ________%

Loading Rate Determination

Brief SWT= ________

Adjusted Moderate SWT = ________

Adjusted Long SWT= ________

Loading Rate = ________ **gpd/ft^2**