Part 7: Soils

Contents

1.0 General Conditions

1.1 Site Analysis

A. Prior to developing recommendations for soil modifications, an analysis of existing soil conditions shall be made. All information shall be recorded on a scale drawing of the site. The soil section of the specification guidelines is dependent on the site analysis being completed prior to determining recommendations for soil modifications. It is the responsibility of the landscape contractor to perform the analysis, unless the owner provides soil modifications in the bid package. If the owner refers to the specification guidelines and makes specific soil modification recommendations, the landscape contractor can assume that the owner has undertaken this analysis prior to preparing the bid documents. It is necessary to comply with all local codes regarding disturbance and sediment control requirements.

B. The analysis shall include the following:

1. Analysis of historical land use to determine previous development activity and soil disturbance at the site. The historical land use analysis shall include consideration of construction activity at the site that will occur between the time of the analysis and the time of the installation of new plantings.

2. Analysis of existing vegetative cover and topography that may indicate variability in soil conditions.

3. Sampling of existing soils, as follows:

   a. Identify areas with different soil conditions based on historical, topographic, and vegetative analysis.

   b. For each area, take a minimum of one composite soil sample (1 cup) that consists of five (5) core samples. Each core sample shall be taken at a depth of 6–8" after first removing the upper duff layer, if any. The five (5) core samples are to be mixed and air- dried prior to submittal to the testing laboratory.

   c. Soil testing shall be conducted as per section 1.7 (Soil Testing) in this guideline.

   d. If the soil in the top 6–8" of soil indicates a pH level two or more units above or below the optimum pH level desired, additional testing of subsoil pH is recommended.

   e. A second sample at a depth of 18–24" is advisable to test for subsurface soil conditions and is to be mixed and air-dried prior to submittal to the testing laboratory. Do NOT mix upper layer and lower layer soil samples; they need to be tested separately.

4. Compaction analysis

   a. Based on historical, vegetative, and topographic analysis, determine areas of the sites that may have been compacted. For any area of the site where compaction potential has been identified, perform multiple soil penetrometer tests to determine degree and extent of compaction.

   b. Conduct a penetration resistance test as follows:

   - Penetration reading must be taken when soil moisture is at field capacity (several days after free drainage). Using a cone penetrometer), apply slow, even pressure so that the penetrometer advances in the soil at a rate of 4 seconds per 6". Record pressure readings at 0–4" depth (surface soil) and at 10–14" depth (subsoil).

   - Pressure in psi shall be as follows:
     - <110 psi surface soil (all textures).
     - <260 psi subsurface soil – loamy sand, sandy loam, sandy clay loam, sandy clay, loam, silt loam, silty clay loam, and silty clay.
     - <225 psi subsurface soil – clay loam.

   c. A bulk density test shall be performed if the results of the penetrometer are outside the acceptable range. The contractor is to notify owner if this is needed.

5. Drainage analysis:

   a. Determine areas that are suspected to be poorly drained based on the site analysis and the topography.

   b. Soils that exhibit the following characteristics shall be considered poorly drained:

   - Standing water
   - Anaerobic soils (may have objectionable odor)
   - Gray soils (hydric)
   - Presence of wetland species

C. Definitions of soils and planting mixes are as follows:

1. *Existing soils* are soils that are present on the site at the time of estimating.

2. *Imported soils* are soils that are brought onto the site during the course of the job. Onsite stockpiles of soil that may have been present at the time of estimating shall also be considered imported soils.
3. *Planting soils* are the prepared and often amended soils, whether they are existing, imported, or a blend of both existing and imported soils, that will be at the surface of the soil profile when planting begins. The goal of this specification is to help create excellent planting soils that more effectively support healthy plant growth.
4. *Planting mixes* are blends of soils; sand/soil/compost; and soil-less media used to grow plants. A typical use of planting mixes is to fill planters located above structure.
5. *Subsoil* is soil that, in an undisturbed soil profile, would be the B horizon. In many cases, developers have removed the A or C horizon from the site, so the surface soil is actually a subsoil.

D. Based on the above analysis and definitions, prepare a composite drawing identifying the soil characteristics based on the following categories.

1. Minimum soil modification required to create planting soils, as follows:
   a. Nutrient and pH adjustments less than 0.5 pH units, in either direction on the pH scale, to existing soils. The range is based on the pH tolerance of the plants being placed in that location.
   b. Addition of organic amendments to the existing soils.
   c. Tilling of existing soils.
2. Significant modification(s) required to create planting soils, as follows: (in addition to the requirements of paragraph D.1 above)
   a. Subsoiling to reduce compaction below planting soils.
   b. Installing subsurface drainage.
   c. Regrading to improve surface drainage.
   d. Significant pH adjustment to existing soil or subsoil of more than 0.5 pH units.
   e. Adding imported soils or planting mixes.
3. Significant modifications beyond the scope of these specifications.

   The following conditions require consultation with a soil specialist to determine appropriate action:

   a. Soils containing quantities of man-made inerts, such as drywall material (Gypsum), considered harmful to plant growth.
   b. Soils suspected of containing harmful chemical contaminants.
   c. Soils suspected of containing naturally occurring compounds harmful to plant growth that are not easily mediated.
   d. Subsoil conditions that require modifications beyond basic drainage and subsoiling.
   e. Soils not classified as a type of loam (e.g., clay, clay/silt, sand, sandy clay) using the USDA soils classification.

1.2 Scope of Work

A. The landscape contractor shall provide all materials, labor, and equipment to complete all soil and/or drainage work as shown on the plans and specifications.

B. It is recommended that the landscape contractor have Landscape Industry Certified Technicians–Exterior on staff and performing the work whenever possible.

C. All soils and drainage work within the critical root zone of any tree to remain shall be undertaken in such a manner so as to comply with the tree preservation requirements specified in *Landscape Specification Guidelines Part 8: Tree Preservation.*

1.3 Submittals

When requested by the owner, samples of all soil, planting mix, and drainage materials shall be submitted to the owner or owner's designated representative for approval. For soil, planting mix, and organic amendments, submit 1-pound samples and the required soil testing results. For other materials, submit the manufacturer's product literature.

1.4 Approvals

All approvals shall be in writing.

1.5 Utilities and Underground Features

A. The landscape contractor shall notify utility companies and/or the general contractor in advance of construction to locate the utilities. Please contact

Miss Utility at www.missutility.net for Maryland, D.C., Virginia, and Delaware.

B. Private underground features, such as irrigation systems, septic systems, drain systems, invisible pet fencing, landscape lighting, underground natural gas, and security systems, shall be located by the owner or general contractor.

C. If there is a conflict with the utilities and the proposed soil work, the owner shall be responsible for changing the design requirements. Any costs incurred for changing soil design requirements shall be borne by the owner.

1.6 Concealed Contingencies

The correction of undisclosed subsurface conditions, such as rocks, roots, stumps, poor drainage, water, clay pan, soils contaminated with toxic substances, or other obstacles encountered in excavation work that are not apparent at the time of estimating or indicated on the soil analysis, may result in additional costs to the owner. Upon discovery of undisclosed conditions, the landscape contractor shall notify the owner of any items to be corrected and the associated costs, if any, before corrective measures are taken. Notification, change orders, and approval shall be in writing.

1.7 Soil Testing

A. Soil tests shall be made of existing soils, imported soils, and planting mixes to determine soil texture, pH, total calcium, magnesium, phosphorous, potassium, soluble salts and percent organic matter. Each sample to be submitted for testing shall be extracted from a composite sample representing a minimum five (5) core samples for each soil area. Soil tests shall be conducted by a state agricultural soil testing laboratory or by a commercial agricultural soil testing laboratory.

B. All soil testing costs shall be borne by the landscape contractor. If the owner has already tested the existing soil prior to the preparation of bid documents, the soil test results shall be provided to the landscape contractor so that they may be included in the composite soil analysis plan.

C. Each soil test shall examine the following chemical and physical attributes. Any soil that falls within the indicated range of results shall be considered provisionally acceptable. Soil that falls outside of any of the indicated ranges may be amended, retested, and resubmitted for approval by the owner. Once a soil is considered provisionally acceptable, its pH level should be examined for suitability with the plants that are to be grown on the site. Special attention should be paid to the pH tolerances of plants that require acidic soil for healthy growth.

The following nutrient recommendations are for turf but may include a variety of landscape plants. Recommended nutrient ranges vary widely, and depending on soil characteristics and laboratory nutrient extraction methods, test results can also vary greatly. Nutrient availability is soil pH dependent. Some nutrients, like iron, zinc and, manganese, are minimally available in high pH soils and are very available in acidic soils.

Plant requirements for pH vary. Most plants do well in a pH between 6.0 and 6.8, where most nutrients are optimally available. However, some species, like ericaceous plants (e.g., Rhododendron, Azaleas, Pieris), require low pH soils, whereas others (e.g., *Cercis* sp.) may require higher pH soils. Avoid placing plants with different pH soil requirements together.

Suggested Ranges

Nutrient	Parts per Million Concentration Depending on CEC*
Calcium	400 to 4,000
Magnesium	60 to 450
Potassium	91 to 250
Phosphorus	30 to 50
If the following nutrients are analyzed (suggested for sandy soils)	
Iron	5 to 20
Manganese	5 to 20
Copper	0.3 to 1
Boron	0.5 to 1
Zinc	1 to 3
**SS	0.2 to 1/5 mmhos/cm
pH	6.0 to 7.5

**Ca, K ,and Mg optimal ranges depend on the ability of a soil to hold cations (Cation Exchange Capacity). Nutrient levels shall be as recommended by the soils lab for the types of plants and soil conditions.*

***Soluble salts or electrical conductivity (EC) depend on the type of test being performed. The recommendation is for a 1:1 soil/water extract. The EC units of mmhos/cm, dS/m, and mS/cm are interchangeable.*

D. These additional tests are required when the following conditions exist:

Condition	Test Required	Acceptable Results
sandy soils	boron	0.5–2.0 ppm
hardwood forest soils or history of continuous mulching with hardwood bark	manganese	15–40 ppm
seaside and bay side	sodium	*
imported soils, planting mixes	mechanical analysis, including particle size analysis of sand fraction	Requirements vary dependent on application and may require the recommendation of a soils expert.

** Soils relatively high in sodium (Na) and low in other base cations (calcium, potassium and magnesium) are considered sodic soils. Proportionally high Na can lead to plant toxicities or nutrient deficiencies. Sodic soils usually have high pH above 8.5. Sodium can start to be a problem if its % Base Saturation is greater than 5%, especially in clay soils. Electrical Conductivity should be below 4 dS/m (mmho/cm) or you may have saline soils (a mixture of many nutrients). Corrective actions to remove Na from soil include application of calcium, usually by calcium sulfate (gypsum). Gypsum should not be used if soil EC is above 4 dS/m (mmho/cm).*

E. In the event that pH is higher than the limits of the plants specified, the plant type shall be changed to a plant that is adaptable to the pH of the soil.

F. In the event that the owner rejects the recommendations of the soil test and requires the landscape contractor to proceed with planting in soils that otherwise require amendments, the landscape contractor may void the guarantee for plantings or lawns. In the event that the contractor voids the guarantee, the owner shall be notified in writing of such action prior to the installation of any plantings or lawns. No consideration of changes to the conditions of the guarantee will be allowed without written notification prior to planting.

1.8 Workmanship

A. During the delivery and installation of soils and drainage, the landscape contractor shall perform in a professional manner, coordinating his/her activities so as not to interfere unduly with the work of other trades and leaving his/her work area(s) neat and clean of litter and debris at the close of each workday.

B. Upon completion, all debris and waste material resulting from soil and drainage operations shall be removed from the project and the area cleaned up.

C. Any damaged areas caused by the landscape contractor shall be restored to their original condition.

2.0 Products

2.1 Organic Amendments

A. The following is a list of types of organic amendments that may be used as soil amendments:

1. Sedge peat – decomposed peat containing no identifiable fibers.

2. Yard debris mature compost (e.g., Leafgro®) – leaves, grass clippings, and prunings screened through a 3/4" screen and containing less than 1% man-made inerts.

   Compost: Organic blended material, properly composted at temperatures sufficient to break down all woody fibers, seeds, and leaf structures; free of toxic and nonorganic matter. Source material shall be yard waste trimmings blended with other organic material designed to produce compost high in fungal material.

   Compost shall be commercially prepared compost and meet U.S. Compost Council STA/TMECC criteria, or as modified in this section for stable, mature compost intended for landscape backfill mix component.

   http://compostingcouncil.org/admin/wp-content/plugins/wp-pdfupload/pdf/191/LandscapeArch_Specs.pdf

   Compost shall comply with the following parameters:

   a. pH 5.5–8.0.

   b. Salt concentration (electrical conductivity) maximum 5 dS/m (mmhos/cm).

   c. Moisture content %, wet weight basis 30–60%.

   d. Particle size % passing a selected mesh size, dry weight basis 98% pass through 3/4" screen or smaller.

   e. Solvita maturity test – 6 or higher.

   f. Physical contaminants (inerts) %, dry weight basis <1.

   g. Chemical contaminants mg/kg (ppm) meet or exceed U.S. EPA Class A standard, 40 CFR § 503.13, Tables 1 and 3 levels.

   h. Biological contaminants select pathogens fecal coliform, bacteria, or salmonella, meet or exceed U.S. EPA Class A standard, 40 CFR § 503.32(a) levels.

3. Animal manure mature compost made from poultry, swine, cattle, or equine manures composted with bedding, wood waste, or yard debris.
4. Pine bark – potting grade pine bark screened through a 3/4" screen and containing less than 10% sapwood fibers. Any pine bark containing more than 10% sapwood must be composted through the first heat stage.
5. Pine fines – a product derived from the processing and composting of pine bark mulch containing a minimum of 75% sawdust size and dust-sized particles.

2.2 Imported Soils

A. Imported soil shall meet acceptable soil test levels as specified in section 1.7 (Soil Testing) in this guideline. A certificate of soil test analysis, soil source location, and list of crops grown in the soil over the past three years must be submitted to the owner for approval before any soil is delivered to the project. Submit a 1-pound sample of soil source of each soil to accompany soil test.

B. Imported soils shall be loams of textural classification specified for each application. Unless otherwise indicated, imported soil installed on grade shall be suitable for the plants to be grown. In extreme clay or sandy subsoil, follow recommendations of a soil specialist.

C. Imported soil shall not contain toxic substances harmful to plant growth. The total volume of stones, green plant parts, fibrous root mats, man-made inert material and wood or woody roots in the soil shall not exceed 5%. Soil shall not contain sharp glass or metal objects. Imported soil shall also be free of Bermuda Grass, Quack Grass, Johnson Grass, Mugwort, Nutsedge, Poison Ivy, Canada Thistle, and other invasive weeds.

D. Imported soil shall not be harvested, transported, and/or graded when soil moisture exceeds field capacity or when the material is frozen.

E. Protect imported soil stockpiles from erosion, saturation, or weed growth using plastic sheeting or tarps.

2.3 Planting Mixes

A. The recommendations of mix requirements is application specific and beyond the scope of this specification guideline. Consult a soil specialist for planting mix specifications.

B. To minimize volume reduction over time, only the following organic sources shall be permitted: milled pine bark, pine fines, mature yard debris compost (e.g., Leafgro) or manure compost.

C. Planting mixes shall be blended mechanically using a commercial mixer or shredder. Ingredients shall be uniformly incorporated to obtain a consistent blend.

D. Protect plant mix stockpiles after mixing by using plastic sheeting or tarps.

E. Prior to mixing any planting mix, prepare sample mix ratios and submit to the owner for approval along with test results. If the sample does not meet the mix criteria, resubmit alternative mix ratio samples with test results.

2.4 Fertilizers

All fertilizers shall be uniform in composition, free flowing, and suitable for application with approved equipment. Fertilizers shall be delivered to the site fully labeled according to applicable state fertilizer laws and shall bear the name, trade name, or trademark and warranty of the producer. Application rates shall be determined by soil test recommendations.

2.5 Lime

Lime material shall be ground or pulverized limestone that contains at least 50% total oxides. The use of either dolomitic lime (lime with magnesium) or calcitic lime (lime without magnesium) shall be determined by soil test recommendations. Limestone shall be ground to such fineness that at least 50% will pass through a 100-mesh sieve and 98–100% will pass through a 20-mesh sieve. Granular or pelletized lime may be used but it must follow the same specifications as above prior to being granulated or pelletized.

2.6 Acidifying Amendment

Acidifying amendments shall be flowers of sulfur, pelletized sulfur, granular sulfur, or iron sulfate. The application rates of these materials will be determined by soil test recommendations.

2.7 Subsurface Drain Lines

Subsurface drain lines shall be perforated, corrugated polyethylene plastic drainpipe with manufacturers' standard connectors such as tees, elbows, caps.

2.8 Gravel

Gravel shall be pea gravel or AASHTO #57 crushed stone.

2.9 Filter Fabric

Non-woven, continuous filament polyester fabric with a weight of 4.0 oz per square yard, minimum grab strength of 100 lb, and a water flow rate of 100 gpm.

2.10 Coarse Sand

Coarse concrete sand, ASTM C-33 Fine Aggregate.

3.0 Soil Preparation

3.1 Minimum Modifications to Create Planting Soils

A. General conditions

1. Identify utilities and underground utilities (see section 1.5 in this guideline). All areas on either side of the utility marking, where the distance is dictated by the local jurisdiction, shall be amended by hand.
2. Prior to amending soils, the general contractor or owner shall clear the surface of all trash, debris and stones larger than 1½" in diameter or length, and of all roots, brush, weeds, grass, wire, grade stakes and other objects that would interfere with soil preparation. Installation of all utilities and irrigation mainlines shall be completed prior to beginning soil work.
3. The soil shall not be tilled or amended when the soil's moisture level is above field capacity or when the soil is frozen.
4. Grades after amendment, tilling, and fine grading in the specified area shall conform to the drawings and/or other applicable specifications and shall be maintained true and even.
5. Rototilling shall not be performed within the critical root zone of existing trees.

3.2 Modifications to Existing Soils

A. General conditions

1. Amendments shall be applied uniformly based on the following recommendations and soil test results. Thoroughly incorporate the amendments into the upper 6" of soil. After adding amendments, retest planting soil to confirm that the soil has responded to meet the design criteria. Submit the test results to the owner for approval.
    a. Soils with optimum nutrient concentration but with excessively high pH levels shall be amended with pine bark or pine fines and acidifying amendments to lower pH to desired level. Soils with adequate levels of nutrients and organic matter shall be amended with lime or acidifying agents (if necessary) depending on the pH requirements of plants. The contractor may also suggest changing the plant(s) to those that meet the existing pH conditions.
    b. Soils with an acceptable pH but low levels of potassium or low organic matter shall be amended with yard debris compost or animal manure compost.
    c. Soils with an acceptable pH and with adequate amounts of organic matter but low in nutrients shall be amended with fertilizers based on the soil test results.
    d. To reduce the bulk density of clay loam soils, in the upper 6" of soil, amend with pine fines or compost. For example, on a typical landscape clay loam soil, place a 2" layer of compost and till to a 6" depth.
    e. To reduce bulk density deeper than 6", subsoil using a back hoe bucket or ripping bar to the depth of the compaction or to a minimum of 30" depth. Then add compost to the surface and till the soil using a rototiller to a depth of 6".

3.3 Significant Modifications to Create Planting Soils

A. General conditions

1. Identify utilities and underground utilities (see section 1.5 in this guideline). All areas on either side of the utility marking, where the distance is dictated by the local jurisdiction, shall be amended by hand.
2. Prior to amending soils, the general contractor or owner shall clear the surface of all trash, debris, and stones larger than 1½" in diameter or length, and of all roots, brush, weeds, grass, wire, grade stakes, and other objects that would interfere with soil preparation. Installation of all utilities and irrigation mainlines shall be completed prior to beginning soil work.
3. The soil shall not be tilled, regraded, amended, or otherwise worked when the soil's moisture level is above field capacity or when the soil is frozen.
4. Grades after amendment, tilling, and fine grading in the specified area shall conform to the drawings and/or other applicable specifications and shall be maintained true and even.
5. Work to add soil shall proceed only after rough

grading of the subsoil has been completed and the subgrade is within 1" to 2" from final subgrade, as indicated on the drawings. If the rough-graded area develops volunteer weed growth, the growth must be eliminated prior to spreading the imported soil at the expense of the general contractor or owner.

6. Rototilling shall not be performed within the critical root zone of existing trees.

3.4 Subsoiling to Reduce Compaction

A. Subsoiling shall be done using a trencher (e.g., Ditchwitch), backhoe, mini-excavator, or rotary spader. Do not use a vibratory plow. Subsoiling may be performed when soil is neither wet nor dry. If a shovel cannot be forced into the soil, it is too dry. If the surface is sticky or muddy, it is too wet.

B. The subsoiler shall penetrate the soil to a depth of 24" at a maximum 24" interval with two passes in each area at 90 degrees to each other. In sloped areas, the first pass of subsoiling equipment shall be across the slope. The second pass of subsoiling equipment shall be up and down the slope.

C. If the soil being subsoiled is a loam, silt loam, or clay loam, spread a 4" to 6" layer of pine fines, pine bark, or mature compost.

D. Use a backhoe rear bucket or similar equipment with a tined bucket to break up the compacted soil and incorporate the compost. Work backwards away from excavated soils so that treated soil is not trafficked by the equipment. Insert the bucket through the compost layer and into the subsoil to a depth of 24" and raise a bucket of soil at least 24" above the soil surface. Tip the bucket and allow soil to fall. Repeat this procedure until no clumps of compacted soil larger than 12" in diameter remain. The tines of the bucket can be used to break apart larger clumps if necessary. 50% of the soil shall be in clumps 6" or smaller. No clumps shall be greater than 18" in diameter. The subsoiling is not intended to homogenize the compost and soil, but rather loosen the soil to a 24"depth and create veins of compost down to that depth as well. To ensure that subsoiling reached the appropriate depth, a push tube soil sampler shall be used to verify that compost is present at 24" depth.

3.5 Installing Subsurface Drainage

A. All subsurface drainage work should be completed as indicated on the drawing or as described in the contract. The plan shall identify the location of all drain lines, the desired slope of the drain lines and the depth they will be set, the materials and details to be used, and any required connections. The recommendations of the plan should be provided by the landscape contractor, preferably with the advice of a soils expert, or from drawings provided by the owner or owner's representative.

1. Absent a plan developed prior to bidding, the following minimum standards shall apply to any area where subsurface drain lines are requested by the owner or required by field conditions:

   a. Provide one drain line at the lowest portion of each turf or planting soil area that is aligned parallel to any walk, property line or structure that defines the edge of the planting soil bed.

   b. Provide additional lines at a minimum of 20 feet on center throughout the turf or planting soil area. The alignment of the lines shall be such that they flow at a minimum slope of 1% when set approximately parallel to the final grade contours.

   c. All lines shall be terminated in a location that allows the water to flow onto the surface or be connected to a storm drain where available.

B. Provide horizontal field engineering at all times when drain lines are being installed to ensure that the slope on all perforated drain lines is positive toward itsintended outfall and also remains at the correct depth as shown on the drawings.

C. Excavate a trench a minimum of 8" wide to a depth required to provide positive drainage from the high points of the system to the outfall or connection point to a storm sewer. Eliminate dips or rises that will trap water. The invert of the pipe shall be a minimum of 4" below the depth of the top of the subgrade soil.

D. Install the drain lines using one of the following two options:

1. Sand filter option (preferred): Install the drain lines in a bed of coarse sand. Provide a minimum of 2" of coarse sand on the bottom and sides of the drain line and a minimum of 4" on top and sides of the pipe. Place the pipe with the perforations facing toward the bottom of the trench. In the case where pipe is used that has perforations on all sides of the pipe, place a 10" wide strip of 4 ml plastic over the top and sides of the pipes before adding sand to the sides and top of the trench.

2. Gravel/filter cloth option: Install the drainage gravel to the depths and profiles shown on the

drawings. Provide a minimum of 2" of gravel on the bottom and sides of the drain line and a minimum of 4" on top of the pipe. Wrap the gravel in filter fabric according to the drainage details. Provide a minimum of 8' of overlap where the filter cloth comes together. Phase the construction to keep the gravel from being contaminated with soil.

E. All connections and splices shall use the pipe manufacturers' standard fittings. All joints shall be secure.

F. When the top of the sand or filter cloth is below depth of the planting soil or bed preparation, backfill the trench with coarse sand or gravel to the elevation of the top of the subgrade soil.

3.6 Adding Soils or Planting Mixes

A. Add imported soil or planting mix when required on the drawings. The limits and depths of the soil to be added shall be as indicated on the drawings. Depths shall be as measured from the top of the subsoil to the fine graded soil level for mulched and seeded lawn areas and to the bottom of the sod for sodded lawn areas. All soil depths are to be as measured after initial compaction and 12 months settlement.

B. All subsoil modification, installation of drain lines, planter drainage and rough grading shall be completed prior to adding soils. All subgrades shall be inspected by the owner or owner's representative and approved prior to adding soils.

C. Till the subgrade to a minimum depth of 6" or scarify to a depth of 4 inches using the teeth of a back hoe just prior to adding the first lift of soil or planting mix. This is in addition to any other required subsoiling. Leave the subgrade rough to receive imported soils and break soil interface lines. Tilling may be accomplished with a rototiller, the teeth of a backhoe bucket, an agricultural plow, or other suitable equipment.

D. Add imported soil or planting mix in lifts not to exceed 12" in depth.

   1. Compact each soil lift using a plate vibrator or light roller to a density between 100 and 250 psi reading with a penetrometer.

   2. Soil that has been compacted should drain water at the rate of 1" per hour. Soils that drain less than 1" per hour are considered over-compacted and must be tilled and rolled again.

3.7 Significant pH Adjustment of Planting Soils and/or Subsoils

A. If the pH of the subsoil is more than 0.5 pH units above or below the desired range, amend with the recommended amount of lime or acidifying amendment and incorporate into the upper 4" to 6" of the subsoil prior to establishing the sub- grade. If the subsoil is more than 2 pH units above the desired range, till a 2" layer of pine fines into the top 6" of the sub-grade soil.

B. If the pH of the existing soils is more than 2 pH units above or below the desired range, amend with the recommended amount of lime or acidifying amendment and incorporate into the upper 4" to 6" of the existing soil prior to fine grading. If the existing soil has a pH that is more than 2 units above the desired range, incorporate a 2" layer of pine fines in addition to the acidifying amendment.

3.8 Grading

A. All grading to improve surface drainage shall be done according to an agreed- upon plan. The plan shall identify the location, slope, and details of any areas that are to be graded or swales to be created. The recommendations of the plan should be provided by the landscape contractor or from drawings provided by the owner or owner's representative.

B. Provide horizontal field engineering to ensure appropriate slopes of the swales and final grades.

C. Avoid unnecessary compaction of the soil during grading.

3.9 Soil Compaction Testing

A. Following grading or soil installation, test the soil compaction with the penetrometer.

B. Prior to testing the soil with the penetrometer, check the soil moisture. Penetrometer readings are impacted by soil moisture, and excessively wet or dry soils will read significantly lower or higher than soils at optimum moisture.

C. The penetrometer readings shall be within 100–250 psi to the full depth of the installed soil or to a depth of the amended or tilled soil, whichever is greater, when moisture levels are consistent with soil moisture during time of installation.

D. Any areas that fail to meet the above criteria shall, if requested by the owner, be reworked to attain the required compaction.

E. Make the penetrometer available to the owner for use in observing the soil compaction. The owner may at any time check the compaction in the soil.

3.10 Cleanup

A. Immediately following each day's work, clean all dirt, excess soil, debris, and trash from the job site. Store additional soils in stockpiles protected from erosion and contamination by other contractors with tarps.

B. At the end of the installation of all soils, leave the site in a clean and clear condition. Dispose of all dirt, excess soil, debris, and trash in a legal manner off site.

3.11 Protection

A. Maintain grades and protect soil from erosion, compaction and contamination until planting/seeding/sodding operations begin.

B. Restore any erosion washes, break compaction by tilling, and remove and replace any contaminated soils.

3.12 Restoring Settled Grades

Soil that settles below the design grade as a result of work completed by the landscape contractor shall be regraded 12 months after completion by removing the mulch or sod and adding additional soil. Soil that settles as a result of work performed by other trades (examples include, but are not limited to, backfilling of utilities, walls, and foundations and the lack of compaction thereof) shall not be the responsibility of the landscape contractor.