1. **REVISION OF SECTION 207**

**SUBSOIL AND TOPSOIL**

**DESCRIPTION**

1. This work consists of salvaging onsite and wetland topsoil, developing engineered topsoil, importing, stockpiling, maintaining, and placing topsoil, and subsoil preparation in areas planned for revegetation establishment. Subsoil preparation as specified occurs on areas to be revegetated within the right of way and precedes all final grading, soil amendment, seeding, and mulching activities.

**MATERIALS**

1. **General.** Topsoil shall be salvaged from onsite, imported, or engineered as shown on the plans **☖**.

Topsoil shall not include heavy clay, hard clods, toxic substances, pathogens, or other material that is detrimental to vegetation growth. Topsoil shall be free of trash and debris.

**Definitions***.*

**Excessively Wet Soil.** Soil is considered excessively wet when a handful of soil squeezed together forms a ball and when poked with a finger does not fall apart easily or when squeezed together water droplets appear.

**Litter and Duff Layer.** The organic surface layer of topsoil composed of plant material, twigs, leaves, and needles, (litter) and mostly decayed plant material (duff).

**Subsoil.** Subsoil is the layer of soil under the topsoil layer of the soil profile. Like topsoil, it is composed of a variable mixture of small particles such as sand, silt, and clay but lacks organic matter and soil organisms.

**Subsoil Preparation.** Deep scarification, ripping, using specialized equipment, usually performed on compacted subsoils before replacing topsoil with the purpose of increasing pore space and improving soil structure for plant growth and infiltration of stormwater.

**Topsoil (Engineered).** Topsoil produced by uniformly blending onsite sand, silt, and clay, with organic soil amendments. Engineered topsoil shall consist of soil amendments and one or more of the following approved materials: subsoil, overburden, or material generated from rock.

**Topsoil (Imported).** Naturally occurring or commercially produced topsoil obtained from a source outside the project’s LDA.

**Topsoil (Onsite).** Existing, native topsoil, collected from within the Limits of Disturbance (LDA) that consists of the upper 6-inch layer of easily crumbled soil, or at the depths and locations shown on the plans.

**Topsoil Stockpile**. Topsoil placed in piles or moved into uncompacted berms for temporary storage during construction.

**Topsoil (Wetland).** Existing, native topsoil that is within delineated wetlands and includes any existing vegetation and plant matter, including roots, rhizomes, and seeds.

1. **Material General**
2. *Topsoil (Onsite).* Topsoil (Onsite) shall not be salvaged where 20% or more of vegetative cover consist of invasive or noxious weeds as listed in the current State of Colorado Noxious Weed List and County weed lists **♧**.
3. *Topsoil (Imported) and Topsoil (Engineered)*. Topsoil (Imported) and Topsoil (Engineered) shall be screened to be free of roots, clods, stones, coarse sand, invasive weeds, noxious weeds, lumber, brush, and other litter greater than 3 inches. Topsoil (Imported) and Topsoil (Engineered) may contain no more than 5 percent rock greater than 3 inches. Topsoil (Imported) and Topsoil (Engineered) shall be a sandy loam, loam, or clay loam as defined by USDA classification.

Imported topsoil shall be free of:

* Subsoils (no B or C soil horizons)
* Coarse Sand and Gravel
* Stiff clay, hard clods, or hardpan soils,
* Trash, litter, or refuse
* Invasive or noxious weeds or seeds
1. *Topsoil (Imported) and Topsoil (Engineered) Analysis.* The Contractor shall provide a current agronomic nutrient and full textural class analysis of a topsoil sample collected from the topsoil proposed for import or engineered. The results of the analysis shall determine a soil amendment protocol for Topsoil (Imported) and Topsoil (Engineered) and shall meet the properties in Table 207-1 and Textural Class Analysis in accordance with ASTM D5268 that meets the properties in 207-2.

**Table 207-1
PHYSICAL PROPERTIES OF TOPSOIL (IMPORTED)**

**AND TOPSOIL (ENGINEERED)**

|  |  |  |
| --- | --- | --- |
| **Property** | **Range** | **Test Methods** |
| pH (s.u) | 5.6 to 8.3 | ASA Mono. #9, Part 2, Method 10-3.2 or TMECC 04.11-A |
| Electrical Conductivity (EC) (mmhos/cm or ds/m) | < 2 | ASA Mono. #9, Part 2, Method 10-3.3 |
| SAR (s.u.) | < 10 | ASA Mono. #9, Part 2, Method 10-3.4 |
| Soluble salts (ppm) | < 2 |  |
| OM % | 1 to 3 | Methods of Soil Analysis, Part 3, Method 34 |
| N (NO3-n, ppm) | > 20 | Methods of Soil Analysis, Part 3. Chemical Methods. Ch. 38 Nitrogen – Inorganic Forms |
| Potassium | 60 to 120 | ASA Mono. #9, Part 2, Method 13-3.5 |
| Phosphorus | > 13.0 | ASA Mono. #9, Part 2, Method 24-5.4, or other as required based on soil pH |
| NOTES: **SAR** **=** Sodium adsorption ratio; **OM =** Soil Organic Matter; **N =** Nitrogen; **P =** Phosphorus; **K =** Potassium; **C:N Ratio** = Carbon to Nitrogen Ratio; **s.u.** = standard unit; **ppm** = parts per million; **mmhos/cm** = Millimhos per centimeter; **dS/m =** decisiemens per meter  |

**Table 207-2
PHYSICAL COMPOSITION GRADATION**

|  |  |  |
| --- | --- | --- |
| **Texture Class Diameter Range** | **% Of Total Weight** | **Average %** |
| Sand (0.05 - 2 mm) | 25 to 75 | 50 |
| Silt (0.002 - 0.05 mm) | 15 to 40 | 27.5 |
| Clay (<0.002 mm) | 15 to 30 | 22.5 |

**CONSTRUCTION REQUIREMENTS**

**207.04 Submittals**

1. *Method Statement.* The Contractor shall submit a method statement prior to commencing work including the equipment and how they will perform the following:
	* topsoil stockpile location(s) shown on plan sheets
	* maintenance and erosion control of stockpiles
	* wetland topsoil stockpiling, maintenance, and watering
	* subsoil preparation method, including rod penetrometer use
	* topsoil placement
	* removal of clods, sticks, stones, debris, concrete, and asphalt for placed topsoil
	* noxious weed treatment of stockpiles and project area of disturbance (State of Colorado and County A and B Noxious Weed Lists) and invasive weeds. ♣ [the project may want to include other known C list or invasive weed species, i.e. Kochia]
	* manufacturing of Topsoil (Engineered)
	* amendment protocol for Topsoil (Imported) and Topsoil (Engineered) if applicable

Include topsoil stockpiling, subsoil preparation, and topsoil placement as milestones in the approved Baseline Schedule.

1. *Topsoil (Imported)*
	1. The Contractor shall submit a Certificate of Compliance (COC) from the supplier for approval before import, verifying that the source material has been managed per the State of Colorado Noxious Weed Act 35-5.5-115.
	2. The Contractor shall submit a Certified Test Report (CTR) for approval before import per Subsection 106.13. Include a complete Soil Nutrient Analysis for the properties listed in Table 207-2 from an independent laboratory participating in the National Association for Proficiency Testing (NAPT).

If topsoil nutrient analysis is deficient, the Contractor shall submit an Amendment Protocol with a complete list of amendments and associated quantities for approval.

1. *Topsoil (Engineered)*
	1. Soil Nutrient Analysis for the properties listed in Section 207-2 shall be performed by an independent laboratory participating in the NAPT. The Soil Nutrient Analysis shall determine if subsoil or rock is preferable and to determine a Soil Amendment Protocol.
	2. The Contractor shall submit a CTR for approval a minimum of 14 days before outside amendment materials are purchased, per subsection 106.13 (excluding lot, heat, and batch number), confirming that the excavated material conforms to the requirements in Table 207-2.
	3. The Contractor shall submit a plan for approval a minimum of 14 days before the manufacture of engineered topsoil specifying the mixing location, mixing methodology, dust palliative procedures during mixing, and timeline from generation to installation. An Amendment Protocol shall be submitted for pre-approval. The Amendment Protocol shall contain a complete list of amendments and associated quantities to produce topsoil that conforms to Table 207-2.
2. **Site Pre-vegetation Conference.** The Site Pre-vegetation Conference shall occur before the initial subsoil preparation. The Engineer, the region permanent stabilization subject matter expert, the Superintendent, Foreman, and the personnel performing the subsoil preparation, soil amendments, and seeding shall attend the Site Pre-vegetation conference.
3. **Topsoil (Onsite) Stripping.**  Excessively wet, muddy, or frozen topsoil shall not be moved and allowed to dry as determined by the Engineer. Topsoil within the LDA shall be salvaged prior to the start of clearing, grubbing, hauling, excavating, or fill operations by excavating and stockpiling the material at designated locations. Native vegetation including litter and duff shall be collected as part of the salvaging of topsoil unless specified in the plans or by the Engineer to be removed and hauled off site. All trash and debris shall be removed before moving topsoil for stockpiling.
4. **Delivery, Storage, and Handling.** Topsoil shall not be delivered or placed in frozen, wet, or muddy conditions. Place topsoil stockpiles within the LDA. Topsoil stockpiles shall not be compacted. Topsoil stockpiles placed along the perimeter require a control measure. Stockpile topsoil in a manner to facilitate measurement, to not obstruct natural drainage, and minimize sediment transport.

All topsoil stockpiles scheduled to remain in place for 14 days or more shall receive Interim Stabilization per subsection 208.04. Topsoil shall not be dumped or stored near structures, utilities, walkways, pavements, trees, shrubs, inlets, environmentally sensitive areas, or on existing vegetated areas outside the LDA.

Each topsoil stockpile shall be identified using white pin flags marked legibly with “TOPSOIL”. For stockpiles larger than 100 cubic yards or linear stockpiles, pin flags shall be placed at a maximum spacing of every 100 feet.

1. *Topsoil (Onsite).* Stockpiles shall be treated with herbicide only if the 217 pay item is included in the plans, per Section 217, or as directed. If topsoil is stored over 9 months **♤**, The Contractor shall send a representative sample of topsoil to a CDOT approved laboratory for nutrient panel testing and add amendments as required before placement at no additional cost to the Department.
2. *Topsoil (Imported).* Import shall not begin until the material has been approved. Topsoil (Imported) shall not be stockpiled on site for longer than 30 Days and shall receive Interim Stabilization if in place for 14 days or more.
3. *Topsoil (Engineered).* Prior to incorporation into parent material at the stockpiles, all amendment quantities need to be approved. Mixing shall occur prior to topsoil placement to produce homogeneous soils. Mixing shall not be performed within 50 feet of a waterway or drainage facility.
4. *Topsoil (Wetland)*. Wetland topsoil shall be extracted from the project site to a depth of 12 inches or at the locations and depths as shown on the plans **♦**. Differing soil depths may be approved by the Engineer in coordination with the Region Wetland Specialist. Stockpiling wetland topsoil shall not exceed 3 months (not including a winter shutdown) or as shown on plans **♢**. Stockpiles shall be kept moist during hot, dry weather, from an approved water source. Wetland stockpiles shall not be treated with herbicide. The Contractor shall hand pull all weeds as directed by the Engineer, in coordination with the Region Wetland Specialist. Wetland topsoil shall be placed as soon as practicable.
5. **Subsoil Preparation.** Excessively wet subsoils shall be dried as necessary before beginning subsoil preparation. Performance of subsoil preparation shall consist of fracturing the soil uniformly to a depth of 14 inches **▶**, or to a depth as shown in the plans, without lifting or furrowing the surface excessively. If multiple passes are needed to achieve depth, there shall be a minimum overlap of 1 foot between passes to ensure consistent subsoil preparation. Following ripping, all construction debris and trash shall be removed.

Subsoil preparation shall be performed in all areas to be reseeded as called out in the plans. Subsoil preparation shall not be conducted on areas steeper than 3:1.

Areas where subsoil preparation has been completed shall be left in a roughened state until topsoil placement. Topsoil shall be placed within 14 days of subsoil preparation.

Embankment material shall be decompacted in areas where final stabilization requires topsoil and seeding. The distance subsoil preparation begins from the edge of pavement is per plan.

Subsoil preparation is not required where aggregate base course or recycled asphalt are used as a shouldering technique.

Areas not accessible to heavy equipment shall be decompacted to a depth of 6 inches with a rototiller, appropriate equipment, or hand tools.

1. **Equipment, Calibration, and Verification**

Subsoil preparation equipment shall be able to fracture the soil uniformly without excessively lifting or furrowing the subsoil surface.

Initial Pass Verification. The Contractor shall verify that the required depth of subsoil preparation was achieved by performing the following test with a rod penetrometer on the initial pass in presence of Engineer:

1. Perform subsoil preparation on the initial 30 linear feet.
2. To verify that that decompaction was achieved:
	1. Place a tape measure the length of the width of equipment and perpendicular to the direction of travel.
	2. Using the rod penetrometer, measure each foot along the tape measure confirming decompaction was achieved to 12-inch depth (2 inches less than subsoil preparation depth), or depth specified on plans, before 300 psi is reached on the pressure gauge (approximately 30 pounds of pressure on the T-handle).
3. If a minimum decompaction is not achieved, adjust equipment and re-rip the area until the required decompaction depth is achieved before continuing the decompaction on the remaining areas.

Once subsoil preparation operations have been completed, the Contractor shall confirm subsoil preparation was achieved using the penetrometer, at a minimum of ten random locations per acre as selected by the Engineer. If this depth cannot be achieved for 80 percent of the locations, the Contractor shall re-rip the area at no additional cost to the Department.

1. **Topsoil Placement and Distribution.** On areas to be revegetated, the Contractor shall place onsite, imported, or engineered topsoil to a depth of 6 inches, or to the depth shown on the plans **☗**. Topsoil shall be placed in a method that does not recompact subsoil. Topsoil should only be handled when it is dry enough to work without damaging soil structure, as determined by the Engineer. Topsoil shall not be placed if the ground is extremely dry, as determined by the Engineer. Soil shall be thoroughly moistened to prevent dust from leaving the site. Topsoil shall be able to make a ball in the palm of the hand and be moist enough to stick together and then break apart easily, yet not be so dry and hard that it either does not stick together or does not break apart easily. Dry hard soils should be moisture conditioned with a fine spray by nozzles or spray bars, in a manner to avoid erosion.

Remove clods, sticks, stones, debris, concrete, and asphalt more than 4 inches in any dimension from topsoil and remove from the project site.

1. *Topsoil (Onsite)*. The Contractor shall salvage and stockpile sufficient material to satisfy the revegetation needs of the project. Excess topsoil shall be disposed of offsite or as approved by the Engineer.
2. *Topsoil (Imported).* Add amendments to stockpiles or after placement. Imported topsoil stockpiles shall be placed within seven days of mixing amendments.
3. *Topsoil (Engineered)*. Distribute onsite within seven days of mixing amendments.
4. *Topsoil (Wetland).*Wetland topsoil shall only be placed within designated wetland areas.

When placed over riprap, wetland topsoil shall be placed at a minimum depth of 12 inches, or to the depth shown on the plans **♠**

Wetland topsoil shall not be placed below the ordinary high-water mark except as otherwise specified in the plans.

1. **Avoiding Recompaction and Remedies.** Equipment and vehicle traffic on areas to be revegetated shall be limited to the equipment being utilized to place topsoil and any other equipment required for the revegetation work. Areas to be revegetated shall also be kept free of trash and debris and protected from storage of materials and erosion after topsoil placement. Topsoil that is tainted during construction shall be removed from site, disposed of at a licensed landfill, and replaced with imported topsoil at no additional cost to the Department. Any re-ripping that is necessary due to recompaction is the responsibility of the Contractor as directed by the Engineer.
2. **Timing of Stabilization*.*** Soil amendments, seeding, and permanent stabilization mulching, per Section 212, shall be accomplished within four working days of placing the topsoil. If permanent stabilization control measures cannot be implemented on placed topsoil within four working days, the Contractor shall complete interim stabilization methods per subsection 208.04, at no additional cost to the Department.

**METHOD OF MEASUREMENT**

1. Topsoil material will be measured by the actual number of cubic yards of topsoil placed and accepted.

Subsoil preparation will be measured by the square yards of subgrade which is ripped and accepted for adequate decompaction.

**BASIS OF PAYMENT**

1. The accepted quantities measured will be paid for at the Contract unit price for each of the pay items listed below that appear in the bid schedule.

Payment will be made under:

**Pay Item Pay Unit**

Topsoil (Onsite) Cubic Yard

Topsoil (Engineered) Cubic Yard

Topsoil (Imported) Cubic Yard

Topsoil (Wetland) Cubic Yard

Subsoil Preparation Square Yard

The Site Pre-vegetation Conference will not be paid for separately but shall be included in the work.

Subsoil preparation includes rod penetrometer or T-handle and associated verification testing and will not be measured and paid for separately but shall be included in the work.

Additional passes with the ripping equipment to achieve the desired subsoil decompaction will not be measured and paid for separately but shall be included in the work.

Topsoil salvaging, stockpiling, erosion control, and placement will not be measured and paid for separately but shall be included in the work.

Testing and amendments of Topsoil (Engineered) and Topsoil (Imported) will not be measured and paid for separately but shall be included in the work.

Noxious and Invasive Weed Management will be measured and paid for per Section 217.

Topsoil (Wetland) includes hand pulling of weeds and measures to keep soils moist.

Removing clods, sticks, stones, debris, concrete, and asphalt more than 4 inches in any dimension for all topsoil placed will not be measured and paid for separately but shall be included in the work.

**INSTRUCTIONS TO DESIGNERS:** (Please delete these instructions before including in the project.)

Guidance for the below items can be found [here](https://www.codot.gov/programs/environmental/landscape-architecture/construction-specifications-details-tools-1/207-and-212-psp-required-swmp-development-tools/instructions-during-the-development-of-the-swmp.pdf). Topsoil testing and vegetation transect forms and additional guidance are available on the CDOT Landscape Architecture page [here](https://www.codot.gov/programs/environmental/landscape-architecture/construction-specifications-details-tools-1/207-and-212-psp-required-swmp-development-tools-1).

**☖** Determine the amount of topsoil required and if additional topsoil will be required to be imported from off-site or engineered from onsite subsoils. Document in the SWMP.

**☗** Determine the depth of topsoil to be salvaged and replaced. Document in the SWMP.

**♧** Include 217 PSP and pay items for noxious and invasive weed management.

**♣** Document the weeds of concern in the project area. Include method and timing for treatment. Include pay items.

**♦** Coordinate with the Region Wetland Specialist to determine the depth and limits of wetland topsoil to be salvaged. Document and include pay item.

**♢** Coordinate with the protect team, including the Region Wetland Specialist to determine what the length of time wetland topsoil will be in stockpiles, if project phasing can occur, and maintenance of wetland topsoils. Document.

**♠**. Coordinate with the Region Wetland Specialist to determine the depth of wetland topsoil over riprap, where it is salvaged from and the limits of wetland soils.

**♤** Coordinate with the project team to determine the length of time topsoil will be stockpiled. Include amounts of additional amendments and add to quantities in pay items.

**▶** Document depth of subsoil preparation, coordinating with the project team, in the SWMP.