

MIT

Design Standards

DIVISION 32 — Site Improvements

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Department
of Facilities

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1. 321313 - CONCRETE PAVING

1.1 Project Includes

For cast-in-place exterior flatwork, the MIT campus standard is broom finish, with control joints saw-cut (not troweled). For Cambridge City ROW, meet the Cambridge DPW Specification.

2. 321314 - EXPOSED AGGREGATE CONCRETE PAVING

2.1 Project Includes

Use of exposed aggregate paving shall be limited to:

1. Where used to match a larger field of existing exposed aggregate paving.
2. In Killian Court, with review by Office of Campus Planning (OCP).

3. 321400 - UNIT PAVING

3.1 Project Includes

Concrete unit paving.

3.2 Quality Assurance

Comply with governing codes and regulations. Provide products of acceptable manufacturers which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions. Mock-Ups: Provide mock-up as required to demonstrate quality of workmanship.

3.3 Products

Refer to the MIT Campus Standard Unit Pavers schedule following this Section.

Pavers shall be Hanover Prest-Brick, hydraulically precast concrete pavers, manufactured by Hanover Architectural Products, Inc., 5000 Hanover Road, Hanover, PA 17331; Tel. 717-637-0500; Fax: 717-637-7145; Web; www.hanoverpavers.com, or approved equal.

1. Pavers shall have an average minimum compressive strength of 8000 psi, with no individual unit less than 7,200 psi, in accordance with ASTM C 93.
2. Water absorption shall be 5% or less.
3. Color and finish shall be selected by the Architect from the manufacturer's full range of standard colors and finishes, with first priority given to colors in the Campus Standard Unit Paver Schedule, and review by OCP.

4. Traffic types may include:
 - Driveways and entrances
 - Exterior commercial walkways
 - Low traffic walkways and patios

Setting Bed Materials:

1. Mortar: Latex-modified Portland cement setting-bed mortar.
2. Bond Coat: Latex-modified Portland cement slurry.
3. Grout: Latex-modified Portland cement grout.
4. Asphalt cement/fine aggregate bituminous setting bed with neoprene-modified asphalt adhesive.
5. Clean, sharp, natural sand conforming to ASTM C 33, except that the fineness modulus shall be 2.25 ± 0.10 .
6. Stone dust of decomposed granite or trap rock conforming to the gradation requirements of AASHTO M 43, No. 10, or "stone dust" minus 1/4 in. screenings.
7. Paver Spacer: Provide 3/16 in. "T" masonry spacer capable of ensuring even joint spacing of pavers.
8. Setting Beds may include:
 - a. Mortar over concrete slab.
 - b. Bituminous setting bed over concrete base slab.
 - c. Bituminous setting bed over bituminous concrete base.
 - d. Sand or stone dust over compacted aggregate base.
 - e. Sand over perforated concrete base slab.

Joints may include:

1. Hand-tight joints with stone dust filler.
2. Hand-tight joints with sand filler.
3. Hand-tight joints with polymeric sand filler.
4. Latex-Modified Portland cement grout.

Edge Restraints:

1. Steel Edge Restraints: Painted commercial steel edging with loops pressed from or welded to face to receive stakes at 36 inches (900 mm) o.c., and steel stakes 15 inches (380 mm) long for each loop.
2. Extruded-aluminum edging with loops pressed from face to receive stakes at 12 inches (300 mm) o.c., and aluminum stakes 12 inches (300 mm) long for each loop.
3. Plastic Edge Restraints: Manufacturer's standard triangular PVC extrusions designed to serve as edge restraints for unit pavers; rigid type for straight edges and flexible type for curved edges, with pipe connectors and 3/8-inch (9.5-mm) diameter by 12-inch- (300-mm-) long steel spikes.

3.4 Installation

Install materials in accordance with manufacturer's instructions and approved submittals. Install materials in proper relation with adjacent construction and with uniform appearance. Coordinate with work of other sections.

Do not use unit pavers with chips, cracks, voids, discolorations, and other defects that might be visible or cause staining in finished work.

Mix pavers from several pallets or cubes, as they are placed, to produce uniform blend of colors and textures.

Cut unit pavers with motor-driven masonry saw equipment to provide clean, sharp, unchipped edges. Cut units to provide pattern indicated and to fit adjoining work neatly. Use full units without cutting where possible. Hammer cutting is not acceptable.

Tolerances:

1. Where slopes to drains are critical: Do not exceed 1/32-inch (0.8-mm) unit-to-unit offset from flush (lippage) nor 1/8 inch in 10 feet (3 mm in 3 m) from level, or indicated slope, for finished surface of paving.
2. Where normal control of paving is acceptable: Do not exceed 1/16-inch (1.6-mm) unit-to-unit offset from flush (lippage) nor 1/8 inch in 24 inches (3 mm in 600 mm) and 1/4 inch in 10 feet (6 mm in 3 m) from level, or indicated slope, for finished surface of paving.

Expansion and Control Joints: Provide for sealant-filled joints at locations and of widths indicated. Provide joint filler as backing for sealant-filled joints where indicated. Install joint filler before setting pavers.

Install edge restraints before placing unit pavers.

Aggregate material for base beneath concrete pavers shall be applied in lifts less than or equal to 6 in. thick, compacted measure. Each lift shall be separately compacted at optimum moisture content to not less than 95% of maximum density as determined by ASTM D 1557.

Setting on Mortar Bed:

1. Apply latex-modified bond coat and mortar setting bed in accordance with manufacturer's printed instructions.
2. Mix and place only that amount of mortar bed that can be covered with pavers before initial set. Cut back, bevel edge, remove, and discard setting-bed material that has reached initial set before placing pavers.
3. Tamp or beat pavers with a wooden block or rubber mallet to obtain full contact with setting bed and to bring finished surfaces within indicated tolerances. Set each paver in a single operation before initial set of mortar; do not return to areas already set and disturb pavers for purposes of realigning finished surfaces or adjusting joints.
4. Provide 3/8 inch (10 mm) nominal joint width with variations not exceeding plus or

minus 1/16 inch (1.6 mm).

5. All joints, except expansion joints, shall be completely filled with mortar, then raked out to a depth of not less than 3/4 in. Raked joints shall be brushed clean and pointed with mortar grout to a flat cut joint.

Setting on Bituminous Bed:

1. Bituminous setting bed shall be installed over the fully cured concrete or bituminous concrete base.
2. Place bituminous material and power roll to produce a smooth, firm, and even nominal 3/4 inch (19 mm) thick setting bed. Adjust thickness as necessary to allow accurate setting of unit pavers to finished grades indicated.
3. Apply neoprene-modified asphalt adhesive to cold setting bed by squeegeeing or troweling. After the modified asphalt adhesive dry to the touch, carefully place the concrete pavers by hand with hand tight joints and uniform top surface.
4. Spread dry sand and fill joints. Follow manufacturer's printed instructions if using polymeric sand joint filler.

Setting on Sand or Stone Dust Bed:

1. If installing over perforated concrete base then first fill vertical weep holes with drain stone and cover with filter fabric.
2. Spread sand or stone dust over concrete base slab or compacted aggregate base as a setting bed for pavers. Place leveling course and screed to a thickness of 1 to 1-1/2 inches (25 to 38 mm), taking care that moisture content remains constant and density is loose and constant until pavers are set, leveled and compacted to required slope and grade. Bed shall not be compacted until pavers are installed.
3. Set pavers with a minimum joint width of 1/16 inch (1.6 mm) and a maximum of 1/8 inch (3 mm), being careful not to disturb leveling base. If pavers have spacer bars, place pavers hand tight against spacer bars. Use string lines to keep straight lines. Fill gaps between units that exceed 3/8 inch (10 mm) with pieces cut to fit from full-size unit pavers.
4. Spread dry sand and vibrate pavers into leveling course. Add sand until joints are completely filled, then remove excess sand.
5. Follow manufacturer's printed instructions if using polymeric sand joint filler.

Restore damaged pavers. Clean and protect work from damage

4. 321600 - CURBS

4.1 Project Includes

All curbs shall be granite.

4.2 Quality Assurance

- Comply with governing codes and regulations.
- Provide products of acceptable manufacturers which have been in satisfactory use in similar service for three years.
- Use experienced installers.
- Deliver, handle, and store materials in accordance with manufacturer's instructions.

Construction Tolerance:

- 1/8 inch in 10 feet for grade and alignment
- 1/4 inch 10 feet for vertical or sloped face on longitudinal axis.
- Mock-Ups: Provide mock-up as required to demonstrate quality of workmanship.

4.3 Products

Granite Curbs: conforming to MHD Specifications Section M9.04.0 and ASTM C 615, Class I Engineering Grade, suitable for curbstone use.

1. Vertical Granite Curb: Sawed top and smooth quarry split face.
2. Sloped Granite Curb: Smooth quarry split face.

4.4 Installation

Provide acceptable materials and install curbing in strict compliance with Commonwealth of Massachusetts Highway Department; Standard Specifications for Highways and Bridges, Section 501.

Set curbs on compacted gravel base with joints between curb pieces from 1/8 inch to 3/4 inch wide. Provide concrete haunch if indicated on the Drawings. Point joints with mortar and tool concave; remove surplus mortar and clean curbs.

5. 321800 – PLAYGROUND SAFETY SURFACING

5.1 Project Includes

Playground safety surfacing.

5.2 Quality Assurance

Comply with governing codes and regulations. Provide products of acceptable manufacturers which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

Poured In Place Surfacing - Performance Requirements: Provide a 2 layer rubber-polyurethane playground surfacing system which has been designed, manufactured and installed to meet the following criteria:

1. Shock Attenuation (ASTM F1292):
 - a. Gmax: Less than 200.
 - b. Head Injury Criteria: Less than 1000.
2. Flammability (ASTM D2859): Pass.
3. Tensile Strength (ASTM D412): 60 psi (413 kPa).
4. Tear Resistance (ASTM D624): 140%.
5. Water Permeability: 0.4 gal/yd²/second.
6. Accessibility: Comply with requirements of ASTM F1951.

Certified test data indicating that safety surface meets or exceeds the following:

1. Current Consumer Product Safety Commission (CPSC) guidelines issued in "A Handbook for Public Playground Safety" (latest edition) for a minimum fall height of 6 feet .
2. Current Americans with Disabilities Act Guidelines (ADAG).
3. Current ASTM F-1292 requirements.

5.3 Products

Playground Safety Surfacing Systems:

1. Manufacturers: Surface America, Williamsville, NY 14231, Telephone: (800) 999-0555, (716) 632-8413; Fax: (716) 632-8324; E-mail: info@surfaceamerica.com; website: <http://www.surfaceamerica.com>., or approved equal.
2. Application: Playground Safety Surfacing.
3. Types may include:
 - a. Playground Safety Surfacing ace, base mat type.
 - b. Playground Safety Surfacing face, full pour type.
4. Colors: as selected by Architect and Owner.

5.4 Installation

Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials and systems in proper relation with adjacent construction. Coordinate with work of other sections.

Restore damaged surfaces and protect work.

6. 323300 - SITE FURNISHINGS

6.1 Project Includes

Loose and fixed seating, bike racks, and railings and related items.

Refer to the list of MIT Campus Standard Furnishings at the end of this Section.

6.2 Quality Assurance

Comply with governing codes and regulations. Provide products of acceptable manufacturers which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions. Where appropriate, and when approved by the Architect, manufacturer's catalogue cuts may be substituted for shop drawings.

Certificate of wood treatment shall be submitted upon delivery of treated wood items.

Submit assembly instruction drawings showing layout(s), connections, bolting and anchoring details as per manufacturer's standards.

A report of site furnishing parts consisting of recycled materials. Product specification data, providing test information for deflection and creep in accordance with ASTM D 648 and ASTM D 2990 for site furnishings which use plastic lumber as a component, shall be submitted. The data shall provide a comparison of deflection and creep measurements to other comparable materials.

Furnish evidence indicating that source of Ipe wood or other sustainably-sourced tropical hardwoods used for table and bench construction is a plantation farm or other designated source practicing sustain yield concept in forestry, and regulated by governing authorities regarding the growing, harvesting, and replanting of tropical hardwood trees.

6.3 Products

Refer to the MIT Campus Standard Furnishings schedule at the end of this Section. All proposed colors, materials, and finishes shall be reviewed by OCP.

6.4 Installation

Install site furnishings in accordance with manufacturer's instructions and approved submittals. Install materials and systems in proper relation with adjacent construction. Coordinate with work of other sections.

Restore damaged surfaces and protect work.

7. 328000 - IRRIGATION

7.1 Project Includes

Irrigation systems for exterior lawn and planting areas.

Contact the MIT Office of Campus Planning for a copy of the Standards Catalogue for additional information.

7.2 Quality Assurance

Comply with governing codes and regulations. Provide products of acceptable manufacturers which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

Water Coverage for Turf Areas: 100 percent.

Water Coverage for Planting Areas: 100 percent.

Testing: Hydrostatic test at 100 psi.

All applicable ANSI, AWWA, and ASTM Standards and Specifications, and all applicable building codes and other public agencies having jurisdiction upon the work.

Contractor shall be responsible for constructing the system in complete accordance with all local codes, ordinances and laws. Any modification made to conform with said codes, laws and ordinances shall be completed at the Contractor's expense with no additional compensation allowed.

Protection of Existing Plants and Site Conditions: The Contractor shall take necessary precautions to protect site conditions to remain. Should damages be incurred, this Contractor shall repair the damage to its original condition at his own expense. Any disruption, destruction, or disturbance of any existing plant, tree, shrub, or turf, or any structure shall be completely restored to the satisfaction of the Owner, solely at the Contractor's expense.

Permits and Fees: Obtain all permits and pay required fees to any governmental agency having jurisdiction over the work. Inspection required by local ordinances during the course of construction shall be arranged as required. On completion of the work, satisfactory evidence shall be furnished to Architect to show that all work has been installed in accordance with the ordinances and code requirements.

On-Site Observation: At any time during the installation of the irrigation system by the Contractor, the Owner may visit the site to observe work underway. Upon request, the Contractor shall be required to uncover specified work as directed by the Owner without compensation. Should the material, workmanship or method of installation not meet the standards specified herein, the Contractor shall replace the work at his own expense.

Workmanship: All work shall be installed by skilled personnel, proficient in the trades required, in a neat, orderly, and responsible manner with recognized standards of workmanship. The Contractor shall have had considerable experience and demonstrated ability in the installation of sprinkler irrigation systems of this type.

Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:

1. Notify Owner no fewer than two days in advance of proposed interruption of water service.
2. Do not proceed with interruption of water service without Owner's written permission

7.3 Products

Irrigation Systems:

1. Manufacturers: Provide components from preferred manufacturers included in MIT Design Standards .
 - a. All rotor heads used for installation shall be Hunter I-20, Hunter I-25, or Hunter MP rotator.
 - b. All spray heads installed shall be Hunter Prospray PRS30 or Rainbird 1800 SAM PRS heads for use with variable arc or fixed pattern nozzles.
 - c. All spray heads installed shall be Hunter Prospray PRS40 heads for use with Hunter MP rotator heads.
 - d. All exterior electric valves installed shall be Rainbird PEB or PESB Series valves or Hunter ICV valves.
 - e. All drip irrigation tubing installed shall be Netafim Techline .9 GPH piping.
 - f. All Valve boxes installed shall be Carson or Amtek.
 - g. All automated irrigation controllers installed should be Rainbird ESP-SAT Series controllers for intended use with Maxicom.
 - h. All Quick coupler valves installed should be 1” Rainbird 5RC valves for use with a 55K Quick coupler key. For use on systems using non-potable water, locking rubber cover shall have molded-in warnings of "DO NOT DRINK" in English and Spanish.
 - i. All PVC piping should be SDR 21 (class 200) or thicker walled.
 - j. All new irrigation systems should contain a master valve and flow sensor.
 - k. All Hunter I-25 heads to be installed on Spears schedule 80 swing joints.
2. Applications may include:
 - a. Irrigation for site plantings.
 - b. Irrigation for lawns.
3. Piping may include:
 - a. Copper.
 - b. PVC plastic.
 - c. Polyethylene
4. Valves: Cast bronze.
5. Backflow Preventers: Cast bronze.
6. Sprinkler Heads: Suitable for service.
7. Quick coupling valves shall be 1 in. heavy duty brass construction one-piece body design, with locking rubber cover. Furnish to the Owner the following additional items: three hollow coupler keys and three swivel hose ell adapters.
 - a. For use on systems using non-potable water, locking rubber cover shall have

molded-in warnings of "DO NOT DRINK" in English and Spanish.

8. Control and ground wiring shall be minimum Type "UF", #12 wire, 600 volt, solid copper, single conductor wire with PVC insulation and shall bear UL approval for direct underground burial feeder cable.
9. Rain sensor shall be a micro-electronic solid-state type, capable of interrupting the power from the irrigation controller to the valves when rainfall exceeds a preselected quantity.
10. Automatic Control Systems, UL listed and tested, may include:
 - a. Interior locations.
 - b. Exterior locations.

7.4 Installation

Coordinate all installation with landscape planting work, especially plant locations, fine grading, and soil preparation for planting areas. Protect existing landscaping from damage. Repair and repave cut paving to match paving in original condition.

Excavation required for the installation of the irrigation system shall conform to ASTM F 690. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials and systems in proper relation with adjacent construction. Coordinate with work of other sections.

Coverage Test: After completion of the system, test the operation of entire system and adjust sprinklers as directed by the Owner. Demonstrate to the Owner that all irrigated areas are being adequately covered. Furnish and install materials required to correct inadequacies of coverage due to deviations from the Drawings or where the system has been willfully installed when it is obviously inadequate or inappropriate without bringing it to the attention of the Owner.

Instruct Owner's personnel in proper operation and maintenance procedures.

At the end of the first irrigation season, the system shall be fully drained by use of compressed air (600 CFM or larger; do not exceed 50 psi) and shutdown for the season.

Prior to the start of the second irrigation season, the system shall be restarted, checked, and repaired. This start up procedure shall include but not be limited to:

1. Testing of all system components, (valves, heads, controllers, quick coupling valves, piping, etc.) for proper working order.
2. Adjustments, repair, or replacement of all system components that are not in proper working order.

8. 329000 - PLANTING

8.1 Project Includes

Trees, shrubs, ground covers, perennials, seed lawns and sod lawns.

8.2 Quality Assurance

Comply with governing codes and regulations. Provide products of acceptable manufacturers which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

Balled and Burlapped Plants and Trees: Graded to American Standard for Nursery Stock, ANSI Z60.1.

Fall digging hazards shall conform to American National Standards Institute, Inc. (ANSI) species and guidelines

Testing: Laboratory testing for suitable soil amendments and fertilizer.

Storage: Unless specific authorization is obtained from the Architect, plants shall not remain on the site of work longer than three days prior to being planted.

Plants shall be guaranteed for a period of two years after the date of Acceptance by the Owner.

8.3 Products

Plants:

1. Except as otherwise specified, size and grade of plant materials shall conform to ANSI Z60.1, latest edition. In no case shall ball size be less than 11 in. in diameter for each inch of caliper.
 - a. Shade Trees: Single-stem trees with straight trunk, well-balanced crown, and intact leader, of height and caliper indicated, complying with ANSI Z60.1 for type of trees required. Minimum 6 ft. height above root flare for branches.
 - b. Small Trees: Branched or pruned naturally according to species and type, with relationship of caliper, height, and branching according to ANSI Z60.1.
 - c. Multistem Trees: Branched or pruned naturally according to species and type, with relationship of caliper, height, and branching according to ANSI Z60.1.
 - d. Deciduous Shrubs: Form and Size: Deciduous shrubs with not less than the minimum number of canes required by and measured according to ANSI Z60.1 for type, shape, and height of shrub.
 - e. Coniferous Evergreens: Form and Size: Normal-quality, well-balanced, coniferous evergreens, of type, height, spread, and shape required, complying with ANSI Z60.1.
 - f. Broadleaf Evergreens: Form and Size: Normal-quality, well-balanced, broadleaf evergreens, of type, height, spread, and shape required, complying with ANSI Z60.1.
2. All trees and shrubs shall be labeled. Labels shall be durable and legible, stating the correct plant name and size in weather-resistant ink or embossed process. Labels shall be securely attached to all plants prior to delivery to the site, being careful not to restrict growth.
3. Container grown plants shall be well rooted and established in the container in which they are growing. They shall have grown in the container for a sufficient length of time for the root system to hold the planting medium when taken from the container, but not long enough to become root bound. Container grown plants exceeding the sizes indicated in ANSI Z60.1 shall have containers which are not less than 75% of the ball sizes for comparable B&B plant material. Each container plant shall be inspected and root pruned as needed.

4. Ground Cover and Perennials: Provide ground cover and perennials of species indicated, established and well rooted in pots or similar containers, and complying with ANSI Z60.1 .

Planting Soil and Amendments:

1. Planting soil and amendments shall be as specified in Specification Section 329115 - MIT PLANTING SOILS and meet MIT Imported Soil Specification for sourcing and testing in Section 312322 - MIT Imported Fill Criteria and Management.

Planting Accessories:

1. Accessories
 - a. Shredded pine bark mulch
 - b. Wood Stakes: Straight, sound, rough sawn lumber 2 in. x 2 in., if square, or 2-1/2 in. diameter, if round; stained dark green. Wire for staking shall be 12 gauge steel.
 - c. Strapping: Arbortie, manufactured by DeepRoot Green Infrastructure, LLC, 530 Washington Street, San Francisco, CA 94111 Tel: 800 458 7668 or 415 781 9700; Fax: 800 277 7668 or 415 781 0191, or approved equal.
 - d. Wrapping: Arbor Tape, supplied by American Arborist Supplies, 882 S Matlack Street, Unit A, West Chester, PA 19382: Phone: 800-441-8381/610-430-1214; Fax: 610-430-8560; E-mail Address: info@arborist.com, or approved equal.
 - e. Edging: extruded aluminum, 6063 alloy, T-6 hardness, maintenance strip edging for straight-line and gentle curve applications in corrugated L-shaped profile.
 - f. Antidesiccant shall be an emulsion specifically manufactured for plant protection which provides a protective film over plant surfaces which is permeable enough to permit transpiration.
 - g. Root barrier shall be linear type root barrier or root box, capable of blocking tree roots from interfering with adjacent pavement without sacrificing secondary lateral root growth for stability, similar to "Deep Root" tree barrier, manufactured by Deeproot Partners, L.P., Burlingame, CA 94010; "Shawtown Root Barrier Panels" manufactured by NDA Inc., Lindsey, CA 93247; or approved equal.
 - h. Tree watering system shall be 20 gallon Treegator, a slow release watering system for new trees., capable of delivering a high volume of water directly to the root system of a newly planted tree with no run-off or evaporation, manufactured by Spectrum Products, Inc., Youngsville, North Carolina, 27596; supplied by PlanetGreenSpot.com PO Box 674 Pasadena, MD 21123, Tel. 888.574.6348.
 - i. Tree watering stake shall be Deep Drip Tree Watering Stake, manufactured by Green King, LLC – World Headquarters, 162 W. Boxelder Place – Suite #2, Chandler, AZ 85225; Tel: (480) 422-0251 <http://www.deepdrip.com/contact/> - #; Fax: (480) 503-2329 <http://www.deepdrip.com/contact/> - #; Email: info@deepdrip.com, or approved equal.

Lawns:

1. Part Shade Lawn Seed mix shall be as follows.

<u>Name of Seed</u>	<u>% by Weight in Mixture</u>	<u>Minimum % Purity</u>	<u>Minimum % Germination</u>
Jasper			
Creeping Red Fescue	25%	95	87
Victory			
Chewings Fescue	25%	95	87
Spartan Hard Fescue	25%	95	87
America			
Kentucky Bluegrass	15%	90	87
Jefferson			
Kentucky Bluegrass	10%	90	87

2. Full Sun and High Traffic Lawn Seed mix shall be as follows.

- a. Characteristics: A general purpose sports field mixture that features Rebel Turf-Type Tall Fescues, Perennial ryegrass and Kentucky bluegrass. It shall be a very durable mix that offers heat and drought tolerance. This mix shall be appropriate for high use sites that have limited watering capabilities. All chosen varieties shall be from the MD/VA recommended list as specified by the latest edition of The University of Maryland's Turfgrass Technical Update #TT-77 (formally Agronomy Mimeo 77).

<u>Name of Seed</u>	<u>% by Weight in Mixture</u>	<u>Minimum % Purity</u>	<u>Minimum % Germination</u>
Houndog 6 or, Coronado Gold; Olympic Gold., or			
Endeavor Tall Fescue	80	95	90
Keystone 2, or Palmer III, or Brightstar II			
Perennial Ryegrass	10	98	90
Geronimo, or Gold Rush			
Kentucky Bluegrass	10	98	90

3. Sod shall be as follows.

- a. Certified Turfgrass Sod: Superior sod grown from certified, high quality seed of known origin or from plantings of certified grass seedlings or stolons. It shall be inspected by the certification agency of the state in which it is grown to assure satisfactory genetic identity and purity, overall high quality and freedom from noxious weeds as well as excessive quantities of other crop and weedy plants at time of harvest. All seed or original plant material in mixture must be certified. Turfgrass sod shall meet the published state standards for certification.

1. Full Sun Mix – Sod - Premium Kentucky Bluegrass Blend supplied by Tuckahoe Farms - #305 Hubbard Rd, Berwick, ME 03901, or other sod farm

capable of meeting the sod farm growing medium specified in Section 329115, PLANTING SOILS.

2. Alternate: Part Shade Mix - Fine Fescue/Bluegrass supplied by Tuckahoe Farms - #305 Hubbard Rd, Berwick, ME 03901 or other sod farm capable of meeting the sod farm growing medium specified in Section 329115, PLANTING SOILS.

4. Sod Characteristics:

- a. Thickness of Cut: Sod shall be machine cut at a uniform soil thickness of 5/8 in., plus or minus 1/4 in., at the time of cutting. Measurement for thickness shall exclude top growth and thatch.
- b. Strip Size: Individual pieces of sod shall be cut to the supplier's standard width and length. Maximum allowable deviation from standard widths and lengths shall be plus or minus 1/2 in. on width, and plus or minus 5% on length. Broken strips and torn and uneven ends will not be acceptable.
- c. Strength of Sod Strips: Standard size sections of sod shall be strong enough to support their own weight and retain their size and shape if suspended vertically when grasped in the upper 10% of the section.
- d. Moisture Content: Sod shall not be harvested or transplanted when moisture content (excessively dry or wet) may adversely affect its survival.
- e. Time Limitations: Sod shall be harvested, delivered, and transplanted within a 36 hour period unless a suitable preservation method is approved prior to delivery. Sod not transplanted within this period shall be inspected and approved by the Architect prior to its installation.
- f. Thatch: Sod shall be relatively free of thatch. A maximum of 1/2 in. (uncompressed) thatch will be permitted.

Lawn Accessories:

1. Hydroseeding Mulch: Wood fiber mulch shall be composed of 100% Thermally Refined wood fiber with the highest quality cellulose, delivering up to 15% greater yield, contain a green color additive, be weed free, and non-polluting, containing no germination or growth - inhibiting factors, similar to Conwed Fibers EnviroBlend with TriFlo, manufactured by Conwed Fibers, Profile Products LLC, 750 Lake Cook Rd, Suite 440, Buffalo Grove, IL 60089; Phone: 800-508-8681 Fax: 847-215-0577; SoilCover Wood, manufactured by Profile Products LLC • 750 Lake Cook Road • Suite 440 • Buffalo Grove, IL 60089; Technical Assistance: 800-508-8681; www.profileproducts.com, or approved equal.
2. Soil stabilization fiber shall be Stalok Fiber, polypropylene fiber filaments suitable for mixing with planting soil to provide structural reinforcement properties, manufactured by Stabilizer, Phoenix, AZ 85018, or approved equal.

8.4 Installation

Install materials in accordance with approved submittals. Install landscape work in proper relation with adjacent construction and with uniform appearance. Coordinate with work of other sections.

Preparation

1. Decompaction of planting areas and percolation testing shall be conducted in accordance with MIT Master Specification Section 329115 - MIT PLANTING SOILS.

Planting Soil

1. Prepare and place planting soil for plants and lawn areas in accordance with MIT Master Specification Section 329115 - MIT PLANTING SOILS.
 - a. Final surface of planting soil immediately before seeding and sodding shall be within $\pm 1/2$ in. of required elevation, with no ruts, mounds, ridges, or other faults, and no pockets or low spots in which water can collect. Stones, roots, and other debris greater than 1 in. in any dimension, which are visible at the surface, shall be removed and the resulting holes filled with topsoil, leaving a uniform planar surface

Excavate as required for trees and shrubs.

If the planting pit for any tree is dug too deep, soil shall be added to bring it to correct level, and the soil shall be thoroughly tamped. Walls of plant pits shall be dug so that they are sloped as shown on the Drawings, and scarified.

For seeded lawns, apply seed at rate recommended by seed supplier. Seed shall be applied in two applications; first shall be by mechanical spreader; second shall be by hydroseeding method.

Sod shall be placed and all sodding operations completed within 72 hours following stripping from sod source bed. For lawns with sod, place sod tightly, with grain in same direction. Edges of the sodded areas shall be smooth, and all sodded areas shall conform to the design cross sections and grade. At edges adjacent to curbs, paved areas, etc., top surface of earth in sod shall be 1/2 in. below adjacent hard surface.

Plants shall be set as indicated on Drawings. Plants shall be set so that the root flare is at, or slightly above, finished grade. Plants located in poorly drained soils shall be set 2 to 4 inches above finished grade, gradually sloping between the top of the root ball and the surrounding finished grade.

Install plant material and backfill with planting soil mix. Stake and guy trees. Wrap trees and mulch tree pits and plant beds as required. Water thoroughly. Allow for soil settlement.

Planting Maintenance:

Provide maintenance and watering until turnover to MIT for maintenance and watering. Replace damaged materials and dead or unhealthy plants prior to turnover to MIT; determination as acceptable to the MIT Project Manager.

1. Maintenance shall consist of pruning, watering, cultivating, weeding, mulching, fertilizing, removal of dead material, repairing and replacing of tree stakes, tightening and repairing of guys, adjusting and replacing of damaged tree wrap material, resetting plants to proper grades and upright position, and furnishing and applying such sprays as

- are necessary to keep plantings free of insects and disease, and in a healthy growing condition.
2. One-Year Warranty Period: Provide replacement of plants that fail to thrive for a period of one year after turnover to MIT; determination as acceptable to the MIT Project Manager.

Lawn Maintenance:

Provide maintenance and watering until turnover to MIT for maintenance and watering. Replace damaged materials and dead or unhealthy lawns prior to turnover to MIT; determination as acceptable to the MIT Project Manager.

1. Maintenance of seeded areas shall begin upon completion of seeding and shall continue until acceptance of the building, or until mowing as specified below is completed, or until average height of grass is 1-1/2 in., whichever occurs later.
 - a. Watering:
 1. Week No. 1: Provide all watering necessary to keep seed bed moist at all times. Perform watering daily or as necessary to maintain moist soil to a depth of 4 in.
 2. Week No. 2 and until acceptance of the building, or until mowing as specified below is completed, or until average height of grass is 1-1/2 in., whichever occurs later: Water as necessary to maintain adequate moisture in the upper 4 in. of soil to promote seed germination.
 - b. Mowing
 1. Not more than 40% of the grass leaf shall be removed during the first or subsequent mowings.
 2. Bluegrass and other cool season grasses shall be maintained between 1-1/2 in. and 2-1/2 in.
 3. All clippings shall be removed.
 - c. One-Year Warranty
 1. Provide replacement of lawns that fail to thrive for a period of one year after turnover to MIT; determination as acceptable to the MIT Project Manager.
2. Maintenance of sodded areas shall begin upon completion of sodding and shall continue for 45 days thereafter, unless sodding is not completed until after September 15, in which case maintenance shall continue until the June 15 following. Replace damaged materials and dead or unhealthy sod prior to turnover to MIT; determination as acceptable to the MIT Project Manager.
 - a. Watering
 1. Week No. 1: Provide all watering necessary for rooting of sod. Soil on sod pads shall be kept moist at all times. Perform watering daily or as necessary to maintain moist soil to a depth of 4 in. Watering shall be done during the heat of the day to prevent wilting.
 2. Week No. 2 and Subsequent Weeks: Water as necessary to maintain adequate moisture in the upper 4 in. of soil to promote deep root growth.
 - b. Mowing

1. Mowing shall not be attempted until the sod is firmly rooted and securely in place. Not more than 40% of the grass leaf shall be removed during the first or subsequent mowings.
 2. Bluegrass and other cool season grasses shall be maintained between 1-1/2 in. and 2-1/2 in.
 3. All clippings shall be removed.
 4. After 2 mowings, the Contractor shall top dress the sod with an application of fertilizer at the rate of 1 pound of actual nitrogen per 1000 square feet.
- c. One-Year Warranty
1. Provide replacement of sod that fail to thrive for a period of one year after turnover to MIT; determination as acceptable to the MIT Project Manager.

9. MIT CAMPUS STANDARD UNIT PAVERS

Refer to the following schedule following this page.

MIT Campus Standard Furnishings

10. MIT CAMPUS STANDARD SITE FURNISHINGS

Refer to the following schedule following this page.

MIT Campus Standard Furnishings

11. CONSTRUCTION SPECIFICATIONS

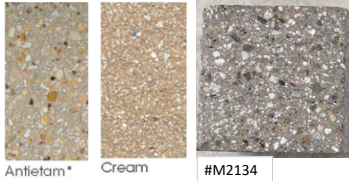

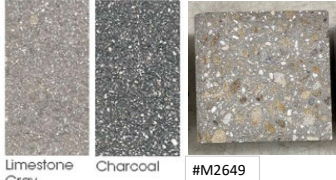




11.1 Section 329115 - MIT Planting Soils







The construction specification which follows this page is to be used in its entirety for applicable projects. Request an electronic copy from your MIT Project Manager.

Refer also to Division 01 for construction specifications for Section 013514 - MIT Specialized Root Zone and Soil Excavation and Section 013515 - MIT Imported Fill Criteria and Management.

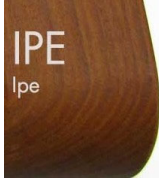













END OF DOCUMENT

MIT CAMPUS STANDARD UNIT PAVERS




SITE	VENDOR	DESCRIPTION	PAVER COLOR	SIZE (IN INCHES)	IMAGES
VASSAR STREET	HANOVER	PEDESTRIAN WALK HANOVER PREST BRICK	ANTIETAM (40% OF MIX) CREAM (30% OF MIX) M2134 (30% OF MIX) <u>DRIVEWAY RAMP AREA</u> ANTIETAM	12 X 12 X 3 12 X 12 X 3 12 X 12 X 3 12 X 12 X 3 (CUT 3 X 3)	 Antietam* Cream #M2134
	HANOVER	CYCLE TRACK BORDER PAVER HANOVER PREST BRICK	MATRIX M1151 <u>DRIVEWAY RAMP AREA</u> MATRIX M1151	12 X 12 X 3 12 X 12 X 3 (CUT 3 X 3)	 Matrix #1151*
	CAMBRIDGE CITY STANDARD	TACTILE WARNING TILE CAST IRON DETECTABLE WARNING TILE	CITY STANDARD	CITY STANDARD	
HOCKFIELD COURT	HANOVER	HANOVER PREST BRICK	LIMESTONE GRAY CHARCOAL MATRIX #M2649	6 X 12 X 3 6 X 12 X 3 6 X 12 X 3	 Limestone Gray Charcoal #M2649
NORTH CORRIDOR	HANOVER	HANOVER PREST BRICK	NATURAL MATRIX #B91041 CHARCOAL GRAY MATRIX #B93331	6 X 12 X 3 6 X 12 X 3 6 X 12 X 3 6 X 12 X 3	 Natural* Charcoal Charcoal Charcoal
KENDALL/ MIT OPEN SPACE	HANOVER	HANOVER PREST BRICK	B9 1442 B9 1041 CHARCOAL B9 1256 B9 3518 B9 3270 GLACIER WHITE	6 X 12 X 3 6 X 12 X 3 6 X 12 X 3 6 X 12 X 3 6 X 12 X 3 6 X 12 X 3 6 X 12 X 3	 B91442 B91041 Charcoal B91256 B93518 B93270 Glacier White
	HANOVER	HANOVER PREST BRICK	M1256	12 X 18	 M1256
	HANOVER	HANOVER PREST BRICK	B93639	4 X 8 X 3	 B93639

MIT CAMPUS STANDARD UNIT PAVERS					
SITE	VENDOR	DESCRIPTION	PAVER COLOR	SIZE (IN INCHES)	IMAGES
W46 NEW VASSAR STREET RESIDENCE	HANOVER	PERMEABLE	MATRIX B91151	6 X 12 X 3	 B91151
	HANOVER	PERMEABLE	ANTIETAM	6 X 12 X 3	 Antietam*
	FOR ALL VASSAR STREET REFERENCES SEE VASSAR STREET PAVER SECTION				
W87 / W88 VASSAR STREET GRADUATE DORMS (IN CONSTRUCTION)	HANOVER	UNIT PAVING TYPE 3 HANOVER PREST BRICK	M2134 (30% OF MIX) MULTIPLE COLOR AND TEXTURE VARIATIONS TO COMPLIMENT M2134 (70% OF MIX)	12 X 36 X 3 & 6 X 18 X 3	 #M2134
	HANOVER	UNIT PAVING TYPE 4 PERMEABLE PRECAST CONCRETE	CREAM	4 X 8 X 3	 Cream
	FOR ALL VASSAR STREET REFERENCES SEE VASSAR STREET PAVER SECTION				
E55 EAPS PAVILION	ENDICOTT CLAY PRODUCTS CO.	BRICK PAVER	MANGANESE IRONSPOT	2-1/4 X 4 X 12 LAID ON EDGE	 MANGANESE IRONSPOT
BUILDING 42C CUP	HANOVER	PERMEABLE	CHOCOLATE NATURAL	3-7/8 X 7-7/8 X 3 3-7/8 X 7-7/8 X 3	 Chocolate  Natural*
W18 MUSIC BUILDING (IN CONSTRUCTION)	HANOVER	HANOVER PREST BRICK	Per Spec & PM Color is TBD	6 X 12 X 3	

MIT CAMPUS STANDARD FURNISHINGS

VENDOR	MODEL NUMBER	DESCRIPTION	FINISHES	IMAGE
EQUIPARC	EP 1990 (BACK) EP 1991 (BACKLESS)	ESPLANADE COLLECTION ARMLESS PARK BENCH WITH OR WITHOUT BACK.	IPE SLAT WITH GALVANIZED FRAME/LEGS 	
EQUIPARC	EP 2990	ESPLANADE COLLECTION PICNIC TABLE (INCLUDES SET OF BENCHES)	IPE SLAT WITH GALVANIZED FRAME/LEGS 	
LANDSCAPE FORMS	36" OR 42" ROUND	CANTINA TABLE, POWDER COATED, DINING HEIGHT, FREESTANDING, NO UMBRELLA HOLE, PERFORATED TOP	ARCHITECTURAL SERIES (LOW SHEEN): DUSK 	
LANDSCAPE FORMS	ARM OR ARMLESS	VERONA CHAIR, GRID STYLE, STANDARD HEIGHT, POWDER COATED, STACKING	ARCHITECTURAL SERIES (LOW SHEEN): DUSK 	
LANDSCAPE FORMS	(1) HARVEST DINING TABLE (2) HARVEST DINING BENCH	HARVEST PICNIC TABLE DINING HEIGHT TABLE 47.75" X 94.75" X 18.75" FREESTANDING, NO UMBRELLA HOLE HARVEST DINING BENCH 15.25" X 94" X 18.75"	APPLE RED, CHARCOAL, LEAF GREEN 	
LOLL	AD-4SFC (color code)	COMPACT 4 SLAT ADIRONDACK CHAIR	APPLE RED, CHARCOAL, LEAF GREEN 	
LOLL	LG-LO (color code)	LOLLYGAGGER OTTOMAN/SIDE TABLE	APPLE RED, CHARCOAL, LEAF GREEN 	

MIT CAMPUS STANDARD FURNISHINGS

VENDOR	MODEL NUMBER	DESCRIPTION	FINISHES	IMAGE
CREATIVE PIPE / SCH ENTERPRISES	CBR-6-E-SS-F	FIXED, EMBEDDED-MOUNT BOLLARD 6" DIA ROUND SS PIPE, FLAT TOP	304 SS WITH #4 SATIN FINISH	 <p data-bbox="1377 388 1511 422">NOTE: DO NOT SPECIFY A FLANGE AT BASE</p>
WIKK INDUSTRIES	BOLLARD SERIES	ADA PUSH-BUTTON RECTANGULAR BOLLARD 3" X 6" X 35" WELDED FLAT TOP	304 SS WITH SATIN FINISH	
DERO	SWERVE RACK	IN GROUND MOUNT BIKE RACK	GALVANIZED or STAINLESS STEEL	

SECTION 329115

MIT PLANTING SOILS

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

- A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.
- B. Examine all Drawings and all Sections of the Specifications for requirements and provisions affecting the Work of this Section.

1.2 DESCRIPTION OF WORK

- A. The work of this Section consists of providing all equipment and materials and do all work necessary to supply and place planting soils as indicated on the Contract Documents and as specified. Supplying and placement of planting soils shall include, but not be limited to:
 - 1. Sampling and testing of planting soil components, including existing topsoil, loam borrow, sand and compost.
 - 2. Sampling and testing of blended planting soil mixes.
 - 3. Supplying, placing, spreading and grading of planting soil, including:
 - a. Plant Bed Soil (for Trees, Shrubs and Ground Covers)
 - b. High Use Lawn Planting Soil
 - c. Sand Based Structural Planting Soil
 - d. Bioinfiltration Planting Soil
 - 4. Providing all other sampling, testing, supplying, placing, spreading and grading of planting soils as required by this Section.

1.3 DEFINITIONS

- A. Owner: an MIT Landscape Architect, and/or MIT Grounds Supervisor.
- B. Finish Grade: Elevation of finished surfaces.
- C. Subgrade: Surface or elevation of subgrade soil remaining after completing excavation, or top surface of a fill or backfill immediately beneath planting soil.
- D. Topsoil: Soil that is present at the top layer of the existing soil profile at the Project site. This shall be considered the "Base Loam 1" component of Planting Soil mixes.
- E. Loam: Soil that contains a combination of particles typically almost equal in parts sand, silt and clay and including organic matter.
- F. Loam Borrow: Loam soil formed under natural conditions and obtained from off-site sources without admixtures of sand or organic matter sources (composts). This shall be considered the "Base Loam 2" component of Planting Soil mixes when Base Loam 1 component is found to be

contaminated with subsoil, or there is insufficient quantity of Base Loam 1 to complete the work of this Section.

- G. Sand: Clean, inert, rounded to sub-angular grains of quartz or other durable rock free from loam or clay, surface coatings and deleterious materials graded as specified herein.
- H. Compost (Organic Amendment Material): a stable, humus-like material produced from the aerobic decomposition and curing of leaf yard waste, composted for a minimum of one year (12 months), free of debris, stones larger than 1/2", larger branches and roots and wood chips over 1" in length or diameter. The compost shall be a dark brown to black color and be capable of supporting plant growth with appropriate management practices in conjunction with addition of fertilizer and other amendments as applicable, with no visible free water or dust, with no unpleasant odor.
- I. Planting Soil: Unless otherwise indicated throughout this Section, the term "Planting Soil" shall apply to either on-site blended planting soil or pre-blended planting soil from off-site source, as indicate
- J. Blended Planting Soil: To the extent available, existing on-site topsoil stripped and stockpiled for reuse, existing in-place topsoil; and/or loam borrow; that is modified on-site with planting soil components and soil amendments to meet the specific Planting Soil mix requirements specified herein.
 - 1. The lawn and planting soils shall consist of a blend of natural topsoil and/or loam borrow, uniform sand, and organic material. The quality of the blend depends on the quality of the original components. The Contractor shall be responsible for locating and obtaining approval of sources of natural topsoil, uniform sand, and organic material that meet the Specification requirements. The Contractor shall then be responsible for mixing the components. Approximate mixing ratios are provided, but may require adjustment, depending on the final materials and with the approval of the Landscape Architect and testing laboratory, in order to meet Specification requirements for each blend.
 - 2. Base Components
 - a. Base Loam shall be approved topsoil and/or loam borrow.
 - b. Sand shall be uniformly graded coarse san
 - c. Organic Material shall be fully decomposed organic material – Compost.
- K. Pre-Blended Planting Soil: Planting Soil produced off-site by homogeneously blending natural loam soil with planting soil components and soil amendments to meet the specific Planting Soil Mix requirements specified herein, and delivered to the Project site.
 - 1. Lawn and planting soils consist of a blend of natural loam soil, uniform sand, and organic material. The quality of the blend depends on the quality of the original components. The Contractor is responsible for locating and obtaining approval of the source capable of producing the pre-blended planting soil meeting the Specification requirements of this Section.

1.4 QUALITY ASSURANCE

- A. Soil-Testing Laboratory: UMass Soil and Plant Tissue Testing Lab West Experiment Station 682 North Pleasant Street University of Massachusetts Amherst, MA 01003 Phone: (413) 545-2311 Fax: (413) 545-1931 E-mail: soiltest@psis.umass.edu Website: <http://www.umass.edu/plsoils/soiltest/>.

- B. Soil Analysis: For each unamended soil type, furnish soil analysis and a written report by UMass Soil and Plant Tissue Testing Lab stating percentages of organic matter; gradation of sand, silt, and clay content; cation exchange capacity; sodium absorption ratio; deleterious material; pH; and mineral and plant-nutrient content of the soil.
1. Report shall also state recommendations for ratio of soil components and soil amendments to be incorporate State recommendations in weight per 1000 sq. ft. (99 sq. m) or volume per cu. y (0.76 cu. m) for nitrogen, phosphorus, and potash nutrients and soil amendments to be added to produce a gradation, organic content and pH for planting soil suitable for supporting healthy, viable plant growth.
 2. The soil-testing laboratory shall oversee soil sampling; with depth, location, and number of samples to be taken per instructions from the Owner. A minimum of three representative samples shall be taken from every 200 cubic yards of stockpiled topsoil to be used or amended for planting purposes.
- C. Work will be subject to inspection at all times by the Owner. The Owner reserves the right to engage an independent testing laboratory to analyze and test materials used in the construction of the work. Where directed by the Owner, the testing laboratory will make material analyses and will report to the Owner whether materials conform to the requirements of this specification.
1. Cost of tests and material analyses made by the testing laboratory will be borne by the Owner when they indicate compliance with the specification, and by the Contractor when they indicate non-compliance.
 2. Testing equipment will be provided by and tests performed by the testing laboratory.
- D. Samples of individual components of planting soil mixes shall be submitted by the Contractor for testing and analysis to UMass Soil and Plant Tissue Testing La Include verification testing of on-site stripped and stockpiled topsoil. Comply with specific materials requirements specified.
1. No base component material shall be used until certified test reports by UMass Soil and Plant Tissue Testing Lab have been received and approved by the Owner.
- E. Owner may request additional testing by Contractor for confirmation of mix quality and/or soil mix amendments at any time until final acceptance.

1.5 TESTING AND SUBMITTALS

- A. Certificates: Provide certificates required by authorities having jurisdiction, especially for any composted materials. Contractor shall submit certification that all planting soil components and all planting soil mixes meet all environmental standards of the MIT Standard Specifications Section 312322 - MIT IMPORTED FILL CRITERIA AND MANAGEMENT.
- B. Contractor Testing:
1. At least 7 days prior to intended use, the Contractor shall provide the samples and submittals for approval in conformance with the requirements of this Section. Do not order materials until Owner's approval of test results has been obtained. Delivered materials shall closely match the approved samples. Acceptance shall not constitute final acceptance. Owner reserves the right to reject on or after delivery any material that does not meet these Specifications.
 2. Contractor shall be responsible for recognizing that these critical project materials warrant timely and serious attention, that the testing process to achieve Approved materials should be considered a lead time item, and that under no circumstance shall failure to comply with all specification requirements be an excuse for "staying on project construction schedule."

3. Testing shall be at the Contractor's expense. Contractor shall deliver all samples to UMass Soil and Plant Tissue Testing Lab via overnight courier. Contractor shall submit test results.
- C. Testing reports shall include the following tests and recommendations. Report shall indicate whether or not the material meets the required specifications and any proposed recommendation for amending the soil mix component to meet specifications. Testing is required at the following intervals:
1. Testing of individual components for planting soil mixes. Tests are as described in Paragraph 7,
 2. In-place tests: Compaction tests of each type of material placed in accordance with Paragraph 7,
 3. Testing of Subgrade: Prior to placement of the planting soil profile, perc test the subgrade as described in this Section. Coordinate the testing of the subgrade with the Sitework Contractor before the planting soil is place
- D. Test Reports: Submit certified reports for tests as described in this Section.
1. Tests shall be conducted in accordance UMass Soil and Plant Tissue Testing Lab; Tests include the following:
 - a. Test for soil Organic Matter by loss of weight on ignition, as described in Northeastern Regional Publication No. 493, p. 59.
 - b. Test for soil CEC by exchangeable acidity method as described in Northeastern Regional Publication No. 493, p. 6
 - c. Test for soil Soluble Salts shall be by the 1:2 (v:v) soil:water Extract Method as described in Northeastern Regional Publication No. 493, p. 7
 - d. Test for Buffer pH by the SMP method as described in Northeastern Regional Publication No. 49
 - e. Tests for pH shall be conducted on a 1:1 soil to distilled water ratio.
 2. Certified reports on analyses from producers of composted organic materials are required, particularly when sources are change Analyses will include all tests for criteria specified herein.
 3. Density Tests: ASTM D1556 Density of soil and rock in place using Sand Cone Method". ASTM D698 Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort.
 - a. In-place density tests shall be carried out at a rate of one test per 2,000 square feet for each type of material place
- E. Samples: Prior to ordering soil mix components, submit 1 gallon samples to Testing Laboratory for approval.
1. Submittals of Planting Soil Base Components:
 - a. Base Loam
 - b. Compost
 - c. Sand
- F. Soil Test Reports: Submit reports for planting soil base components above for approval. Only after approval of components, submit reports for soil blend mixes for approval. All reports must be from recent analyses, less than 90 days old and represent materials that are available for delivery to the site.

- G. Submit reports for each of the above samples as described in Paragraph 7: Submit sample from each proposed source for testing and approval. Deliver samples to the testing laboratory and pay costs. Send report directly to the Owner.
- H. Sources for Sand and Compost: Submit information identifying sources for all soil components and the firm responsible for mixing and delivery of planting soil mix.
 - 1. Testing Laboratory and Owner shall have the right to reject any soil supplier.
 - 2. Submit supplier name, address, telephone and fax numbers and contact name.
 - 3. Submit certification that accepted supplier is able to provide sufficient quantities of materials for the entire project.

1.6 EXAMINATION OF CONDITIONS

- A. All areas of the existing site where topsoil is to be sampled for testing shall be inspected by the Contractor before starting work and any issues that might inhibit or prevent the sampling operation shall be reported to the Owner prior to beginning this work.
- B. The Contractor and any sub-Contractor responsible for the execution of the Work of this Section shall review and confirm in writing that the subgrade soil elevations have been brought to the proper subgrade elevations prior to proceeding with the spreading of planting soil.
- C. Carefully review the requirements of this Section to understand the requirements of percolation testing, compaction, slope and absence of debris of the subgrade prior to spreading planting soil.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Material shall not be handled, hauled, placed, spread or compacted when it is wet as after a heavy rainfall or is frozen. Soil shall be handled only when the moisture content is less than at field capacity. Testing Laboratory and the Owner shall be consulted to determine if the soil is too wet to handle.
- B. Store and handle packaged materials in strict compliance with manufacturer's instructions and recommendations. Protect all materials from weather, damage, injury and theft.
- C. Sequence deliveries to avoid delay. Deliver materials only after preparations for placement of planting soil have been complete
- D. Prohibit vehicular and pedestrian traffic on or around stockpiled planting soil.
- E. Protection of Planting Soil on-site: All planting soil delivered or stockpiled on the site shall be protected from erosion at all times. Materials shall be spread immediately. Otherwise, materials that sit on site for more than 24 hours shall be covered with tarpaulin or other soil erosion system acceptable to the Owner and surrounded by silt fence.

1.8 PROJECT/SITE CONDITIONS

- A. Soil Moisture Content
 - 1. Contractor shall not move, blend or grade soil when moisture content is so great that excessive compaction will occur, nor when it is so dry that dust will form in the air or that clods will not break readily, nor when it is frozen. Apply water, if necessary, or allow to dry to bring soil moisture between 60% of optimum moisture content as determined by ASTM D698 for compaction, grading and plantings.

2. Field Soil Moisture Test

- a. Form soil in palm of hand, if soil retains shape and crumbles upon touching, the soil may be worked.
- b. If the soil will not retain shape it is too dry and should not be worked.
- c. If the soil retains shape and will not crumble, it is too wet and should not be worked
- d. If the soil glistens or free water is observed when the sample is patted in the palm of hand the soil is too wet and should not be worked.

PART 2 - PRODUCTS

2.1 PLANTING SOIL COMPONENTS

A. Base Loam 1:

1. Shall be stockpiled topsoil stripped from the site as required for mixing with Sand and Compost to produce the Planting Soil Mixes specified herein. If Base Loam 1 does not meet the grain size distribution, organic content, pH or chemical analysis for loam borrow specified below, is found to be contaminated with subsoil during stripping or storage, or quantities are not sufficient to complete the work of this Section, the Contractor shall supply Base Loam 2 from off-site sources.

B. Base Loam 2:

1. Shall be loam borrow, a "sandy loam" determined by mechanical analysis (ASTM D 422) and based on the "USDA Classification System". It shall be of uniform composition, without admixture of subsoil. All loam borrow shall be mechanically screened and free of subsoil, stones 1 in. or larger diameter, earth clods, sticks, stumps, clay lumps, roots or other objectionable, extraneous matter or debris. Base Loam 2 shall also be free of extraneous materials harmful to plant growth; free of obnoxious weeds and invasive plants; not infested with nematodes; grubs; or other pests. Base Loam shall not be delivered or used for planting while in a frozen or muddy condition. Base Loam 2 for mixing shall conform to the following grain size distribution for material passing the #10 sieve:

US Sieve Size Number	<i>Percent Passing</i>	
	Maximum	Minimum
10	--	100
18	85	100
35	70	95
60	50	85
140	36	53
270	32	42
0.002 mm	3	6

2. The ratio of the particle size for 80% passing (D80) to the particle size for 30% passing (D30) shall be 8 or less ($D80/D30 < 8$).
3. Maximum size shall be one-inch largest dimension. The maximum retained on the #10 sieve shall be 20% by weight of the total sample. Tests shall be by combined hydrometer and wet sieving in compliance with ASTM D422 after destruction of organic matter by ignition.
4. The organic content shall be between 0 and 8.0 percent by weight.
5. pH shall be between 5.0 and 6.0.

6. Chemical analysis shall be undertaken for Phosphorus, Potassium, Calcium Magnesium, Aluminum, Iron, Manganese, Lead, Cation Exchange Capacity, Soluble Salts, acidity (pH) and buffer pH in accordance with MIT Standard Specification Section 312322, MIT IMPORTED FILL CRITERIA AND MANAGEMENT.

C. Sand

1. Sand for Planting Soil Mixes shall be uniformly graded medium to coarse sand consisting of clean, inert, rounded to sub-angular grains of quartz or other durable rock free from loam or clay, surface coatings and deleterious materials with the following gradation.

US Sieve Size Number	Percent Passing	
	Maximum	Minimum
10	100	--
18	60	80
35	25	45
60	8	20
140	0	8
270	0	3
0.002 mm	0	0.5

2. Maximum size shall be one-inch largest dimension. The maximum retained on the #10 sieve shall be 20% by weight of the total sample.
3. The ratio of the particle size for 70% passing (D_{70}) to the particle size for 20% passing (D_{20}) shall be 8 or less ($D_{70}/D_{20} < 8$). Tests shall be by combined hydrometer and wet sieving in compliance with ASTM D42
4. pH shall be less than 7.5.

D. Compost

1. Organic Matter for amending planting soil mixes shall be a stable, humus-like material produced from the aerobic decomposition and curing of Leaf Yard Waste Compost, composted for a minimum of one year (12 months). Compost shall be free of debris such as plastics, metal, concrete or other debris. Compost shall be free of stones larger than 1/2", larger branches and roots, and wood chips over 1" in length or diameter. The compost shall be a dark brown to black color and be capable of supporting plant growth with appropriate management practices in conjunction with amendments as applicable, with no visible free water or dust, with no unpleasant odor, and meeting criteria of UMass Soil and Plant Tissue Testing Lab.
 - a. Organic Content shall be at least 20 percent (dry weight). One hundred percent of the material shall pass a 3/8-inch (or smaller) screen.
 - b. The compost shall be screened to 1/2 inch maximum particle size and shall contain not more than 3 percent material finer than 0.002 mm as determined by hydrometer test on ashed material.
 - c. Nutrient content shall be determined by the UMass Soil and Plant Tissue Testing Lab and utilized to evaluate soil required amendments for the mixed soils.

2.2 PLANTING SOIL MIXES - GENERAL

- A. Uniformly mix ingredients by windrowing/tilling on an approved hard surface are Organic matter shall be maintained moist, not wet, during mixing. Amendments shall not be added unless directed by a Testing Laboratory to extent and quantity of amendments require Percentages of

components, unless otherwise noted, will be established upon completion of individual test results for components of the various mixes.

- B. After component percentages are determined by the Testing Laboratory, each planting soil mix shall be tested for physical and chemical analysis as specified in Paragraph 7 of this Section.

2.3 TREE, SHRUB, GROUND COVER AND PERENNIAL PLANTING BED SOIL

A. Tree, Shrub, Ground Cover and Perennial Planting Bed Soil

1. Tree, Shrub, Ground Cover and Perennial Planting Bed Soil shall consist of a blend of approximately equal parts by volume of Sand, Base Loam and Compost (1S:1L:1C). Blending of the components shall be carried out with earth moving equipment prior to placement. The components shall be blended to create a uniform mixture with an organic content between 5.0 and 10.0 percent by weight and pH range as recommended by UMass Soil and Plant Tissue Testing Lab for types of plant material propose
2. Final mix shall conform to the following gradation requirements for material passing a Number 10 sieve.

US Sieve Size Number	<i>Percent Passing</i>	
	Maximum	Minimum
10	100	--
18	85	95
35	60	85
60	42	65
140	21	44
270	18	24
0.002 mm	2	4

3. Maximum size shall be one half-inch largest dimension. The maximum retained on the #10 sieve shall be 10% by weight of the total sample.
4. The ratio of the particle size for 80% passing (D_{80}) to the particle size for 30% passing (D_{30}) shall be 6 or less ($D_{80}/D_{30} < 6$).

2.4 HIGH USE LAWN PLANTING SOIL

A. High Use Lawn Planting Medium:

1. Base Loam, Sand and Compost, each as specified above, shall be combined in an approximate mix ratio of two parts by volume Sand to one part by volume Base Loam to one and one half parts by volume Compost (2S:1L:5C) to create a uniform blend which meets the following requirements.
2. Gradation for Material Passing the Number 10 Sieve:

US Sieve Size Number	<i>Percent Passing</i>	
	Maximum	Minimum
10	100	100
18	70	90
35	45	72
60	26	40
140	14	20
270	10	13
0.002 mm	2	4

3. Maximum size shall be one-inch largest dimension. The maximum retained on the #10 sieve shall be 20% by weight of the total sample.
4. Ratio of the particle size for 70% passing (D70) to the particle size for 20% passing (D20) shall be 2 or less ($D70/D20 < 2$).
5. Organic content shall be between 0 and 6.0 percent by weight.
6. pH shall be between 6.2 and 6.8

2.5 SAND-BASED STRUCTURAL PLANTING SOIL

A. Sand-Based Structural Soil Planting Medium:

1. Base Loam, Sand and Compost, each as specified above, shall be combined in an approximate mix ratio of four parts by volume Sand to one part by volume Imported Base Loam to one and one half part by volume Compost (4S:1L:5C) to create a uniform blend which meets the following requirements.
2. Gradation for Material Passing the Number 10 Sieve:

US Sieve Size Number	Percent Passing	
	Maximum	Minimum
10	100	--
18	68	90
35	38	63
60	18	39
140	9	18
270	8	10
0.002 mm	1	2

3. Maximum size shall be one-inch largest dimension. The maximum retained on the #10 sieve shall be 15% by weight of the total sample.
4. Ratio of the particle size for 70% passing (D70) to the particle size for 20% passing (D20) shall be 2 or less. ($D70/D20 < 2$)
5. Saturated hydraulic conductivity of the mix: not less than 6 inches per hour, according to ASTM D5856-95 (2000) when compacted to a minimum of 92% Standard Proctor, ASTM 698.
6. Organic content: between 5 and 5 percent by weight.
7. The pH shall be between 6.0 and 6.5.
8. When conducting horticultural testing described above, conduct Standard Proctor Test ASTM 698 to obtain maximum dry density and optimum moisture content values.

2.6 SOD FARM GROWING MEDIUM

A. Sod Farm Growing Medium:

1. Soil in which sod was grown shall be USDA classified as sand and shall conform to the following grain size distribution for material passing the #10 sieve:

US Sieve Size Number	Percent Passing	
	Maximum	Minimum
10	100	--
18	85	100
35	60	85
60	25	40
140	6	26
270	4	18

0.002 mm	2	5
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2. The maximum particle size shall be 1/2 inch.
3. The maximum retained on the #10 sieve shall be 10% by weight of the total sample. Tests shall be by combined hydrometer and wet sieving in compliance with ASTM D42

2.7 BIOINFILTRATION PLANTING SOIL

A. Bioinfiltration Planting Soil

1. Base Loam, Sand and Compost, each as specified above, shall be combined in an approximate mix ratio of two parts by volume Sand to one part by volume Base Loam to one half part by volume Compost (2S:1L:0.5C) to create a uniform blend which meets the following requirements.
2. Gradation for Material Passing the Number 10 Sieve:

US Sieve Size Number	Percent Passing	
	Maximum	Minimum
10	100	
18	70	90
35	42	75
60	24	40
140	13	20
270	9	12
0.002 mm	2	4

3. Maximum size shall be one-inch largest dimension. The maximum retained on the #10 sieve shall be 15% by weight of the total sample.
4. Ratio of the particle size for 70% passing (D₇₀) to the particle size for 20% passing (D₂₀) shall be 5.0 or less (D₇₀/D₂₀ < 5.0)
5. Organic content shall be between 0 and 0 percent by weight.

B. Bioinfiltration Subsoil

1. Bioinfiltration Subsoil shall be placed in profiles where Bioinfiltration Planting Soil exceed twelve inches.
2. Bioinfiltration Subsoil shall meet the same gradation as Bioinfiltration Planting Soil. Compost shall be reduced in the blend to manufacture a soil containing an organic content from 0 to 0 percent by weight.

2.8 PRE-PLANT FERTILIZER

- A. Complete, fertilizer made from all-natural ingredients complying with State and Federal fertilizer laws. Fertilizer shall contain the following available plant food by weight, unless soils test indicate a need for different composition:

1. Deciduous Trees and Shrubs: Nitrogen: 2%. Phosphorous: 3%. Potash: 3%
2. Evergreen Trees and Shrubs: Nitrogen: 2%. Phosphorous: 3%. Potash: 3%

- B. Fertilizer: Pro Start 2-3-3 manufactured by North Country Organics, Bradford, Vermont 05033, ph# 80224277.

- C. Fertilizer to be delivered in original unopened standard size bags showing weight, analysis ingredients and manufacturer's name.

2.9 SOIL AMENDMENTS

- A. Follow soil test report recommendations for soil additives for planting soils.
- B. Superphosphate shall be composed of finely ground phosphate rock as commonly used for agricultural purposes, and containing not less than 20% available phosphoric acid. The superphosphate shall be delivered to the site in the original unopened containers, each bearing the manufacturer's guaranteed analysis. Any superphosphate which becomes caked or otherwise damaged making it unsuitable for use, will be rejected.
- C. Limestone shall be an approved agricultural limestone containing no less than 50% of total carbonates, and 25% total magnesium with a neutralizing value of at least 100%. The material shall be ground to such a fineness that 40% will pass through a No. 100 U.S. Standard Sieve, and 98% will pass through a No. 20 U.S. Standard Sieve. The lime shall be uniform in composition, dry and free flowing, and shall be delivered to the site in the original unopened containers, each bearing the manufacturer's guaranteed analysis. Any lime which becomes caked or otherwise damaged making it unsuitable for use, will be rejected.
- D. Commercial fertilizer shall be a product complying with the State and United States fertilizer laws. Deliver fertilizer to the site in the original unopened containers bearing the manufacturer's certificate of compliance covering analysis and which shall be furnished to the Owner. Fertilizer shall contain not less than the percentages of weight of ingredients as recommended by the soil analysis.
 - 1. Fertilizer for planting shall be formulated for top-dressing, soil surface application to plants. Fertilizer shall be designed and certified by the manufacturer to provide controlled release of fertilizer continuously for not less than 9 months. One hundred percent of the nitrogen content shall be derived from organic materials. Nitrogen source shall be coated to ensure slow release. Fertilizer percentages of weight of ingredients shall be as recommended by the soil testing and analysis specified, performed, and paid for under this Section.
- E. Aluminum Sulfate: Commercial grade, unadulterated.

2.10 WATER

- A. Water: furnished by Owner, unless otherwise specified, and suitable for irrigation and free from ingredients harmful to plant life. Hose and other watering equipment furnished by Contractor.

PART 3 - EXECUTION

3.1 PRE-INSTALLATION EXAMINATION AND PREPARATION

- A. Refer to Section 015640, MIT TEMPORARY TREE AND SOIL PROTECTION.
- B. Coordinate activities with other project contractors so that there is no soil disturbance from traffic or other construction activities subsequent to placement.
- C. Pre-Installation Examination Required: The Contractor shall examine previous work, related work, and conditions under which this work is to be performed and shall notify Owner in writing of all deficiencies and conditions detrimental to the proper completion of this work. Beginning

work means Contractor accepts substrates, previous work, and conditions. The Contractor shall not place any planting soil until all work in adjacent areas is complete and approved by the Owner.

- D. Examination of Subgrade: The subgrade shall be examined by the Contractor prior to the start of soil placement and planting. Any deficiencies shall be noted and related to the Landscape Architect in writing prior to acceptance of the subgrade by the Landscape Contractor. Deficiencies include, but shall not be limited to the following:
1. Prepared subgrade must infiltrate water at the rate of at least two inches per hour.
 2. Construction debris present within the planting areas.
 3. The subgrade is at incorrect depths for installing the designed soil profile and drainage layer.
 4. Incomplete irrigation and/or subsurface drainage installation.
 5. 5. Incomplete lighting and exterior electrical installation.
 6. 6. Conflict with underground utilities.
 7. 7. Subgrade contaminated with oils, compressible material, silt or clay
- E. Do not proceed with Subgrade Preparations or placement of Lawn Soil, until all utility work in the area has been installed.
1. The Contractor shall identify the locations of underground utilities prior to proceeding with soil work and shall protect all utilities from damage

3.2 EXCAVATION AND REMOVAL

- A. Portions of the project site may require removal and replacement of existing soils to accommodate the new soil profile. Other portions of the project site will require in situ de-compaction and amendment of soils.
- B. Some of the stripped topsoil shall be re-used on the project site, as determined by soil testing, and after approval by the Owner and Testing Laboratory.
- C. No off-campus removal or transport of soils without written permission from Owner (MIT EH&S).

3.3 MIXING OF PLANTING SOIL MIXES

- A. Soil blends shall be produced with equipment that blends together each component in a thorough and uniform manner. This may be accomplished by a minimum of three handling events on a hard surfaced area with earth moving equipment or by alternately passing soil components through a screener.
- B. Base components and Soil Mix stockpiles should be protected from wind and rain and shall not be permitted to be stored in standing water.

3.4 SUBGRADE PREPARATION, INSPECTION AND PERCOLATION TESTING

- A. After subgrade levels have been reached, the Architect or Soil Scientist shall observe de-compaction and preparation of the subgrade according to this Section and inspect soil conditions to evaluate subsurface drainage conditions.
- B. Coordinate the following scarification work to eliminate subgrade compaction and improve drainage conditions when located in lawn areas outside of Critical Root Zones.
1. Heavy Site Subgrade Compaction Mitigation:

- a. Heavily compacted subgrade areas such as, but not limited to, temporary parking areas, material stockpile areas, temporary roadways, construction areas and areas around structures and other similar areas.
 - b. Prior to establishing the final subgrade, these areas shall be dug up or ripped to a depth of (18) inches to break up the soil hard pan, then re-compacted with two passes of the tracks of a wide track bulldozer size D-6 or smaller, or other approved equipment. Vibratory compaction of subgrade in planted areas is prohibited.
2. General Site Subgrade Preparation for Lawn Soil and Planted Areas:
- a. Subgrade preparation shall be conducted after subgrade elevations have been established and approved and all utility and other construction activities have conclude
 - b. The entire subgrade shall be loosened to a minimum depth of 8-inches using the teeth of an excavator or other suitable equipment in a coarse manner. The object is to shatter the subsoil and relieve over-compaction.
 - c. The subgrade shall then re-compacted with two passes of the tracks of a wide track bulldozer size D-6 or smaller, or other approved equipment. Vibratory compaction of subgrade in planted areas is prohibited.
- C. After Subgrade has been prepared as described above, it shall be recompressed by using the tracks of a wide-tracked bulldozer, multiple passes of a skid steer loader, or the curled bucket of an excavator. Verify the subgrade passes water at or greater than the minimum requirement.
- D. Remove all stones or debris greater than 6" in any dimension from the subgrade prior to placing any Lawn or Planting Soils.
- E. After the subgrade has been prepared, Percolation Tests shall be performed according to the following test procedures.
- 1. Utilize perforated canisters or buckets seven to ten inches in diameter and a minimum of six inches high.
 - 2. A test hole shall be hand dug at the soil horizon to be tested approximately one-inch larger than the diameter of the test canister and approximately six inches deep. The sides of the test hole shall not be smoothed.
 - 3. Place one-half inch of clean coarse sand in the bottom of the hole and place the canister firmly into the hole. The space around the canister shall then be filled with coarse san Tamp the coarse sand to firmly fill any void space around the test canister.
 - 4. Fill the canister with water to the soil horizon level and allow to drain until approximately one inch of water remains, or a minimum of 1 hour.
 - 5. Refill the canister to the soil horizon level. After the water level drops approximately one inch, start the test. Record time versus water level as the water level drops. The percolation rate is the length of time for the water level to drop per inch. The field scientist shall record the rate of percolation for a minimum of two hours or until the water level has dropped a minimum of three inches after the start of measurements.
 - 6. Prepared subgrade shall infiltrate water at a minimum rate of two-inches per hour. If subgrade fails to pass water at the minimum rate, notify Architect and soil scientist. Addition subgrade preparation may be required

3.5 5PREPARATION OF TREE PITS

- A. After tree planting pits have been excavated to the dimensions shown on the plans, the entire bottom area of the pit shall be loosened to a minimum depth of two feet utilizing the bucket of a backhoe or equivalent equipment. The entire loosened area shall then be compressed firmly

with the bucket of the backhoe. The central portion of the pit, beneath the rootball, shall be compressed adequately to support the rootball and prevent settlement.

3.6 PLACEMENT OF PLANTING SOIL IN PLANTING BEDS

- A. Planting Bed Medium shall be spread in lifts not greater than twelve inches and compacted to a density between 82 and 86 percent Standard Proctor Maximum Dry Density. The surface area of each lift, including the subgrade after it has been compressed by a backhoe, shall be scarified by raking prior to placing the next lift.
- B. Place and spread planting medium to a depth greater than required such that after settlement, finished grade conforming to the lines, grades and elevations shown on the Drawings. Ensure proper drainage in an uninterrupted pattern free of hollows and pockets.
- C. Remove stiff clods, lumps, brush, roots, stumps, litter and other foreign material and stones over one inch in diameter and dispose of legally off site.

3.7 PLACEMENT OF PLANTING SOILS IN High Use LAWN AREAS

- A. Lawn Root Zone Medium shall be spread over the area and shall be compressed with a minimum of two perpendicular passes of the tracks of a bulldozer size Caterpillar D-4 or D-5 or equivalent to a density of 86 to 88% Standard Proctor maximum dry density. No vibratory compaction of the subgrade or the planting medium shall take place. No rubber-tired equipment or heavy equipment except for a small bulldozer shall pass over soils after they have been loosened or planting medium spread. If the Contractor plans to utilize such areas for any use of heavy equipment, this work should be carried out prior to beginning the process of loosening soils
- B. Place and spread planting mixture and soil to a depth greater than required such that after settlement, finished grade conforming to the lines, grades and elevations shown on the Drawings. Ensure proper drainage in an uninterrupted pattern free of hollows and pockets.
- C. Remove stiff clods, lumps, brush, roots, stumps, litter and other foreign material and stones over one inch in diameter and dispose of legally off site.

3.8 PLACEMENT OF BIOINFILTRATION PLANTING MEDIUM

- A. Bioinfiltration Planting Medium shall be spread in lifts not greater than twelve inches and compacted to a density between 84 and 86 percent Standard Proctor Maximum Dry Density. The surface area of each lift, including the subgrade after it has been compressed by a backhoe, shall be scarified by raking prior to placing the next lift.
- B. Place and spread planting medium to a depth greater than required such that after settlement, finished grade conforming to the lines, grades and elevations shown on the Drawings. Ensure proper drainage in an uninterrupted pattern free of hollows and pockets.
- C. Remove stiff clods, lumps, brush, roots, stumps, litter and other foreign material and stones over one inch in diameter and dispose of legally off site.

3.9 PLACEMENT OF STRUCTURAL SOIL

- A. Sand-Based Structural Planting Medium shall be spread in lifts not greater than eight inches and compacted with a minimum of three passes of vibratory compaction equipment to a density between 92 and 96 percent Standard Proctor Maximum Dry Density. Sand-Based Structural

Planting Medium shall be placed to a minimum depth of two feet within the areas shown on the Drawings, except as otherwise indicated

1. Density testing for Sand Based Structural Soil must be by ASTM D6938-10 Nuclear Methods, after ASTM D698 Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort. Density testing shall be conducted at a minimum of one test for each plant bed for each lift. Independent testing agency must be on-site to conduct soil moisture and density tests during installation of Sand Based Structural Soil.
- B. A minimum of eight inches of 3/4 inch crushed stone shall be placed over the Sand-Based Structural Planting Medium in sidewalk areas and a minimum of twelve inches shall be placed in vehicular areas to provide support for the overlying surface. Perforated pipes shall be placed within the crushed stone and connected to open air conditions to provide aeration within the stone per Drawings.

3.10 FINE GRADING

- A. Grade Stakes: Sufficient grade stakes shall be set for checking the finished grades. Stakes must be set in the bottom of swales and at the top of slopes. Deviation from indicated elevations that are greater than one-tenth of a foot shall not be permitted. Connect contours and spot elevations with an even slope. Finish grades shall be smooth and continuous with no abrupt changes at the top or bottom of slopes.
- B. Unless off-site pre-blended planting soil is used, soil additives shall be spread and thoroughly incorporated into the layer of planting soil by harrowing or other methods reviewed by the Owner.
1. Contractor shall add soil amendments as recommended by the soil analysis and retest planting soil after amendments are completed.
- C. Pre-blended planting soil shall be sampled and tested as specified.
- D. Soil Compaction:
1. During the compaction process, all depressions caused by settlement or rolling shall be filled with additional planting soil and the surface shall be regraded and rolled until presenting a smooth and even finish corresponding to the required grades.
 2. Percolation Tests: Compact each lift sufficiently to reduce settling but not enough to prevent the movement of water and feeder roots through the soil. The planting soil in each lift should feel firm to the foot in all areas and make only slight heel prints. At completion of the planting soil installation, the soil should offer a firm, even resistance when a soil sampling tube is inserted from lift to lift. After the placement of each lift, perform percolation tests to determine if the planting soil has been over compacted. Perform the following percolation test procedure:
 - a. Dig a hole in the installed planting soil that is a minimum of 4 inches in diameter. Holes in 6-inch lift in turf areas shall be 4 inches deep. Holes in 12-inch lifts in plant beds shall be 8 inches deep. Do not penetrate through the lift being tested
 - b. Fill the hole with water and let it drain completely. Immediately refill the hole with water and measure the rate of fall in the water level.
 - c. In the event that the water drains at a rate less than one inch per hour, till the planting soil to a depth required to break the over compaction.
 - d. Perform a minimum of one soil percolation test per 10,000 square feet area of turf area and 2,500 square feet of tree and shrub planting area

3. Contractor shall install planting soil in successive horizontal lifts no thicker than 6 inches in turf areas and 12 inches in plant bed areas to the desired compaction as described in this Section. Contractor shall install the planting soil at a higher level to anticipate any reduction of planting soil volume due to settling, erosion, decomposition, and other similar processes during the warranty period. Contractor shall ensure that the full 6 inches of planting soil are obtained by digging holes in the planting soil at the same frequency as for compaction testing.
 4. Movement of equipment: Select equipment and otherwise phase the installation of the planting soil to ensure that wheeled equipment does not travel over subgrade or already installed planting soil. Movement of tracked equipment over said soils will be reviewed and considered for approval by the Owner. If it is determined by the Owner that wheeled equipment must travel over already installed soil, provide a written description of sequencing of work that ensures that compacted soil is loosened and un-compacted as the work progresses or place a one-inch thick steel plate over the length and width of any travel way to cover planting soil to protect it from compaction.
- E. Disturbance outside of limit of work: Disturbed areas outside the limit of work and outside CRZ shall be graded smooth and spread with a minimum of six (6) inches of planting soil to the finished grade.
- F. Stockpiles: Upon written approval by the Owner, Contractor shall remove all excess, unused existing on-site topsoil from the site and dispose of it in a legal manner.

3.11 LAWN SOILS AT CRITICAL ROOT ZONES

- A. The Contractor shall engage a board certified master arborist with a minimum of 5 years of experience, including experience with supersonic air tools such as the "Airsfade" for the project. All excavation, and backfilling within Critical Root Zones shall be by approved equipment by the arborist or under the supervision of the arborist.
1. Air Spading is a state of the art excavating tool that uses high volumes of compressed air to remove and break up soil without damaging roots. Air spading allows the contractor to amend lawn and planting soils within Critical Root Zones with minimal disruption to the root structure.
 2. Delineate the areas of soil disturbance within the Critical Root Zones. The Contractor's arborist is to perform subsurface root exploration and evaluate root distribution in the area of the disturbance.
 3. As a guideline, the minimum tree protection zone is the distance from trunk of tree is established by taking the tree's diameter at breast height in inches, and converting it to feet. (For example, 12" caliper tree translates into a 12' offset from the edge of the trunk to the final cut line.) Site constraints may dictate that final cut line is closer to the trunk than guidelines will allow. Do not perform subsurface exploration near the trunk or within the drip line without the presence of the University arborist.
 4. Arborist to incorporate 3-inches of sand the existing soil at Critical Root Zones to a depth of six inches using air spade equipment. The Contractor and the arborist will minimize exposure of tree root systems during the exploration and construction activities.
 5. When root systems are potentially exposed for extended time periods of greater than one work day/8 hours, and during or between periods of excavation/construction activity, lay burlap over exposed roots, support edge of excavation and mulch to a depth approved by arborist. Saturate burlap and mulch with water and maintain the burlap in a damp condition during daylight hours as to not allow roots to dry out.
 6. If necessary to achieve finish grades, approved high use lawn soil shall be hand placed in Critical Root Zones. The placed soil should be compacted by manual or foot tamping as necessary. No track or wheeled equipment shall be permitted to traverse the tree protection areas.

3.12 PROTECTION

- A. The Contractor shall protect landscape work and materials from damage due to landscape operations, operations by other Contractors or trespassers. Maintain protection during installation until acceptance. Treat, repair or replace damaged Lawn Soil installation work immediately.
- B. Provide all means necessary, including fences, to protect all soil areas from compaction and contamination by trash, dust, debris, and any toxic material harmful to plants or humans after placement. Any area that becomes compacted, shall be de-compacted and tilled to the extent determined by the soil scientist and recompressed to the density ranges specified. Any uneven or settled areas shall be filled, re-graded and re-compacted to meet the requirements of this Specification. Soil that becomes contaminated shall be removed and replaced with specified soil material.
- C. Phase the installation of the High Use Lawn Soil such that equipment does not have to travel over already installed soil. Use of haul roads is acceptable provided that the haul road is completely re-worked to meet the requirements of this Specification.
- D. Apply filter fabric covering and planking or other engineering controls over soil to minimize compaction and collect dust and debris in any area where the Contractor must work after the installation of High Use Lawn Soil.
- E. Till compacted High Use Lawn Soil and replace High Use Lawn Soil that has become over compacted or contaminated as determined by the Soil Scientist or Architect. Non-Compliant High Use Lawn Soil shall be tilled or replaced by the Contractor at no expense to the Owner.

3.13 CLEAN-UP

- A. During installation, keep pavements clean and work area in an orderly condition.
- B. Keep the site free of trash and debris at all times. Immediately dispose of wrappings or waste materials associated with products necessary for the completion of the work.
- C. All trash and debris shall be kept in a central collection container. Do not bury trash and debris in back-fill.
- D. Once installation is complete, remove any excess soil from pavements or embedded in fixtures.

3.14 COORDINATION AND EXCESS MATERIALS

- A. Coordinate activities with other project contractors so that there is no soil disturbance from traffic or other construction activities subsequent to placement.
- B. Excess Planting Soil Mixtures and Materials: Remove the excess planting soil mixture and materials from the site at no additional cost to the Owner unless otherwise requested

3.15 ACCEPTANCE

- A. Confirm that the final grade of planting soil is at the proper finish grade elevations.

END OF SECTION