

## SECTION 312300 – EARTHWORK

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to this section.

#### 1.2 SUMMARY

- A. Provide all labor, materials and equipment as necessary to complete all work as indicated on the Drawings and specified herein.

*Note: Designer shall reserve materials to be provided by owner with the Landscape Services Construction Coordinator at (517) 355-7750 prior to completion of bid documents. Modify documents to reflect each material's availability accordingly.*

- 1. Verify quantities needed*
- 2. Schedule approximate pick-up dates*
- 3. Obtain quote from Landscape Services and include cost in project budget*

- B. Related sections include the following:

1. Division 01 Section 15000-TEMPORARY FACILITIES AND CONTROLS
2. Division 02 Section 024116-SITE DEMOLITION
3. Division 31 Section 311400-SITE CLEARING
4. Division 32 Section 321216-BITUMINOUS PAVEMENT
5. Division 32 Section 321313-CONCRETE PAVEMENT

*Note Delete Topsoil section if Topsoil is from Owner's stockpile.*

6. Division 32 Section 320514-TOPSOIL

- C. Approved Topsoil Installation Contractors shall bid directly to and be contracted directly by the General Contractor or Construction Manager.

- D. Approved Topsoil Installation Contractors:

1. Anderson Fischer Associates Inc., 225 E. Kipp Rd, Mason MI 48854-1946  
(517) 676-5522
2. Carols Excavating Inc., 5103 Lansing Rd, Charlotte MI 48813  
(517) 645-0670
3. Central Excavating LLC , 11303 W Price Rd, Westphalia MI 48894-8208  
(517) 749-2566
4. E.T. MacKenzie, 4248 W. Saginaw Highway, Grand Ledge MI 48837  
(517) 627-8408

5. Eagle Excavation Inc., 4295 Holiday Drive, Flint MI 48507  
(810) 767-7878

6. Owner Pre-Approved Topsoil Installation Contractor

E. Testing and inspection agency will be under contract with the contractor and will perform QA activities of the material below all pavements and structures.

### 1.3 DEFINITIONS

A. Excavation: Removal of material encountered to indicated subgrade elevations and subsequent disposal of materials removed. Excavation material is unclassified.

B. Unauthorized Excavation: Removal of materials beyond indicated subgrade elevations or dimensions without specific direction by the Project Representative. Unauthorized excavation shall be at the Contractor's expense. Undermining of existing footings or disturbing the bearing soil shall not be permitted unless it is specifically indicated or specified in the Contract Documents.

C. Additional Excavation: When excavation has reached required subgrade elevations the Contractor shall notify the Project Representative who will inspect conditions. If the Contractor encounters unsuitable bearing materials at the required subgrade elevations Contractor shall carry excavations deeper and replace excavated material as directed by the Project Representative. Removal of unsuitable material and its replacement, as directed, is part of this Contract.

D. Backfilling: Placement of fill soil, either provided on site or Contractor-furnished, which shall be uniformly compacted to the required density.

E. Bedding: The material placed around a utility between 4 inches below to 12 inches above the utility the full width of the trench.

F. Building Compacted Areas: Areas under slabs on ground within the building line. Exterior concrete slabs attached to the building, such as entrances, shall be considered within the building line.

G. Contract Limits: Those areas of the project site on which, or upon which, work will be done in accordance with the Contract.

H. Fill: Imported material which is placed in structure undercut.

I. Imported Material: Soil material which is purchased by Contractor and hauled onto the site.

J. MDOT: Michigan Department of Transportation's Standard Specifications for Construction, 2012.

K. Proof-Rolling: The use of a loaded 10 CY capacity or larger truck driven over the subgrade and subbase to check for unstable areas that should be undercut. The method, pattern and frequency will be determined by the Pavement Consultant.

L. Quality Assurance (QA): All activities that have to do with the Owner ensuring the quality of the product as specified, including materials sampling and testing, construction inspection, and

review of Contractor quality control documentation. This work will be performed by the Pavement Consultant.

- M. Quality Control (QC): All activities that have to do with the Contractor producing the quality of the product as specified, including training, materials sampling and testing, project oversight and documentation.
- N. Rock Excavation:
  - 1. Excavation of igneous, metamorphic or sedimentary rock or hardpan which cannot be excavated without continuous drilling or continuous use of a ripper or other special equipment.
  - 2. Excavation of boulders of 1/2-cubic yard or more in volume.
- O. SESC: Soil Erosion and Sedimentation Control as required in Division 01 “General Requirements – Temporary Facilities and Controls” and elsewhere in these Specifications.
- P. Site Compacted Areas: Areas outside of the building line within the Contract limits.
- Q. Structure: A building, retaining wall, tank, footing, slab or other similar construction.
- R. Structure Backfill: Soil or other material which is placed against walls or sides of structures.
- S. Subbase: Compacted fine and course aggregate layers used in the pavement between the subgrade and the pavement.
- T. Subgrade: Compacted soil, either existing or provided as part of the Work, upon which new construction is to be installed.
- U. Undercut: Excavation of native material from below the bottom of footings, floors, structures and subbases.

#### 1.4 SOIL EROSION AND SEDIMENTATION CONTROL

- A. Prior to and during earthwork operations refer to Division 01 Section “General Requirements - Temporary Facilities and Controls” to ensure that provisions of that section are fulfilled.

#### 1.5 BACKFILL COMPACTION TESTING

- A. Contractor shall retain a licensed soils testing engineer, approved by the Owner, paid for as an allowance item, and shall submit to the Project Representative 3 copies of a report containing testing procedure, test results, and a statement that soil has been compacted in accordance with the specifications. The Project Representative shall give final approval of the backfill before construction continues. The following submittals shall be submitted directly to the Project Representative from the soils testing engineer, with one copy to the Contractor:
  - 1. Test reports of borrow material.
  - 2. Verification of each footing subbase.
  - 3. Field density test reports.
  - 4. One optimum moisture-maximum density curve for each type of soil.

- B. Where more than one lift of soil is being placed, the soils testing engineer shall be present during the entire filling operation to confirm that each lift is properly compacted with approved soil.
- C. Perform a maximum density test conforming to ASTM D1557 (Modified Proctor) for each type of soil encountered.
- D. Field density tests shall conform to ASTM D2922 - Nuclear Method.
- E. The frequency of testing shall be as follows:
  - 1. Footing Subgrade: As required by Project Representative.
  - 2. Paved Areas and Building Slab Subbase: One test per 2000 square feet for Subbase and one test per 1500 square feet per lift.
  - 3. Footing and Trench Backfill: One test per 50 lineal feet per lift.
  - 4. Trench Backfill: One test per 50 lineal feet per lift.
  - 5. Post Backfill: One test per 12-inch lift (provided equipment is available).
  - 6. Tree Stump Backfill: One test per 12-inch backfill lift (same as above).
- F. Quality Assurance for Bituminous Pavement: the Pavement Consultant will perform QA of existing and installed material below the bituminous pavement. In order to perform that function, Contractor shall contact the Pavement Consultant 2 days prior to separately proof rolling the subgrade and subbase material, as well as keep the Pavement Consultant informed of the schedule of the installation of aggregates prior to paving. the Pavement Consultant will inform the Owner of deficient areas that have not been identified by Contractor as part of the Contractor's quality control procedure. This inspection by the Pavement Consultant does not relieve Contractor of Contractor's responsibility to provide adequate quality control.

## 1.6 DESIGN AND PERFORMANCE REQUIREMENTS

- A. Trench Bottom Suitability:
  - 1. Contractor shall be responsible for the suitability of the normal trench bottom in supporting utility, bedding and backfill.
  - 2. Contractor shall notify the Project Representative and await the Project Representative's decision if a possible unsuitable condition exists.
  - 3. NOTE: Poor dewatering techniques or lack of excess water control shall not be a reason for additional payment for remedial measures.
- B. Trench Wall Stability:
  - 1. Contractor shall be responsible for trench configuration, including sheeting, shoring and bracing necessary to support trench side walls from collapsing.

2. Contractor shall be responsible for structural design and stability of a pipe-laying box if utilized on the Project to prevent trench walls from collapsing.

- C. Excavation Side Stability: Be responsible for structural design of sheet piling, underpinning, shoring and bracing to prevent sides of excavation from collapsing and causing damage to adjacent structures pavements and materials.

#### 1.7 MATERIAL STORAGE

- A. Stockpile satisfactory excavated materials in accordance with MDOT Standards where directed, until required for backfill or fill. Place grade, and shape stockpiles for proper drainage. Locate and retain soil materials away from edge of excavations. Do not store within drip line of trees indicated to remain. Place silt fence around stockpile, if left overnight.

#### 1.8 WARRANTY

- A. Failures of surface areas caused by settlement shall be repaired at Contractor's expense for a period of 3 years after completion of Contract.

### PART 2 - PRODUCTS

#### 2.1 MATERIALS

- A. Satisfactory Soil Materials: For backfill and fill, soils complying with ASTM D2487 soil classification groups GW, GP, GM, SM, SW, and SP. (Contractor shall note exceptions under Article 3.11 – Backfill and Fill.)
- B. Unsatisfactory Soil Materials: For backfill and fill, soils complying with ASTM D2487 soil classification groups GC, SC, ML, MH, CL, CH, OL, OH, and PT.
- C. Granular Materials: In accordance with MDOT Sections 301, 302 and 902 for 22A aggregate, Class I, II and Class II Subbase materials, except no foundry sand is permitted. Granular material shall contain sufficient binder to provide fill capable of supporting construction equipment without displacement.
  1. Sections 2.11 and 8.02 for Class II Subbase and shall meet or exceed a minimum permeability requirement (K) of 8 feet per day as determined by the Michigan Test Method (MTM) 122.
  2. Quality control shall include a lab test prior to delivery and field testing each 1000 cubic yard delivered or fraction thereafter. Each test shall include taking 3 samples, testing them individually and averaging the results.
  3. The Michigan Test Method (MTM) shall be used to determine acceptable material. Once tested and accepted, Contractor shall acquire the material from the identical location.

4. Contractor shall notify the Project Representative in advance of changing the source location.
5. Field permeability test samples shall only be taken after the material has been spread uniformly on the subgrade and before compaction takes place. Material shall be less than 90% saturated upon completion of the test.
6. Material that fails the test shall be replaced at no cost to the Owner, and the cost for failed tests shall be paid by Contractor.

D. Sand:

1. Fill Sand: MDOT Class II granular material that is free of clay.
2. Washed Sand: MDOT 2NS.

E. Lean Concrete: Mixture of Portland cement, aggregate and water having compressive strength of 2,000 psi at 28 days.

F. Granular Surface Materials: In accordance with MDOT specifications.

1. Gravel Drives: 22A aggregate modified to minimum 6% wash.
2. Limestone Drives: 21AA limestone aggregate.
3. Construction Tracking Mat: 6A crushed limestone.
4. Pavement Subbase: If not specified on Drawings, place thicknesses and materials as follows:
  - a. For concrete pavement, use 2-inch Class II sand compacted in place (CIP).

*Note: Select one of the following **two** options. Contact Landscape Services Construction Coordinator at (517) 884-2328 to determine whether the estimated quantity of recycled concrete aggregate will be available at the time of construction.*

- b. For bituminous pavement in parking lots, use 6-inch Owner provided 21AA recycled concrete aggregate (CIP) over 6-inch Class II Subbase (CIP). *(Option 1)*
  - 1) Provided to Contractor from Owner stockpile. Loaded by Owner. Contractor is responsible for hauling, spreading and compacting.
- b. For bituminous pavement in parking lots, use 6-inch -22A aggregate (CIP) over 6-inch Class II Subbase (CIP). *(Option 2)*
  - 1) Owner stockpile is located at 4080 Beaumont Rd., East Lansing, MI 48824, phone: 517-884-4881
    - a) Hours of operation are 6:00am-4:00pm Monday – Friday excluding university holidays.
    - b) Extended hours available with minimum 24 hour notice.

- c. For bituminous pavement in roadways and loading docks with parking spaces, use 8-inch -21AA aggregate (CIP) over 12-inch Class II Subbase (CIP).

G. Topsoil

*Note: Select one of the following **three** options.*

1. Topsoil (Owner-Provided & Placed). *(Option 1)*
1. Topsoil (Owner-Provided & Contractor Placed): *(Option 2)*
  - a. Provided to Contractor from Owner stockpile or site stockpiled topsoil, or both, and approved by the Owner. Contractor is responsible for hauling and spreading the topsoil.
  - b. 6-inches total depth of screened topsoil with compaction of 80-85% maximum density to eliminate settling.
  - c. Owner shall direct Contractor as to which topsoil stockpile shall be used.
2. Topsoil (Contractor-Provided & Placed): *(Option 3)*
  - a. Provided by Contractor in accordance with Division 32 Section "Topsoil."
  - b. 6-inches total depth of screened topsoil with compaction of 80-85% maximum density to eliminate settling.

2.2 UTILITY SLEEVING

- A. Schedule 80 PVC under roads.
- B. Schedule 40 PVC under walks.
- C. End caps as required.

2.3 SMART BALL

- A. Product 1428-XR/1D purple; manufactured by 3M Dynatel. Michigan Representative: Gregware Equipment, Grand Rapids, Michigan; 1-800-248-5678.
  1. Provided by Owner
- B. Quantity:
  1. One smart ball on pipe lengths 0 to 12 feet; with end cap at other end.
  2. For pipe lengths over 12 feet, place one smart ball at each end of the sleeve.

PART 3 - EXECUTION

3.1 SOIL EROSION AND SEDIMENTATION CONTROL

- A. Prior to and during earthwork operations, refer to Division 01 Section "General Requirements - Temporary Facilities and Controls" to ensure that provisions of that section are fulfilled.

### 3.2 PREPARATION

- A. Plan the Work to minimize the time excavation remains open. If excavation remains open beyond the time approved in the Project schedule, additional requirements may be imposed at no additional cost to the Owner.
- B. Adequately barricade the excavation at all times to protect workers and the public from the danger of the open excavation.

### 3.3 EXCAVATION FOR STRUCTURES

- A. Excavations shall extend a sufficient distance from footings and foundations to permit placement and removal of concrete formwork, installation of services, other construction, and inspection. Care shall be taken not to disturb bottom of excavation. Trim bottoms to required lines and grades to leave solid base to receive concrete.
- B. Bracing and Sheeting:
  - 1. Do not install by jetting.
  - 2. Furnish, put in place and maintain sheeting, bracing and shoring, as may be required to properly support the sides of excavations and to prevent movement of earth which could in any way injure the Work or adjacent property.
  - 3. Exercise care in removal of sheeting, shoring, bracing and timbering to prevent collapse or caving of excavation faces being supported and damage to the Work and adjacent property.
  - 4. Do not leave sheeting or bracing in the excavation after completion of the Work, unless approved by the Project Representative.
- C. Undercut:
  - 1. If suitable bearing for foundations is not encountered at elevations indicated on the Drawings, immediately notify the Project Representative.
  - 2. If soft material, which in the opinion of the independent testing laboratory is not suitable, is encountered below a structure, the Project Representative may order removal of this soft material and its replacement with specified material in order to make a suitable foundation for construction of the structure.
  - 3. Undercutting made at the order of the Project Representative will be paid for on the basis of the actual quantity of material excavated. Do not proceed further until instructions are received and necessary measurements made for purposes of establishing additional volume of excavation.
  - 4. No extra payment will be made if removal is required as a result of poor dewatering techniques.
  - 5. Undercutting, which is specifically indicated on the Drawings or herein specified, shall be included in the base bid.



6. Soil removed may be used as fill in areas not below driving surfaces, structures or utility structures.
7. Compact subgrade at bottom of undercut prior to placing fill.
8. Place and compact specified fill in undercut.
9. Lateral extent of undercut shall be a horizontal distance equal to the depth of undercut below structure.

D. Excavating:

1. Excavation shall be by open cut from the surface except as herein specified or as indicated on the Drawings.
2. Excavations for structures shall be made in such manner and to such depth and width as will give ample room for building the structures and for bracing, sheeting and supporting the side of the excavation, for pumping and draining groundwater and wastewater which may be encountered, and for removal of material excavated.
3. Excavate to required cross section and elevation indicated on the Drawings. Subgrade shall not vary more than 0.1 feet above or below the established elevations.
4. Depression caused by excess excavation, traffic or rolling shall be filled with MDOT 902 Granular Material Class II or approved fill and rerolled and compacted in place as specified herein.
5. If required because of excess water conditions, place stone stabilization course prior to proceeding with construction. Place filter fabric over stone stabilization course.

3.4 EXCAVATION FOR PAVEMENT

- A. Cut surface under pavements to comply with cross-sections, elevations and grades as indicated on Drawings.

3.5 EXCAVATION FOR UTILITIES

A. Width of Trenches:

1. Steam Tunnels: Widths at bottom of trench shall be 3 feet wider than the overall width of tunnel or vault, and shall at all times be of sufficient width to permit tunnel and vaults to be built properly, waterproofed and backfilled.
2. Pipelines: Widths of trenches for pipe lines shall allow for proper compaction of the haunching. The trench width at the spring line of the pipe for pipes less than 48 inches shall be pipe width plus 18 inches. The trench width for pipes larger than 48 inches shall be the pipe diameter plus 30 inches.
3. Electric and Telephone Ducts: Trench shall be the proper width and depth for the duct bank, allowing a minimum of 3 inches of concrete on each side of the duct formation.

4. Street Light Cable: Minimum trench width shall be 6 inches, maximum width shall be 12 inches, and minimum depth shall be 30 inches.

- B. Length of Trenches: Excavation shall be finished to the required grade for an adequate distance in advance of the completed installation. Unless otherwise permitted by the Project Representative, the amount of trench that shall be open in advance of the construction shall not exceed the following limits:

1. Steam Tunnels: Length between 2 vaults, minimum.
2. Buried Steam Systems: Length between 2 vaults, minimum.
3. Sewers: 50 lf.
4. Water Mains: 50 lf.
5. Electric and Telephone Ducts: The amount that can be encased in concrete in a day.
6. Street Light Cable: The amount of cable that can be laid in a day.

### 3.6 REMOVAL OF EXCESS SUBSOIL

- A. Excess subsoil shall be removed from the Owner's property and legally disposed.

### 3.7 UTILITIES TO BE ABANDONED

- A. When pipes, conduits, sewers or utility structures are removed from the trench, leaving dead ends in the ground, fully plug such ends with brick and mortar.
- B. Entirely remove abandoned utility structures unless otherwise specified or indicated on Drawings.
- C. Remove materials which can be readily salvaged from the excavation and store on site as indicated on the Drawings.
- D. Salvageable materials will remain the property of the Owner unless otherwise indicated on the Drawings.

### 3.8 UTILITY SLEEVING

- A. Place sleeve as located on the Drawings. Maintain structural integrity of pipe.
- B. Place Smart ball at end of pipe and fabric. Attach with duct tape to end of pipe. See PART 2 - PRODUCTS for quantities.
- C. Place PVC cap on end of pipe when only one Smart ball is required.

### 3.9 BEDDING

- A. Place bedding material up to 1/8 the height of the utility. Compact as herein specified.
- B. Accurately shape bedding material to fit pipe shape. Recess bedding to relieve pressure on the bell or other projecting utility joint.
- C. After laying out the utility, tamp additional bedding in place up to the midpoint of the utility. Use hand-operated compactors to achieve required compaction.

- D. Place additional bedding up to 12 inches above top of utility. Use hand-operated compactors to achieve required compaction.
- E. Place bedding in maximum lifts of 12 inches.
- F. No payment shall be made for aggregate or stone bedding when used for Contractor convenience.
- G. Provide concrete encasement at utilities as indicated on the Drawings.

### 3.10 SHEETING, SHORING AND BRACING EXCAVATIONS

#### A. General:

- 1. Furnish, put in place and maintain sheeting, bracing and shoring as may be required to properly support side of excavations and to prevent movement of earth, which could in any way injure the Work or adjacent property.
- 2. Exercise care in the removal of sheeting, shoring, bracing and timbering to prevent collapse or caving of excavation faces being supported and damage to the Work or adjacent property.
- 3. A pipe-laying box may be used in lieu of sheeting.

#### B. Sheeting:

- 1. Do not install by jetting.
- 2. Remove as backfilling proceeds, unless ordered left in place by the Project Representative. Use care to fill and compact voids created by removal, especially below mid-height of utility.
- 3. Sheeting Left In Place:
  - a. Required written approval of the Project Representative.
  - b. Cut off minimum of 4 feet below finished grade.

### 3.11 BACKFILL AND FILL

#### A. General:

- 1. Commencement of Backfill Operations: Backfill excavations as promptly as work permits, but not until completion of the following:
  - a. Acceptance by Project Representative of construction below finish grade including where applicable, dampproofing, waterproofing and perimeter insulation.
  - b. Removal of trash and debris.
  - c. Permanent or temporary horizontal bracing is in place on horizontally supported wall.

- d. Removal of concrete formwork.
  - e. Removal of shoring and bracing, and backfilling of voids with satisfactory materials. Cut off temporary sheet piling driven below bottom of structures and remove in manner to prevent settlement of the structure or utilities. Contractor shall leave shoring to be embedded in the backfill of the trench or other excavation, for the purpose of preventing injury to the completed structure or other adjacent structures or property. Ends of sheeting, bracing or timber left embedded in the backfill shall be cut off and removed at least 2 feet below the established grade.
2. Acceptable Backfill: Place specified soil material in layers to required subgrade elevations, up to, but not including subbase material, for each area classification listed below:
- a. In excavations, use approved excavated or borrow material, except as otherwise specified.
  - b. Under grassed areas use satisfactory excavated materials, unsatisfactory excavated soil classification groups GC, SC, ML, and CL, or approved borrow material.
  - c. Under pavement use satisfactory excavated Class II and Class II subbase granular material. Soil classification groups GC, SC, ML and CL may be used with the approval of the Project Representative.
  - d. Under building slabs, use Class II granular material.
  - e. In utility trenches, use Class II granular material.
3. Required Concrete Within Backfill:
- a. Backfill trenches with concrete where trench excavations pass within 18 inches of column or wall footings and are carried below bottom of such footings, or which pass under wall footings. Place concrete to level of bottom of adjacent footing.
  - b. For piping or conduit less than 2'-6" inches below surface of roadways, provide 4-inch thick concrete base slab support. After installation and testing of piping or conduit, provide minimum 4-inch thick encasement (sides and top of concrete) prior to backfilling or placement of roadway subbase.
- B. Ground Surface Preparation:
1. Remove vegetation, debris, unsatisfactory soil materials, obstructions, and deleterious materials from ground surface prior to placement of fills. Plow strip, or break-up sloped surfaces steeper than 1-foot vertical to 4 feet horizontal so that fill material will bond with existing surface.
  2. Subsoil Preparation Prior to Topsoiling: This procedure is required to prevent permanent establishment of a dense layer of soil caused by construction operations, that would make it difficult for vigorous plant growth and proper drainage. In areas of the Project site that are compacted during construction, as determined by Project Representative, and after

completion of exterior building construction operations, where vehicles/equipment would be required to travel across the soil around the structure or the constructed site improvements, or both, the existing subsoil, as well as the top 12 inches of newly placed subsoil, shall be loosened using the following procedures:

- a. Prior to beginning this work, notify Project Representative at least 1 business day in advance. Also, re-stake existing and new utilities that may be disturbed by these earthwork operations.
- b. The moisture content of existing and new soil shall be optimum for this earthwork operation. Each step shall be approved by the Project Representative, prior to continuing to the next step, and prior to satisfactory completion of the final step.
- c. For areas where the existing subsoil grade is to remain and for areas which will receive additional soil:
  - 1) STEP 1 – Loosening Existing Subsoil and Debris Removal: Existing subsoil shall be brought to a friable condition 12-inches deep, prior to placing additional subsoil fill. Possible equipment to use to loosen the soil include, but are not limited to, chisel plow, backhoe bucket, disc or harrow; followed by discing, if a disc is not initially used, to reduce the soil clump to the desired size. Contractor will submit a proposed method of loosening the subsoil to the Project Representative for approval at least 14 days prior to commencement of the work. The submittal shall include the method of equipment to be used. The soil shall be broken up sufficiently so that the resulting soil fragments are small. Also it is equally important to legally dispose of construction debris and rocks larger than 27 cubic inches exposed during this process.
  - 2) STEP 2 – Placing of Additional Subsoil Fill- Transitional Layer Blending: Where additional fill is required, place the initial “transitional” layer and blend with the existing subsoil utilizing methods mentioned in Step 1.
  - 3) STEP 3 –Subsoil Fill - Top Layer Loosening: Loosen top layer to a friable condition, blending in the first 1”-2” of topsoil. If no additional subsoil is required, delete Step 2.
  - 4) STEP 4 – Final Grading and Protection: Grade the disturbed area to the elevations as specified, in preparation for topsoil placement. Do not otherwise recompact the subsoil. Once the subgrade is approved, construction equipment and vehicles unrelated to topsoiling and planting operations shall be prohibited. (Contractor may be required to provide temporary construction fencing to prevent recompaction of the subsoils. Costs for temporary fencing is a Contractor expense.)
- d. For areas where existing subgrade is to be lowered:
  - 1) STEP 1 – Existing Subsoil Excavation and Debris Removal: Excavate the subsoil, removing all excess material from the site to the proposed subgrade.

Remove and legally dispose of construction debris exposed during this process.

- 2) STEP 2 – Subsoil Loosening: Existing subsoil shall be brought to a friable condition 12-inches deep. Possible equipment to use to loosen the soil include, but are not limited to, chisel plow, backhoe bucket, disc or harrow; followed by discing, if a disc is not initially used, to reduce the soil clump to the desired size. The resulting soil shall be broken up sufficiently so that the resulting soil fragments are small.
- 3) STEP 3 – Final Grading and Protection: Grade the disturbed area, as specified, in preparation for topsoil placement. Do not otherwise recompact the subsoil. Once the subgrade is approved, construction equipment and vehicles, unrelated to topsoiling and planting operations, shall be prohibited. (Contractor may be required to provide temporary construction fencing to prevent recompaction of the subsoils. Costs for temporary fencing is a Contractor expense.)

3. Subsoil Preparation for Paved Areas:

- a. If, after rough grade has been achieved in cut areas and prior to placement of fill material in fill areas, the exposed subgrade has a density less than that specified under Article 3.12 – Compaction for particular area classification, break-up ground surface, pulverize, moisture condition to optimum moisture content, and compact to required depth and percentage of maximum density. Entire area shall be proof rolled with a heavy rubber-tired vehicle, such as a loaded scraper or loaded dump truck, to locate areas of extreme pumping and yielding, which shall be repaired as follows:
  - 1) Soft areas due to moisture laden soil shall be corrected by applying an appropriate soil stabilization procedure to be specified, or as directed by Project Representative.
  - 2) If required density cannot be obtained, the objectionable material shall be removed and replaced as ordered by the Project Representative.
  - 3) The cost of corrective measures incurred as a result of stabilizing poor subgrade conditions shall be paid on basis of contract conditions relative to changes in work.

C. Placement and Compaction:

1. No backfill shall be placed without it being compacted in place. Backfill material shall be compacted in layers not exceeding 6 inches in compacted thickness.
  - a. Granular, non-cohesive soils shall be compacted with mechanical tamping or vibration-type compactors. Sand may be compacted by flooding the trench when water is available.

- b. When clays are encountered, a mechanical tamper or sheeps-foot roller shall be used to compact the soil. Manual mechanical tamping equipment shall have a rammer which weighs not less than 20 pounds and has surface area of not more than 36 square inches. Hand compaction is not acceptable.
2. Before compaction, moisten or aerate each layer as necessary to provide the optimum moisture content. Compact each layer to required percentage of maximum dry density or relative dry density for each area classification. Do not place backfill or fill material on surfaces that are muddy, frozen or contain frost or ice.
3. Place backfill and fill materials evenly adjacent to structures, to required elevations. Take care to prevent wedging action of backfill against structures by carrying the material uniformly around structure to approximately same elevation in each lift.
4. Existing Utilities: Where existing utilities are required to be tunneled under, the area under the utility shall be filled with compacted sand, and have the pipe embedment reconstructed as for new piping.
5. Pipe Embedment: New piping shall be laid on a sand leveling bed compacted to maximum thickness of 6 inches. Dig holes in bedding for bells and fittings so pipe bears uniformly along its length. Hand compact the haunching under the spring line of the pipe. Take extra care to control the density of the haunching on plastic pipe in accordance with the manufacturer's instructions.

### 3.12 COMPACTION

- A. General: Control soil compaction during construction providing minimum percentage of density specified for each area classification. Perform all required tests.
- B. Moisture Control:
  1. Where soil material must be moisture conditioned before compaction, uniformly apply water to surface of subbase, or layer of soil material, to prevent free water appearing on surface during or subsequent to compaction operations.
  2. Remove and replace, or scarify and air dry, soil material that is too wet to permit compaction to specified density.
  3. Soil material that has been removed because it is too wet to permit compaction may be stockpiled or spread and allowed to dry. Assist drying by discing, harrowing or pulverizing until moisture content is reduced to a satisfactory value.
- C. Required Densities:
  1. Structures, Building Slabs and Steps: Compact top 18 inches of subgrade and each layer of backfill or fill material to 95% of maximum density or greater.

2. Pavements: Compact disturbed soil to remain and subbase material to 95% maximum density or greater.
3. Lawn or Unpaved Areas: 80-85% maximum density, Refer to Article 3.11.B.
4. Trench Backfill: Compact layers 6 inches or less to 95% maximum density or greater.
5. Walkways: Compact top 6 inches of subgrade and each layer of backfill or fill material to 95% maximum density or greater.
6. Fill Under Existing Utilities: Compact top 6 inches of subgrade and each layer of backfill to 95% maximum density or greater.
7. Sand Pipe Bedding: Compact top 6 inches of subgrade and 6-inch layer of sand to 95% maximum density or greater.

### 3.13 FINISH GRADING

- A. Finish surfaces free from irregular surface changes, and as follows:
  1. Lawn or Unpaved Areas: Finish topsoil to within not more than 0.10 feet above or below specified finish grade as measured after settlement and/or specified compaction is attained
  2. Pavements: Shape surface of areas under pavement to line, grade and cross section, with finish surface not more than  $\frac{3}{4}$  of an inch above or below required subgrade elevation.
  3. Grading Surface of Fill Under Building Slabs: Grade smooth and even, free of voids, compacted as specified, and to required elevation. Provide final grades within tolerance of 2 inches when tested with a 10 foot straightedge.
- B. After grading, compact subgrade surfaces to the depth and indicated percentage of maximum or relative density for each area classification.
- C. Proof Roll: Contractor shall arrange with the Pavement Consultant to approve subgrade as indicated in Articles 3.11 and 3.12.

### 3.14 PAVEMENT SUBBASE COURSE

- A. Grade Control: During construction, maintain lines and grades including crown/cross-slope of subbase course.
- B. Placing: Place subbase course material on prepared subgrade in layers of uniform thickness of 6 inches or less, conforming to indicated cross section and thickness. Maintain optimum moisture content for compacting subbase material during placement operations.
- C. Class II subbase shall be spread and compacted identical to regular Class II material.
- D. Proof-roll before placing the bituminous pavement.

### 3.15 GRANULAR SURFACE COURSE



- A. Grade Control: During construction, maintain lines and grades including cross-slope of subbase course.
- B. Placing: Place granular course material (22A gravel for parking areas and 21AA for roadways and loading docks) on prepared subbase in a layer of uniform thickness, as indicated on the Drawings for cross section and thickness.

### 3.16 BUILDING SLAB SUBBASE

- A. Place subbase material on prepared subgrade in layers of uniform thickness, conforming to indicated cross-section and thickness. Maintain optimum moisture content for compacting material during placement operations.
- B. Compact subbase in maximum 6-inch lifts.

### 3.17 TOPSOIL OPERATIONS (SUBSOIL SURFACE PREPARATION, HAULING, SPREADING, ROUGH GRADING AND CLEAN-UP)

- A. Project Representative shall approve rough grade elevations of existing subsoil prior to commencement of subsoil loosening operations.
- B. Once loosening of subsoil has been completed, the Project Representative shall approve prior to topsoiling.
- C. Topsoiling operation shall be complete before October 31, unless approved by the Project Representative.
- D. Topsoil shall be placed by an approved topsoil installation contractor.
- E. Contractor shall submit a proposed method for placement of topsoil to the Project Representative for approval at least 14 days prior to commencement of the Work. The submittal shall include equipment to be used.

*Note: Select one of the following two F options and delete other. If topsoil is to be provided by contractor then include SECTION 320514 – TOPSOIL.*

Owner will identify topsoil stockpile for use. The contractor will be responsible for hauling and spreading the topsoil. Stockpile storage site is open from 6 a.m. to 4:30 p.m., unless other times are arranged with Project Representative and MSU Landscape Services Department. *(Option 1)*

- F. Contractor-provided topsoil shall be tested and approved prior to delivery. *(Option 2)*
- F. Topsoil shall be placed in quantities appropriate to result in 6 inches of depth when compacted to 80-85% maximum density, spread to minimize uneven compaction, and placed as follows:
  - 1. Place 6 inches of screened topsoil over loosened subgrade blending first 1”-2” into the subgrade. Obtain approval of subgrade from Project Representative prior to placement of topsoil (review Article 3.11 B Ground Surface Preparation for requirements and procedures).

- G. Place silt fence at locations designated on the Contract Documents and locations specified by the Project Representative prior to topsoil placement. Silt fence shall become property of Owner and removed by Owner.
- H. Notify the Project Representative when topsoiling is complete for final inspection, approval and Owner seeding of site.

### 3.18 INSPECTION

- A. Contractor shall notify the Project Representative when the excavation is complete. A visual subgrade inspection shall be performed prior to placing reinforcing steel, concrete, pipe beddings, etc. If satisfactory soil conditions are not found at the depths indicated, immediately notify the Project Representative in writing before proceeding further. Should Contractor fail to notify the Project Representative, all settlement and damage caused by new work resting on soft or unsound earth shall be made good at the sole expense of the Contractor.

### 3.19 PROTECTION

- A. Protect newly graded areas from traffic and erosion. Keep free of trash, debris and plant material, including weeds and grass.
- B. Repair and re-establish grades in settled, eroded, and rutted areas to specified tolerances. Where settling is measurable or observable at excavated areas during Project warranty period, remove pavement, lawn or other finish, add backfill material, compact, and replace surface treatment. Restore appearance, quality, and condition of surface or finish to match adjacent work, and eliminate evidence of restoration to greatest extent possible.
- C. Where completed compacted areas are disturbed beyond specified tolerances by subsequent construction operations or adverse weather, scarify, reshape, and restore surface to match surface of originally installed work. Eliminate evidence of the repair to the greatest extent possible.
- D. Continue to properly maintain soil erosion and sedimentation control measures. Perform and document required site inspections until the Owner has officially accepted the Project site.

### 3.20 CLEAN-UP

- A. Refer to Division 01 Section "General Requirements - Temporary Facilities and Controls."
- B. The Contractor shall perform daily maintenance and cleanup of construction materials and debris tracked on and off site. Materials and debris that accumulate and are not removed or maintained after a 24-hour notification of a violation by the Owner, will be separately contracted by the Owner and all associated costs will be charged to the Contractor.

END OF SECTION 312300