DIVISION 4100 SITEWORK

SECTION 4120 – STABILIZED SUBGRADE

PART 1 - GENERAL

1.01 SCOPE

This section covers the preparation of subgrade for pavement, sidewalks, recreational trails, and drive approaches.

1.02 REFERENCES

A. KDOT Standard Specification:
   1. Section 205 – Excavation and Embankment for Highways
   2. Section 303 – Cement or Fly Ash Treated Subgrade
   3. Section 305 – Aggregate Base and Aggregate Shoulders
   4. Section 1104 – Aggregates for Aggregate Base Construction

B. ASTM:
   2. C618 – Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
   4. D2487 – Standard Practice for Classification of Soils for Engineering Purposes

1.03 SUBMITTALS

A. Test Reports:
   1. Proctor Analysis.
   2. In-Place Density.
   3. Atterberg Limits.
   4. Any other geotechnical report as required to assist in the evaluation of the suitability of materials to be used in the construction of public infrastructure.
1.04 Definitions

A. Subgrade: The top surface of an embankment or finished cut upon which sub-base and subsequent pavement courses are placed. The subgrade shall be a well-graded and compacted layer.

B. Subgrade Preparation: Subgrade preparation is the repeated operation of fine grading and compaction of the subgrade until the specified lines, grades, and cross-sections have been obtained and the materials are compacted to the specified depth and density and within the tolerances of optimum moisture.

PART 2 - PRODUCTS

2.01 Equipment

A. Vibratory Sheepfoot Roller: A vibratory roller shall be used for initial compaction and shall have a minimum operating weight of twelve (12) tons, with a minimum centrifugal force of twenty-four (24) tons.

B. Pneumatic-Tired Roller: A Pneumatic-tired roller be used for final compaction and shall be of sufficient weight to provide a minimum bearing pressure of two hundred twenty-five (225) pounds per inch of tire width.

C. Smooth-Faced Steel Roller: A Smooth-faced steel roller shall be used for final compaction and shall be eight (8) to twelve (12) tons in weight.

D. Mixer: The mixer used for blending the subgrade material with fly ash shall be a drum-rotary type tiller equipped with an adjustable water proportioning system.

2.02 Materials

A. Fly Ash: Fly ash shall be Class C complying with the physical requirements of ASTM D5239 Paragraph 6.4 and the chemical requirements of ASTM C618, Table 1. The fly ash source shall be prequalified with KDOT as required by KDOT Section 2005.

B. Water: Potable water shall be used in the stabilized mixture.

C. AB-3: AB-3 shall be at least eighty-five percent (85%) limestone or dolomite and produced by mechanical crushing. Physical and prequalification requirements shall be in compliance with KDOT Section 1104.

PART 3 - EXECUTION

3.01 Preparation

A. Earthwork: All preparatory site work shall be in compliance with Section 4110 – Site Preparation and Section 4115 – Earthwork.

B. Grade: The subgrade surface shall be brought to the specified lines, grades, and cross-sections by repeatedly adding or removing material and compacting to the specified density.

C. Testing: Unless provided by the City, the Contractor shall secure the services of a qualified testing agency prior to beginning any work on the stabilized subgrade. The testing agency shall acquire samples of the existing subgrade material to determine Proctor values and Atterberg limits. Test results shall be provided to the Engineer for review at least forty-eight (48) hours prior to commencing subgrade modification work.
D. **Subgrade Modification:** Construction of pavements on high plasticity soils shall be modified with Class C fly ash or replaced with lower plasticity soils. High plasticity soils shall be defined as soils with a liquid limit not exceeding forty (40) and a plasticity index not exceeding twenty-five (25).

E. **Unsuitable Materials:** When unstable or unsuitable materials are encountered they shall be removed to the depth required to reach stable material or as directed by the Engineer. The over-excavated area shall be backfilled with suitable material as defined in *Section 4110 – Earthwork*, or KDOT AB-3 aggregate material may be used if allowed by the Engineer. Backfilled subgrade shall be compacted in accordance with the requirements of this Section.

### 3.02 Subgrade Compaction

A. **Fill Sections:** The maximum density for the subgrade shall be determined in accordance with ASTM D698 and within the tolerances of the optimum moisture at maximum density as determined by the Moisture Density Curve obtained for the given material.

1. Compaction of the final eighteen (18) inches of a subgrade shall be at least ninety-five percent (95%) of maximum density. KDOT Type AA compaction shall be used with a moisture range of KDOT MR-3-3, except as recommended by a qualified testing laboratory and approved by the Engineer.

2. The fill area below the top eighteen (18) inches of subgrade shall be KDOT Type B compaction with a moisture range of KDOT MR-90 unless more stringent compaction is required by the Engineer.

All the work involved in either adding moisture to, or removing moisture from embankment materials shall be considered incidental to the completion of the grading operation.

B. **Cut Sections:** The soil six (6) inches below the finish subgrade line in cut sections shall consist of suitable material, and be scarified, broken up, and then compacted. KDOT Type AA compaction shall be used with a moisture range of KDOT MR-3-3, except as recommended by a qualified testing laboratory and approved by the Engineer.

### 3.03 Subgrade for Residential Driveway Approach, Sidewalk, and Trail Construction

A. **Granular Base Course:** A four (4) inch granular base course of KDOT AB-3 is required for sidewalk and recreational trail construction. The base course shall be compacted to ninety-five percent (95%) of standard density as determined by ASTM D698. Moisture content shall be within three percent (3%) of the optimum moisture content at time of compaction. Exceptions to the requirement for the use of KDOT AB-3 are outlined in *Section 4225 – Sidewalks*.

B. **Subgrade:** The subgrade shall be KDOT Type B compaction with a moisture range of KDOT MR-90 unless more stringent compaction is required by the Engineer.

### 3.04 Subgrade for Commercial Drive Approach and Curb & Gutter Construction

The subgrade for commercial drive approaches and curb shall be compacted to the same density and moisture range as required for the subgrade of the adjacent pavement.

### 3.05 Fly Ash Requirements

A. **Soil Conditions:** Unless preliminary soil test results are provided by the City to the Contractor, the Contractor's testing agency shall determine if fly ash modification of the subgrade material is required, based on Atterberg test results. If it is determined fly ash
modification is required, the Contractor’s testing agency shall determine the areas to be modified, the rate of fly ash to be applied (% by weight), and the depth of subgrade material to be treated.

B. **Testing:** Unless field testing is provided by the City, the Contractor shall secure the services of a qualified testing agency to perform on-site testing. A qualified field technician shall monitor placement, mixing, moisture content, and in place density. Copies of the test results shall be provided to the Engineer for review prior to pavement placement. All costs incurred through the use of the testing agency shall be the responsibility of the Contractor.

C. **Storage:** Fly ash shall be stored and handled in closed weatherproof containers until immediately before distribution. Fly ash exposed to moisture prior to mixing with shall be discarded. Temporary storage (less than 12 hours) of fly ash in open pits will be allowed provided fly ash is protected from rain and groundwater.

D. **Certification:** A certification indicating compliance to these specifications shall be attached to or be part of the scale ticket for each load delivered. The producer’s representative shall sign the certification. The Contractor shall provide weigh tickets from a certified public scale to the Engineer for each load of fly ash delivered to the site.

### 3.06 **SUBGRADE CONSTRUCTION**

A. **Trimming:** The subgrade shall be trimmed to the required lines and grade by means of equipment, which is automatically controlled (from a reference system) in regard to both line and grade. The Contractor shall allow for potential swell of material to minimize waste during final trimming. This may require the subgrade to be trimmed to slightly below the finished grade.

B. **Proof Rolling:** Proof rolling with a loaded tandem dump truck carrying a minimum loaded weight (gross weight) of twenty-five (25) tons is required before acceptance of finished subgrade. Subgrade must be a non-yielding surface that does not exhibit excessive “pumping” and/or “rutting.” Subgrade failures shall be repaired by incorporating additional fly ash into the subgrade and remixing.

C. **Testing:** After each section is completed, the established testing agency shall test the in place density at a frequency of every 500 square yards, or at locations as directed by the Engineer. If the subgrade fails to meet the density requirements, the Engineer may require it be reworked as necessary to meet those requirements and/or require the Contractor to change their construction methods on the next section to obtain required density.

D. **Protection and Maintenance:** The newly finished subgrade shall be repaired from action of the elements. Any settlement or washing that occurs prior to the acceptance of the work shall be repaired and the specific lines, grades, and cross-sections reestablished.

The Contractor shall protect all pavements, curbs, sidewalks, and recreational trails from subgrade operation with an earth cushion, timber planking, or both where tractors, graders, rollers, or other equipment are required to pass, or turn around. All resulting damage shall be repaired or replaced at the expense of the Contractor.

### 3.07 **FLY ASH TREATED SUBGRADE CONSTRUCTION**

A. **Trimming:** The subgrade shall be trimmed to the required lines and grade by means of equipment, which is automatically controlled (from a reference system) in regard to both line and grade. The Contractor shall allow for potential swell of material to minimize waste during final trimming. This may require the subgrade to be trimmed to slightly below the finished grade. If fly ash is required, the following subgrade process shall be followed:
1. **Fly Ash Application**: Fly ash shall be spread in an approved manner at the rate established in Paragraph 3.05 A above. Fly ash shall be distributed at a uniform rate in such a manner as to minimize the scattering of fly ash by wind. Fly ash shall not be applied when wind conditions, in the opinion of the Engineer, are such that blowing fly ash becomes objectionable to adjacent property owners or significantly reduces the amount of fly ash incorporated into the work. Mixing operations shall commence within one (1) hour after distribution of the fly ash and will proceed until all material has been mixed.

2. **Moisture Content**: The required moisture content will be determined by the established testing agency based on laboratory tests on the materials and specific fly ash content to be used for the treatment. Water shall be introduced directly into the rotary mixing drum during the tilling procedure. Final moisture content of the mix, immediately prior to compaction, shall be uniform. If the moisture content is too high or low to achieve required compaction results, additional fly ash may be added to lower the moisture content or additional water shall be added and uniformly blended with the mixture. Additional fly ash added to lower the moisture content shall be at the expense of the Contractor.

3. **Mixing**: The pulverized subgrade material and fly ash shall be thoroughly mixed until a homogenous mixture is obtained. Depth of pulverization shall be as directed by the established testing agency.

4. **Compaction**: Compaction of the mixture shall begin immediately after mixing and confirmation that the moisture content is within the specified range. Compaction shall continue until the entire depth of mixture is compacted in compliance with Part 3.02 of this Section. Areas that are too wet shall be corrected immediately by scarifying the areas affected, adding material as required, and reshaping and recompacting. Areas that are too dry shall have additional water added and be uniformly blended.

5. **Testing**: After each section is completed, the established testing agency shall test the in place density at a frequency of every 500 square yards, or at locations as directed by the Engineer. If the subgrade fails to meet the density requirements, the Engineer may require it be reworked as necessary to meet those requirements and/or require the Contractor to change their construction methods on the next section to obtain required density.

6. **Finishing and Curing**: Following compaction, the treated subgrade shall be trimmed to the required lines and grade by means of equipment, which is automatically controlled (from a reference system) in regard to both line and grade. The surface shall then be compacted with a smooth-faced steel drum roller or a pneumatic tired roller. After the fly ash treated subgrade has been finished, the surface shall be protected against rapid drying for three (3) days or until the subgrade is covered with pavement by either of the following curing methods:
   
   (a) Sprinkle the subgrade to maintain a moist condition

   (b) Apply an asphaltic prime coat. Material is subject to approval by the Engineer.

7. **Weather Limitations**: Fly ash mixing and/or placement shall not be performed when the subgrade is frozen. Mixing operations shall not be allowed until the ambient air temperature is 40° F and rising.

   **B. Protection and Maintenance**: The newly finished subgrade shall be repaired from action of the elements. Any settlement or washing that occurs prior to the acceptance of the work shall be repaired and the specific lines, grades, and cross-sections reestablished.
The Contractor shall protect all pavements, curbs, sidewalks, and recreational trails from subgrade operation with an earth cushion, timber planking, or both where tractors, graders, rollers, or other equipment are required to pass, or turn around. All resulting damage shall be repaired or replaced at the expense of the Contractor.

C. **Proof Rolling:** Proof rolling with a loaded tandem dump truck carrying a minimum loaded weight (gross weight) of twenty-five (25) tons is required before acceptance of finished subgrade. Subgrade must be a non-yielding surface that does not exhibit excessive "pumping" and/or "rutting." Subgrade failures shall be repaired by incorporating additional fly ash into the subgrade and remixing.

3.08 **GRANULAR BASE COURSE**

All sidewalks and recreational trails require a four (4) inch AB-3 granular base course. Placement and compaction requirements for the base course shall conform to the information provided below and as shown in the Standard Details.

A granular base course may be required for street construction. The Engineer will determine based on soil tests if a granular base course will be required for individual street construction.

A. **Material:** Granular base material shall be AB-3 aggregate that is in compliance with Part 2.02, unless an alternative material is approved by the Engineer.

B. **Mixing:** Granular base material shall be processed at a central plant and brought to the site within the optimum moisture range designated by the Engineer.

C. **Placing:** Immediately after mixing the aggregate and water, use an aggregate spreader to place the mixture for the full width of pavement. The maximum compacted thickness of any lift shall be six (6) inches.

D. **Compaction:** The base course shall be compacted to ninety-five percent (95%) of standard density as determined by ASTM D698. Moisture content shall be within three percent (3%) of the optimum moisture content at time of compaction. Testing shall be performed at a frequency of every 500 square yards, or at locations as directed by the Engineer.

E. **Curing:** Allow the base course to cure before any heavy equipment is allowed on it. Curing of the base courses constructed with AB-3 is complete when the moisture content is at a maximum of seventy percent (70%) of the optimum moisture content. Testing shall be performed at a frequency of every 500 square yards, or at locations as directed by the Engineer. Pavement, curb, sidewalk, and/or recreational trails shall not be placed until the Engineer has determined the base course has sufficiently cured.

**PART 4 MEASUREMENT AND PAYMENT**

4.01 **SUBGRADE PREPARATION**

Subgrade preparation will generally be considered subsidiary to other items listed within the Bid Form.

4.02 **FLY ASH**

A. **Method of Measurement:** Field Measured.

B. **Unit:** Square Yard.
C. **Payment:** Payment for fly ash shall be made at the Contract unit price. Materials, equipment, labor, and other appurtenant work shall be considered subsidiary to the unit price of the fly ash.

4.03 **GRANULAR BASE COARSE**

A. **Method of Measurement:** Field Measured.

B. **Unit:** Square Yard.

C. **Payment:** Payment for granular base coarse shall be made at the Contract unit price. Materials, equipment, labor, and other appurtenant work shall be considered subsidiary to the unit price of the granular base coarse.

END OF SECTION