SECTION 02221

TRENCHING, BACKFILLING, AND COMPACTING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Trench Excavation for Piped Utilities.

B. Bedding and Backfilling.

C. Surface Restoration.

1.02 RELATED SECTIONS

A. Soil Erosion and Sedimentation Control: As shown on approved Subdivision Plans.

B. Protection of Underground Utilities: Section 02015.

B. Shoring: Section 02151.

C. Gravity Wastewater Sewer: Section 02731.

D. Force Mains: Section 02732.

E. Division 3 - Concrete.

1.03 DESCRIPTION

A. Definitions:

1. Unclassified Excavation: Removal of materials of any kind in the excavation, including rock excavation.
2. Rock Excavation: Removal of consolidated hard mineral material mass exceeding one-half cubic yard in volume which, cannot be excavated except by drilling and blasting or drilling and wedging. Structure foundations of concrete or of masonry or stone laid in cement-mortar is classified as rock if the volume requiring removal at any single location exceeds one-half cubic yard. No soft or disintegrated rock which can be removed with a pick, or any material which can be broken down by sledge hammers, or any ledge or single boulder less than one-half cubic yard in volume, or loose, shaken, or previously blasted rock, or broken stone in rock filling or elsewhere,

or rock exterior to the line of measurement as hereinafter specified, will be allowed as rock.

a. Items involved in the excavation such as sidewalks, curbs and street or roadway paving of whatever material is not classified as rock excavation.

3. Earth Excavation: Removal of materials of any kind in the excavation which cannot be classified as rock excavation.
4. Miscellaneous Unclassified Excavation: Unclassified excavation required by the Engineer and not included in other items.
5. Subgrade: Trench bottom prepared as specified to receive pipe bedding, concrete cradle or concrete encasement or the bottom of excavations prepared to receive pipe line structures.

1.04 REFERENCES

A. American Association of State Highway and Transportation Officials (AASHTO):
   1. AASHTO T99, Moisture-Density Relations of Soils, Using a 5.5-lb. Rammer and a 12-in. Drop.
   2. AASHTO T191, Standard Method of Test for Density of Soil In-Place by the sand cone method.

B. The "PDT Sections" noted herein refer to sections contained in the Commonwealth of Pennsylvania Department of Transportation Specifications Publication 408, latest edition. The references pertain only to materials, construction equipment, methods and labor. The payment provisions do not apply to work to be performed under this Contract.

C. Commonwealth of Pennsylvania Department of Transportation Specifications.
   1. PDT Section 703 Aggregates

D. State Code: Commonwealth of Pennsylvania, Pennsylvania Code, Title 67, Chapter 459, Occupancy of Highways by Utilities.

E. State Publication: Commonwealth of Pennsylvania, Pennsylvania Code, Title 67, Chapter 213.

1.05 PROJECT CONDITIONS

A. State Highways: All work within the right-of-way of State Highways shall be performed in strict accordance with the requirements of PA DOT Chapter 459.

PART 2 - PRODUCTS

2.01 MATERIAL

A. Backfill Material (To Restoration Depth in Seeded Areas): On-site, or imported (borrowed), excavated material, free of cinders, ash, refuse, vegetable or organic material, boulders, rocks, stone, or other material which, in the opinion of the Engineer, is unsuitable. Backfill material may not contain stones larger than six (6) inches in maximum dimension. A maximum of 20% of the backfill volume may be stones so long as the stones are evenly distributed within the material.

B. Aggregate Backfill and Bedding: Fine aggregates and coarse aggregates conforming to PDT Sections 703.1 and 703.2. Aggregate Backfill and Bedding requirements established under "Classification of Backfill and Bedding Materials," specified below.

C. Classification of Backfill and Bedding Materials:
   1. Pipe Bedding: AASHTO No. 8 or AASHTO No. 57 Coarse Aggregate.
   2. Initial Backfill: AASHTO No. 8 or AASHTO No. 57 Coarse Aggregate.
   3. Aggregate Backfill (To Restoration Depth): PA DOT No. 2A Coarse Aggregate within all existing paved areas, where directed by the Authority, or otherwise required by the Township.

D. Flowable Fill: Type A as specified in PA DOT Publication 408, Section 220.

E. Topsoil: On-site or imported screened, fertile, friable, natural, productive surface topsoil; free of subsoil, clay, stones, or similar hard objects larger than 2 inches in greatest dimension, and partially disintegrated debris and materials toxic or harmful to growth.

F. Lawn seed mixture shall be equivalent to the following:

Red Fescue	40%
Common Kentucky Bluegrass	40%
Annual Ryegrass	20%

G. Pasture and Meadow Grass seed mixture shall be equivalent to the following:

Timothy	18%
Orchard Grass (Pennlate or Pennmeade)	46%
Redtop	18%
Kentucky Bluegrass	18%

H. Underground Warning Tape:
   1. Printed, and alkali resistant, polyethylene tape, 3 inches minimum width, color coded, 1 inch minimum lettering, printed with name or symbol of utility buried below, and suitable for installation in all soil types. Magnetic type shall be manufactured with foil back or other means to enable detection, by a metal detector, when it is buried up to 4 feet deep.
   2. Magnetic.
   3. Provide for:
      a. HDPE sewage force main, green.

PART 3 - EXECUTION

3.01 TRENCH PREPARATION AND EXCAVATION

A. Perform sheeting and shoring in accordance with requirements of Shoring: Section 02151.

B. Perform soil erosion control work in accordance with requirements of the approved subdivision Soil Erosion and Sedimentation Control plan.

C. General: Excavation of every description and of whatever substances encountered shall be performed to the lines and grades indicated on the Drawings and specified herein, or as directed by the Engineer.
   1. Excavation shall be made by open cut, unless written permission to tunnel or bore is given by the Engineer or is specifically outlined in the specifications or shown on the Drawings.
   2. Trenches may be excavated and backfilled either by machinery or by hand as the Contractor may elect, provided, however, the Contractor shall use hand excavation where necessary to protect existing structures, utilities, or private or public properties specified.

D. Stripping, Storing and Restoring Surface Items: The Contractor shall remove all paving, sub-paving, curbing, gutters, brick, paving block, granite curbing, flagging or other similar materials, and grub and clear the surface over the area to be excavated. Properly store and preserve such materials that may be required for future use in restoring the surface. The Contractor shall be responsible for any loss or damage to said materials because of careless removal or neglectful or wasteful storage, disposal, or use of the materials.
   1. All materials which may be removed, including rock, earth and sand taken from the excavation, shall be stored, if practical, in the roadway or such other suitable place and in such manner as the Authority shall approve.

2. If more materials are removed from any trench than can be backfilled over the completed pipe or stored in the street, leaving space for traffic, the excess materials shall be removed and stored at a suitable site provided by the Contractor.
3. The Contractor shall, at his own expense, bring back as much of the approved materials so removed as may be required to properly refill the trench.
4. When directed by the Authority or Engineer, the Contractor shall furnish such other suitable materials as may be necessary to properly refill the trench.
5. The Contractor shall restore all shrubbery, fences, poles or other property and surface structures, removed or disturbed as a part of the work, to a condition equal to that before the work began, furnishing all labor and materials incidental thereto.
6. The Developer or Authority may mark certain trees, shrubs, or other items that are not to be disturbed or damaged. In the event such items are disturbed or damaged, they shall be replaced or compensated for at the Contractor's expense.
7. Any tree which is approved by the Developer or Authority for removal on private property shall be cut into four foot lengths and stacked next to the pipe line right-of-way and become the property of the land owner, unless said landowner requests that it be removed and disposed of.

E. Width of Trench: Pipe trenches shall be sufficiently true in alignment to permit the pipe to be laid in the approximate center of the trench. The trench shall be wide enough to provide a free working space on each side of the pipe; however, the trench width at least 12 inches above the top of the outside barrel of the pipe shall not exceed 12 inches on either side of the pipe.
1. Whenever, for any reason, the maximum trench width is exceeded below the top of the pipe, the Contractor may be ordered by the Authority to cradle or encase the pipe in concrete at the Contractor's expense in order to ensure the structural integrity of the pipe.
2. If the maximum width of trench specified above cannot be maintained, the Contractor shall install temporary sheeting at his own cost and expense.
3. Where lines are to be constructed on rights-of-way or easements in open areas, the maximum width of trench at the top specified hereinbefore may be exceeded only if the construction is kept entirely within the limits of the right-of-way or easements and can be carried on without damage to adjoining property. The angle of slope shall be the angle at which the trench bank will stand without sliding and in no case shall the angle of slope be steeper than one-half horizontal to one vertical.
4. In locations other than rights-of-way or easements, the Authority may, as warranted by working conditions, and where permitted by Federal or State safety requirements, waive the requirements that the maximum width of trench at the top shall not exceed the dimensions specified hereinbefore.

F. Length of Trench:
1. The Contractor shall limit all trench openings to a distance commensurate with all rules of safety.

2. If the work is stopped either totally or partially, the Contractor shall refill the trench and temporarily repave over the same at his expense and the trench shall not be opened until he is ready to proceed with the construction of the pipeline.

G. Pumping and Draining: The Contractor shall remove by pumping, draining, or otherwise, any water which may accumulate in the trenches and other excavations and shall build all dams and do all other work necessary to keep the trenches or other excavation as free from water as possible.
   1. Where it is impractical to completely drain the trench, special pipe or jointing materials may be authorized.
   2. While the pipelines are being laid, the Contractor shall have sufficient pumping machinery ready for immediate use.
   3. Grade the surface or provide diversion measures in the vicinity of excavation to prevent surface water from entering open trenches or excavations.

H. Accommodations of Drainage: Contractor shall prevent storm or sanitary sewer systems from being obstructed and shall maintain flows in these pipelines at all times during construction operations. When the material excavated from the trenches must temporarily be placed over open drainage gutters or other waterways Contractor shall install a temporary bridge over the gutters, or provide other means for allowing water to flow through.

I. Maintenance of Traffic: Work shall be conducted so as to cause a minimum of inconvenience to pedestrian and vehicular traffic and to private and public properties along the line of work. It shall be the duty of the Contractor, at all times, to maintain crossings, walks, sidewalks, and other roadways open to traffic and in a satisfactory condition, and to keep all fire hydrants, water valves, fire alarm boxes, and letter boxes accessible for use. Whenever it is necessary to maintain pedestrian traffic over open trenches, a timber bridge at least three feet in width and equipped with side railings shall be provided. When the excavated material will encroach upon sidewalks or private property, planking shall be placed in order to keep the sidewalk or private property clear of excavated material.
   1. In important thoroughfares, highways, or in narrow streets, the material excavated from the trench shall be removed from the site of the work at the Contractor's own expense in order to provide suitable space for traffic. The Contractor shall, at his own expense, bring back as much of the approved material as necessary to properly refill the trench; or he shall, at his own cost and expense, furnish such other suitable materials as may be necessary to properly refill the trench.
   2. When it is necessary to haul soft or wet materials over public streets, the Contractor shall provide suitable vehicles and shall conform to all laws and ordinances relevant to such hauling.
   3. Where in order to keep one side of the roadway free from any obstruction or to keep the material stored alongside the trench from falling on private property outside the right-of-way, a safe and suitable barrier shall be placed alongside the trench.
   4. Refer to Section 01570 for traffic regulations.

J. Blasting and Explosives: The use of explosives shall be governed by Act 362 of 1957, as amended, which regulates the use of explosives in certain blasting operations and confers powers and imposes duties on the Pennsylvania Department of Environmental Protection (DEP) and only used with the approval of the Authority and/or Township.

1. Blasting is not permitted within 500 of any structure unless approved in writing by the Authority and/or Township.
2. The Contractor shall be solely responsible for injury to persons or property located within or beyond the area or scope of the project that may result from the use of explosives.
3. All blasting shall be performed under the supervision of and by individuals who possess current licenses indicating they have successfully passed the required yearly examination prescribed by DEP.
4. Whenever any pipe main or conduit is encountered in the trench, all material within five feet of the same shall be removed by some method other than blasting or as otherwise directed by the owner of the utility.
5. The Contractor shall be responsible for the depths to which all blasting is performed.
6. Should any street paving adjoining any trench be damaged due to the Contractor's blasting operations, Contractor shall immediately cease the blasting operations and repair the damaged street paving; also, Contractor shall not again proceed with any blasting until written approval has been obtained from the Authority.
7. Blasting within State Highway rights-of-way not permitted unless authorized by the PADOT.

K. Protection of Utilities, Property and Structures: The existence and location of underground utilities indicated on the Drawings is to serve as a notification that such utilities exist in the general proximity of the work. Utilities not shown, or not located where shown, shall not relieve the Contractor of the responsibility for their protection during construction.

1. The Contractor shall notify all utility companies, through the Pennsylvania One Call System, in advance of construction, to locate their facilities in accordance with Pennsylvania Act 287 of 1974, as amended by Act 121 of 2008 (the Act); and shall cooperate with agents of these companies during performance of the Work. Procedures for emergency action and repairs to utilities shall be as established by the Act.
2. When the Contractor, during the progress of the excavation uncovers pipelines or conduits, which because of injury or age are in poor condition, Contractor shall immediately notify the owner of the utility in order that steps may be taken for replacement or repair. Contractor shall record locations and procedures of repairs made by Contractor.
3. Refer to Section 02015 for specific requirements for protection and repair of underground utilities.

L. Stream Crossings: Excavate trenches in stream crossings to the depth shown on the Drawings or otherwise required by the Authority.

1. Material excavated may be used as backfill unless specifically prohibited by any state agency having jurisdiction.
2. Make all necessary provisions for cofferdaming, dewatering, and removal of excess excavated material.
3. Maintain the flow in the stream at all times.
4. Where rock is encountered in the stream crossings, do not use forms to construct the concrete encasement; place concrete on firm rock below the pipe and against firm rock on both sides of the pipe to provide a firm bond between the encasement and the rock. Should the Contractor excavate beyond the dimensions specified herein before for the concrete encasement, he will be required to furnish and place all additional concrete required beyond the dimensions schedule shown on the drawings at his own expense.
5. Construct stream crossings in accordance with requirements indicated on the Drawings or appropriate permit requirements.
6. Construct stream crossings in accordance with any additional requirements specified on the approved Sedimentation and Erosion Control plans.

3.02 PIPE BEDDING AND TRENCH BACKFILL

A. Bedding: The trench shall be excavated to a depth of six (6) inches below the outside diameter of the pipe barrel, or deeper if so specified. The resultant subgrade shall be undisturbed, or compacted as approved by the Engineer if disturbed. The bedding shall then be prepared by placing a layer of thoroughly compacted aggregate bedding and initial backfill material, as specified, in uncompacted 4-inch to 12-inches thickness layers above top of pipe. Bedding shall provide uniform and continuous bearing and support for the pipe at every point between bell holes.

B. Special Bedding:
   1. Concrete Cradle and Concrete Encasement: If concrete cradle and/or encasement is indicated on the Drawings or required by the Engineer, the trench shall be excavated to a depth of six (6) inches below the outside of the barrel of pipes. All of this excavation may be done by machine. Method of placement is specified in Section 02731.
   2. Unstable Subgrade: Where the bottom of the trench at subgrade is found to be unstable or to include ashes, cinders, any type of refuse, vegetable, or other organic material, or large pieces or fragments of inorganic material, which, in the opinion of the Engineer, should be removed, the Contractor shall excavate and remove such unsuitable material to the width and depth recommended by the Engineer.
      a. Before pipe is laid, the subgrade shall be made by backfilling with aggregate material, as directed by the Engineer, in 3-inch (uncompacted thickness) layers thoroughly tamped and the bedding prepared as hereinbefore specified.
   3. Special Foundations: Where the bottom of the trench at the subgrade is found to consist of material which is unstable to such a degree that, in the opinion of the Authority, it cannot be removed and replaced with an approved material

thoroughly compacted in place to support the pipe properly, the Contractor shall construct a foundation for the pipe in accordance with plans approved by the Authority.

4. Excavation in Fill: When the pipe is laid in fill, the compacted embankment shall be brought to a height of at least 9 inches above the proposed top of the pipe before the trench is excavated.

C. Backfilling Methods:
   1. General: Backfilling shall not be done in freezing weather except by permission of the Engineer, and it shall not be done with frozen material. Do not backfill when the material already in the trench is frozen.
      a. Where aggregate backfill is not indicated on the Drawings or specified herein, and in the opinion of the Engineer or Authority should be used in any part of the work, the Contractor shall furnish and backfill with aggregate as directed.
   2. In State Highways all backfill shall be in accordance with the requirements of PA DOT Chapter 459.
   3. In existing Township streets, all backfill shall be PA DOT 2A stone unless otherwise provided in the Township Street Opening Permit.

D. Pipe Bedding Beneath and to Centerline of Pipe: All trenches shall be backfilled, from the bottom of the trench to the centerline of the pipe. Bedding material shall be deposited in the trench for its full width on each side of the pipe and fittings simultaneously and the full length of the pipe shall be chocked by appropriate methods. The Contractor shall take special care so as to avoid damaging or moving the pipe.

E. Initial Backfill Over Pipe: From the centerline of the pipe and fittings to a depth of a minimum of one (1) foot above the top of the pipe, the trench shall be backfilled by hand or by approved mechanical methods. The Contractor shall use special care in placing and compacting this portion of the backfill so as to avoid damaging or moving the pipe. The backfill shall be placed to a depth of one (1) foot minimum above the pipe and compacted by approved mechanical methods.

F. Aggregate Backfill to Restoration Depth (Roadways, Driveways and Other Paved Areas): From one (1) foot above the top of the pipe to restoration depth, the trench shall be backfilled by hand or by approved mechanical methods. Backfill in this section of the trench shall be coarse aggregate material subject to limitations specified and consolidated by approved mechanical methods in layers not exceeding 12 inches unless otherwise specified. Any consolidation method utilizing water such as jetting or puddling shall not be permitted. Consolidation shall proceed from the center of the trench to the sides to prevent arching.

G. Backfill Material to Restoration Depth (Seeded Areas): From one (1) foot above the top of the pipe to restoration depth, the trench shall be backfilled by hand or by approved mechanical methods. Backfill in this section of the trench shall be excavated material subject to limitations specified and consolidated by approved mechanical methods in

layers not exceeding 12 inches unless otherwise specified. Any consolidation method utilizing water, such as jetting or puddling shall not be permitted. Consolidation shall proceed from the center of the trench to the sides to prevent arching.

H. Underground Warning Tape: For the purposes of early warning and identification of buried pipes during future trenching or other excavation, provide continuous identification tapes in trenches. Install in accordance with printed recommendations of the tape manufacturer, and as modified herein. Bury tape at a depth of 12 inches above the stone envelope for the pipe.
   1. Provide in trenches for utilities indicated in Part 2.

I. Compacting: During the course of backfilling and compacting work, the Authority may, at any location or depth of trench, make tests to determine whether the Contractor's compaction operations are sufficient to meet specified requirements. Compact trench backfill as follows:
   1. All trench excavation and backfill within State Highway right-of-way will be subject to inspection by representatives of the Commonwealth of Pennsylvania, Department of Transportation, and the work must be performed in accordance with the requirements of that department without additional payment even though such requirements may entail more labor or services than the methods herein described.
   2. Use mechanical tampers to compact backfill materials in trench refill operations to produce a density of backfill at the bottom of each layer of not less than 95 percent of maximum density obtained at optimum moisture content as determined by AASHTO T99. Perform field determinations of density, when requested by the Engineer, in accordance with AASHTO T191.

3.03 RESTORATION AND CLEAN-UP OF SURFACE

A. Replacement or Restoration of Surface Items: The Contractor shall restore (unless otherwise stipulated) all sidewalks, curbing, gutters, shrubbery, fences, poles, sod or other property and surface structures removed or disturbed as a part of the work to a condition equal to that before the work began, furnishing all labor and materials incidental thereto.
   1. Replacement of curbs and sidewalks shall be in full accordance with the materials and methods specified by the Township of Bethlehem, and as detailed on the Drawings.

B. Pavement Replacement: As specified by Township of Bethlehem and as detailed on the approved subdivision Drawings.

C. Clean-Up and Maintenance of Surfaces:
   1. General: During construction, the surfaces of all areas including, but not limited to, roads, streets, and driveways shall be maintained on a daily basis to produce a safe,

desirable, and convenient condition. Streets shall be swept and flushed after backfilling, and recleaned as dust, mud, stones and debris caused by the work, or related to the work again accumulates. Failure of the Contractor to perform this work shall be cause for the Authority to order the work by others, and backcharge all costs to the Contractor/Developer.

a. All surplus materials furnished by the Contractor and temporary structures shall be removed from the site by the Contractor.
b. All dirt, rubbish and excess earth from the excavation shall be disposed of by the Contractor in a manner and place acceptable to all governing agencies.
c. The construction site shall be left clean at the end of each working day to the satisfaction of the Authority.

2. Repair or Correction of Unsatisfactory Conditions: All unsatisfactory conditions resulting from the work shall be corrected.
   a. Any subnormal or dangerous condition caused by the work, on any surface, shall be repaired or corrected within two hours of observance or notification of its existence. If repairs or corrections are not made within this period, the Authority may cause to have the work completed with the resulting cost being the responsibility of the Contractor/Developer.

D. Restoration of Lawns, Meadows, and Cultivated Fields:
   1. General: Final restoration of all areas shall be performed in accordance with the specifications for the particular land use as herein defined.
      a. Final restoration shall be performed no later than the start of the next planting season following construction. The planting season shall be as established by the U.S. Agricultural Service for the area of construction.
      b. Topsoil shall be screened free from subsoil, brush, weeds, or other litter, clay lumps and stones, but may contain decaying vegetable matter as is present in good topsoil.
      c. Precautions shall be exercised as necessary to conform with laws relating to erosion and sediment control.
      d. Seed shall be not more than two (2) years old. Germination tests of seeds shall be made not more than six (6) months prior to seeding. Seed, which has become wet, moldy or otherwise damaged shall not be used.
      e. All seed mixtures shall be submitted to the Authority for approval prior to seeding.
      f. The Contractor shall be responsible to produce a stand of grass in all seeded or sodded areas. Erosion, drought, or any other condition encountered shall not relieve the Contractor of this requirement.
   2. Lawns: All disturbed areas, whether inside or outside the pay-lines shall receive a minimum of 6-inches of topsoil, and the surface hand raked, stones removed and natural drainage features provided and/or restored prior to the application of seed. The Contractor shall improve all disturbed areas to a condition equal to or better than prior to construction.
      a. The seed shall be sown with approved seeding procedure at the rate of four (5) pounds per 1,000 square feet. An approved starter fertilizer shall be utilized

and applied per manufacturer's recommendations. Hydroseed shall be allowed with approved application mixtures.

3. Pasture and Meadow Grass: Prior to construction, the full depth of the existing topsoil, but no less than 12-inches, shall be stripped from all areas anticipated to be disturbed, and shall be stockpiled during construction. Upon completion of the construction, all topsoil removed shall be replaced. As the final class of material is applied, bringing the area to finished grade, the depth of topsoil replaced shall not be less than the depth removed.
   a. The seed shall be sown with approved seeding procedure at the rate of 22 to 25 pounds per acre.
4. Cultivated Fields: Prior to construction, the full depth of the existing topsoil, but no less than 12-inches, shall be stripped from the area of the anticipated trench, and shall be stockpiled during construction.
   a. Upon completion of construction, the entire disturbed area shall be cleaned of all rubbish, stones, and other objects over two (2) inches in maximum dimension, and all crushed stone related to the construction operations.
   b. All disturbed and traveled areas relevant to the work shall be scarified to a depth of ten (10) inches.
   c. All the topsoil removed shall be replaced, and the entire disturbed and traveled areas graded to the original grade. The depth of the topsoil replaced shall not be less than the depth removed.
5. Sod: Sodding shall consist of a grass equivalent to the seeding specified for that particular land use. Sod shall be used where directed by the Authority.
6. Seeding and soil supplement application shall be performed by the hydroseeding method. Rates of application, methods and equipment shall be approved by Engineer prior to commencing with work.
7. Erosion Control/Seed Germination mat shall be applied in accordance with manufacturer's instructions either before or after hydroseeding operations where required or as directed by the Authority.

E. Traffic Signal Systems: Severed, damaged or removed loop detectors, lead-in wires, conduit, junction boxes, etc., shall be repaired within five (5) days. The Contractor shall engage a PA DOT approved traffic signal contractor to perform repairs/restoration. Only PA DOT approved materials shall be used.

END OF SECTION