

SECTION 31 00 00 – EARTHWORK

PART 1 - GENERAL

1.01 UNIT PRICES

- A. Temporary Shoring and Dewatering – Outboard Locations
 - 1. Payment: Payment for “Temporary Shoring and Dewatering – Outboard Locations” shall include designing and providing the temporary shoring and dewatering systems required to construct the two (2) outboard water control structures located outside of the Ted Harvey Conservation as shown on the Contract Drawings. This price shall also include transporting all temporary shoring and dewatering components to and from the project site, storing the components on-site, construction engineering costs associated with outboard shoring and dewatering systems, and extraction of all temporary outboard components.
 - 2. Measurement: The quantity to be paid shall be the lump sum unit price quoted on the bid form for “Temporary Shoring and Dewatering – Outboard Locations”.
 - 3. Unit of Measure: Lump Sum (LS).
- B. Offsite Select Borrow for Levee Raising
 - 1. Payment: Payment for “Offsite Select Borrow for Levee Raising” shall include all handling, hauling, stockpiling, placement, and compaction of fill material associated with raising the height of the existing dike to the elevation shown in the contract drawings.
 - 2. Measurement: The quantity to be paid shall be the Cubic Yard unit price quoted on the bid form for “Offsite Select Borrow for Levee Raising”.
 - 3. Unit of Measure: Cubic Yard (CY).
- C. Excavation, Stockpile, Backfill & Compact
 - 1. Payment: Payment for “Excavation, Stockpile, Backfill & Compact” shall include all excavation, handling, stockpiling, replacement and compaction of material, and all temporary shoring and dewatering measures associated with the two (2) inboard water control structures inside of the Ted Harvey Conservation Area as shown on the contract drawings.
 - 2. Measurement: The quantity to be paid shall be the lump sum unit price quoted on the bid form for “Excavation, Stockpile, Backfill & Compact”.
 - 3. Unit of Measure: Lump Sum (LS).

D. Topsoil Stripping

1. Payment: Payment for "Topsoil Stripping" shall include all excavation, handling and stockpiling of material.
2. Measurement: The quantity to be paid shall be the Square Yard unit price quoted on the bid form for "Topsoil Stripping".
3. Unit of Measure: Square Yard (SY).

E. Unsuitable Excavation and Backfill

1. Payment: Payment for "Unsuitable Excavation and Backfill" shall include all excavation, handling, stockpiling, replacement and compaction of material.
2. Measurement: The quantity to be paid shall be the Cubic Yard unit price quoted on the bid form for "Unsuitable Excavation and Backfill".
3. Unit of Measure: Cubic Yard (CY).

F. Seeding

1. Payment: Payment for "Seeding" shall include all fertilizer, mulch and seed.
2. Measurement: The quantity to be paid shall be the Thousand Square Foot unit price quoted on the bid form for "Seeding".
3. Unit of Measure: Thousand Square Foot (MSF).

1.02 CRITERIA FOR BIDDING

A. Base bids on the following criteria:

1. Surface elevations are as indicated.
2. Pipes or other artificial obstructions, except those indicated, will not be encountered.
3. Ground water elevations indicated by the boring log were those existing at the time subsurface investigations were made and do not necessarily represent ground water elevation at the time of construction. See Geotechnical Reports in Appendix 2 for further information.
4. Material character is indicated by the boring logs. See Geotechnical Reports in Appendix 2 for further information.

1.03 REFERENCES

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

- B. American Association of State Highway And Transportation Officials (AASHTO)
- AASHTO T 180 Standard Method of Test for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop
- AASHTO T 224 Standard Method of Test for Correction for Coarse Particles in the Soil Compaction Test
- C. American Welding Society (AWS)
- AWS D1.1/D1.1M Structural Welding Code - Steel
- D. ASTM International (ASTM)
- ASTM C33/C33M (2013) Standard Specification for Concrete Aggregates
- ASTM C136/C136M (2014) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
- ASTM D422 (2007)e2 Particle-Size Analysis of Soils
- ASTM D698 (2012e2) Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/cu. ft. (600 kN-m/cu. m.))
- ASTM D1140 (2014) Standard Test Methods for Determining the Amount of Material Finer than No. 200 (75-micrometer) Sieve in Soils by Washing
- ASTM D1556 (2015) Density and Unit Weight of Soil in Place by the Sand-Cone Method
- ASTM D1557 (2012e1) Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³) (2700 kN-m/m³)
- ASTM D2167 (2015) Density and Unit Weight of Soil in Place by the Rubber Balloon Method
- ASTM D2487 (2011) Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)
- ASTM D2937 (2010) Density of Soil in Place by the Drive-Cylinder Method
- ASTM D4318 (2010e1) Liquid Limit, Plastic Limit, and Plasticity Index of Soils

ASTM D6938 (2015) Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

E. State of Delaware Department of Transportation

Standard Specifications for Road and Bridge Construction August 2001

F. U.S. Army Corps of Engineers (USACE)

USACE EM 385-1-1 (2014) Safety and Health Requirements Manual

G. U.S. Environmental Protection Agency (EPA)

EPA 600/4-79/020 Methods for Chemical Analysis of Water and Wastes

EPA SW-846.3-3 Test Methods for Evaluating Solid Waste: Physical/Chemical Methods

H. U.S. General Services Administration (GSA)

CID A-A-203 Paper, Kraft, Untreated

1.04 DEFINITIONS

A. Satisfactory Materials: Satisfactory materials comprise any materials classified by ASTM D2487 as GW, GP, GM, GP-GM, GW-GM, GC, GP-GC, GM-GC, SW, SP,. Satisfactory materials for grading comprise stones less than 8 inches

B. Unsatisfactory Materials: Materials which do not comply with the requirements for satisfactory materials are unsatisfactory. Unsatisfactory materials also include man-made fills; trash; refuse; backfills from previous construction; and material classified as satisfactory which contains root and other organic matter or frozen material. Notify the Engineer when encountering any contaminated materials.

C. Cohesionless and Cohesive Materials: Cohesionless materials include materials classified in ASTM D2487 as GW, GP, SW, and SP. Cohesive materials include materials classified as GC, SC, ML, CL, MH, and CH. Materials classified as GM and SM will be identified as cohesionless only when the fines are nonplastic. Perform testing, required for classifying materials, in accordance with ASTM D4318, ASTM C136/C136M, ASTM D422, and ASTM D1140.

D. Degree of Compaction: Degree of compaction required, except as noted in the second sentence, is expressed as a percentage of the maximum density obtained by the test procedure presented in ASTM D1557 abbreviated as a percent of laboratory maximum density. Since ASTM D1557 applies only to soils that have 30 percent or less by weight of their particles retained on the 3/4 inch sieve, express the degree of compaction for material having more than 30 percent by weight of their particles retained on the 3/4 inch sieve as a percentage

of the maximum density in accordance with AASHTO T 180 and corrected with AASHTO T 224. To maintain the same percentage of coarse material, use the "remove and replace" procedure as described in NOTE 8 of Paragraph 7.2 in AASHTO T 180.

- E. Topsoil: Material suitable for topsoils obtained from offsite areas is defined as: Natural, friable soil representative of productive, well-drained soils in the area, free of subsoil, stumps, rocks larger than one inch diameter, brush, weeds, toxic substances, and other material detrimental to plant growth. Amend topsoil pH range to obtain a pH of 5.5 to 7.
- F. Unstable Material: Unstable materials are too wet to properly support the utility pipe, conduit, or appurtenant structure.
- G. Select Granular Material:
 - 1. General Requirements: Select granular material consist of materials classified as GW, GP, GM, SW, SP, SM by ASTM D2487 where indicated. The liquid limit of such material must not exceed 40 percent when tested in accordance with ASTM D4318. The plasticity index must not be greater than 12 percent when tested in accordance with ASTM D4318, and not more than 30 percent by weight may be finer than No. 200 sieve when tested in accordance with ASTM D1140

Sieve Size	Percent Passing by Weight
2-1/2 inches	100
No. 4	40 - 85
No. 10	20 - 80
No. 40	10 - 60
No. 200	5 - 25

- H. Initial Backfill Material: Initial backfill consists of select granular material or satisfactory materials free from rocks 8 inches or larger in any dimension or free from rocks of such size as recommended by the pipe manufacturer, whichever is smaller. When the pipe is coated or wrapped for corrosion protection, free the initial backfill material of stones larger than 2 inches in any dimension or as recommended by the pipe manufacturer, whichever is smaller.
- I. Pile Supported Structure: As used herein, a structure where both the foundation and floor slab are pile supported.

1.05 SYSTEM DESCRIPTION

- A. Subsurface soil boring logs are included in the Geotechnical Report in Appendix 2. These data represent the best subsurface information available; however, variations may exist in the subsurface between boring locations.

- B. Classification of Excavation: No consideration will be given to the nature of the materials, and all excavation will be designated as unclassified excavation.
 - 1. Common Excavation: Include common excavation with the satisfactory removal and disposal of all materials not classified as rock excavation.
- C. Dewatering Work Plan: Submit procedures for accomplishing dewatering work.

1.06 SUBMITTALS

- A. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:
 - 1. Preconstruction Submittals
 - 2. Shoring
 - 3. Dewatering Work Plan
 - 4. Test Reports
 - 5. Testing

PART 2 - PRODUCTS

2.01 REQUIREMENTS FOR OFFSITE SOILS

- A. Test offsite soils brought in for use as backfill for Total Petroleum Hydrocarbons (TPH), Benzene, Toluene, Ethyl Benzene, and Xylene (BTEX) and full Toxicity Characteristic Leaching Procedure (TCLP) including ignitability, corrosivity and reactivity. Backfill shall contain a maximum of 100 parts per million (ppm) of total petroleum hydrocarbons (TPH) and a maximum of 10ppm of the sum of Benzene, Toluene, Ethyl Benzene, and Xylene (BTEX) and shall pass the TCPL test. Determine TPH concentrations by using EPA 600/4-79/020 Method 418.1. Determine BTEX concentrations by using EPA SW-846.3-3 Method 5030/8020. Perform TCLP in accordance with EPA SW-846.3-3 Method 1311. Provide Borrow Site Testing for TPH, BTEX and TCLP from a composite sample of material from the borrow site, with at least one test from each borrow site. Do not bring material onsite until tests have been approved by the Engineer.

2.02 BURIED WARNING AND IDENTIFICATION TAPE

- A. Provide polyethylene plastic metallic core or metallic-faced, acid- and alkali-resistant, polyethylene plastic warning tape manufactured specifically for warning and identification of buried utility lines. Provide tape on rolls, 3 inches minimum width, color coded as specified below for the intended utility with warning and identification imprinted in bold black letters continuously over the entire tape length. Warning and identification to read, "CAUTION, BURIED STORM DRAIN LINE BELOW" or similar wording. Provide permanent color and printing, unaffected by moisture or soil.

Warning Tape Color Codes	
Red	Electric

Warning Tape Color Codes	
Yellow	Gas, Oil; Dangerous Materials
Orange	Telephone and Other Communications
Blue	Water Systems
Green	Sewer Systems
White	Steam Systems
Gray	Compressed Air

- B. Detectable Warning Tape for Non-Metallic Piping: Provide polyethylene plastic tape conforming to the width, color, and printing requirements specified above, with a minimum thickness of 0.004 inch, and a minimum strength of 1500 psi lengthwise and 1250 psi crosswise. Manufacture tape with integral wires, foil backing, or other means of enabling detection by a metal detector when tape is buried up to 3 feet deep. Encase metallic element of the tape in a protective jacket or provide with other means of corrosion protection.

2.03 DETECTION WIRE FOR NON-METALLIC PIPING

- A. Insulate a single strand, solid copper detection wire with a minimum of 12 AWG.

2.04 MATERIAL FOR RIP-RAP

- A. Provide bedding material, filter fabric and rock conforming to DeIDOT State Standard for construction indicated.
- B. Bedding Material: Provide bedding material consisting of sand, gravel, or crushed rock, well graded, with a maximum particle size of 2 inches. Compose material of tough, durable particles. Allow fines passing the No. 200 standard sieve with a plasticity index less than six.
- C. Rock: Provide rock fragments sufficiently durable to ensure permanence in the structure and the environment in which it is to be used. Use rock fragments free from cracks, seams, and other defects that would increase the risk of deterioration from natural causes. Provide fragments sized so that no individual fragment exceeds a weight of 150 pounds and that no more than 10 percent of the mixture, by weight, consists of fragments weighing 2 pounds or less each. Provide rock with a minimum specific gravity of 2.50. Do not permit the inclusion of more than trace quantities of dirt, sand, clay, and rock fines.

2.05 SEEDING

- A. Seeding shall conform to DeIDOT Standard Specifications for Road and Bridge Construction Section 734. Seed shall be the mix specified for Permanent Grass Seeding – Dry Ground.

PART 3 - EXECUTION

3.01 STRIPPING OF TOPSOIL

- A. Where indicated or directed, strip topsoil to a depth of 4 inches. Spread topsoil on areas already graded and prepared for topsoil, or transported and deposited in stockpiles convenient to areas that are to receive application of the topsoil later, or at locations indicated or specified. Keep topsoil separate from other excavated materials, brush, litter, objectionable weeds, roots, stones larger than 2 inches in diameter, and other materials that would interfere with planting and maintenance operations.

3.02 GENERAL EXCAVATION

- A. Perform excavation of every type of material encountered within the limits of the project to the lines, grades, and elevations indicated and as specified. Perform the grading in accordance with the typical sections shown and the tolerances specified in paragraph FINISHING. Transport satisfactory excavated materials and place in fill or embankment within the limits of the work. Excavate unsatisfactory materials encountered within the limits of the work below grade and replace with satisfactory materials as directed. Include such excavated material and the satisfactory material ordered as replacement in excavation. Dispose surplus satisfactory excavated material not required for fill or embankment in areas approved for surplus material storage or designated waste areas. Dispose unsatisfactory excavated material in designated waste or spoil areas. During construction, perform excavation and fill in a manner and sequence that will provide proper drainage at all times. Excavate material required for fill or embankment in excess of that produced by excavation within the grading limits from the borrow areas indicated or from other approved areas selected by the Contractor as specified.
- B. Drainage Structures: Make excavations to the lines, grades, and elevations shown, or as directed. Provide trenches and foundation pits of sufficient size to permit the placement and removal of forms for the full length and width of structure footings and foundations as shown. Clean rock or other hard foundation material of loose debris and cut to a firm, level, stepped, or serrated surface. Remove loose disintegrated rock and thin strata. Do not disturb the bottom of the excavation when concrete or masonry is to be placed in an excavated area. Do not excavate to the final grade level until just before the concrete or masonry is to be placed. Where pile foundations are to be used, stop the excavation of each pit at an elevation 1 foot above the base of the footing, as specified, before piles are driven. After the pile driving has been completed, remove loose and displaced material and complete excavation, leaving a smooth, solid, undisturbed surface to receive the concrete or masonry.
- C. Drainage: Provide for the collection and disposal of surface and subsurface water encountered during construction. Completely drain construction site during periods of construction to keep soil materials sufficiently dry. Construct storm drainage features (ponds/basins) at the earliest stages of site development, and throughout construction grade the construction area to provide positive surface

water runoff away from the construction activity [and] [or] provide temporary ditches, swales, and other drainage features and equipment as required to maintain dry soils. When unsuitable working platforms for equipment operation and unsuitable soil support for subsequent construction features develop, remove unsuitable material and provide new soil material as specified herein. It is the responsibility of the Contractor to assess the soil and ground water conditions presented by the plans and specifications and to employ necessary measures to permit construction to proceed.

- D. Dewatering: Control groundwater flowing toward or into excavations to prevent sloughing of excavation slopes and walls, boils, uplift and heave in the excavation and to eliminate interference with orderly progress of construction. Do not permit French drains, sumps, ditches or trenches within 3 feet of the foundation of any structure, except with specific written approval, and after specific contractual provisions for restoration of the foundation area have been made. Take control measures by the time the excavation reaches the water level in order to maintain the integrity of the in situ material. While the excavation is open, maintain the water level continuously, at least one foot below the working level.
- E. Trench Excavation Requirements: Excavate the trench as recommended by the manufacturer of the pipe to be installed. Slope trench walls below the top of the pipe, or make vertical, and of such width as recommended in the manufacturer's printed installation manual. Provide vertical trench walls where no manufacturer's printed installation manual is available. Shore trench walls more than four feet high, cut back to a stable slope, or provide with equivalent means of protection for employees who may be exposed to moving ground or cave in. Shore vertical trench walls more than four feet high. Excavate trench walls which are cut back to at least the angle of repose of the soil. Give special attention to slopes which may be adversely affected by weather or moisture content. Do not exceed the trench width below the pipe top of 24 inches plus pipe outside diameter (O.D.) for pipes of less than 24 inches inside diameter, and do not exceed 36 inches plus pipe outside diameter for sizes larger than 24 inches inside diameter. Where recommended trench widths are exceeded, provide redesign, stronger pipe, or special installation procedures by the Contractor. The Contractor is responsible for the cost of redesign, stronger pipe, or special installation procedures without any additional cost to the Owner.
1. Bottom Preparation: Grade the bottoms of trenches accurately to provide uniform bearing and support for the bottom quadrant of each section of the pipe. Excavate bell holes to the necessary size at each joint or coupling to eliminate point bearing. Remove stones of two inch or greater in any dimension, or as recommended by the pipe manufacturer, whichever is smaller, to avoid point bearing.
 2. Removal of Unyielding Material: Where unyielding material is encountered in the bottom of the trench, remove such material six inch below the required grade and replaced with suitable materials as provided in paragraph BACKFILLING AND COMPACTION.
 3. Removal of Unstable Material: Where unstable material is encountered in the bottom of the trench, remove such material to the depth directed and replace it to the proper grade with select granular material as provided in paragraph BACKFILLING AND COMPACTION. When removal of

unstable material is required due to the Contractor's fault or neglect in performing the work, the Contractor is responsible for excavating the resulting material and replacing it without additional cost to the Owner.

4. Jacking, Boring, and Tunneling: Unless otherwise indicated, provide excavation by open cut except that sections of a trench may be jacked, bored, or tunneled if, in the opinion of the Engineer, the pipe, cable, or duct can be safely and properly installed and backfill can be properly compacted in such sections.

- F. Underground Utilities: The Contractor is responsible for movement of construction machinery and equipment over pipes and utilities during construction. Excavation made with power-driven equipment is not permitted within two feet of known Owner-owned utility or subsurface construction. For work immediately adjacent to or for excavations exposing a utility or other buried obstruction, excavate by hand. Start hand excavation on each side of the indicated obstruction and continue until the obstruction is uncovered or until clearance for the new grade is assured. Support uncovered lines or other existing work affected by the contract excavation until approval for backfill is granted by the Engineer. Report damage to utility lines or subsurface construction immediately to the Engineer.

- G. Structural Excavation: Ensure that footing subgrades have been inspected and approved by the Engineer prior to concrete placement. Excavate to bottom of pile cap prior to placing or driving piles, unless authorized otherwise by the Engineer. Backfill and compact over excavations and changes in grade due to pile driving operations to 95 percent of ASTM D698 maximum density.

3.03 SELECTION OF BORROW MATERIAL

- A. Select borrow material to meet the requirements and conditions of the particular fill or embankment for which it is to be used. Obtain borrow material from approved private sources. Unless otherwise provided in the contract, the Contractor is responsible for obtaining the right to procure material, pay royalties and other charges involved, and bear the expense of developing the sources, including rights-of-way for hauling from the owners. Borrow material from approved sources on Owner-controlled land may be obtained without payment of royalties. Unless specifically provided, do not obtain borrow within the limits of the project site without prior written approval. Consider necessary clearing, grubbing, and satisfactory drainage of borrow pits and the disposal of debris thereon related operations to the borrow excavation.

3.04 SHORING

- A. General Requirements: Submit a Shoring and Sheet piling plan for approval 15 days prior to starting work. Submit drawings and calculations, certified by a registered professional engineer, describing the methods for shoring and sheet piling of excavations. Finish shoring, including sheet piling, and install as necessary to protect workmen, banks, adjacent paving, structures, and utilities. Remove shoring, bracing, and sheet piling as excavations are backfilled, in a manner to prevent caving.

- B. Geotechnical Engineer: Hire a Professional Geotechnical Engineer to provide inspection of excavations and soil/groundwater conditions throughout construction. The Geotechnical Engineer is responsible for performing pre-construction and periodic site visits throughout construction to assess site conditions. The Geotechnical Engineer is responsible for updating the excavation, sheeting and dewatering plans as construction progresses to reflect changing conditions and submit an updated plan if necessary. Submit a monthly written report, informing the Contractor and Engineer of the status of the plan and an accounting of the Contractor's adherence to the plan addressing any present or potential problems. The Engineer is responsible for arranging meetings with the Geotechnical Engineer at any time throughout the contract duration.

3.05 GRADING AREAS

- A. Where indicated, divide work into grading areas within which satisfactory excavated material will be placed in embankments, fills, and required backfills. Do not haul satisfactory material excavated in one grading area to another grading area except when so directed in writing. Place and grade stockpiles of satisfactory [and unsatisfactory] [and wasted materials] as specified. Keep stockpiles in a neat and well drained condition, giving due consideration to drainage at all times. Clear, grub, and seal by rubber-tired equipment, the ground surface at stockpile locations; separately stockpile excavated satisfactory and unsatisfactory materials. Protect stockpiles of satisfactory materials from contamination which may destroy the quality and fitness of the stockpiled material. If the Contractor fails to protect the stockpiles, and any material becomes unsatisfactory, remove and replace such material with satisfactory material from approved sources.

3.06 FINAL GRADE OF SURFACES TO SUPPORT CONCRETE

- A. Do not excavate to final grade until just before concrete is to be placed. For pile foundations, stop the excavation at an elevation of from 6 to 12 inches above the bottom of the footing before driving piles. After pile driving has been completed, complete the remainder of the excavation to the elevations shown. Only use excavation methods that will leave the foundation rock in a solid and unshattered condition. Roughen the level surfaces, and cut the sloped surfaces, as indicated, into rough steps or benches to provide a satisfactory bond. Protect shales from slaking and all surfaces from erosion resulting from ponding or water flow.

3.07 GROUND SURFACE PREPARATION

- A. General Requirements: Remove and replace unsatisfactory material with satisfactory materials, as directed by the Engineer, in surfaces to receive fill or in excavated areas. Scarify the surface to a depth of 6 inches before the fill is started. Plow, step, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so that the fill material will bond with the existing material. When subgrades are less than the specified density, break up the ground surface to a minimum depth of 6 inches, pulverizing, and compacting to the specified density. When the subgrade is part fill and part excavation or natural ground, scarify the excavated or natural ground portion to a depth of 12 inches and compact it as specified for the adjacent fill.

- B. Frozen Material: Do not place material on surfaces that are muddy, frozen, or contain frost. Finish compaction by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, or other approved equipment well suited to the soil being compacted. Moisten material as necessary 14 percent of optimum moisture to provide the moisture content that will readily facilitate obtaining the specified compaction with the equipment used.

3.08 UTILIZATION OF EXCAVATED MATERIALS

- A. Dispose unsatisfactory materials removing from excavations into designated waste disposal or spoil areas. Use satisfactory material removed from excavations, insofar as practicable, in the construction of fills, embankments, subgrades, shoulders, bedding (as backfill), and for similar purposes. Submit procedure and location for disposal of unused satisfactory material. Submit proposed source of borrow material. Do not waste any satisfactory excavated material without specific written authorization. Dispose of satisfactory material, authorized to be wasted, in designated areas approved for surplus material storage or designated waste areas as directed. Clear and grub newly designated waste areas on Owner-controlled land before disposal of waste material thereon. Stockpile and use coarse rock from excavations for constructing slopes or embankments adjacent to streams, or sides and bottoms of channels and for protecting against erosion. Do not dispose excavated material to obstruct the flow of any stream, endanger a partly finished structure, impair the efficiency or appearance of any structure, or be detrimental to the completed work in any way.

3.09 BURIED TAPE AND DETECTION WIRE

- A. Buried Warning and Identification Tape: Provide buried utility lines with utility identification tape. Bury tape 12 inches below finished grade; under pavements and slabs, bury tape 6 inches below top of subgrade.
- B. Buried Detection Wire: Bury detection wire directly above non-metallic piping at a distance not to exceed 12 inches above the top of pipe. Extend the wire continuously and unbroken, from manhole to manhole. Terminate the ends of the wire inside the manholes at each end of the pipe, with a minimum of 3 feet of wire, coiled, remaining accessible in each manhole. Furnish insulated wire over its entire length. Install wires at manholes between the top of the corbel and the frame, and extend up through the chimney seal between the frame and the chimney seal. For force mains, terminate the wire in the valve pit at the pump station end of the pipe.

3.10 BACKFILLING AND COMPACTION

- A. Place backfill adjacent to any and all types of structures, and compact to at least 90 percent laboratory maximum density for cohesive materials or 95 percent laboratory maximum density for cohesionless materials, to prevent wedging action or eccentric loading upon or against the structure. Prepare ground surface on which backfill is to be placed and provide compaction requirements for backfill materials in conformance with the applicable portions of paragraphs GROUND SURFACE PREPARATION. Finish compaction by sheepsfoot rollers,

pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment.

- B. Trench Backfill: Backfill trenches to the grade shown.
1. Replacement of Unyielding Material: Replace unyielding material removed from the bottom of the trench with select granular material or initial backfill material.
 2. Replacement of Unstable Material: Replace unstable material removed from the bottom of the trench or excavation with select granular material placed in layers not exceeding 6 inches loose thickness.
 3. Bedding and Initial Backfill: Place initial backfill material and compact it with approved tampers to a height of at least one foot above the utility pipe or conduit. Bring up the backfill evenly on both sides of the pipe for the full length of the pipe. Take care to ensure thorough compaction of the fill under the haunches of the pipe. Except as specified otherwise in the individual piping section, provide bedding for buried piping in accordance with AWWA C600, Type 4, except as specified herein. Compact backfill to top of pipe to 95 percent of ASTM D698 maximum density. Provide plastic piping with bedding to spring line of pipe. Provide materials as follows:
 - a. Class I: Angular, 0.25 to 1.5 inch, graded stone, including a number of fill materials that have regional significance such as coral, slag, cinders, crushed stone, and crushed shells.
 - b. Class II: Coarse sands and gravels with maximum particle size of 1.5 inch, including various graded sands and gravels containing small percentages of fines, generally granular and non-cohesive, either wet or dry. Soil Types GW, GP, SW, and SP are included in this class as specified in ASTM D2487.
 4. Final Backfill: Fill the remainder of the trench, except for special materials for roadways, railroads and airfields, with satisfactory material. Place backfill material and compact as follows:
 - a. Roadways: Place backfill up to the required elevation as specified. Do not permit water flooding or jetting methods of compaction.
- C. Backfill for Appurtenances: After the structure has been constructed [and the concrete has been allowed to cure for 3 days, place backfill in such a manner that the structure is not be damaged by the shock of falling earth. Deposit the backfill material, compact it as specified for final backfill, and bring up the backfill evenly on all sides of the structure to prevent eccentric loading and excessive stress.

3.11 SPECIAL REQUIREMENTS

- A. Special requirements for both excavation and backfill relating to the specific utilities are as follows:
- B. Rip-Rap Construction: Construct rip-rap on bedding material on filter fabric in accordance with DOT State Standard, in the areas indicated. Trim and dress indicated areas to conform to cross sections, lines and grades shown within a tolerance of 0.1 foot.

1. Bedding Placement: Spread filter fabric on prepared subgrade as indicated. Finish bedding to present even surface free from mounds and windrows.
2. Stone Placement: Place rock for rip-rap on prepared bedding material to produce a well graded mass with the minimum practicable percentage of voids in conformance with lines and grades indicated. Distribute larger rock fragments, with dimensions extending the full depth of the rip-rap throughout the entire mass and eliminate "pockets" of small rock fragments. Rearrange individual pieces by mechanical equipment or by hand as necessary to obtain the distribution of fragment sizes specified above.

3.12 EMBANKMENTS

- A. Earth Embankments: Construct earth embankments from satisfactory materials free of organic or frozen material and rocks with any dimension greater than 3 inches. Place the material in successive horizontal layers of loose material not more than 12 inches in depth. Spread each layer uniformly on a soil surface that has been moistened or aerated as necessary, and scarified or otherwise broken up so that the fill will bond with the surface on which it is placed. After spreading, plow, disk, or otherwise brake up each layer; moisten or aerate as necessary; thoroughly mix; and compact to at least 90 percent laboratory maximum density for cohesive materials or 95 percent laboratory maximum density for cohesionless materials. Compaction requirements for the upper portion of earth embankments forming subgrade for pavements are identical with those requirements specified in paragraph SUBGRADE PREPARATION. Finish compaction by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment.

3.13 FINISHING

- A. Finish the surface of excavations, embankments, and subgrades to a smooth and compact surface in accordance with the lines, grades, and cross sections or elevations shown. Provide the degree of finish for graded areas within 0.1 foot of the grades and elevations indicated except that the degree of finish for subgrades specified in paragraph SUBGRADE PREPARATION. Finish gutters and ditches in a manner that will result in effective drainage. Finish the surface of areas to be turfed from settlement or washing to a smoothness suitable for the application of turfing materials. Repair graded, topsoiled, or backfilled areas prior to acceptance of the work, and re-established grades to the required elevations and slopes.
- B. Subgrade and Embankments: During construction, keep embankments and excavations shaped and drained. Maintain ditches and drains along subgrade to drain effectively at all times. Do not disturb the finished subgrade by traffic or other operation. Protect and maintain the finished subgrade in a satisfactory condition until ballast, subbase, base, or pavement is placed. Do not permit the storage or stockpiling of materials on the finished subgrade. Do not lay subbase, base course, ballast, or pavement until the subgrade has been checked and approved, and in no case place subbase, base, surfacing, pavement, or ballast on a muddy, spongy, or frozen subgrade.

- C. Grading Around Structures: Construct areas within 5 feet outside of each building and structure line true-to-grade, shape to drain, and maintain free of trash and debris until final inspection has been completed and the work has been accepted.

3.14 PLACING TOPSOIL

- A. On areas to receive topsoil, prepare the compacted subgrade soil to a 2 inches depth for bonding of topsoil with subsoil. Spread topsoil evenly to a thickness of 6 inch and grade to the elevations and slopes shown. Do not spread topsoil when frozen or excessively wet or dry. Obtain material required for topsoil in excess of that produced by excavation within the grading limits from offsite areas.

3.15 TESTING

- A. Perform testing by a Corps validated commercial testing laboratory or the Contractor's validated testing facility. Submit qualifications of the Corps validated commercial testing laboratory or the Contractor's validated testing facilities. If the Contractor elects to establish testing facilities, do not permit work requiring testing until the Contractor's facilities have been inspected, Corps validated and approved by the Engineer.
 - 1. Determine field in-place density in accordance with ASTM D1556, ASTM D2167, or ASTM D6938. When ASTM D6938 is used, check the calibration curves and adjust using only the sand cone method as described in ASTM D1556.
 - 2. Check the calibration curves furnished with the moisture gauges along with density calibration checks as described in ASTM D6938; check the calibration of both the density and moisture gauges at the beginning of a job on each different type of material encountered and at intervals as directed by the Engineer. When test results indicate, as determined by the Engineer, that compaction is not as specified, remove the material, replace and recompact to meet specification requirements.
 - 3. Perform tests on recompacted areas to determine conformance with specification requirements. Appoint a registered professional civil engineer to certify inspections and test results. These certifications shall state that the tests and observations were performed by or under the direct supervision of the engineer and that the results are representative of the materials or conditions being certified by the tests. The following number of tests, if performed at the appropriate time, will be the minimum acceptable for each type operation.
- B. Fill and Backfill Material Gradation: One test per 100 cubic yards stockpiled or in-place source material. Determine gradation of fill and backfill material in accordance with ASTM C136/C136M.
- C. In-Place Densities
 - 1. One test per 1,000 square feet, or fraction thereof, of each lift of fill or backfill areas compacted by other than hand-operated machines.
 - 2. One test per 1,000 square feet, or fraction thereof, of each lift of fill or backfill areas compacted by hand-operated machines.

- D. Moisture Contents: In the stockpile, excavation, or borrow areas, perform a minimum of two tests per day per type of material or source of material being placed during stable weather conditions. During unstable weather, perform tests as dictated by local conditions and approved by the Engineer.
- E. Optimum Moisture and Laboratory Maximum Density: Perform tests for each type material or source of material including borrow material to determine the optimum moisture and laboratory maximum density values. One representative test per 1,000 cubic yards of fill and backfill, or when any change in material occurs which may affect the optimum moisture content or laboratory maximum density.
- F. Tolerance Tests for Subgrades: Perform continuous checks on the degree of finish specified in paragraph SUBGRADE PREPARATION during construction of the subgrades.
- G. Displacement of Sewers: After other required tests have been performed and the trench backfill compacted to 2, feet above the top of the pipe, inspect the pipe to determine whether significant displacement has occurred. Conduct this inspection in the presence of the Engineer. Inspect pipe sizes larger than 36 inches, while inspecting smaller diameter pipe by shining a light or laser between manholes or manhole locations, or by the use of television cameras passed through the pipe. If, in the judgment of the Engineer, the interior of the pipe shows poor alignment or any other defects that would cause improper functioning of the system, replace or repair the defects as directed at no additional cost to the Owner.

3.16 DISPOSITION OF SURPLUS MATERIAL

- A. Remove surplus material or other soil material not required or suitable for filling or backfilling, and brush, refuse, stumps, roots, and to an approved licensed/permitted facility approved by the Engineer.

3.17 MEASUREMENT PROCEDURES

- A. Excavation: The unit of measurement for excavation and borrow will be the cubic yard, computed by the average end area method from cross sections taken before and after the excavation and borrow operations, including the excavation for ditches, gutters, and channel changes, when the material is acceptably utilized or disposed of as herein specified. The measurements will include authorized excavation of rock (except for piping trenches that is covered below), authorized excavation of unsatisfactory subgrade soil, and the volume of loose, scattered rocks and boulders collected within the limits of the work; allowance will be made on the same basis for selected backfill ordered as replacement. The measurement will not include the volume of subgrade material or other material that is scarified or plowed and reused in-place, and will not include the volume excavated without authorization or the volume of any material used for purposes other than directed. The volume of overburden stripped from borrow pits and the volume of excavation for ditches to drain borrow pits, unless used as borrow material, will not be measured for payment. The measurement will not include

the volume of any excavation performed prior to the taking of elevations and measurements of the undisturbed grade.

- B. Piping Trench Excavation: Measure trench excavation by the number of linear feet along the centerline of the trench and excavate to the depths and widths specified for the particular size of pipe. Replace unstable trench bottoms with a selected granular material. Include the additional width at manholes and similar structures, the furnishing, placing and removal of sheeting and bracing, pumping and bailing, and all incidentals necessary to complete the work required by this section.
- C. Topsoil Requirements: Separate excavation, hauling, and spreading or piling of topsoil and related miscellaneous operations will be considered subsidiary obligations of the Contractor, covered under the contract unit price for Offsite Select Borrow for Levee Raising.
- D. Overhaul Requirements: Allow the unit of measurement for overhaul to be the station-yard. The overhaul distance will be the distance in stations between the center of volume of the overhaul material in its original position and the center of volume after placing, minus the free-haul distance in stations. The haul distance will be measured along the shortest route determined by the Engineer as feasible and satisfactory. Do not measure or waste unsatisfactory materials for overhaul where the length of haul for borrow is within the free-haul limits.
- E. Select Granular Material: Measure select granular material in place as the actual cubic yards replacing wet or unstable material in trench bottoms within the limits shown. Provide unit prices which include furnishing and placing the granular material, excavation and disposal of unsatisfactory material, and additional requirements for sheeting and bracing, pumping, bailing, cleaning, and other incidentals necessary to complete the work.

3.18 PAYMENT PROCEDURES

- A. Payment will constitute full compensation for all labor, equipment, tools, supplies, and incidentals necessary to complete the work.
- B. Classified Excavation: Classified excavation will be paid for at the contract unit prices per cubic yard for common or rock excavation.
- C. Piping Trench Excavation: Payment for trench excavation will constitute full payment for excavation and backfilling, [including specified overdepth] except in rock or unstable trench bottoms.
- D. Unclassified Excavation: Unclassified excavation will be paid for at the contract unit price per cubic yard for unclassified excavation.
- E. Classified Borrow: Classified borrow will be paid for at the contract unit prices per cubic yard for common or rock borrow.
- F. Unclassified Borrow: Unclassified borrow will be paid for at the contract unit price per cubic yard for unclassified borrow.

- G. Authorized Overhaul: The number of station-yards of overhaul to be paid for will be the product of number of cubic yards of overhaul material measured in the original position, multiplied by the overhaul distance measured in stations of 100 feet and will be paid for at the contract unit price per station-yard for overhaul in excess of the free-haul limit as designated in paragraph DEFINITIONS.
- H. Sheeting and Bracing: Sheeting and bracing, when shown or authorized by the Engineer to be left in place, will be paid for as follows:
1. Timber Sheeting: Timber sheeting will be paid for as the number of board feet of lumber below finish grade measured in place prior to backfilling. Include in the measurement sheeting wasted when cut off between the finished grade and 1 foot below the finished grade.
 2. Steel Sheeting and Soldier Piles: Steel sheeting, soldier piles, and steel bracing will be paid for according to the number of pounds of steel calculated. Calculate the steel by multiplying the measured in-place length in feet below finish grade by the unit weight of the section in pounds per foot. Obtain unit weight of rolled steel sections from recognized steel manuals

END OF SECTION