

DECEMBER 5, 2019
SAFETY AND OPERATIONAL IMPROVEMENTS ON I-84
STATE PROJECT NO. 155-171
TOWN OF WEST HARTFORD

ADDENDUM NO. 2

This Addendum addresses the following questions and answers contained on the “CTDOT QUESTIONS AND ANSWERS WEBSITE FOR ADVERTISED CONSTRUCTION PROJECTS”:

Question and Answer No’s. 35, 38, 49, 58, 61, 62, 63, 64, 66, 67, 68, 69, 71, 75, 77, 80, 83, 84, 87, 88, 89, 91, 93, 94, 95, 96, 97, & 98

SPECIAL PROVISIONS

NEW SPECIAL PROVISION

The following Special Provision is hereby added to the Contract:

- ITEM NO. 1008720A – 4” RIGID METAL MULTI DUCT CONDUIT – UNDER ROADWAY
ITEM NO. 1008770A – 4” PVC MULTI DUCT CONDUIT – IN TRENCH
ITEM NO. 1008780A – 4” PVC MULTI DUCT CONDUIT – UNDER ROADWAY
ITEM NO. 1008860A – 4” FIBERGLASS MULTI DUCT CONDUIT – EXTRA HEAVY WALL

REVISED SPECIAL PROVISIONS

The following Special Provisions are hereby deleted in their entirety and replaced with the attached like-named Special Provisions:

- ITEM NO. 0406275A – FINE MILLING OF BITUMINOUS CONCRETE (0 TO 4 INCHES)
- ITEM NO. 0651592A – HORIZONTAL DIRECTIONAL DRILLING 6” HDPE
- ITEM NO. 0916111A – NOISE BARRIER WALL (STRUCTURE)
- ITEM NO. 0916126A – NOISE BARRIER WALL
ITEM NO. 0916127A – NOISE BARRIER WALL (EARTH RETAINING PANELS)
ITEM NO. 0916219A – ROCK IN POLE EXCAVATION

DELETED SPECIAL PROVISIONS

The following Special Provisions are hereby deleted from the Contract:

- SECTION 1.10 – ENVIRONMENTAL COMPLIANCE
- ITEM NO. 1017033A – SERVICE CABINET
- ITEM NO. 1017034A – INSTALL SERVICE

CONTRACT ITEMS

NEW CONTRACT ITEMS

<u>ITEM NO.</u>	<u>DESCRIPTION</u>	<u>UNIT</u>	<u>QUANTITY</u>
0586701.02	CONVERT CATCH BASIN TO TYPE 'C-L' CATCH BASIN DOUBLE GRATE TYPE II	EA.	1 EA.
0686900	CONCRETE PIPE CONNECTION	EA.	26 EA.

REVISED CONTRACT ITEMS

<u>ITEM NO.</u>	<u>DESCRIPTION</u>	<u>ORIGINAL QUANTITY</u>	<u>REVISED QUANTITY</u>
0203000	STRUCTURE EXCAVATION – EARTH (COMPLETE)	4960 C.Y.	10900 C.Y.
0216000	PERVIOUS STRUCTURE BACKFILL	3790 C.Y.	480 C.Y.
0508052	SHEAR CONNECTORS (SITE NO. 2)	2100 EA.	4200 EA.
0508053	SHEAR CONNECTORS (SITE NO. 3)	2500 EA.	4900 EA.
0586701	CONVERT CATCH BASIN TO TYPE 'C-L' CATCH BASIN	9 EA.	8 EA.
0712021A	GRS ABUTMENT AND WINGWALL	6080 C.Y.	9100 C.Y.
0916111A	NOISE BARRIER WALL (STRUCTURE)	2945 SF	2205 SF
0916126A	NOISE BARRIER WALL	145260 SF	127900 SF
0916127A	NOISE BARRIER WALL (EARTH RETAINING PANELS)	15630 SF	23000 SF

DELETED CONTRACT ITEMS

<u>ITEM NO.</u>	<u>DESCRIPTION</u>	<u>ORIGINAL QUANTITY</u>	<u>REVISED QUANTITY</u>
1017033A	SERVICE CABINET	1 EA.	0
1017034A	INSTALL SERVICE	1 EA.	0

PLANS

REVISED PLANS

The following Plan Sheets are hereby deleted and replaced with the like-numbered Plan Sheets, appended with “.A2”:

SUBSET	SHEET NO.
02	02.01.A2
03	03.008.A2, 03.009.A2, 03.010.A2, 03.011.A2, 03.012.A2, 03.013.A2, 03.014.A2, 03.015.A2, 03.016.A2
07	07.004.A2, 07.010.A2, 07.011.A2, 07.014.A2, 07.015.A2, 07.016.A2, 07.017.A2, 07.018.A2, 07.027.A2, 07.028.A2, 07.029.A2, 07.030.A2, 07.031.A2, 07.038.A2, 07.039.A2, 07.040.A2, 07.041.A2, 07.042.A2
08	08.075.A2, 08.076.A2, 08.077.A2, 08.078.A2, 08.079.A2, 08.080.A2, 08.081.A2, 08.082.A2, 08.083.A2, 08.086.A2, 08.087.A2, 08.088.A2
09	09.07.A2, 09.08.A2, 09.09.A2, 09.10.A2
13	13.20.A2, 13.22.A2, 13.28.A2, 13.31.A2
14	14.13.A2, 14.21.A2, 14.22.A2
15	15.13.A2, 15.21.A2, 15.22.A2
21	21.20.A2

The Bid Proposal Form has been revised to reflect these changes.

The Detailed Estimate Sheets do not reflect these changes.

There will be no change in the number of calendar days due to this Addendum.

The foregoing is hereby made a part of the Contract.

ITEM #0406275A - FINE MILLING OF BITUMINOUS CONCRETE (0 TO 4 INCHES)

Description: This work shall consist of the milling, removal, and disposal of existing bituminous concrete pavement.

Construction Methods: The Contractor shall remove the bituminous concrete material using means acceptable to the Engineer. The pavement surface shall be removed to the line, grade, and existing or typical cross-section shown on the plans or as directed by the Engineer.

The bituminous concrete material shall be disposed of offsite by the Contractor at an approved disposal facility unless otherwise stated in the Contract.

Any milled surface, or portion thereof, that is exposed to traffic shall be paved within five (5) calendar days unless otherwise stated in the plans or Contract. Specifically, the Contractor shall be allowed up to ten (10) calendar days only for placement of the PMA wedge course following operations for milling and filling of pavement joints and cracks on the I-84 mainline and ramps.

The equipment for milling the pavement surface shall be designed and built for milling bituminous concrete pavements. It shall be self propelled with sufficient power, traction, and stability to maintain depth and slope and shall be capable of removing the existing bituminous concrete pavement.

The milling machine shall be equipped with a built-in automatic grade averaging control system that can control the longitudinal profile and the transverse cross-slope to produce the specified results. The longitudinal controls shall be capable of operating from any longitudinal grade reference, including string line, contact ski (30 feet minimum), non-contact ski (20 feet minimum), or mobile string line (30 feet minimum). The transverse controls shall have an automatic system for controlling cross-slope at a given rate. The Engineer may waive the requirement for automatic grade or slope controls where the situation warrants such action.

The machine shall be able to provide a 0 to 4 inch deep cut in one pass. The rotary drum of the machine shall use carbide or diamond tipped tools spaced not more than $\frac{5}{16}$ inch apart. The forward speed of the milling machine shall be limited to no more than 45 feet/minute. The tools on the revolving cutting drum must be continually maintained and shall be replaced as warranted to provide a uniform pavement texture.

The machine shall be equipped with an integral pickup and conveying device to immediately remove material being milled from the surface of the roadway and discharge the millings into a truck, all in one operation. The machine shall also be equipped with a means of effectively limiting the amount of dust escaping from the milling and removal operation.

When milling smaller areas or areas where it is impractical to use the above described equipment, the use of a lesser equipped milling machine may be permitted when approved by the Engineer.

Protection shall be provided around existing catch basin inlets, manholes, utility valve boxes, and any similar structures. Any damage to such structures as a result of the milling operation is the Contractor's responsibility and shall be repaired at the Contractor's expense.

To prevent the infiltration of milled material into the storm drainage system, the Contractor shall take special care to prevent the milled material from falling into the inlet openings or inlet grates. Any milled material that has fallen into inlet openings or inlet grates shall be removed at the Contractor's expense.

Surface Tolerance: The milled surface shall provide a satisfactory riding surface with a uniform textured appearance. The milled surface shall be free from gouges, longitudinal grooves and ridges, oil film, and other imperfections that are a result of defective equipment, improper use of equipment, or poor workmanship. The Contractor, under the direction of the Inspector, shall perform random spot-checks with a Contractor supplied ten-foot straightedge to verify surface tolerances at a minimum of five (5) locations per day. The variation of the top of two ridges from the testing edge of the straightedge, between any two ridge contact points, shall not exceed ¼ inch. The variation of the top of any ridge to the bottom of the groove adjacent to that ridge shall not exceed ¼ inch. Any unsatisfactory surfaces produced are the responsibility of the Contractor and shall be corrected at the Contractor's expense and to the satisfaction of the Engineer.

The depth of removal will be verified by taking measurements every 250 feet per each pass of the milling machine, or as directed by the Engineer. These depth measurements shall be used to monitor the average depth of removal.

Where a surface delamination between bituminous concrete layers or a surface delamination of bituminous concrete on Portland cement concrete causes a non-uniform texture to occur, the depth of milling shall be adjusted in small increments to a maximum of +/- ½ inch to eliminate the condition.

When removing bituminous concrete pavement entirely from an underlying Portland cement concrete pavement, all of the bituminous concrete pavement shall be removed leaving a uniform surface of Portland cement concrete, unless otherwise directed by the Engineer.

Any unsatisfactory surfaces produced by the milling operation are the Contractor's responsibility and shall be corrected at the Contractor's expense and to the satisfaction of the Engineer.

No vertical faces, transverse or longitudinal, shall be left exposed to traffic unless the requirements below are met. This shall include roadway structures (catch basins, manholes, utility valve boxes, etc.). If any vertical face is formed in an area exposed to traffic, a temporary

paved transition shall be established according to the requirements shown on the plans. If the milling machine is used to form a temporary transition, the length of the temporary transition shall conform to Special Provision Section 4.06 –Bituminous Concrete, “Transitions for Roadway Surface,” the requirements shown on the plans, or as directed by the Engineer. At all permanent limits of removal, a clean vertical face shall be established by saw cutting prior to paving.

Roadway structures shall not have a vertical face of greater than one (1) inch exposed to traffic as a result of milling. All structures within the roadway that are exposed to traffic and greater than one (1) inch above the milled surface shall receive a transition meeting the following requirements:

For roadways with a posted speed limit of 35 mph or less*:

1. Round structures with a vertical face of greater than 1 inch to 2.5 inches shall be transitioned with a hard rubber tapered protection ring of the appropriate inside diameter designed specifically to protect roadway structures.
2. Round structures with a vertical face greater than 2.5 inches shall receive a transition of bituminous concrete formed at a minimum 24 to 1 (24:1) taper in all directions.
3. All rectangular structures with a vertical face greater than 1 inch shall receive a transition of bituminous concrete formed at a minimum 24 to 1 (24:1) taper in all directions.

*Bituminous concrete tapers at a minimum 24 to 1 (24:1) taper in all directions may be substituted for the protection rings if approved by the Engineer.

For roadways with a posted speed limit of 40, 45 or 50 mph:

1. All structures shall receive a transition of bituminous concrete formed at a minimum 36 to 1 (36:1) taper in the direction of travel. Direction of travel includes both the leading and trailing side of a structure. The minimum taper shall be 24 to 1 (24:1) in all other directions.

For roadways with a posted speed limit of greater than 50 mph:

1. All structures shall receive a transition of bituminous concrete formed at a minimum 60 to 1 (60:1) taper in the direction of travel. Direction of travel includes both the leading and trailing side of a structure. The minimum taper shall be 24 to 1 (24:1) in all other directions.

All roadway structure edges and bituminous concrete tapers shall be clearly marked with fluorescent paint. The paint shall be maintained throughout the exposure to traffic.

The milling operation shall proceed in accordance with the requirements of the “Maintenance and Protection of Traffic” and “Prosecution and Progress” specifications, or other Contract requirements. The more stringent specification shall apply.

Prior to opening an area which has been milled to traffic, the pavement shall be thoroughly swept with a sweeper truck. The sweeper truck shall be equipped with a water tank and be capable of removing the millings and loose debris from the surface. The sweeper truck shall operate at a forward speed that allows for the maximum pickup of millings from the roadway surface. Other sweeping equipment may be provided in lieu of the sweeper truck where acceptable by the Engineer.

Any milled area that will not be exposed to live traffic for a minimum of 48 hours prior to paving shall require a vacuum sweeper truck in addition to, or in lieu of, mechanical sweeping. The vacuum sweeper truck shall have sufficient power and capacity to completely remove all millings from the roadway surface including any fine particles within the texture of the milled surface. Vacuum sweeper truck hose attachments shall be used to clean around pavement structures or areas that cannot be reached effectively by the main vacuum. Compressed air may be used in lieu of vacuum attachments if approved by the Engineer.

Method of Measurement: This work will be measured for payment by the number of square yards of area from which the milling of asphalt has been completed and the work accepted. No area deductions will be made for minor unmilled areas such as catch basin inlets, manholes, utility boxes and any similar structures.

Basis of Payment: This work will be paid for at the Contract unit price per square yard for “Fine Milling of Bituminous Concrete (0 to 4 Inches).” This price shall include all equipment, tools, labor, and materials incidental thereto.

No additional payments will be made for multiple passes with the milling machine to remove the bituminous surface.

No separate payments will be made for cleaning the pavement prior to paving; providing protection and doing handwork removal of bituminous concrete around catch basin inlets, manholes, utility valve boxes and any similar structures; repairing surface defects as a result of the Contractors negligence; providing protection to underground utilities from the vibration of the milling operation; removal of any temporary milled or paved transition; removal and disposal of millings; furnishing a sweeper truck and sweeping after milling. The costs for these items shall be included in the Contract unit price.

Pay Item
Fine Milling of Bituminous Concrete (0 to 4 Inches)

Pay Unit
s.y.

ITEM #0651592A – HORIZONTAL DIRECTIONAL DRILLING 6” HDPE

DESCRIPTION:

This section specifies the acceptable methods and materials for installing casing pipes for fiber optic cables, copper communications/low voltage power cables and/or electric service cables under existing highways, ramps or other sensitive areas by the horizontal directional drilling (HDD) method, and the requirements for high density polyethylene (HDPE) pipe casing and innerducts to be installed as part of the HDD method, including standards for dimensionality, testing, quality, acceptable fusion practice, safe handling, and storage.

MATERIALS:

A. General:

1. The pipe casing supplied under this specification shall be high performance, high molecular weight, and high density polyethylene (HDPE) pipe. All piping system components shall be the products of one manufacturer and shall conform to the latest edition of ASTM D1248, ASTM D3350, and ASTM F714.
2. Pipe shall conform to the nominal diameters shown on the plans, with the standard dimension ratio of D/t, SDR, of 11 or less, and as required by the pipe manufacturer.
3. The pipe material shall be a Type III, Class C, Category 5, P34 material as described in ASTM D1248. The polyethylene resin shall meet or exceed the requirements of ASTM D3350 for PE 3408 material with a cell classification of 335434C, or better. The fittings and bends supplied under this specification shall be molded from a polyethylene compound having a cell classification equal to or exceeding the cell classification of the pipe supplied under this specification.
4. Physical properties of pipe and pipe compound:
 - a. Density – The density shall be 0.941 – 0.957 gms/cm³ when tested in accordance with ASTM D1505.
 - b. Melt Flow – Melt Flow shall be no greater than 0.11 gms/10 min. when tested in accordance with ASTM D1238 – Condition E.
 - c. Flex Modulus – Flex Modulus shall be 110,000 psi to less than 160,000 psi when tested in accordance with ASTM D790.
 - d. Tensile Strength at Yield – Tensile strength at yield shall be 3,200 psi to less than 3,500 psi when tested in accordance with ASTM D638.
 - e. ESCR – Environmental Stress Crack Resistance shall be in excess of 5,000 hours with zero failures when tested in accordance with ASTM D1693 – Condition C.
 - f. Hydrostatic Design Basic shall be 1,600 psi at 73.4 degrees F when tested in accordance with ASTM D2837.

5. The polyethylene compound shall be suitably protected against degradation by ultraviolet light by means of carbon black, well dispersed by precompounding in a concentration of not less than 2 percent.
6. Pipe shall be homogeneous throughout and be free of visible cracks, holes, foreign material, blisters, or other visible deleterious faults.
7. The pipe manufacturer shall be listed with the Plastic Pipe Institute as meeting the recipe and mixing requirements of the resin manufacturer for the resin used to manufacture the pipe in this project.

B. HDPE Innerduct

1. HDPE innerduct shall meet or exceed the following properties:

ASTM TEST	DESCRIPTION	VALUE HDPE
D-1505	Density kg/m ³	< 941
D-1238	Melt Index, kg/10 min Cond E	< .00055kg/10 min
D-638	Tensile strength at yield (Mpa)	20.7 min
D-638	% Ultimate Elongation Value	400% max
D-1693	Environmental Stress Crack Resistance Condition B, F20	96 hrs.
D-790	Flexural Modulus, Mpa (Mpa)	> 551.6 (Mpa)
D-746	Brittleness Temperature	-75 ° C Max.

2. HDPE innerduct shall be SDR 13.5 – ASTM F 2160 smooth wall. Couplings shall be manufactured for use with OD controlled (ASTM F 2176) smooth wall HDPE conduit.
3. Innerduct shall be mandrel tested. Mandrel shall be 95% of diameter of the tested innerduct. Contractor to submit mandrel dimensions for approval prior to testing. Mandrel length shall be a minimum of 4 inches on HDPE piping.
4. The number and size of HDPE innerducts shall be as shown on the plans.
5. The detectable pull tape shall consist of a single 24 AWG copper wire with polyethylene or PVC jacket woven into the polyester tape. The pull tape shall be NEPTCO Part No. DP1250P, or approved equal, for cable sizes of less than 97 fibers. NEPTCO Part No. DP1800P, or approved equal, shall be used for cable size of 97-288 fibers. The detectable pull tape shall have the following properties:
 - 1250 lb (5.56 kN) tensile strength
 - flat, not round, construction
 - printed foot markings
 - pre-lubricated for reduced pulling tension at start of cable pull
 - low susceptibility to absorption of moisture; moisture resistant
6. The detectable pull tape shall be field installed within each innerduct for the purpose of attaching to, and pulling of, the fiber optic cable. The Detectable Pulling Tape shall be tied off to an expanding Neoprene Plug.

C. Fusion Joints

1. Unless otherwise specified, fusible polyethylene pipe lengths shall be assembled in the field with thermal butt-fused joints. The Contractor shall follow the pipe supplier's guidelines for this procedure. All fusion joints shall be completed as described in this specification.

D. Pipe Connections

1. Fusible Polyethylene Bends

- a. Fusible polyethylene bends shall conform to the same sizing convention, diameter, dimensional tolerances and pressure class of the pipe that they are joining together.
- b. Fusible polyethylene bends shall be manufactured from the same fusible polyethylene pipe being used for the installation, and shall have at least 2 feet of straight section on either end of the bend to allow for fusion of the bend to the pipe installation.
- c. Standard fusible polyethylene bend angles shall not be greater than 22.5 degrees, and shall be used in nominal diameters ranging from 4 inch through 16 inch.

2. Connection to Handholes/Pullboxes

- a. Fusible polyethylene pipe shall be connected to handholes or pullboxes to provide a leak-free environment.
- b. Connections to a new handhole or pullbox shall be as indicated in the construction documents.
- c. A flexible, watertight gasket per ASTM C 923 shall be cast integrally with riser section(s) for all precast handholes or pullboxes.
- d. Grout internal joint space with non-shrink grout

E. Backfill Grout

1. Backfill grout shall be a proportional mixture of Portland cement, fly-ash (Type F), and water. Water to cement ratio shall not exceed 8 gallons of water per sack (94 lbs.) of cement. Fly-ash may substitute up to 50% of cement content.

F. Drilling System Equipment

1. General

The HDD equipment, as a minimum, shall consist of a directional drilling rig of sufficient capacity to perform the bore(s) and pull-back of the pipe(s), a drilling fluid mixing & delivery system of sufficient capacity to successfully complete the crossing, a guidance system to accurately guide boring operations, and trained and competent personnel to operate the system. All equipment shall be in good, safe operating condition with sufficient supplies, materials and spare parts on hand to maintain the system in good working order for the duration of this project. All

required equipment shall be included in the emergency and contingency plan as these specifications.

2. Drilling Rig

- a. The directional drilling machine shall consist of a hydraulically powered system to rotate, push and pull drill pipe while delivering a pressurized fluid mixture to a drill head. The machine shall be anchored to withstand the pulling, pushing and rotating forces required to complete the project.
- b. The drilling rig hydraulic system shall be of sufficient pressure and volume to power drilling operations. The hydraulic system shall be free from leaks.
- c. The drilling rig shall have a system to monitor pull-back hydraulic pressure during pull-back operations.
- d. Drill pipe shall be API steel drill pipe, Range 2, Premium Class or higher, Grade S-135 in a diameter sufficient for the torque and longitudinal loads and fluid capacities required for the work. Only drill pipe inspected under API's Recommended Practice Specification API RP 7G within 30 days prior to start and certified as double white band or better shall be used.

3. Drill Head

- a. The horizontal directional drilling equipment shall produce a stable fluid lined tunnel with the use of a steer-able drill head and any subsequent pre-reaming heads.
- b. The system must be able to control the depth and direction of the drilling operation.
- c. Drill head shall contain all necessary cutters and fluid jets for the operation, and shall be of the appropriate design for the ground medium being drilled.

4. Drilling Fluid System

- a. Drilling Fluid (Drilling Mud)
 - i. Drilling fluid shall be composed of clean water and the appropriate bentonite clay and other additive(s) for the fluid to be used. Water shall be from a clean source and shall meet the mixing requirements of the mixture manufacturer(s). The fluid shall be inert.
 - ii. The water and additives shall be mixed thoroughly to assure the absence of any clumps or clods. No hazardous additives may be used.
 - iii. Technical criteria for bentonite shall be as given in API Spec. 13A, Specification for Oil Well Drilling Fluids Material for fresh water drilling fluids. Any modification to the basic drilling fluid involving additives must describe the type of material to be used and be included in Contractor's drilling plan presented to the Engineer.

- iv. Drilling fluid shall be maintained at a viscosity sufficient to suspend cuttings and maintain the integrity of bore wall(s).
 - v. Drilling fluid shall be disposed of off-site in accordance with local, state and federal requirements and/or permit conditions.
 - vi. No additional chemicals or polymer surfactants shall be allowed to be added to the drilling fluid unless they have been submitted per this specification.
- b. Mixing System
- i. A drilling fluid mixing system shall be of sufficient size to mix and deliver drilling fluid for the project.
 - ii. The mixing system shall be able to ensure thorough mixing of the drilling fluid. The drilling fluid reservoir tank shall be sized for adequate storage of the fluid.
 - iii. The mixing system shall continually agitate the drilling fluid during drilling operations.
- c. Drilling Fluid Delivery and Recovery System
- i. The drilling fluid pumping system shall have a minimum capacity to supply drilling fluid in accordance with the drilling equipment pull-back rating at a constant required pressure.
 - ii. The delivery system shall have filters or other appropriate in-line equipment to prevent solids from being pumped into the drill pipe.
 - iii. Used drilling fluid and drilling fluid spilled during drilling operations shall be contained and properly disposed of. The use of spill containment measures shall be maintained around drill rigs, drilling fluid mixing system, entry and exit pits and drilling fluid recycling system (if used) to prevent spills into the surrounding environment. Pumps, vacuum truck(s), and/or storage of sufficient size shall be in place to contain excess drilling fluid.
 - iv. All excavated pits used in the drilling operation shall be lined with heavy duty plastic sheeting with sealed joints to prevent the migration of drilling fluids and/or groundwater.
 - v. A closed-loop drilling fluid system and a drilling fluid cleaning system should be used to whatever extent practical, depending upon project size and conditions. Under no circumstances shall drilling fluid that has escaped containment be reused in the drilling system.
5. Drilling Control System
- a. Calibration of the electronic detection and control system shall be verified prior to the start of the bore.

- b. The drilling head shall be remotely steer-able by means of an electronic or magnetic detection system. The drilling head location shall be monitored in three dimensions:
 - Offset from the baseline,
 - Distance along the baseline, and
 - Depth of cover.
- c. Point of rotation of the head shall also be monitored.
- d. Guidance system:
 - i. The directional drilling guidance system shall have the capability of measuring vertical and horizontal positions and roll with the following accuracy levels:
 - Vertical position: 1 inch in either directions
 - Horizontal position: 2 inches in either directions
 - Roll: 0.1° over a range of 0° to 360°
 - ii. Furnish manufacturer's certificate that the guidance system meets these requirements for the proposed depth of bores.
 - iii. The Contractor shall demonstrate a viable method to eliminate accumulated error.
 - iv. The guidance system shall be capable of generating a plot of the bore hole survey for the purpose of an as-built drawing.

G. Pipe Pull Heads

- 1. Pipe pull heads shall be utilized that employ a positive through-bolt design assuring a smooth wall against the pipe cross-section at all times.
- 2. Pipe pull heads shall be specifically designed for use with fusible polyethylene pipe, and shall be as recommended by the pipe supplier.

H. Pipe Rollers

- 1. Pipe rollers, if required, shall be of sufficient size to fully support the weight of the pipe during handling and pullback operations.
- 2. A sufficient quantity of rollers and spacing, per the pipe supplier's guidelines shall be used to assure adequate support and excessive sagging of the product pipe.

I. Quality Assurance

1. Qualifications

- a. Directional drilling Contractor shall have actively engaged in the installation of pipe using guided boring for a minimum of five (5) years, with at least 5 projects in similar type ground and similar size and length crossings.
- b. Field supervisory personnel employed by the directional drilling contractor shall have at least five (5) years' experience in the performance of the work.
- c. All polyethylene pipes shall be cut, fabricated, and installed in strict conformance with the pipe manufacturer's recommendations. Joining, laying, and pulling of polyethylene pipe shall be accomplished by personnel experienced in working with polyethylene pipe. The pipe supplier shall certify in writing that the Contractor is qualified to join, lay, and pull the pipe or representative of the pipe manufacturer shall be on site to oversee the pipe joining. Expense for the representative shall be paid for by the Contractor.

2. Fusion Technician Requirements

- a. Fusion Technician shall be fully qualified by the pipe supplier to install fusible high density polyethylene pipe of the type(s) and size(s) being used. Qualification shall be current as of the actual date of fusion performance on the project.

J. Warranty

1. The pipe shall be warranted for one year per the pipe supplier's standard terms.
2. In addition to the standard pipe warranty, the fusion services shall be warranted for one year per the fusion service provider's standard terms.

CONSTRUCTION METHODS:

A. Requirements

1. Contractor shall provide HDPE pipe casing and innerducts conforming to all standards and procedures, and meeting all testing and material properties as described in this specification for installation by HDD.
2. Contractor shall be responsible for all installation processes and procedures associated with the installation by HDD in accordance with this specification.

B. Site Conditions

1. The proposed installation locations are based on alignments to accommodate easements, to facilitate connections to the remaining fiber optic cables and copper communications/low voltage power cables installed by trenching and backfilling construction, to avoid known obstructions, and to properly maintain enough horizontal and vertical clearances from the surface. The Contractor may request

changes to the proposed vertical and horizontal alignment of the installation and the location of the entry and exit points. Proposed changes shall be submitted in writing to the Department for approval prior to the start of construction.

2. The Contractor shall be responsible for safe access to work sites, including temporary removal of guiderails as necessary. Drilling operations shall not interfere with, interrupt, or endanger traffic on nearby highways and ramps. Areas outside designated work areas shall not be disturbed. Removed guiderail shall be restored to its original condition after work is completed.
3. Water required for the drilling operations shall be provided by the Contractor. In some locations, hydrants may be available as a source of water. The Contractor is responsible for obtaining all required permits for tapping into the hydrants if he/she elects to use these as a source of water.
4. The Contractor shall be responsible for the safety and security of all staging areas, and must comply with all applicable jurisdictional codes and OSHA requirements.
5. Prior to mobilizing operations, the Contractor shall dig test pits at locations of HDD, one at each end of the crossing, for purposes of confirming existing soil conditions. Conditions are assumed to consist of a mixture of sand and gravel soils, with some cobbles and boulders at various locations. The Contractor shall select a suitable drilling machine for his/her operations capable of boring through cobbles and boulders. In the event rock, as classified in Article 2.02.02, is encountered that requires additional equipment, this work will be paid for as Extra Work and in accordance with Article 1.04.05.
6. In order to avoid damage to any subsurface structures, before the Contractor begins any work on horizontal directional drilling, the Contractor shall contact Call Before You Dig for each location prior to disturbing existing ground in any way. The Contractor shall also notify the appropriate municipalities and ConnDOT for underground lighting.

C. Submittals

1. At least 7 days prior to mobilizing equipment Contractor shall submit his qualifications and detailed installation plan to the Engineer. The plan shall include a detailed plan and profile of the bores and be plotted at a scale no smaller than 1 inch equals 20 feet horizontal and vertical.
2. The plan shall also include a listing of major equipment and supervisory personnel and a description of the methods to be used.
3. Submit bentonite drilling mud products information (MSDS), special precaution necessary, method of mixing and applications, and method of removing and disposal of the spoils.
4. The following PRODUCT DATA is required from the pipe supplier and/or fusion provider:
 - a. Pipe Size

- b. Dimensionality
 - c. Pressure Class per applicable standard
 - d. Color
 - e. Recommended Minimum Bending Radius
 - f. Recommended Maximum Safe Pull Force
 - g. Pipe and fusion services warranty information.
 - h. Written procedural documentation for piping products including proper handling and storage, installation, tapping, and testing.
 - i. Fusion technician qualification indicating conformance with this specification
5. Submit certified lab data or manufacturer's written certifications to verify the physical properties of the materials supplied under this specification.
6. The following Working Drawings and supporting information are required from the contractor and/or horizontal directional drilling Contractor. These Working Drawings shall also be supplied to the pipe supplier, should it be requested:
- a. Shoring and jacking pit plan for each installation shall be prepared by and bear the seal and signature of a Connecticut licensed Professional Engineer. Working Drawing shall include for each HDD installation any excavation locations and dimensions; shoring, bracing, struts, walers or sheet pile designs; size and type of casing; interfering utilities; bore dimensions and locations including bend radii used; and traffic control schematics for protection of vehicular and pedestrian traffic.
 - b. Plan for insertion of the HDPE pipe into the opened bore hole. This plan shall include pullback procedure, ballasting, use of rollers, side booms and side rollers, coating protection, internal cleaning, internal gauging, hydrostatic tests, dewatering, and purging.
 - c. A project safety and contingency plan which shall include but shall not be limited to drilling fluid containment and cleanup procedures, equipment and plan for compromised utility installations including electrical and power lines, water, wastewater and any other subsurface utility in the area.
 - d. A drilling fluid plan which details types of drilling fluids, cleaning and recycling equipment, estimated flow rates, and procedures for minimizing drilling fluid escape.
 - e. An HDD schedule identifying daily work hours and working dates for each installation.

D. Delivery and Off-Loading

- 1. Care shall be taken during transportation of the pipe to ensure that it is not cut, kinked, or otherwise damaged.

2. All pipes shall be bundled or packaged in such a manner as to provide adequate protection of the ends during transportation to the site. Any pipe damaged in shipment shall be replaced as directed by the Engineer.
3. Each pipe shipment shall be inspected prior to unloading to see if the load has shifted or otherwise been damaged. Notify Engineer immediately if more than immaterial damage is found. Each pipe shipment shall be checked for quantity and proper pipe size, color and type.
4. Pipe shall be loaded, off-loaded, and otherwise handled in accordance with all of the pipe supplier's guidelines.
5. Off-loading devices such as chains, wire rope, chokers, or other pipe handling implements that may scratch, nick, cut, or gouge the pipe are strictly prohibited.
6. During removal and handling, proper care shall be taken to ensure that the pipe does not strike anything. Significant impact could cause damage, particularly during cold weather.
7. If appropriate unloading equipment is not available, pipe may be unloaded by removing individual pieces. Care shall be taken to ensure that pipe is not dropped or damaged. Pipe shall be carefully lowered, not dropped, from trucks.

E. Handling and Storage

1. Any length of pipe showing a crack or which has received a blow that may have caused an incident fracture, even though no such fracture can be seen, shall be marked as rejected and removed at once from the work site. Damaged areas, or possible areas of damage may be removed by cutting out and removing the suspected incident fracture area. Limits of the acceptable length of pipe shall be determined by the Engineer.
2. Any scratch or gouge greater than 10% of the wall thickness will be considered significant and will be rejected unless determined acceptable by the Engineer.
3. Pipe lengths shall be stored and placed on level ground, preferably turf or sand, free of sharp objects which could damage the pipe. Pipe shall be stored at the job site in the unit packaging provided by the manufacturer. Caution shall be exercised to avoid compression, damage, or deformation to the ends of the pipe. Stacking of the polyethylene pipe shall be limited to a height that will not cause excessive deformation of the bottom layers of pipes under anticipated temperature condition. Where necessary due to ground conditions, the pipe shall be stored on wooden sleepers, spaced suitably and of such widths as not to allow deformation of the pipe at the point of contact with the sleeper or between supports.
4. The interior of the pipe, as well as all end surfaces, shall be kept free from dirt and foreign matter. The open ends of all sections of joined and/or installed pipe (not in service) shall be plugged at night to prevent animals or foreign material from entering the pipe line or pipe section. Waterproof nightcaps of approved design may be used but they shall also be so constructed that they will prevent the entrance of

any type of natural precipitation into the pipe and will be fastened to the pipe in such a manner that the wind cannot blow them loose. The practice of stuffing cloth or paper in the open ends of the pipe will be considered unacceptable.

5. Where possible, the pipe shall be raised and supported at a suitable distance back from the open end such that the open end will be below the level of the pipe at the point of support.
6. Pipe shall be handled and supported with the use of woven fiber pipe slings or approved equal. Care shall be exercised when handling the pipe to not cut, gouge, scratch or otherwise abrade the piping in any way. Two slings spread apart shall be used for lifting each length of pipe. Pipe or fittings shall not be dropped onto rocky or unprepared ground. Slings for handling the pipeline shall not be positioned at butt-fused joints.
7. If pipe is to be stored for periods of 1 year or longer, the pipe shall be shaded or otherwise shielded from direct sunlight. Covering of the pipe which allows for temperature build-up is strictly prohibited. Pipe should be covered with an opaque material while permitting adequate air circulation above and around the pipe as required to prevent excess heat accumulation.
8. Pipe shall be stored and stacked per the pipe supplier's guidelines.

F. Drilling Operations

1. General

- a. The Contractor shall install the HDPE casing pipeline for fiber optic cables and copper communications/low voltage power cables by means of horizontal directional drilling. The Contractor shall assemble, support, and pretest the pipeline prior to installation in the directional drill borehole.
- b. Horizontal directional drilling shall consist of the drilling of a small diameter pilot hole from one end of the alignment to the other, followed by enlarging the hole diameter for the pipeline insertion. The exact method and techniques for completing the directionally drilled installation will be determined by the Contractor, subject to the requirements of these specifications.
- c. Bore locations are as indicated in the contract documents. The path of the bore may be modified based on field and equipment conditions, as well as the entry and exit locations. Control-point elevations and minimum depths below the roadway or surface shall be maintained as indicated in the contract documents.
- d. Bend radii shown in the contract documents are minimum allowable radii and shall not be reduced.
- e. The required piping shall be assembled in a manner that does not obstruct adjacent ramps and highways.

- f. The Engineer must be notified a minimum of 48 hours in advance of starting work. The boring procedure shall not begin until the Engineer is present at the job site and agrees that the proper preparations for the operation have been made. The Engineer approval for beginning the installation shall in no way relieve the Contractor of the ultimate responsibility for the satisfactory completion of the work as authorized under the contract.

2. Location and Protection of Underground Utilities

- a. Correct location of all underground utilities that may impact the HDD installation is the responsibility of the Contractor, regardless of any locations shown on the drawings or previous surveys completed.
- b. The Contractor shall contact Call Before You Dig prior to the start of any construction. The Contractor shall be responsible for any necessary notification services; such contacts shall be done by the Contractor prior to the start of construction.
- c. All existing lines and underground utilities shall be positively identified, including exposing those facilities that are located within an envelope of possible impact of HDD installation as determined for the project specific site conditions. It is the Contractor and HDD system operator's responsibility to determine this envelope of safe offset from existing utilities. This will include, but is not limited to, soil conditions and layering, utility proximity and material, HDD system and equipment, and foreign subsurface material.
- d. The Contractor shall be responsible for identifying any drainage lines crossing within the limits of the proposed work. Adjustments to the profile of the HDD shall be made as necessary to avoid any conflicts with drainage system elements.

3. Site Location Preparation

- a. Work sites as indicated on drawings shall be graded or filled to provide a level working area. No alterations beyond what is required for operations are to be made.
- b. The general work areas on the entry and exit sides of the crossing shall be enclosed by a berm to contain unplanned spills or discharge. Equipment (graders, shovels, etc.) and materials (such as groundsheets, hay bales, booms, and absorbent pads) for cleanup and contingencies shall be provided in sufficient quantities by the Contractor and maintained at all sites for use in the event of inadvertent leaks, seeps or spills.
- c. The Contractor shall place sedimentation fence between all drilling operations and any drainage, wetland, waterway or other sensitive areas designated for such protection by contract documents, state, federal, and local regulations. Additional environmental protection necessary to contain any hydraulic or drilling fluid spills shall be put in place, including berms,

liners, turbidity curtains and other measures. The Contractor shall adhere to all applicable environmental regulations.

- d. Contractor shall confine all activities to designated work areas.

4. Drilling Layout and Tolerances

- a. The drill path shall be accurately surveyed with entry and exit areas placed in the appropriate locations within the areas indicated on drawings. If using a magnetic guidance system, drill path shall be surveyed for any surface geomagnetic variations or anomalies.
- b. Instrumentation shall be provided and maintained at all times that accurately locates the pilot hole, measures drill-string axial and torsional loads and measures drilling fluid discharge rate and pressure.
- c. Entry and exit areas shall be drilled so as not to exceed the bending limitations of the pipe as recommended by the pipe supplier.
- d. Pipe installed by the directional drilled method must be located in plan as shown on the Drawings, and must be no shallower than shown on the Drawings unless otherwise approved by the Engineer. The Contractor shall plot the actual horizontal and vertical alignment of the pilot bore at intervals not exceeding 15 feet. This “as built” plan and profile shall be updated as the pilot bore is advanced.
- e. Line and grade deviations at the upstream end or entry point shall not exceed 12 inches and 6 inches, respectively.
- f. Each exit point shall be located as shown with an over-length tolerance of 5 feet and an alignment tolerance of 5 feet left/right with due consideration of the right-of-way boundary and handhole/pullbox connection position to tie the HDPE crossing pipe to the remaining fiber optic cables and copper communications/low voltage power cable segments. The alignment of each pilot bore must be approved by the Engineer before pipe can be pulled. If the pilot bore fails to conform to the above tolerances, the Engineer may, at his option, require a new pilot boring to be made.
- g. After the pipe is in place, cleaning pigs shall be used to remove residual water and debris. After the cleaning operation, the Contractor shall provide and run a sizing pig or mandrel to check for anomalies in the form of buckles, dents, excessive out-of-roundness, and any other deformations. The sizing pig run shall be considered acceptable if the survey results indicate that there are no sharp anomalies (e.g. dents, buckles, gouges, and internal obstructions) greater than 2 percent of the nominal pipe diameter, or excessive ovality greater than 5 percent of the nominal pipe diameter. Pipe ovality shall be measured as the percent difference between the maximum and minimum pipe diameters.

5. Pilot Hole Bore

- a. Pilot hole shall be drilled along bore path. In the event that the pilot bore does deviate from the bore path, it may require contractor to pull-back and re-drill from the location along bore path before the deviation.
- b. The Contractor shall limit curvature in any direction to reduce force on the pipe during pull-back. The minimum radius of curvature shall be no less than that specified by the pipe supplier and as indicated on the drawings.

6. Reaming

- a. After successfully completing the pilot hole, the bore hole shall be reamed to a diameter which meets the requirements of the pipe being installed. The following is offered as an estimated guide:

<u>Nominal Pipe Diameter</u>	<u>Bore Hole Diameter</u>
< 8 inches	Pipe Dia. + 4 inches
8 inches to 24 inches	Pipe Dia. X 1.5

- b. Multiple reaming passes shall be used at the discretion of the Contractor and shall conform to this specification.
- c. In the event of a drilling fluid fracture of formations at locations other than the entry and exit points, returns loss or other loss of drilling fluid, the Contractor shall be responsible for restoring any damaged facility to original condition and cleaning up the area in the vicinity of the damage or loss.

G. Pipe Pull-Back and Insertion

- 1. Pipe shall be fused prior to insertion, if the site and conditions allow, into one continuous length.
- 2. Contractor shall handle the pipe in a manner that will not over-stress the pipe prior to insertion. Vertical and horizontal curves shall be limited so that the pipe does not bend past the pipe supplier’s minimum allowable bend radius, buckle, or otherwise become damaged. Damaged portions of the pipe shall be removed and replaced at the Contractor’s expense.
- 3. The pipe entry area shall be graded as needed to provide support for the pipe and to allow free movement into the bore hole.
 - a. The pipe shall be guided into the bore hole to avoid deformation of, or damage to, the pipe.
 - b. The fusible polyethylene pipe may be continuously or partially supported on rollers or other friction decreasing implement approved by the Engineer during joining and insertion, as long as the pipe is not over-stressed or critically abraded prior to, or during installation.
 - c. A swivel shall be used between the reaming head and the fusible polyethylene pipe to minimize torsion stress on the pipe assembly.

- d. The lead end of the pipe shall be closed during the pull-back operation.
4. Buoyancy modification shall be at the sole discretion of the Contractor, and shall not exceed the pipe supplier's guidelines in regards to maximum pull force or minimum bend radius of the pipe. Damage caused by buoyancy modifications shall be the responsibility of the Contractor.
5. Once pull-back operations have commenced, the operation shall continue without interruption until the pipe is completely pulled through the bore hole.
6. The maximum allowable pull exerted on the HDPE pipelines shall be measured continuously and limited to the maximum allowed by the pipe manufacturer so that the pipe or joints are not over stressed.
7. After pipe installation, annular space around the pipe shall be backfill grouted.
8. The Contractor shall allow sufficient lengths of product pipe to extend past the termination point to allow connections to adjacent handholes/pullboxes. Pulled pipe shall be allowed 48 hours of stabilization prior to making tie-ins or backfill grouting of the pipe. The length of extra product pipe shall be at the Contractor's discretion.
9. Upon completion of the filling of the annular space, HDPE inner duct, of the quantity and size identified on the plans, shall be installed.
10. The pipe shall be installed in a manner that does not cause upheaval, settlement, cracking, or movement and distortion of surface pavements and features. Any damages caused by the Contractor's operations shall be corrected by the Contractor as directed by the Engineer. Such repairs and corrections shall be at the Contractor's expense.

H. Installation Cleanup

1. Following the installation, the project site shall be returned to a condition equal to or better than the pre-construction condition of the site. Drill pits shall be backfilled with pervious structure backfill as prescribed in Article 2.16.03 of the Standard Specifications. All excavations will be backfilled and compacted per the construction documents and jurisdictional standards. All pavement and hardscape shall be repaired per applicable jurisdictional standards, excess materials shall be removed from the site, and disturbed areas shall be restored with 4" of topsoil and seeded. All drilling fluid shall be properly disposed of per these specifications and all applicable jurisdictional laws.
2. Waste drilling mud and cuttings shall be dewatered, dried, and stock piled such that it can be loaded by a front end loader, transferred to a truck and hauled offsite to a suitable legal disposal site. The maximum allowed water content of these solids is 50% of weight. Water from the dewatering process shall be treated by the Contractor to meet permit requirements and disposed of locally.
3. Contractor shall verify that all utilities, structures, and surface features in the project area are sound. The Contractor shall be responsible for monitoring the road

crossings at the completion of the work for signs of roadway settlement. If evidence of settlement or other disturbance to the surface is identified, the Contractor shall notify the Engineer immediately for direction on how to remedy such conditions. The Contractor shall be solely responsible for the cost associated with any work necessary to address unsound conditions.

I. Pressure Testing

1. Unless otherwise approved, new pipe crossing systems shall be completely assembled and successfully tested prior to installation of HDPE inner duct and making connections into pull boxes or handholes.
2. At the Contractor's option, hydrostatic or air pressure testing of the pipe may be done each time after fusing several segments of the HDPE pipe together on the surface. This testing is intended to verify proper fusion of the pipe segments prior to pulling the pipe through the hole, but will not verify proper fusion of these segments to those previously pulled through the hole. The test shall be conducted at a minimum 25 psi.
3. Once the pipe is pulled through the hole, it shall be tested at a minimum pressure of 25 psi for 1 hour to verify that the pipe or pipe joints have no cracks as a result of the pullback.
4. Hydrostatic or air testing is acceptable.
5. Pipe not holding the specified pressure for the test duration shall be removed from the hole, repaired, and installed and tested again.

J. Post-Construction Submittals

1. The following AS-RECORDED DATA is required from the Contractor and/or fusion provider to the Department at the completion of work:
 - a. Fusion report for each fusion joint performed on the project, including joints that were rejected. Specific requirements of the Fusion Technician's joint report shall include:
 - i. Pipe Size and Thickness
 - ii. Machine Size
 - iii. Fusion Technician Identification
 - iv. Job Identification
 - v. Fusion Joint Number
 - vi. Fusion, Heating, and Drag Pressure Settings
 - vii. Heat Plate Temperature
 - viii. Time Stamp

- ix. Heating and Cool Down Time of Fusion
- x. Ambient Temperature
- b. As-recorded Information
 - i. The as-built survey of the pilot hole prior to pre-reaming, indicating conformance with the specified requirements.
 - ii. All fittings or other appurtenances will also be referenced and shown.
 - iii. A daily project log, along with tracking log sheets, should they be used, shall be provided. Tracking log sheet data, should it be employed, shall include any and all that apply, including inclination, depth, azimuth, and hydraulic pull-back and rotational force measured.

METHOD OF MEASUREMENT:

This item shall be measured for payment by the actual number of linear feet of HDPE pipe installed by Horizontal Directional Drilling methods and accepted by the Department. The measured length shall be from end to end of HDPE pipe along the centerline through all fittings.

BASIS OF PAYMENT:

This work shall be paid for at the contract unit price per linear foot for Horizontal Directional Drilling of the specified pipe diameter. Price shall include all submittals, materials and work required including HDPE pipe and HDPE innerduct, fittings, grout, exploratory test pits, horizontal directional drilling, pipe inspection and testing, excavating, backfilling, pervious structure backfill, topsoil, seeding, temporary removal and restoration of guiderail, shoring, environmental protection materials and installation, engineering, surveying, cleaning, mark-out, mobilization, and all equipment, tools, labor and work incidental thereto.

ITEM #0916111A - NOISE BARRIER WALL (STRUCTURE)

Section 9.16 Noise Barrier Wall is hereby deleted in its entirety and replaced with the following:

Description:

Work under this item shall consist of designing, fabricating, furnishing and erecting a Noise Barrier Wall (Structure) to be supported by an appurtenant structure at the locations shown on the Contract Drawings, in this specification, or as directed by the Engineer.

Noise Barrier Wall (Structure) shall have a reinforced normal-weight concrete core and by virtue of its overall construction and composition, is impervious to the passage of light and has the ability to absorb noise. The maximum unit weight of the panels shall be 50 lbs/sf.

The structural support system of the Noise Barrier Wall (Structure) may be attached, to either an existing structure or new construction, as indicated in the Contract Drawings. This specialized construction of a noise barrier wall shall be fully designed, detailed and manufactured taking into account its structural adequacy and integrity with the supporting structure. The maximum post spacing shall be 5'-6" on the structure.

Specific types of walls are indicated on the Contract Drawings and in this specification that are acceptable by the Connecticut Department of Transportation (Department) to be constructed on specific locations based on their conformance with the requirements in the project. The Contractor shall select the appropriate wall type from a list in the Contract Drawings and in this specification.

The Contractor is directed to verify at the site, all dimensions and information pertaining to the existing construction that are needed in the design, preparation of Working Drawings and in the overall execution of this project.

The Contract Drawings prepared by the Department for this project contain only conceptual and schematic interpretations for the general approach of design. The Contractor shall prepare its structural design calculations and Working Drawings based on the concept and scheme as presented in the Contract Drawings, and in conformance with this specification. **The structural design calculations and Working Drawings prepared by the Contractor shall be reviewed and approved by the Engineer prior to the start of fabrication of any element of the Noise Barrier Wall (Structure).**

Within Thirty (30) days after the bid opening, the Contractor shall identify by the type and name, in his proposal, the specific type of the wall for each location upon which his bid is based. All noise barriers selected for each location shall be furnished from the same system and shall be on the same type pattern and color.

Materials:

The materials to be used for the various components of the Noise Barrier Wall (Structure), including all appurtenant support systems, shall be as specified in this specification.

All materials for the noise barrier walls shall comply with the FTA's Buy America requirements in 49 USC & 5323(j) and 49 CFR Part 661.

The Noise Barrier Wall (Structure) chosen shall be selected from the list provided in this Specification. This list identifies various types of noise barrier wall systems that are considered appropriate and acceptable for each specific location in the project but does not guarantee that all the listed proprietary noise barrier wall systems can be designed to meet all the dimensional, structural, or geotechnical constraints at each site. **The Contractor shall not commence with the production of its proposed system of Noise Barrier Wall (Structure) without the Engineer's review and written approval.**

The General List shown in this Specification and on the Contract Drawings identifies the acceptable systems of Noise Barrier Wall (Structure) of the absorptive type for use in this Project:

1. Durisol - NB15

Durisol
8270 Greensboro Drive, Suite 810
McLean, VA 22102
(302) 299-6821
andrew.weaver@durisol.com
www.durisol.com

2. Whisper Wall

Concrete Systems, Inc.
9 Commercial Street
Hudson, NH 03051
(800) 342-3374 EXT. 409
Email: tgarcia@csigroup.com
www.whisper-wall.com

3. Soundsorb

Concrete Solutions, Inc.
3300 Bee Cave Road, Suite 650
Austin, TX 78746
(512)736-6447
Email: csi@soundsorb.com
www.soundsorb.com

4. JBM75

JBM Solutions
P.O. Box 4861
Pinehurst, NC 28374
(703) 861-9004
Email: jmcneal@jbm75.com
www.jbm75.com

Not all of the above-listed walls are suited for use at specific locations due to structural requirements and concerns or, that the environment or locality warrants a certain type or style of wall to be used.

The materials used for the types of noise barrier walls shall be durable, and not be prone to developing openings, cracks or gaps from loading, warping, splitting, shrinkage, expansion, delamination, weathering and other weather-related and climactic-induced deterioration. The noise barrier wall panels shall be U.V.-resistant, flame-retardant, and could resist degradation from ozone, hydrocarbons and freeze-thaw cycling.

The Noise Barrier Wall (Structure) shall be able to provide a minimum Sound Transmission Class (S.T.C.) rating of 34 measured by ASTM E90. The Noise Reduction Coefficient (N.R.C.) shall have a minimum rating of 0.70, as measured by ASTM C423 and E 795. The sound- absorbing portions of the wall shall be durable and resistant against deterioration of material and damage from moderate scratch and abrasion and shall have a minimum of 20-year life cycle free from peeling, rotting or visible deterioration.

The Noise Barrier Wall (Structure) shall have a textured absorptive surface pattern on both sides. Specific textured surface patterns have been approved for use by the Department. The selected pattern for each wall location shall be as shown or noted on the Contract Drawings, and other patterns will not be acceptable. If both sides of the Noise Barrier Wall (Structure) contain a textured surface pattern, the side of the panels covered with the sound-absorbing material shall consistently face the roadway throughout the project. The sound-absorbing material shall be installed on the entire wall face. Post covers or other devices supplied by the manufacturer and approved by the Engineer should be used.

The color of the Noise Barrier Wall (Structure) exposed to traffic will be indicated on the Contract Plans, conforming to Federal Standard 595 Colors except if specified otherwise on the plans. Only one color may be used on the wall components to maintain uniformity, except where specified otherwise on the Contract plans.

Federal Standard 595 Color No.	Color
FS 36492	Gray
FS 34230	Green
FS 30215	Brown
FS 36622	Gray

The Noise Barrier Wall (Structure) panels shall be integrally-pigmented to a significant depth into its cross-section in conformance with the requirements of ASTM C979, in order to produce a uniform color should the panel become scratched, chipped or otherwise surface-damaged. Variation in color or shading from panel to panel shall not be acceptable. Field-staining or painting to achieve a uniform overall color is not allowed.

Individualized design panels may vary from standard wall colors, textures, and patterns, as

depicted in the Contract Drawings.

The Noise Barrier Wall (Structure) shall have a suitable surface for repainting, staining, sandblasting or other acceptable method of returning the panels to their original color and texture should they become damaged after construction. Touching-up, re-staining, repainting, or sandblasting portions of the panels shall not result in visible color variation.

The manufacturer of the Noise Barrier Wall (Structure) shall provide to the Department, an Aesthetic Coating Warranty of its product that covers a minimum of ten (10) years.

The Contractor shall also supply the Department with two (2) full-panel sections of Noise Barrier Wall (Structure) measuring 4 feet high of similar length and width as the panels to be constructed. These panels of noise barrier walls shall be of the same color and pattern as the Noise Barrier Wall (Structure) to be constructed. These noise barrier wall panels shall be delivered and unloaded at a recommended D.O.T. Maintenance Facility that will be ultimately responsible for the maintenance of the Noise Barrier Walls.

Other:

All other materials shall conform to the requirements as indicated on the approved Working Drawings of the specific system of Noise Barrier Wall (Structure) selected for the project.

Construction Methods:

Design:

The Noise Barrier Wall (Structure), including all structural supports such as but not limited to, reinforced concrete parapets, barrier curbs, columns, piles, caissons and footings, anchor bolts, and structural steel columns, beams, bolts and plates for the framing and support of the noise barrier wall, shall be designed for the most severe combination of gravity and lateral loads in accordance with the AASHTO LRFD Bridge Design Specifications, 7th edition with interim revisions up to and including 2016 and the Standard Specifications for Highway Bridges (AASHTO – 2002 with Interim Specifications up to and including 2003).

At the specific locations shown on the Contract Drawings containing the concrete-type Noise Barrier Wall (Structure), the entire length of the wall must be fully supported along the bottom panel, with a structural steel beam that spans between steel columns. The steel beam on either side of the column must frame onto the column so as to impose a stabilizing dead load on the assembly against overturning from lateral loads. All steel components of the structural system supporting the Noise Barrier Wall (Structure), including but not limited to beams, columns, base plates and anchor bolts shall be galvanized after fabrication.

The visible sections of the Noise Barrier Wall (Structure) shall have the same color, pattern, texture and height of individual panels as that of the adjacent sections of Noise Barrier Wall in the Highway portions of the project, unless otherwise specified in the Contract Drawings or this

Specification. Post covers or other devices supplied by the manufacturer and approved by the Engineer shall be installed on both sides of the noise barrier wall (structure) in accordance with manufacturer's requirements over all noise barrier wall (structure) posts the full visible length of the noise barrier wall (structure) system.

At a minimum, the top of the Noise Barrier Wall (Structure) shall be at the Top of the Wall Elevations shown on the Contract Drawings.

The bottom panel of the Noise Barrier Wall (Structure) shall have a minimum height of 4 feet.

The Noise Barrier Wall (Structure) shall also be designed in accordance with the manufacturer's requirements, details and specifications for the type of wall chosen if proved that such design parameters are consistent with, or more adequate and stringent than the design requirements established in this Specification or in the Contract Drawings, and if reviewed and approved by the Engineer.

The concrete Noise Barrier Wall (Structure) shall have an integral cap with a maximum height of 6" on the top panels. The caps shall be cast with a sound-absorptive material.

The horizontal joint lines between panels in Noise Barrier Wall (Structure) shall match for a minimum distance of 60 feet. If steps-up are required in cases of significant changes in grade, the elevation difference between the horizontal joints of adjacent panels shall not be less than 3" or greater than 12". These requirements shall also apply to the top elevations of the walls. Strict adherence to these requirements may be waived at angle breaks greater than 30 degrees or as approved by the Engineer.

When a particular type of noise barrier wall transitions into a different type, or when a segment of noise barrier wall transitions onto an adjacent segment as necessitated by geometric offset on plan and/or elevation or by the differences in the support structures, or as indicated in the Contract Drawings, the Contractor shall be responsible for the design of the transition and connection components of the noise barrier wall systems.

All longitudinal gaps between the noise barrier wall panels and the top of parapets must be provided with auxiliary members to close such gaps and prevent the escape of noise. The system or mechanism to prevent the escape of noise through these gaps must be designed by the manufacturers of Noise Barrier Wall (Structure) and be clearly detailed in the Contractor's Working Drawings. The design and detail drawings must take into account the relative movements between the noise barrier wall panels and parapets.

The minimum distance from centerline of post to an expansion or construction joint shall be no less than 24". Post covers shall be installed on both sides of the noise barrier wall (structure).

The structural design of Noise Barrier Wall (Structure) shall take into account any expansion and contraction movements of the various framing components and supporting structures due to changes in temperature, most especially at locations in proximity with expansion joints at the

bridge deck and parapets. A thermal expansion and contraction of not less than 1 ½ inches of the bridge deck, bridge parapets and wingwall parapets at all existing expansion joints must be accounted for in the design. Provisions to account for the localized and global effects of these temperature-induced movements in the design of the various framing components and supporting structures must be explicitly detailed in the Contractor's Working Drawings.

Submittals:

The Contractor shall be fully responsible for the structural design, preparation of drawings and conformance to all additional specifications required for the selected Noise Barrier Wall (Structure). The Designer or Responsible Engineer shall have at least Five (5) years of professional experience in the structural design of the afore-mentioned types of noise barrier walls. All drawings to be submitted by the Contractor shall conform to Section 1.05.02 regarding Working Drawings with the following additions:

Preliminary Submissions for Proprietary Noise Barrier Wall (Structure): Prior to the start of fabrication or the construction of the Noise Barrier Wall (Structure), the Contractor shall submit to the Engineer a design package, which shall include six (6) sets of Working Drawings and four (4) sets of Structural Design Calculations for review and approval by the Engineer in accordance with Article 1.05.02 The design package shall include, but not be limited to the following:

Working Drawings and Structural Design Calculations:

1. Plans shall be submitted in a PDF format.
2. All Plans and Computations to be submitted to the Engineer shall be stamped by a licensed Professional Engineer in the State of Connecticut, who shall also be available for consultation in interpreting his computations and drawings, and in the resolution of any issues that may occur during the performance of his work.
3. Full Plan View, drawn to scale, of the Noise Barrier Wall. This view shall show:
 - a Beginning and end of the wall, as well as any angle points;
 - b Posts shall be identified, numbered and located with the proposed coordinates;
 - c Roadway baseline with 100-ft stations labeled;
 - d Location of existing and/or proposed cantilever and truss sign supports, if any;
 - e Location of existing and/or proposed utilities. (Any existing utilities which are shown on the plans should be verified in the field.)
4. Full Elevation View (Roadway side), drawn to scale, of the Noise Barrier Wall, and including:
 - a Elevations of the finished top and bottom of the Noise Barrier Wall panels at all locations;
 - b Panel sizes;

- c Location of horizontal angle points;
 - d Post lengths.
 - e Transitions between different wall styles or types;
 - f The approximate locations of 100-ft. baseline stations (perpendicular);
 - g Location of access for fire hoses or other appurtenances as applicable.
5. Drawings shall include Plans, Details and Sections for the following:
- a Representative wall panels showing the pattern, color, and texture of the proposed Noise Barrier Wall
 - b Any individualized design panel depicting pattern, dimensions, depth of pattern, textures, and colors
 - c Footings for all expected soil conditions (soil, rock, partial soil/rock)
 - d Attachment and anchorage of the Noise Barrier Wall gravity and lateral loads resisting systems onto the parapets of the existing bridge and wingwalls or onto new concrete columns, considering:
 - i. Anchor bolts in sustained tension loading must not be installed in a chemical anchoring material.
 - ii. Show arrangement of anchor bolts on plan and section.
 - iii. Consideration of tolerances for the locations of Noise Barrier Wall posts relative to locations of expansion joints in the parapets.
 - iv. Details and methods for eliminating gaps between the parapet top and side with the Noise Barrier Wall panels.
 - v. Allowable installation tolerances for posts including allowable variations of horizontal spacing and from plumb.
 - e New columns and footings supporting the Noise Barrier Wall gravity and lateral loads resisting systems
 - f Transition between different wall styles or types
 - g Transition between walls at geometric offset on plan and elevation
 - h Transition between walls on different supporting structures
 - i Provisions for temperature expansion and contraction in the wall support systems.
 - j Methods of protection of any existing utilities, facilities and sub- structures during the construction of the Noise Barrier Wall
 - k Any false-work required to temporarily support the components during construction.
 - l Construction and installation procedures
 - m Allowable fabrication tolerances for wall panels and posts
 - n Details for covering noise barrier wall posts with manufacturer supplied post covers or other approved devices.
6. Calculations shall include:
- a Computations shall clearly comply with and reference applicable AASTHO provisions.
 - b Structural design for the footings/foundations for the Noise Barrier Wall, modeling all expected soil conditions (soil, rock, and partial soil/rock).

- c. Structural design for the support and framing systems of the Noise Barrier Wall for the combination of gravity and lateral loads (wind and seismic).
- d. Structural design for the attachment and anchorage of the support and framing systems of the Noise Barrier Wall for the combination of gravity and lateral loads (wind and seismic).
- e. Structural design for the gravity and lateral (wind and seismic) load resisting systems of the Noise Barrier Wall.
- f. Documentation of computer programs utilized, including all design parameters.

Final Submissions of Noise Barrier Wall (Structure) Drawings:

Once the Working Drawings for the Noise Barrier Wall (Structure) have been reviewed and accepted by the Department, the Contractor shall submit the Final Plans. The final submission shall be made within 14 days of acceptance by the Department. No work shall be performed on the walls until the final submission has been received. Acceptance of the final design shall not relieve the Contractor of his responsibility under the Contract for the successful completion of the work.

Construction Specifications:

1. Construction tolerances, methods and material specifications specific to the noise barrier walls chosen shall be provided to the Department. Submittal requirements for materials such as certification, quality, and acceptance/rejection criteria should be included.
2. Any requirements from the Manufacturer specific to the noise barrier wall that are not stated herein shall also be included.

Tolerances:

All noise barrier wall components shall conform to the following:

Posts

Post Dimension Tolerances:

1. Post Height = $\pm 1/2$ " Post Vertical Sweep:
2. Posts $\leq 16'$ long = $\pm 1/8$ "
Posts $> 16'$ long = $\pm 1/4$ "

Post Installation:

1. In horizontal plane from plan location = ± 1 "
2. In horizontal plane from center of cylindrical footing = ± 1 "
3. In horizontal plane from adjacent post = $\pm 1/2$ "
4. Post plumb = $\pm 1/8$ " per 10' of wall height

Panels

Panel Dimension Tolerances:

1. Panel Length and Height = $\pm 1/4$ "
2. Panel Structural Thickness = $\pm 1/4$ "
3. Panel Absorptive Material Thickness = $\pm 1/4$ "
4. Panel Horizontal Sweep = $\pm 1/8$ "
5. Panel Vertical Sweep = $\pm 1/8$ "

Position of Lifting Inserts:

1. Along Panel Length = ± 1 "
2. Along Panel Thickness = $\pm 1/4$ "

Reinforcing Steel Tolerances:

1. Splice = +1" from Standard Lap Splice Requirement
2. Concrete Cover = +2

Other

There shall be no openings in the wall or under the wall, which would allow sound transmission.

Fabrication of Panels:

Textured Surface Treatment: Formed surfaces other than the exposed face shall not require a textured finish. The textured surface finish shall be similar and consistent in material and construction with that of the Highway portion of Noise Barrier Wall in the project.

If the proposed noise barrier wall is being used to replace an existing noise barrier wall, the top of the proposed noise barrier wall shall be constructed to no lower than the top elevation of the existing wall or as shown on the Contract Plans, or unless specifically noted otherwise.

Unexpected Obstructions:

If during construction, the avoidance of unexpected or unforeseen obstructions requires the revision of portions of the original design, the Contractor shall provide a revised design of the affected portions for review and written approval by the Engineer.

The Contractor shall schedule its construction operations such that access to the areas behind the walls would not be required in the performance of the remainder of the work once access has been rendered difficult or inexpedient. The Contractor, having caused its own access to be restricted or limited, as a result of prioritizing to finish grades, stabilize slopes or establish turf ahead of the other work, shall not be permitted to use any of these circumstances as a reason to not perform or finish the required work. Should the Contractor need access to these areas, the additional work to re-establish grades, re-establish slopes, re-establish turf or any work to restore the ground to a finished condition as shown in the Contract Drawings, shall be performed at the sole expense of the Contractor.

The Contractor shall restore all ground beyond the established Limits of Disturbance, if disturbed

by the construction of the noise barrier walls. The ground restoration shall be in accordance with the proposed finished condition shown in the Contract Drawings. The Contractor shall remove all excess materials from the site.

Prior to any excavation, the Contractor shall field-verify the location of all existing utilities, sewers and culverts shown on the Contract Plans. Should a sewer, or culvert be damaged by the Contractor's omission or negligence, the Contractor shall replace the damaged sections at its own cost.

On-Site Representative:

A qualified and experienced representative from the manufacturer of noise barrier wall shall be present at the site during the start of construction to assist the Contractor and the Engineer. The representative shall also be available for consultation on an as-needed basis, if requested by the Contractor or the Engineer.

Installation:

All panel units shall be installed in accordance with the Manufacturer's recommendations by an Installer who is duly qualified, approved and certified by the Manufacturer to perform the work, and who exhibits reasonable familiarity and experience for the type of work involved in the installation of Noise Barrier Wall (Structure) described in this Specification and Contract Drawings.

Special care shall be taken to properly set the bottom panel units true-to-line and grade. All bottom panel units shall have a minimum height of 4 feet.

The assembly of the various components shall be performed in such a manner that no undue strain or stress is placed on any of the members that constitute the completed structure.

Inspection and Rejection:

Marking: The date of manufacture, the production lot number, and the piece-mark shall be clearly marked on the side of each panel or module.

The quality of materials, the process of manufacture, and the finished units shall be subject to inspection by the Engineer prior to shipment.

Panels with textured surface treatments shall be rejected if the exposed face deviates from the look of the approved model as to color or texture as determined by the Engineer.

Acceptance Criteria for Sound Barrier Wall (Structure):

Precast components shall be accepted for use in wall construction provided the concrete strength

meets or exceeds the minimum compressive strength requirement, and the panel or module dimensions are free from any chipping, cracks, honeycomb surface treatment, open texture concrete, broken corners or other defects as determined by the Engineer.

The Contractor shall be responsible for ensuring a completed sound barrier wall system free of discoloration, cracks or objectionable marks which may adversely affect the barriers performance, aesthetics, or serviceability as determined by the Engineer. All panels that exhibit any form of structural damage, as determined by the Engineer, will be rejected without any cost to the Department, either at the fabrication shop or at the construction site, even after installation, but prior to acceptance of the job.

Panels with textured surface treatments shall be rejected if the color and texture on the exposed faces deviate, or show variations from the approved model, as determined by the Engineer.

Rejected panels deemed to require repair or replacement shall be replaced at the Contractor's expense. No payment shall be made for removing, temporarily storing, or re-installing panels to enable access to the panel to be replaced. Any panels that are damaged during panel replacement shall also be replaced or repaired per the direction of the Engineer. Any work to stabilize areas adjacent to the wall required due to replacement of cracked or damaged panels shall be done at the Contractor's own cost.

Method of Measurement:

Noise Barrier Wall (Structure) shall be measured for payment by the number of square feet of Noise Barrier Wall (Structure) completed and accepted within the limits indicated on the plans or as ordered by the Engineer and shall be measured from center to center distance between vertical columns supporting each wall panel. The vertical pay limit shall be measured from the bottom to the top of the barrier panel section. Each span between columns shall be measured for payment separately, as stepping may be required.

The two (2) full panel sections of Noise Barrier Wall (Structure) delivered to the D.O.T. Maintenance Facility shall be measured and paid for as Noise Barrier Wall (Structure) (sq ft)

Basis of Payment:

Payment for this work will be made at the Contract unit price per square foot for Noise Barrier Wall (Structure) complete in place, which price shall include engineering and design, on-call and on-site services of the representative from the wall manufacturers, all work and materials used for the fabrication, complete installation and construction of the walls, facing panels, excavation, grading, disposal of surplus material, equipment, tools, labor and work incidental to the installation of the wall.

Payment shall also include the cost for all materials and labor for the construction of concrete columns and footings as designed by the Contractor and the retrofit of the existing retaining wall if found structurally inadequate for the addition of new loads as designed by the Contractor.

Payment shall also include the pigmentation and coatings of the walls.

No payment shall be made for survey, field-verification work and the preparation of working drawings.

No additional payment will be made for the delivery of the additional panels to the DOT Maintenance Facility but the cost thereof shall be included in the unit cost for this item.

PAY ITEM

PAY UNIT

Noise Barrier Wall (Structure)

s.f.

ITEM #0916126A – NOISE BARRIER WALL

ITEM #0916127A – NOISE BARRIER WALL (EARTH RETAINING PANELS)

ITEM #0916219A – ROCK IN POLE EXCAVATION

Section 9.16 Noise Barrier Wall is hereby deleted in its entirety and replaced with the following:

Description:

Work under this item shall consist of designing, fabricating, furnishing and erecting noise barrier wall systems in the locations, elevations, and dimensions shown on the plans, and in accordance with these specifications or as directed by the Engineer. Specific types of walls may be required by the Contract drawings; the Contractor may select any one of the types listed and detailed on the plans.

Materials:

The noise barrier wall system chosen shall be selected from the list provided in this specification. This will identify all noise barrier wall systems that are considered appropriate and acceptable for each specific project site. This does not warrant that all listed noise wall systems can be designed to meet either the dimensional, structural, or geotechnical constraints at each site.

Within Thirty (30) days after the bid opening, the Contractor shall identify by the type and name, in his proposal, the specific type of the wall for each location upon which his bid is based. All noise barriers selected for each location shall be furnished from the same system and shall be on the same type pattern and color.

All materials for the noise barrier walls shall comply with the FTA's Buy America requirements in 49 USC & & 5323(j) and 49 CFR Part 661.

The General List shown in this Specification identifies the acceptable systems of Noise Barrier Wall of the absorptive type for use in this Project:

1. Durisol - NB15

Durisol
8270 Greensboro Drive, Suite 810
McLean, VA 22102
(302) 299-6821
andrew.weaver@durisol.com
www.durisol.com

2. Whisper Wall

Concrete Systems, Inc.
9 Commercial Street
Hudson, NH 03051
(800) 342-3374 EXT. 409
Email: tgarcia@csigroup.com
www.whisper-wall.com

3. Soundsorb

Concrete Solutions, Inc.
3300 Bee Cave Road, Suite 650
Austin, TX 78746
(512)736-6447
Email: csi@soundsorb.com
www.soundsorb.com

4. JBM75

JBM Solutions
P.O. Box 4861
Pinehurst, NC 28374
(703) 861-9004
Email: jmcneal@jbm75.com
www.jbm75.com

Some of these walls are specifically suited for use in special locations where there are structural concerns, or the surrounding area warrants a certain type or style of wall to be used.

Material(s) used for the noise barrier wall shall durable, and not prone to developing openings, cracks or gaps from loading, warping, splitting, shrinkage, delamination, or weathering. Noise barrier wall panels shall be U.V. resistant, flame retardant, and resist degradation from ozone, hydrocarbons and freeze/thaw cycling. The sound absorbing portions of the wall shall be durable, resistant to erosion of material and damage from moderate abrasion. The noise barrier wall shall have a minimum 20-year life cycle free from peeling, rotting or visible deterioration.

Absorptive noise barrier wall(s) shall be able to provide a minimum Sound Transmission Class (S.T.C.) rating of 34 measured by ASTM E90. The Noise Reduction Coefficient (N.R.C.) shall have a minimum rating of 0.70, as measured by ASTM C423 and E 795.

Specific textured surface patterns have been approved for use by the Department. The selected textured surface patterns shall match the textured surface pattern used on surrounding noise barrier walls. Other patterns will not be acceptable.

The noise barrier wall shall have a textured absorptive surface pattern on both sides if not noted otherwise in the contract drawings. The selected patterns shall be submitted to the Engineer for approval. Post covers, panel caps, bottom panel or other devices shall be supplied by the manufacturer and approved by the Engineer. They shall have the same color, textured surface pattern, and absorptive properties as the rest of the noise barrier wall panels.

The color of the noise barrier wall exposed to traffic will be indicated on the plans, conforming to Federal Standard 595 Colors except if specified otherwise on the Contract plans. Only one color may be used on the wall components to maintain uniformity, except where specified otherwise on the Contract plans.

<u>Federal Standard 595 Color No.</u>	<u>Color</u>
FS 36492	Gray
FS 36622	Gray
FS 34230	Green
FS 30215	Brown

The noise barrier wall panels shall be integrally-pigmented (meeting the requirements of ASTM C979,) a significant depth into its cross-section so as to produce a uniform color should the panel become scratched, chipped or otherwise surface damaged. Variation in color or shading from panel to panel shall not be acceptable during construction. Field staining or painting to achieve a uniform overall color is not allowed during construction.

Individualized design panels may vary from standard noise barrier wall colors, textures, and patterns, as depicted in the Contract drawings.

The manufacturer of the noise barrier wall shall provide an aesthetic coating warranty to the Department of Transportation for a minimum of 10 years.

The noise barrier wall shall have a suitable surface for repainting, staining, sandblasting or other acceptable method of returning panels to their original color and texture should it become damaged after construction. Touching up, restaining, repainting, or sandblasting portions of the panel shall not result in visible color variation. Additionally, the noise wall manufacturer shall supply the Department with 25 gallons of matching color paint or stain to repair surface damage or vandalism. The matching color paint or stain shall be supplied along with the supplier name, wall location, project number, and a color identification number.

The Contractor shall also supply four (4) full panel sections of noise barrier wall, measuring 4 feet high each to the Department. These sections of noise barrier wall shall be of the same color and pattern as the noise barrier wall. The Contractor shall deliver and unload the materials at the recommended D.O.T. Maintenance Facility. The noise wall sections and matching color paint/stain shall be delivered and unloaded at the recommended D.O.T. Maintenance facility that will be ultimately responsible for the noise barrier wall.

Reinforcing steel shall conform to the requirements of Article M.06.01. Additionally, all steel components, including fasteners and anchor bolts shall be completely hot-dip galvanized, after fabrication, in accordance with ASTM A123 or ASTM A153, as applicable. Zinc-rich field primer for touch up shall conform to the requirements of ASTM A780. The use of aerosol spray cans shall not be permitted.

Concrete for footings shall have a minimum 28-day compressive strength f'_c , of 4400 psi and conform to the requirements of Article M.03.01.

Wall sections which are mounted on a structure or used to maintain a grade difference on each side of the wall (earth retaining panels), as identified in the Contract drawings shall be designed and manufactured for those purposes. Specific calculations and details will be required when these types of walls are specified. Noise Barrier Wall mounted on a structure shall conform to the requirements of the special provision for "Noise Barrier Wall (Structure)."

Noise Barrier Wall (Earth Retaining Panels) (additional requirements):

Earth retaining panels produced by the noise wall manufacturer will be allowed where specified in the Contract Drawings, where the grade difference between the front and back of the noise barrier wall does not exceed 4 feet.

Noise barrier wall (earth retaining panels) shall have the same color, pattern, and textured absorptive surface pattern on both sides as the other sections of noise barrier wall. Integrated sections shall be designed and reinforced to withstand any earth retaining lateral loads. Other necessary materials such as drainage holes, subdrain, filter fabric, or stone necessary to properly construct the integral retaining wall shall conform to manufacturer's specifications.

Other:

Rock in so far as it applies to "Rock in Pole Excavation" shall be defined as rock in definite ledge formation, boulders or portions of boulders, cement masonry structures, concrete structures, old noise wall footings or portland cement concrete pavement having a cross-sectional area that exceeds 50% of the cross-sectional area of the designed noise barrier wall upright support hole.

Crushed Stone is required to be placed under or adjacent to the noise barrier wall along the full length of the barrier for drainage and erosion control and shall conform to No. 3 Crushed Stone per Article M.01.01.

Backfill for Noise Barrier Wall (Earth Retaining Panels) shall be suitable surplus excavation taken from within the Project limits and shall not contain any material which passes a No. 200 sieve. Backfill shall be placed in accordance with Section 2.02 of the Standard Specifications.

All other materials shall conform to the requirements as indicated on the individual noise barrier wall plans and approved working drawings.

Experience:

The Noise Barrier Wall Designer shall submit to the Engineer documentation specifying a minimum of five years of experience designing the type of Noise Barrier Walls specified in the Contract Plans. The Contractor shall submit to the Engineer evidence of experience constructing Noise Barrier Walls. This documentation needs to be reviewed and approved by the Engineer prior to commencing the design of the Noise Barrier Walls.

Construction Methods:

Design:

Noise barrier walls shall be designed in accordance with the AASHTO LRFD Bridge Design Specifications, 8th edition dated 2018

The noise barrier wall shall also be designed in accordance with the manufacturer's requirements, details and specifications for the noise barrier chosen.

Post covers or other devices supplied by the manufacturer and approved by the Engineer shall be installed on both sides in accordance with manufacturer's requirements over all noise barrier wall posts the full length of the noise barrier wall system.

General Design Requirements:

The top of the noise barrier wall shall be at the top of the wall elevations (at a minimum) shown on the Contract drawings.

The bottom panel shall be a minimum height of 60 inches and shall be precast reinforced concrete. It will have the same color, pattern, and textured absorptive surface pattern on both sides as the other sections of noise barrier wall.

If the Contractor is required to use different types of wall, or transition at structures, based on the Contract plans, he shall design the transition or connection of the two types.

Noise Barriers shall have a reinforced integral cap with a maximum height of 6" on the top panels. Caps shall be cast with sound absorptive material.

For aesthetic purposes, except in cases of significant changes in grade, horizontal joint lines between panels shall match for a minimum distance of 60 feet, and if steps are required, the elevation difference between the horizontal joints of adjacent panels shall not be less than 3" or greater than 1'-0". These requirements shall also apply to the top elevation of the noise barrier wall. Strict adherence to these requirements is not necessary at angle breaks greater than 30 degrees or as approved by the Engineer.

Crushed stone shall be placed adjacent/under the noise barrier wall as depicted in the Contract Drawings to allow for cross drainage from one side of the wall to the other, to prevent erosion, or to function as a splash pad.

Submittals:

The Contractor is fully responsible for the design, detailing and additional specifications required for the selected noise barrier wall. All submitted drawings shall conform to section 1.05.02 regarding working drawings with the following additions:

Preliminary Submissions for Proprietary Noise Barrier Walls:

Prior to the start of fabrication or noise barrier wall construction, the Contractor shall submit to the Engineer a design package, which shall include six (6) sets of working drawings and four (4) sets of design calculations for review in accordance with Article 1.05.02. The design package shall conform, but not be limited to the following:

Detailed Plans and Computations:

1. Plans shall be submitted by PDF.
2. All submittals (plans and computations) shall be stamped by a licensed Professional Engineer in the State of Connecticut, who shall also be available for consultation in interpreting his computations and drawings, and in the resolution of any problems, which may occur during the performance of his work.
3. Full plan view of the noise barrier wall, drawn to scale. This view shall show:
 - a. Beginning and end of the wall, as well as any angle points;
 - b. Posts shall be identified and numbered, with proposed coordinates of where each post will be placed;
 - c. Roadway baseline with 100-ft stations labeled;
 - d. Location of existing and/or proposed cantilever and truss sign supports;
 - e. Location of existing and/or proposed drainage systems/utilities. (Any existing drainage systems and/or utilities which are shown on the plans should be field verified.)
4. Full elevation view (roadway side) of the noise barrier wall, drawn to scale, and including:
 - a. Elevations of the finished top and bottom of the noise barrier wall panels at all locations;
 - b. Finished grade against the wall (on both sides);
 - c. Panel sizes;
 - d. Location of horizontal angle points;
 - e. Post length and post embedment dimension.
 - f. Transitions between different wall styles or types;
 - g. The approximate locations of 100' baseline stations (perpendicular);
 - h. Location of access for fire hoses or other appurtenances as applicable.
5. Details shall include:
 - a. Detail and description of the pattern, color, and texture of the proposed noise barrier wall;
 - b. Details for any individualized design panel depicting pattern, dimensions, depth of pattern, textures, and colors;
 - c. Details for noise barrier wall foundations/footings, for all expected soil conditions (soil, rock, partial soil/rock);
 - d. Transitions between different wall styles or types;

- e. Details for excavating holes for foundations including drilling and dewatering methods (if required);
 - f. Reinforcement details for the bottom precast concrete panel;
 - g. Details of stepped installations on longitudinal slopes (as required);
 - h. Detail for methods of constructing the noise barrier wall in the vicinity of any existing or proposed drainage systems in the vicinity of the wall;
 - i. Detail for methods of protection of the existing facilities during the construction of the noise barrier wall;
 - j. Drainage details:
 - i. Crushed stone placed adjacent to and/or under the wall panels where proposed on the Contract;
 - ii. Provisions for swaling longitudinally along walls;
 - iii. Structural drainage systems for transporting runoff from one side of the wall to the other side for noise barrier walls and for earth retaining panels;
 - k. Details of any falsework required to temporarily support the components during construction.
 - l. Details for covering noise barrier wall posts with manufacturer supplied post covers or other approved devices.
6. Plans shall also include:
- a. Specifications for all materials used in the construction of the noise barrier wall system;
 - b. Detailed construction and installation procedures;
 - c. Allowable fabrication tolerances for wall panels and posts;
 - d. Allowable installation tolerances for posts, including for allowable variations of horizontal spacing and from plumb.
7. Calculations shall include:
- a. Computations shall clearly comply with and reference applicable AASTHO provisions;
 - b. Calculations for the noise barrier wall foundations/footings, modeling all expected soil conditions (soil, rock, partial soil/rock);
 - c. Calculations for vertical loading of the bottom precast concrete panels (supported on the ends with a uniform load of the total panel weight above.)
 - d. Documentation of computer programs utilized, including all design parameters;
 - e. Computations for earth retaining panels shall conform to the latest edition of the AASHTO Standard Specifications for Highway Bridges including the latest Interims published except as noted herein. Additionally:
 - i. Earth retaining panels will only be allowed where the grade difference between the front and back of the noise barrier wall does not exceed 4 feet;
 - ii. Noise barrier walls with earth retaining panels shall be designed for a minimum 5-foot embedment;
 - iii. Consider a minimum live load surcharge equal to two feet of soil at a unit weight of 125 pounds per cubic foot. If there are a specific live load surcharges, acting on the wall, they shall also be accounted for;

- iv. The minimum equivalent fluid pressure used to design the wall shall be 33 pounds per cubic foot per linear foot of wall.
- v. Earth retained noise barrier wall sections backfill material shall be suitable surplus excavation taken from within the Project limits and shall not contain any material which passes a No. 200 sieve. Backfill shall be placed in accordance with Section 2.02.

Final Submissions of Noise Barrier Wall Drawings:

Once the working drawings have been reviewed and accepted by the Department, the Contractor shall submit the final plans. The final submission shall be made within 14 days of acceptance by the Department. No work shall be performed on the wall until the final submission has been received. Acceptance of the final design shall not relieve the Contractor of his responsibility under the Contract for the successful completion of the work.

One CD containing the final approved drawings in .pdf format and five (5) sets of full-size paper copies shall be submitted for final working drawings and shop drawings for the Department's use and permanent records. Submissions in electronic format shall be created on ANSI D (22' x 34" full scale (1" electronic file = 1" paper) sheets. The purpose of creating these drawings on ANSI D sheets is so that they may be printed/plotted at that size or smaller without loss of legibility.

Construction Specifications:

- 1. Construction tolerances, methods and material specifications specific to the noise barrier walls chosen shall be provided. Submittal requirements for materials such as certification, quality, and acceptance/rejection criteria should be included.
- 2. Any manufacturer requirements specific to the noise barrier wall not stated herein shall also be included.

Tolerances:

All noise barrier wall components shall conform to the following:

Posts:

Post Dimension Tolerances:

- 1. Post Height = +1/2" Post Vertical Sweep:
- 2. Posts < 16' long = +1/8" 2. Posts > 16' long = +1/4"

Post Installation:

- 1. In horizontal plane from plan location = +1"
- 2. In horizontal plane from adjacent post = +1/2"
- 3. Post plumb = +1" per 10' of wall height

Panels:

Panel Dimension Tolerances:

1. Panel Length and Height = +1/4"
2. Panel Structural Thickness = +1/4"
3. Panel Absorptive Material Thickness = +1/4"
4. Panel Horizontal Sweep = +1/8"
5. Panel Vertical Sweep = +1/8"

Position of Lifting Inserts:

1. Along Panel Length = +1"
2. Along Panel Thickness = +1/4"

Reinforcing Steel Tolerances:

1. Splice = +1" from Standard Lap Splice Requirement
2. Concrete Cover = +2"

Other:

There shall be no visible openings in the wall or under the wall, which would allow sound transmission.

Fabrication of Panels:

Textured Surface Treatment: Formed surfaces other than the exposed face shall not require a textured finish. If a textured surface finish is proposed for the wall, before proceeding with production, two (2) noise barrier wall panel samples (matching in surface treatment and color) shall be created:

1. One 24" x 24" x full thickness shall be provided by the fabricator for the Engineer's approval of color and surface treatment(s). Regular panel production may not commence without the Engineer's approval;
2. One full width x full thickness x four (4) feet high model panel, to use as a guide and standard for the color and finish to be furnished on production panels. This model panel shall be kept at the fabricator's plant to be used for comparison purposes during production. It may be used on the project at the end of precasting operations with permission from the Engineer.

If the proposed noise barrier wall is being used to replace an existing noise barrier wall, the existing wall(s) shall be removed and properly disposed of. All permits for its disposal shall be obtained by the Contractor and included in the cost. In this case, the proposed noise barrier wall shall be constructed no lower than to the top elevation of the existing wall or as shown on the Contract plans unless specifically noted otherwise.

Unexpected Obstructions:

Prior to driving piles, the Contractor shall field verify the location of all existing utilities, sewers

and culverts shown on the Contract plans. Should a sewer, or culvert be damaged by the Contractor's omission or negligence, the Contractor shall replace the damaged sections at his own cost.

If during construction, the avoidance of unexpected utilities, drainage or other obstructions requires the use of closer post spacing than that shown on the Contract plans, the Contractor shall furnish additional foundations, posts, and panels as directed by the Engineer. The additional foundations, posts, and panels shall conform to the Contract documents and other approved drawings and specifications. Field cutting of posts or panels will not be accepted.

For noise barrier walls installed on grade, the posts shall be driven unless alternate methods are proposed by the noise barrier wall designer and approved by the Engineer.

The Contractor shall plan his operations such that access is not required to areas behind the wall once access is difficult or once these areas have been stabilized. The Contractor, having caused his own access to be restricted, through finished grades or stabilized slopes shall not be allowed to use this as an acceptable reason to not perform required work. Should the Contractor need access to these areas, all reestablishment of grades, stabilizing slopes, or turf establishment shall be done at his own cost.

All ground beyond the limits disturbed by the installation of the wall shall be restored to its proposed finished condition and all excess material shall be removed from the site.

On Site Representative:

A qualified and experienced representative from the wall supplier shall be at the site at the initiation of the wall construction to assist the Contractor and the Engineer. The representative shall also be available for consultation on an as needed basis, as requested by the Contractor or the Engineer.

Installation:

Panel units shall be installed in accordance with manufacturer's recommendations. Special care shall be taken in setting the bottom course of units properly and to true line and grade.

Assembly of the various components shall be performed in such a manner that no undue strain or stress is placed on any of the members that constitute the completed structure.

Tolerance of driven posts shall be 1" in any two directions from the proposed pile location. If a post becomes driven off-line the post shall be re-aligned to obtain the desired tolerance.

Inspection and Rejection:

Marking: The date of manufacture, the production lot number, and the piece-mark shall be clearly marked on the side of each panel or module.

The quality of materials, the process of manufacture, and the finished units shall be subject to inspection by the Engineer prior to shipment.

Panels with textured surface treatments shall be rejected if there are variations in the exposed face that deviates from the approved model as to color or texture as determined by the Engineer.

Acceptance Criteria for Noise Barrier Wall:

Precast components shall be accepted for use in wall construction provided the concrete strength meets or exceeds the minimum compressive strength requirement, and the panel or module dimensions are free from any chipping, cracks, honeycomb surface treatment, open texture concrete, broken corners or other defects as determined by the Engineer.

The Contractor shall be responsible for ensuring a completed sound barrier system free of discoloration, cracks or objectionable marks which may adversely affect the barriers performance, aesthetics, or serviceability as determined by the Engineer. All structurally cracked panels, as determined by the Engineer, will be rejected either at the fabrication shop or at the construction site, even after installation, but prior to acceptance of the job.

Rejected panels deemed to require repair or replacement shall be replaced at the Contractor's expense. No payment shall be made for removing, temporarily storing, or reinstalling panels to enable access to the panel to be replaced. Any panels which are damaged during panel replacement shall also be replaced or repaired per the direction of the Engineer.

Method of Measurement:

Noise barrier wall and noise barrier wall shall be measured for payment from center to center of each vertical column supporting the wall by the number of square feet of wall system completed and accepted within the limits indicated on the plans or as ordered by the Engineer.

The vertical pay limit shall be from the bottom of the barrier panel section to the top of the barrier panel. Each span between columns shall be measured for payment separately, as stepping may be required.

Noise barrier wall (earth retaining panels) shall be measured for payment by the actual number of square feet of Noise barrier wall (earth retaining panels) installed and accepted. The vertical pay limit for each panel section shall extend from the bottom of the lowest panel, up to the top of the barrier panel above, specifically identified and constructed to retain earth.

Work or features for underdrainage associated with noise barrier wall (earth retaining panels) such as sweep holes, underdrains, filter fabric, pervious structure backfill, and stone backfill for

pipng shall not be measured for payment but included in the item: Noise barrier wall (earth retaining panels).

Rock in so far as it applies to "Rock in Pole Excavation" shall be defined as rock in definite ledge formation, boulders or portions of boulders, cement masonry structures, or existing concrete structures. Where rock is encountered, it will be measured for payment from the top of the rock to the bottom of the necessary rock excavation when such rock has a cross-sectional area that exceeds 50% of the cross-sectional area of the designed noise wall upright support hole. Concrete required to fill the excavation beyond the designed support hole diameter or depth will not be measured for payment.

Matching color paint or stain shall not be measured for payment but included in the price for the noise barrier wall.

The four (4) full panel sections of noise barrier wall delivered to the D.O.T. Maintenance Facility, shall be measured and paid for as Noise Barrier Wall (sq ft).

Crushed Stone used under and/or adjacent to the Noise barrier wall shall not be measured for payment but included in the price for the noise barrier wall.

Basis of Payment:

Payment for this work will be made at the Contract unit price per square foot for Noise Barrier Wall and Noise barrier wall (earth retaining panels complete in place, which price shall include engineering, all materials utilized for the fabrication and installation of the wall itself (panel sections, stepping blocks, anchoring mechanisms, support columns and all necessary hardware), facing panels, excavation, grading, disposal of surplus material, equipment, tools, labor and work incidental to the installation of the wall. Payment shall also include the pigmentation of the wall and coatings.

Any additional material ie: fill, reuse or borrow necessary to construct an access road, temporary pads or any other method for the removal of noise barrier wall or the installation of any portion of the noise barrier wall will not be measured for payment but included in the item or in the overall cost of the work.

This extra material shall be disposed of at no additional cost to the State. Final grades in the front and back of the wall will conform to the proposed cross sections and final approved working drawings.

When rock is encountered within the limits of excavation for vertical supports, its removal will be paid for at the Contract unit price per vertical foot for "Rock in Pole Excavation," which

price shall include any additional excavation to remove the rock and any additional concrete required to fill the excavation beyond the designed pier hole diameter or depth.

Additional foundations, posts, and panels required due to unexpected field changes of the approved design directed by the Engineer shall be paid for at the square foot Contract price for that item.

No payment shall be made for weepholes, subdrainage, filter fabric or stone backfill for underdrainage associated with the noise barrier wall (earth retaining panels). These items shall be included in the cost of the wall.

No payment shall be made for survey, field verification, preparation of working drawings or for paint or stain required to repair vandalism.

No additional payment will be made for delivery of the additional panels to the DOT Maintenance Facility.

<u>Pay Item</u>	<u>Pay Unit</u>
Noise Barrier Wall	s.f.
Noise Barrier Wall (Earth Retaining Panels)	s.f.
Rock in Pole Excavation	v.f.

ITEM #1008720A – 4” RIGID METAL MULTI DUCT CONDUIT – UNDER ROADWAY

ITEM #1008770A – 4” PVC MULTI DUCT CONDUIT – IN TRENCH

ITEM #1008780A – 4” PVC MULTI DUCT CONDUIT – UNDER ROADWAY

ITEM #1008860A – 4” FIBERGLASS MULTI DUCT CONDUIT – EXTRA HEAVY WALL

Description:

The mainline conduit shall be a 4” (100 mm) multiduct conduit system designed and engineered for direct burial and protection of optical fiber cable. The multiduct concept shall maximize duct usage by compartmentalization of cables for current requirements and for future expansion.

The mainline conduit shall contain four (4) factory installed 1.25” (30 mm) PVC or HDPE innerducts within a 4” (100 mm) outer-duct.

As part of this item, the Contractor will be required to test the integrity of the conduit with a poly-line and to install a pull tape in each and separate innerduct as required in the specification.

Work under the above items shall conform to Public Utility Commission Rules and Regulations, where applicable, and to Section 10.08 of the standard specifications, supplemented and amended as follows:

Materials:

A. General:

The multi-cell conduit system shall be a pre-assembled conduit manufactured from a 4” (100 mm) round outerduct containing four (4) factory installed 1.25” (30 mm) PVC or HDPE innerducts. The innerducts shall be held together in a square configuration by a system of spacers, bands, or other mechanism. The coupling system shall be resistant to water infiltration, air loss during cable installation, and shall be capable of locking the system tightly together to not allow free twisting of the innerducts.

The conduit shall be free from defects including non-circularity and foreign inclusions. It shall be nominally uniform (as commercially practical) in color, density, and physical properties. It shall be straight and the ends shall be cut square to the inside diameter. Polyvinyl Chloride (PVC) conduit shall be Type 40 grade conforming to Section M.15.09 of the standard specifications.

Rigid Metal Conduit shall be galvanized steel also conforming to Section M.15.09 of the standard specifications.

B. Shop Drawings

Prior to beginning work and fabrication of any materials, the Contractor shall take all field measurements necessary to assure the proper fit of the finished structure mounted conduit. This shall include all supports, brackets and hangers, fixed and flexible sweep bends, expansion/contraction fittings, junction boxes, and other structure mounted appurtenances. The Contractor shall submit shop drawings to the Engineer for approval in accordance with Article 1.05.02(b).

- a. Layout plans and other pertinent information, including conduit lengths, locations and type of supports, sweep-bends, expansion fittings, junction boxes, etc. for each bridge or sign support that has structure mounted conduit and appurtenances.
- b. Commercial items shall be identified by manufacturer, trade name and catalog number. Catalog sheets, including pertinent specifications, shall be included with the submission.
- c. Complete fabrication details, including material and galvanizing specifications, for all conduit supports, brackets and hangers, hardware, field fasteners including chemical anchorages, etc.
- d. All field measurements shall be submitted for reference to the reviewer.

C. Innerduct:

The inner-duct in straight lengths shall be manufactured from PVC or high density polyethylene (HDPE). Innerducts shall be factory treated with atomized silicone or manufactured in a manner to reduce friction during pulling of fiber optic cable.

Innerduct to be used in bends and sweeps shall have a minimum burn through time of 90 minutes when tested in accordance with Telcordia (formerly Bellcore) GR-2884 Issue 1 Section R3-35, and R3-36.

PVC inner ducts shall not be allowed in bends and sweeps.

The innerducts shall have a permanent dry lubricant extruded within the inner wall and shall incorporate longitudinal ribs within the inner wall. The innerducts shall have a nominal size of 1.25" (30 mm) and shall consist of 4 unique colors: white, red, orange, and yellow. Innerduct colors shall be oriented in a clockwise direction as specified above, looking at the spigot end of the multi-cell conduit system. The white innerduct shall be located directly under the print line on the outerduct.

Each inner-duct shall be sealed with an expanding Neoprene Plug that withstands 22 psi (150 kPa) and seals the inner-duct from water and debris infiltration, and a provision for tying off a pull line.

D. Rigid Metal Outerduct:

All components of the conduit system shall meet or exceed the following specifications and standards:

1. ASTM A 36. Standard Specification for Structural Steel.
2. ASTM A 53. Standard Specification for Steel Pipe.
3. ASTM A 570 Standard specification for Steel.
4. ASTM A 479 Standard Specification For Stainless Steel.

In addition, the steel outer duct shall conform to the following industry standards:

NEC Article 346

ANSI C80.1

U.L. 6

The conduit system shall be a complete system with all the following fittings:

Manhole Terminator Kits

Deflection Fittings

Offset Fittings

Expansion/Contraction Fittings

Lubrication Fittings

Repair Kits

Installation Accessories

Steel to PVC Sched. 40

Steel PVC-Coated Flexible Elbows

Stand Off Fittings

Entrance Fittings

Galvanized outer-duct shall be hot dipped galvanized inside and out; conduit shall be smooth and free from burrs and coated with rust inhibitor.

Rigid steel shall be supplied in 10 foot (3-meter) lengths with a length tolerance of +/- 1/2" (10mm) and shall be Schedule 40 minimum. Conduit shall be supplied with thread protectors.

Each section of steel conduit shall be supplied with one reversing spin coupling that allows straight sections and fittings to be joined without spinning the conduit. The reversing coupling shall be galvanized and have three set screws to lock the coupling in place.

The Steel Outerduct system shall be designed so that the assembly of components can be accomplished in the following steps:

- a. Loosen set screws on coupling spin back to allow for insertion
- b. Insert male into female and spin coupling forward to bottom
- c. Once the spin coupling is installed, there shall be no threads visible on the 4" (100 mm) steel conduits.
- d. Tighten set screws

The Steel conduit system shall offer a complete line of fixed and flexible sweep-bends with system compatible bell and spigot ends. The Steel conduit system shall offer and the Contractor shall utilize the following standard fixed sweep-bends:

Radius	Bend	System
4 ft & 3 ft. (1200mm & 900mm)	11.25°, 22.5°, 45°, 90°	4-way

Note: Direction changes shall not exceed 90 degrees.

The flexible sweep-bend shall be supplied in two lengths to meet field requirements. They shall have a steel core with a PVC outer jacket and be UL Listed for exposed and direct burial installation. The inner-duct shall always remain flush to the end of the flexible elbow, even when bending. PVC inner ducts shall not be allowed in bend and sweeps.

Length Feet (Meters)	Radius Feet (Meters)	Bend degrees (°)	System
10 (3.2)	4 (1.2) min	0-90	4-way
10 (3.2)	6 (1.8)	0-70	4-way
10 (3.2)	9 (2.7)	0-55	4-way
16 (4.9)	4 (1.2) min	0-90	4-way
16 (4.9)	6 (1.8)	0-70	4-way
16 (4.9)	9 (2.7)	0-55	4-way

All bends, including flexible sweeps, shall have a minimum radius of 3 ft. (900 mm). The inner-duct system shall be solvent welded to the coupling body; supported by a moveable spacer every 4 ft. (1.32 m). The bends shall not violate the minimum bending radius of the fiber optic cable.

All bends shall have nylon inner ducts, or approved equivalent, installed to prevent burn-through in accordance with test procedure outlined in GR-2884 Issue 1 Section R3-35 and R3-36.

The following performance requirements shall be met:

Yield	30,000 psi (200 MPa)
Tensile	50,000 psi (345 MPa)
Hardness	Rockwell "B" 55-65

All conduit entering and exiting conduit terminal points shall have a terminator installed that is made of PVC with an anti-reversing gasket that prevents ingress of water and debris into the outer conduit and inner-duct.

The rigid steel conduit system shall offer expansion/contraction fittings with system compatible threads and reversing couplings. The inner-duct of the expansion/contraction fittings shall also be

system compatible. The capacity of the fitting shall be 8” (200 mm) total stroke with 4” (100 mm) expansion and 4” (100 mm) contraction capacities.

E. Conduit Testing:

The poly-line installed to verify the integrity of the conduit system shall be ¼” (6 mm) polypropylene.

The detectable pull tape shall consist of a single 24 AWG copper wire with polyethylene or PVC jacket woven into the polyester tape. The pull tape shall be NEPTCO Part No. DP1250P, or approved equal, for cable sizes of less than 97 fibers. NEPTCO Part No. DP1800P, or approved equal, shall be used for cable size of 97-288 fibers.

The detectable pull tape shall have the following properties:

- 1250 lb (5.56 kN) tensile strength
- flat, not round, construction
- printed foot markings
- pre-lubricated for reduced pulling tension at start of cable pull
- low susceptibility to absorption of moisture; moisture resistant

Underground utility marking tape shall have a minimum tensile strength of 78 lbf (350 N) and a minimum elongation of 700 percent before breakage. The detectable tape shall not delaminate nor smear when wet and shall be resistant to insects. The tape shall not degrade when exposed to alkalis, acids or other corrosive elements found in soil.

Pressure treated wood for Identification Posts shall conform to Article M.12.13 of the Standard Specifications. Signs on Identification Posts shall conform to Article M.18.13 of the Standard Specifications.

F. Bedding Material:

Bedding material for all conduit shall be No. 100 fine aggregate as defined in Section M.03 of the standard specifications and backfill for the pits shall be pervious structure backfill conforming to Article 2.16.02.

Construction Methods:

A. General:

Construction methods shall conform to Article 10.08.03 of the Standard Specifications and to the manufacturer’s instructions.

The Contractor shall layout the trench for the conduit in conjunction with the installation of pullboxes, vaults, or manholes. When installing the conduit, the Contractor shall be aware of the location of the proposed conduit terminal point when they are at a sufficient distance from the

terminal point to allow for adjustment of the trench so that the conduit will line up flush with the applicable entry point. Flexible conduit will not be used indiscriminately.

A silicon, non-petroleum based lubricant on the coupling body may be used to facilitate installation.

Galvanized rigid steel conduit shall extend 2" (50 mm) into the manhole/vault/pull box for installation of grounded end bushings.

Conduits and inner-duct entering conduit terminal points or where terminated in trench, shall be capped or sealed to prevent ingress of water and debris into the conduit. Conduits containing inner-duct shall be plugged using a quadplex expansion plug inside the conduit around the inner-duct. Inner-duct containing one cable shall be plugged using an expandable cable seal off. Conduits terminating in a trench shall be clearly marked and flagged, both in trench and above trench for future locating.

At each conduit terminal point, a PVC coupling body with anti-reversing gasket that seals between the conduit and inner-duct shall be used as follows:

In places where the field installed inner-duct enters and exits existing conduit, the space between the conduit and the inner-duct, as well as the space between the inner-duct and the cable shall be sealed by means of a split internal expansion plug. Bushing sleeves shall be equipped to suit varying cable sizes. Sealing capacity shall withstand 22 psi (150 kPa).

All inner-duct shall be sealed by means of a polypropylene duct plug equipped with a neoprene or polyurethane gasket. Plugs shall be equipped with an attachment to secure the pull rope in the inner-duct.

Warning Tape shall be placed in trench over conduit as shown on the details. Identification Posts shall be carefully placed adjacent to conduit in trench at intervals not to exceed 1200 ft. (365 meters) in length, except at long span bridges and paved areas.

B. Conduit Testing:

The Contractor shall test each cell of the multicell conduit after the conduit is installed. All testing shall be performed using the procedures and mandrel size recommended by the multicell or conduit manufacturer. The Contractor will be required to install a poly-line within each cell of the conduit. The intention of the conduit testing is to verify the integrity of the completed system; therefore, this testing will only be allowed to commence once the conduit system has been completely installed. Testing shall be performed in the presence of the Engineer. The Engineer will document the date, time, and the results of the testing and shall submit this information to Highway Operations for record keeping purposes.

C. Detectable Pull Tape:

The Contractor shall install detectable pull tape, by hand pulling, blowing, or via vacuum method, into each empty conduit and empty cell within a multi-cell conduit during conduit installation.

The Contractor shall install the detectable pull tape after conduit testing has been completed. The Contractor shall neatly coil and secure 10 ft (3 meters) of slacked pull tape in each vault location.

The detectable pull tape shall be field installed within each innerduct for the purpose of attaching to, and pulling of, the fiber optic cable. The Detectable Pulling Tape shall be tied off to an expanding Neoprene Plug.

D. As -Built Plans:

The Contractor shall advise the Engineer of any change of measurement of layout of the Plans submitted to them. Upon completion of construction but prior to acceptance of the contract, the Contractor shall furnish as-built plans on 2 ft. by 3 ft. (55 cm by 91 cm) standard plan sheets (hard copy) form or in an electronic portable document format (.pdf). All construction changes, with the final location and depth of the conduits, etc. shall be shown in sepia or other reproducible format. These plans shall include all field installations. One sepia or other reproducible of the Project Plans will be provided to the Contractor for their use. Any other base maps that may be necessary for the Contractor to comply with this requirement shall be the Contractor's responsibility.

Method Of Measurement:

The conduit shall be measured for payment by the actual number of feet of the type and size installed and accepted. **Expansion fittings, fixed and flexible sweep-bends, flexible metal conduit, and conduit fittings will not be measured for payment but shall be included in the pay item for the conduit of the type and size specified.** The measured length shall be from end to end along the centerline through all fittings.

The warning tape, identification posts with signs, pull tape, and the poly-line conduit testing will not be measured for payment but shall be included in the pay item for the conduit of the type and size specified.

Basis Of Payment:

This work shall be paid for at the contract unit price per foot for conduit of the size and type indicated, within the limits shown on the plans and in the details. This price shall include all materials required including expansion fittings, fixed and flexible sweep-bends, conduit fittings, pervious structure backfill, boxes, caps, entrance fittings, detectable pull tape, poly-line, inserts, warning tape, ground wire, identification posts with signs, bridge hanger assemblies and conduit support devices, chemical anchors, equipment, tools, labor and work incidental thereto.

Trenching and backfilling shall be paid separately under Item #1001001A, Trenching and Backfilling, and as specified in Section 10.01 of the Standard Specifications.