

## **TABLE OF CONTENTS OF SPECIAL PROVISIONS**

Note: This Table of Contents has been prepared for the convenience of those using this contract with the sole express purpose of locating quickly the information contained herein; and no claims shall arise due to omissions, additions, deletions, etc., as this Table of Contents shall not be considered part of the contract.

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AUGUST 8, 2018  
FEDERAL AID PROJECT NO. 0912(137) & 0691(108)  
STATE PROJECT NO. 171-413 & 171-414

INCIDENT MANAGEMENT SYSTEM INSTALLATION  
ALONG I-91 AND I-691

Towns of Meriden, Middletown, Southington, Middlefield, Cromwell,  
Berlin, Rocky Hill, Cheshire and Newington  
Federal Aid Project No. 0912(137) & 0691(108)

The State of Connecticut, Department of Transportation, Standard Specifications for Roads, Bridges, Facilities and Incidental Construction, Form 817, 2016, as revised by the Supplemental Specifications dated January 2018 (otherwise referred to collectively as "ConnDOT Form 817") is hereby made part of this contract, as modified by the Special Provisions contained herein. Form 817 is available at the following DOT website link <http://www.ct.gov/dot/cwp/view.asp?a=3609&q=430362>. The current edition of the State of Connecticut Department of Transportation's "Construction Contract Bidding and Award Manual" ("Manual"), is hereby made part of this contract. If the provisions of this Manual conflict with provisions of other Department documents (not including statutes or regulations), the provisions of the Manual will govern. The Manual is available at the following DOT website link <http://www.ct.gov/dot/cwp/view.asp?a=2288&q=259258>. The Special Provisions relate in particular to the Incident Management System Installation along I-91 and I-691 in the Towns of Meriden, Middletown, Southington, Middlefield, Cromwell, Berlin, Rocky Hill, Cheshire and Newington.

### **COMBINED PROJECTS**

There will be one Contract for Federal Aid Project No. 0912(137) (State Project No. 0171-0413) and Federal Aid Project No. 0691(108) (State Project No. 0171-0414). The two projects will be considered as a single contract in all aspects.

### **CONTRACT TIME AND LIQUIDATED DAMAGES**

Six hundred sixty-six (666) calendar days will be allowed for completion of the work on this project and the liquidated damages charge to apply will be Four Thousand One Hundred Dollars (\$4,100.00) per calendar day.

In order to minimize the hazard, cost and inconvenience to the traveling public, pollution of the environment and the detriment to the business area, it is necessary to limit the time of construction which interferes with traffic as specified in Article 1.08.04 of the Special Provisions.

## **IMS Equipment Installations**

### Equipment Operations/VMS Operations

For this Contract, an assessment for liquidated damages, at a rate of Two Thousand Dollars (\$2,000) per day per CCTV or VMS Site, shall be applied to each full calendar day that the Incident Management System (IMS) equipment are not operational. The IMS equipment included in this Contract are the following:

- Existing CCTV Camera Sites
- Proposed CCTV Camera Sites
- Existing VMS Sites
- Proposed VMS Sites

### Response Time

For this Contract, an assessment per day for liquidated damages, at a rate of One Thousand Dollars (\$1,000) shall be applied for repairs that are not commenced within 8 hours after notification to each CCTV Camera, Traffic Flow Monitor, and/or Variable Message Sign (VMS) Site failure.

The contractor shall refer to the “Notice to Contractor – Installation Qualifications”, Section 1.08 – Prosecution and Progress, Item No. 1050113A Motorists Aid Variable Message Sign System Operations (Estimated Cost) and Item No. 1112252A Equipment Operations (Estimated Cost) special provisions for terms and conditions.

## **Traffic Operations**

An assessment per hour for liquidated damages shall be applied to each hour, or any portion thereof, in which the Contractor interferes with normal traffic operations during the restricted hours given in Article 1.08.04 of the Special Provisions. The liquidated damages shall be as shown in the following tables entitled “Liquidated Damages Per Hour” for each hour, or any portion thereof, in which the Contractor interferes with normal traffic operations during the restricted hours.

For the purpose of administering this contract, normal traffic operations are considered interfered with when:

1. Any portion of the travel lanes or shoulders is occupied by any personnel, equipment, materials, or supplies including signs.
2. There is a one-inch or greater difference in the level of pavement transversely extending for a distance of more than ten feet longitudinally.
3. The transition between the planes of pavement surfaces is at a rate of one inch in less than twenty feet longitudinally.

## LIQUIDATED DAMAGES PER HOUR

### Route 9 Southbound

2 Lane Section Between Route 15 and I-91 Interchanges		
If Working Periods Extends Into	A.M. 1 Lane Closure	P.M. 1 Lane Closure
1st Hour of Restrictive Period	\$ 500	\$ 2,000
2nd Hour of Restrictive Period	\$ 5,000	\$ 10,000
3rd Hour or any Subsequent Hour of Restrictive Period	\$ 8,000	\$ 25,000

### Route 15 Northbound

2 Lane Section Hamden/New Haven Town Line to Exit 68W		
If Working Periods Extends Into	A.M. 1 Lane Closure	P.M. 1 Lane Closure
1st Hour of Restrictive Period	\$ 500	\$ 500
2nd Hour of Restrictive Period	\$ 1,000	\$ 500
3rd Hour or any Subsequent Hour of Restrictive Period	\$ 500	\$ 500

The above liquidated damages apply to those hours shown on the Limitation of Operations charts designated with a “2” or “E” for 2-lane sections and “3” or “E” for 3-lane sections.

For each hour shown on the Limitation of Operations charts designated with an “E”, liquidated damages of \$500 per hour shall apply if all available shoulder widths are not available to traffic.

Liquidated damages in the amount of \$500 shall apply for each hour that the Contractor interferes with existing traffic operations on any ramps during the non-allowable hours.

**Route 15 Southbound**

2 Lane Section Start of Expressway to On Ramp from I-691		
If Working Periods Extends Into	A.M. 1 Lane Closure	P.M. 1 Lane Closure
1st Hour of Restrictive Period	\$ 500	\$ 500
2nd Hour of Restrictive Period	\$ 500	\$ 500
3rd Hour or any Subsequent Hour of Restrictive Period	\$ 500	\$ 500

**Route 15 Southbound**

2 Lane Section On Ramp from I-691 to Hamden/North Haven Town Line		
If Working Periods Extends Into	A.M. 1 Lane Closure	P.M. 1 Lane Closure
1st Hour of Restrictive Period	\$ 500	\$ 500
2nd Hour of Restrictive Period	\$ 2,000	\$ 500
3rd Hour or any Subsequent Hour of Restrictive Period	\$ 2,000	\$ 5,000

The above liquidated damages apply to those hours shown on the Limitation of Operations charts designated with a “2” or “E” for 2-lane sections and “3” or “E” for 3-lane sections.

For each hour shown on the Limitation of Operations charts designated with an “E”, liquidated damages of \$500 per hour shall apply if all available shoulder widths are not available to traffic.

Liquidated damages in the amount of \$500 shall apply for each hour that the Contractor interferes with existing traffic operations on any ramps during the non-allowable hours.



**Route 66 Westbound**

2 Lane Section Start of Expressway to On Ramp from Route I-91N		
If Working Periods Extends Into	A.M. 1 Lane Closure	P.M. 1 Lane Closure
1st Hour of Restrictive Period	\$ 500	\$ 500
2nd Hour of Restrictive Period	\$ 500	\$ 500
3rd Hour or any Subsequent Hour of Restrictive Period	\$ 500	\$ 500

**I-84 Eastbound**

3 Lane Section Near the Burritt Street Overpass			
If Working Periods Extends Into	A.M. 1 Lane Closure	A.M. 2 Lane Closure	P.M. 1 Lane Closure
1st Hour of Restrictive Period	\$ 500	\$ 500	\$ 500
2nd Hour of Restrictive Period	\$ 500	\$ 9,000	\$ 500
3rd Hour or any Subsequent Hour of Restrictive Period	\$ 500	\$ 20,000	\$ 2,000

The above liquidated damages apply to those hours shown on the Limitation of Operations charts designated with a “2” or “E” for 2-lane sections and “3” or “E” for 3-lane sections.

For each hour shown on the Limitation of Operations charts designated with an “E”, liquidated damages of \$500 per hour shall apply if all available shoulder widths are not available to traffic.

Liquidated damages in the amount of \$500 shall apply for each hour that the Contractor interferes with existing traffic operations on any ramps during the non-allowable hours.

**I-84 Westbound**

3 Lane Section Near the Burritt Street Overpass			
If Working Periods Extends Into	A.M. 1 Lane Closure	A.M. 2 Lane Closure	P.M. 1 Lane Closure
1st Hour of Restrictive Period	\$ 500	\$ 15,000	\$ 500
2nd Hour of Restrictive Period	\$ 6,000	\$ 70,000	\$ 500
3rd Hour or any Subsequent Hour of Restrictive Period	\$ 5,000	\$ 100,000	\$ 2,000

**I-91 Northbound**

3 Lane Section Exit 19 to Exit 22			
If Working Periods Extends Into	A.M. 1 Lane Closure	A.M. 2 Lane Closure	P.M. 1 Lane Closure
1st Hour of Restrictive Period	\$ 500	\$ 4,000	\$ 500
2nd Hour of Restrictive Period	\$ 1,000	\$ 35,000	\$ 500
3rd Hour or any Subsequent Hour of Restrictive Period	\$ 500	\$ 60,000	\$ 500

The above liquidated damages apply to those hours shown on the Limitation of Operations charts designated with a “2” or “E” for 2-lane sections and “3” or “E” for 3-lane sections.

For each hour shown on the Limitation of Operations charts designated with an “E”, liquidated damages of \$500 per hour shall apply if all available shoulder widths are not available to traffic.

Liquidated damages in the amount of \$500 shall apply for each hour that the Contractor interferes with existing traffic operations on any ramps during the non-allowable hours.

**I-91 Southbound**

4 Lane Section Exit 23 Off Ramp to Exit 22 Off Ramp				
If Working Periods Extends Into	A.M. 1 Lane Closure	A.M. 2 Lane Closure	A.M. 3 Lane Closure	P.M. 1 Lane Closure
1st Hour of Restrictive Period	\$ 500	\$ 500	\$ 25,000	\$ 500
2nd Hour of Restrictive Period	\$ 1,000	\$ 25,000	\$ 100,000	\$ 7,000
3rd Hour or any Subsequent Hour of Restrictive Period	\$ 1,000	\$ 50,000	\$ 100,000	\$ 15,000

**I-91 Southbound**

3 Lane Section Exit 22 Off Ramp to Exit 17 Off Ramp			
If Working Periods Extends Into	A.M. 1 Lane Closure	A.M. 2 Lane Closure	P.M. 1 Lane Closure
1st Hour of Restrictive Period	\$ 500	\$ 10,000	\$ 500
2nd Hour of Restrictive Period	\$ 5,000	\$ 60,000	\$ 500
3rd Hour or any Subsequent Hour of Restrictive Period	\$ 4,000	\$ 90,000	\$ 2,000

The above liquidated damages apply to those hours shown on the Limitation of Operations charts designated with a “2” or “E” for 2-lane sections and “3” or “E” for 3-lane sections.

For each hour shown on the Limitation of Operations charts designated with an “E”, liquidated damages of \$500 per hour shall apply if all available shoulder widths are not available to traffic.

Liquidated damages in the amount of \$500 shall apply for each hour that the Contractor interferes with existing traffic operations on any ramps during the non-allowable hours.

**I-91 Southbound**

2 Lane Section Exit 17 Off Ramp to Murdock Ave Overpass		
If Working Periods Extends Into	A.M. 1 Lane Closure	P.M. 1 Lane Closure
1st Hour of Restrictive Period	\$ 500	\$ 500
2nd Hour of Restrictive Period	\$ 3,000	\$ 500
3rd Hour or any Subsequent Hour of Restrictive Period	\$ 2,000	\$ 1,000

**I-91 Southbound**

3 Lane Section On Ramp from Route 15 to Exit 10			
If Working Periods Extends Into	A.M. 1 Lane Closure	A.M. 2 Lane Closure	P.M. 1 Lane Closure
1st Hour of Restrictive Period	\$ 500	\$ 8,000	\$ 500
2nd Hour of Restrictive Period	\$ 500	\$ 40,000	\$ 500
3rd Hour or any Subsequent Hour of Restrictive Period	\$ 500	\$ 60,000	\$ 500

The above liquidated damages apply to those hours shown on the Limitation of Operations charts designated with a “2” or “E” for 2-lane sections and “3” or “E” for 3-lane sections.

For each hour shown on the Limitation of Operations charts designated with an “E”, liquidated damages of \$500 per hour shall apply if all available shoulder widths are not available to traffic.

Liquidated damages in the amount of \$500 shall apply for each hour that the Contractor interferes with existing traffic operations on any ramps during the non-allowable hours.

**I-691 Eastbound**

2 Lane Section I-84 Off Ramps to Lane Add at Exit 7		
If Working Periods Extends Into	A.M. 1 Lane Closure	P.M. 1 Lane Closure
1st Hour of Restrictive Period	\$ 500	\$ 500
2nd Hour of Restrictive Period	\$ 9,000	\$ 2,000
3rd Hour or any Subsequent Hour of Restrictive Period	\$ 15,000	\$ 4,000

**I-691 Eastbound**

3 Lane Section Lane Add at Exit 7 to Lane Drop at Exit 10			
If Working Periods Extends Into	A.M. 1 Lane Closure	A.M. 2 Lane Closure	P.M. 1 Lane Closure
1st Hour of Restrictive Period	\$ 500	\$ 7,000	\$ 500
2nd Hour of Restrictive Period	\$ 500	\$ 40,000	\$ 500
3rd Hour or any Subsequent Hour of Restrictive Period	\$ 500	\$ 60,000	\$ 500

The above liquidated damages apply to those hours shown on the Limitation of Operations charts designated with a “2” or “E” for 2-lane sections and “3” or “E” for 3-lane sections.

For each hour shown on the Limitation of Operations charts designated with an “E”, liquidated damages of \$500 per hour shall apply if all available shoulder widths are not available to traffic.

Liquidated damages in the amount of \$500 shall apply for each hour that the Contractor interferes with existing traffic operations on any ramps during the non-allowable hours.

**I-691 Eastbound**

2 Lane Section Lane Drop at Exit 10 to I-91 Off Ramp		
If Working Periods Extends Into	A.M. 1 Lane Closure	P.M. 1 Lane Closure
1st Hour of Restrictive Period	\$ 500	\$ 500
2nd Hour of Restrictive Period	\$ 3,000	\$ 500
3rd Hour or any Subsequent Hour of Restrictive Period	\$ 2,000	\$ 500

**I-691 Westbound**

2 Lane Section Route I-91 On Ramp to On Ramp From 15 NB		
If Working Periods Extends Into	A.M. 1 Lane Closure	P.M. 1 Lane Closure
1st Hour of Restrictive Period	\$ 500	\$ 500
2nd Hour of Restrictive Period	\$ 500	\$ 3,000
3rd Hour or any Subsequent Hour of Restrictive Period	\$ 500	\$ 6,000

The above liquidated damages apply to those hours shown on the Limitation of Operations charts designated with a “2” or “E” for 2-lane sections and “3” or “E” for 3-lane sections.

For each hour shown on the Limitation of Operations charts designated with an “E”, liquidated damages of \$500 per hour shall apply if all available shoulder widths are not available to traffic.

Liquidated damages in the amount of \$500 shall apply for each hour that the Contractor interferes with existing traffic operations on any ramps during the non-allowable hours.

**I-691 Westbound**

3 Lane Section On Ramp From 15 NB to Exit 5 On Ramp			
If Working Periods Extends Into	A.M. 1 Lane Closure	A.M. 2 Lane Closure	P.M. 1 Lane Closure
1st Hour of Restrictive Period	\$ 500	\$ 500	\$ 500
2nd Hour of Restrictive Period	\$ 500	\$ 8,000	\$ 500
3rd Hour or any Subsequent Hour of Restrictive Period	\$ 500	\$ 15,000	\$ 500

**I-691 Westbound**

2 Lane Section Exit 5 On Ramp to I-84 Off Ramps		
If Working Periods Extends Into	A.M. 1 Lane Closure	P.M. 1 Lane Closure
1st Hour of Restrictive Period	\$ 500	\$ 500
2nd Hour of Restrictive Period	\$ 500	\$ 4,000
3rd Hour or any Subsequent Hour of Restrictive Period	\$ 500	\$ 10,000

The above liquidated damages apply to those hours shown on the Limitation of Operations charts designated with a “2” or “E” for 2-lane sections and “3” or “E” for 3-lane sections.

For each hour shown on the Limitation of Operations charts designated with an “E”, liquidated damages of \$500 per hour shall apply if all available shoulder widths are not available to traffic.

Liquidated damages in the amount of \$500 shall apply for each hour that the Contractor interferes with existing traffic operations on any ramps during the non-allowable hours.

**NOTICE TO CONTRACTOR – PRE-CONSTRUCTION WALK-THROUGH**

A Pre-Construction Walk-Through will be held prior the commencement of field activities. At a minimum, the walk-through will include representatives from the Contractor, ConnDOT District 1 Construction Office, ConnDOT Highway Operations Unit, and the Designer.



**NOTICE TO CONTRACTOR – INTERIM MILESTONE FOR FOC  
INSTALLATION ALONG ROUTE 9**

The Contractor shall schedule his work operations such that the installation of all proposed 4” multiduct conduit and fiber optic cable between the Newington Operations Center and the I-91/West Street interchange (via Route 9) is completed and operational prior to December 31, 2019. The Contractor’s baseline schedule shall clearly identify this segment of the proposed work and shall demonstrate that the full installation of this segment of fiber optic cable shall be completed in advance of this milestone.

## **NOTICE TO CONTRACTOR – INSTALLATION QUALIFICATIONS**

All management, construction, installation, and inspection services shall be performed by individuals who have performed the same job function on at least two previously completed construction and installation communication projects of comparable size and complexity.

### **Approval of ITS Equipment Installer:**

Each Contractor or Subcontractor performing the work involved with the installation of Intelligent Transportation System (ITS) equipment related to the Incident Management System shall provide references and resumes of staff that shall meet the following requirements:

Satisfactory completion of at least three (3) projects in the last three (3) years that includes the installation of each of the ITS equipment identified below.

- 4” (100 mm) Multiduct Conduit
- Pullboxes
- Camera Lowering Devices
- Camera Assemblies
- Traffic Management System Cabinets (TMSC)
- Traffic Flow Monitors (TFM) and TFM Poles
- Variable Message Signs (VMS) and VMS Controller Cabinets

The Contractor shall provide a list of each ITS project which the Contractor has performed, including a description of each project, the location of each project, inclusive dates of when the work was performed on each project, and a contact reference for each project listed.

This document shall be submitted to ConnDOT for review and approval before any Incident Management System project work may proceed.

### **Approval of Traffic Structure Foundations Installer:**

The Contractor or Subcontractors performing the work to install large drilled shaft or spread footing “Traffic Structure Foundations” including Traffic Control Foundation – Span Pole Type “C” or Type “D” and Overhead Cantilever Sign Support Foundation (Type VMS 1) shall provide references and resumes of staff that shall meet the following requirements:

All management, construction, installation of traffic structure foundations shall be performed by individuals who have performed the same job function on at least

two previously completed construction and installation projects of comparable size and complexity. Each previously completed project shall have included the installation of at least four (4) drilled shaft foundations for overhead sign support foundations. The Contractor shall submit a list of available equipment that will be used for the installation of the traffic structure foundations proposed in the project. The resumes of staff shall include, but not be limited to, the equipment operator(s) and supervisor who will be responsible for conducting the work. The resume of staff and list of available equipment shall demonstrate the ability to perform the installation of drilled shaft foundations and rock socket foundations to the depths identified on the plans and as demonstrated by the soil boring information.

### **Approval of Fiber-Optic Cable Installation, Splicing and Testing:**

Each Contractor or Subcontractor performing the work involved with installing, splicing and testing of cable and electronic communication systems and installing detection and video systems, shall provide references and resumes of staff that shall meet the following requirements:

Satisfactory completion of at least three (3) fiber-optic based communication projects in the last three years. Experience shall be in related fiber optic systems for installers involving single-mode cables in excess of 6 miles.

The Contractor shall provide a list of each fiber-optic based communications project and/or intelligent transportation system project which the Contractor has performed, including a description of each project, the location of each project, inclusive dates of when the work was performed on each project, and a contact reference for each project listed. Each of the referenced projects shall include completing a minimum of three (3), multifiber, single-mode, optical fiber cable fusion splices, and installation of at least 25 optical connectors on single-mode optical fibers. As a minimum, the contact reference shall include an individual's name, training certificates (including updated licenses), title, and current telephone number.

This document shall be submitted to ConnDOT for review and approval before any Incident Management System project work may proceed.

### **Approval of ITS Systems Integrator:**

The Prime Contractor or qualified proposed ITS Systems Integrator Subcontractor performing the work described in these Special Provisions which are involved with supplying, installing, configuring and testing of electronic communication systems and video systems for the Incident Management System and newly installed video and data transport system, shall provide a printed document (nine copies) that contains the proposed ITS Systems Integrator's experience in the areas noted below, as well as references and resumes for staff proposed to perform the project work. The document

should clearly indicate how the proposed ITS Systems Integrator meets the following requirements:

- Experience involving at least seven (7) ITS system integration projects with overall system responsibility and accountability, each employing at least 8 camera sites used for highway transportation purposes. A minimum of 7 years experience in ITS system integration.
- Design and installation of at least 200 point-to-point optical digital video links used for highway transportation purposes.
- A minimum of two (2) projects using video matrix switchers with a minimum size of 240 inputs and 64 outputs of analog video used for highway transportation purposes.
- Installation of video compression equipment involving at least ten sites, comprising video compression algorithms including but not limited to: H.261, MPEG1, MPEG2, MPEG4, and MJPEG used for highway transportation purposes.
- Experience using various applicable test equipment including: Fiber Optic Spectrum Analyzer, OTDR, BERT, Protocol Analyzer, and Oscilloscope.
- Installation of a minimum of 40 digital video encoder and decoder devices.
- Ability to respond within 2 hours travel by car to Central Office located at ConnDOT, 2800 Berlin Turnpike, Newington CT.
- Provision of 24x7x365 maintenance available with technicians fully trained in ITS related equipment.
- Demonstrate a general working knowledge of specifications RS-170 and RS-250C.
- Demonstrate a general working knowledge of communications protocols utilized in the CCTV industry.
- Demonstrate a general working knowledge of physical communications interfaces such as RS-232, RS-422, RS-485, RS-530, and RS-449.
- Demonstrate extensive working knowledge of Ethernet physical topologies TCP/IP routing schemes, metro ring and link aggregation protocols, VLAN configurations, and Quality of Service configuration and setup.
- Have working experience in configuring Nortel Sonet equipment.

**The document for the ITS Equipment Installer, Traffic Structure Foundations Installer, Fiber-Optic Cable Installation, Splicing and Testing Qualifications, and ITS Systems Integrator shall be submitted for approval within ten (10) days of the Contract Award to:**

Mr. Donald L. Ward, P.E.  
Connecticut Department of Transportation  
District 1 Assistant District Engineer  
1107 Cromwell Avenue  
Rocky Hill, Connecticut 06067

and

Mr. John F. Korte  
Connecticut Department of Transportation  
Bureau of Engineering and Highway Operations  
2800 Berlin Turnpike P.O. Box 317456  
Newington, Connecticut 06131-7546

These requirements shall apply to the following contract item installations:

- Optical Fiber Cable, Single Mode, Loose Buffered Tube Cable, 6-Fiber, 72-Fiber and 144-Fiber
- Fiber Optic Cable Splice Enclosures
- Equipment Operations
- Traffic Management System Cabinets
- Video equipment, including cameras and mountings
- Optical Video/Data Transmitter and Receiver
- 10/100 Base – TX Ethernet Switch
- Terminal Server
- Port Sharing Device
- Ethernet Media Converter
- Wireless Router
- Single Mode Optical Fiber Directional Coupler
- Traffic Flow Monitor
- Motorist Variable Message Signs

**The Contractor shall not start work on the Incident Management System until the Contractor receives approval from the Department.**

The Incident Management System shall be maintained in normal working operation at all times.

In the event that the Contractor needs to remove an Incident Management System device from service, the Contractor shall notify Mr. Robert Kennedy at the Newington Operations Center (830) 594-3458 at least ten (10) working days prior to any scheduled work operation. An Incident Management System device shall include, but is not limited to, the following: CCTV cameras, camera cabinets, mini-hub cabinets, Traffic Flow

Monitors, Variable Message Signs, Highway Advisory Radio site equipment and fiber optic cable including any associated fiber optic communications plant equipment.

All Project related scheduled work that will require the downtime of the Incident Management System, such as the splicing of the fiber optic trunkline cable, shall be performed on a non-holiday weekend as specified in Section 1.08 Prosecution and Progress - Incident Management System and as approved by Mr. Robert Kennedy, Newington Operations Center. The scheduled work performed on the approved non-holiday weekend shall be completed in a fifteen (15) hour work window. The Contractor shall identify the work that will be performed during this work window as well as a list of the approved staff to be performing work on the Incident Management System. Any deviation in the fifteen (15) hour work window must be approved by the Newington Operations Center staff.

Prior to the scheduled start of work on the Incident Management System, the Contractor shall contact the Newington Operations Center to determine if there are any on-going incidents on the highway system. The Incident Management System will not be removed from service until any on-going incidents on the highway system are cleared and approval is granted by the Newington Operations Center staff.

All Contractor personnel involved in the placing, splice preparation and splicing of fiber optic cable shall meet or exceed the above referenced installation qualifications and shall be approved by the Department. Under no circumstance will unqualified, unapproved Contractor personnel be allowed to work on the Incident Management System.

## **NOTICE TO CONTRACTOR -- PROPRIETARY ITEMS**

The Contractor is hereby notified that the following item(s) shall be furnished by the specific manufacturer(s) specified below.

<u>Item No.</u>	<u>Item Description</u>	<u>Manufacturer</u>
1050106A	Motorist Aid Variable Message Sign – Type A	Daktronics
1050107A	Motorist Aid Variable Message Sign – Type B	Daktronics
1108627A	Terminal (Port) Server	Digi International
1108628A	Port Sharing Device	GarrettCom
1108661A	10/100 Base TX Ethernet Switch	GarrettCom
1108670A	Wireless Router	Digi International
1108704A	Optical Video/Data Transmitter	Optelecom
1108707A	Rack Mount Optical Video Data Receiver	Optelecom
1108826A	Optical Termination Patch Panel	Corning, Incorporated
1108841A	Multi-Channel Fiber Optic Video/Data Multiplexer/Demultiplexer	Optelecom
1112210A	Camera Assembly	American Dynamics, Inc.
1112217A	Camera Lowering Device Assembly – Type A	MG-Squared, Incorporated
1112217A	Camera Lowering Device Assembly – Type B	MG-Squared, Incorporated
1112241A	Fiber Optic Cable Splice Enclosure	Corning, Incorporated
1112268A	Single Mode Optical Fiber Directional Couplers	IPITEK Incorporated
1113604A	Optical Fiber Cable - Single Mode, Loose Buffer Tube Cable, 6 Fiber	Corning Incorporated
1113621A	Optical Fiber Cable - Single Mode, Loose Buffer Tube Cable, 72 Fiber	Corning Incorporated
1113627A	Optical Fiber Cable - Single Mode, Loose Buffer Tube Cable, 144 Fiber	Corning Incorporated

**NOTICE TO CONTRACTOR – FLOOD MANAGEMENT GENERAL  
CERTIFICATION**

Boundaries of existing flood zones are shown on the contract plans. All work within these flood zone areas shall be done in conformance with the Contract Documents to ensure compliance with the Flood Management General Certification approved for this project on April 11, 2018.



## **NOTICE TO CONTRACTOR – EXISTING IMS**

The existing CCTV Cameras along I-91 were constructed under Project No. 63-548. The existing Variable Message Signs (VMS) were constructed under Project Nos. 171-375 and 92-646. Copies of these existing project plans will be provided to the Contractor upon request.

The Contractor is hereby notified that existing conditions depicted on the plans (IMS) were developed from existing sources, such as Highway Reconstruction Projects. The available information was then digitized and field checked for discrepancies. These plans are in no way meant to construe accurate survey of actual conditions.

The Contractor is responsible for verifying existing conditions depicted on the plans or contained elsewhere in the specification, any changes found shall be immediately reported to the Engineer.

The Contractor will be responsible for locating, verifying the location of and protecting all IMS below and above the ground. Prior to the start of construction, the Contractor shall contact “Call Before You Dig” and all utility companies within the towns along the project area. The Contractor shall also contact Robert Kennedy (860-594-3458) of ConnDOT Highway Operations to mark out IMS conduit and appurtenances.

In areas adjacent to existing incident management system equipment, the Contractor is required to hand excavate. Any damage to the IMS conduit/equipment caused by the Contractor’s work operation will be the responsibility of the Contractor, and will be replaced by the Contractor at the Contractor’s expense, as directed by the Engineer.

The Contractor is further advised to perform a field review of the entire project area in relation to the location of the proposed conduit to identify actual field conditions.

The Contractor is hereby notified that some of the details provided in the IMS sheets may not apply. These details are meant as typicals, and the Contractor may need to modify or develop new details where required.

## **NOTICE TO CONTRACTOR – INSTALLATION OF FIBER OPTIC CABLE IN EXISTING MULTIDUCT CONDUIT**

The work under this contract includes the installation of new fiber optic cable within existing multiduct conduit. Prior to the installation of the new fiber optic cable, the Contractor shall be responsible for verifying the condition of the existing multiduct conduit and spare innerduct in which the fiber optic cable will be installed. In accordance with the requirements of the respective items for Optical Fiber Cable, Single Mode, Loose Buffer Tube Cable, the Contractor shall submit a testing procedure to the Engineer for approval. The intention of this testing procedure is to verify the integrity of the existing multiduct conduit system prior to installation of the fiber optic cable.

In the event that a blockage is identified as part of the conduit testing and verification process, the Contractor shall alert the Engineer. At the Engineer's direction, the Contractor shall clean the obstructed section of the existing conduit. The work associated with clearing sections of obstructed multiduct conduit will be paid on an hourly basis in accordance with the requirements of Item 1008907A – Cleaning Existing Conduit.

If the conduit is found to be damaged to any extent that the cleaning process will not clear the obstruction, the Engineer will determine whether the conduit is to be repaired or replaced. When directed by the Engineer to repair the damaged or impassable section of multiduct conduit or innerduct, the Contractor shall perform the repairs in accordance with the requirements of Item 1008910A –Multiduct Conduit Repair.

When it is determined by the Engineer to replace entire damaged sections of existing multiduct conduit, the work involved in the replacement of the conduit will be paid separately under the appropriate contract item(s) for RMC Multiduct Conduit, Trenching and Backfilling, and any applicable restoration items.

## **NOTICE TO CONTRACTOR – PRE-BID QUESTIONS AND ANSWERS**

Questions pertaining to DOT advertised construction projects must be presented through the CTDOT Pre-Bid Q and A Website. The Department cannot guarantee that all questions will be answered prior to the bid date. **PLEASE NOTE - at 9:00 am Monday (i.e. typical Wednesday Bid Opening) the project(s) being bid will be closed for questions, at which time questions can no longer be submitted through the Q and A Website.**

**Answers may be provided by the Department up to 12:00 noon, the day before the bid. At this time, the Q and A for those projects will be considered final, unless otherwise stated and/or the bid is postponed to a future date and time to allow for further questions and answers to be posted.**

If a question needs to be asked the day before the bid date, please contact the Contracts Unit staff and email your question to [dotcontracts@ct.gov](mailto:dotcontracts@ct.gov) immediately.

Contractors must identify their company name, contact person, contact email address and phone number when asking a question. The email address and phone number will not be made public.

The questions and answers (if any) located on the Q and A Website are hereby made part of the bid/contract solicitation documents (located on the State Contracting Portal), and resulting contract for the subject project(s). It is the bidder's responsibility to monitor, review, and become familiar with the questions and answers, as with all bid requirements and contract documents, prior to bidding. By signing the bid proposal and resulting contract, the bidder acknowledges receipt of, and agrees to the incorporation of the final list of Q and A, into the contract document.

Contractors will not be permitted to file a future claim based on lack of receipt, or knowledge of the questions and answers associated with a project. All bidding requirements and project information, including but not limited to contract plans, specifications, addenda, Q and A, Notice to Contractors, etc., are made public on the State Contracting Portal and/or the CTDOT website.

**NOTICE TO CONTRACTOR – CONSTRUCTION CONTRACTOR**  
**DIGITAL SUBMISSIONS**

Upon execution of the Contract, the Contractor acknowledges and agrees that contractual submittals for this Project shall be submitted and handled through a system of paperless electronic means as outlined in the special provision for Section 1.05 herein.

Shop drawings, working drawings, and product data shall be created, digitally signed and delivered by the Contractor in accordance with the Department's [Contractor Digital Submission Manual](#) (CDSM). Other deliverables that are required by other special provisions shall be similarly submitted.

Access credentials will be provided to the Contractor by the Department.

The Department will provide the Contractor with a list of email addresses that are to be used for each submittal type.

The Department shall not be held responsible for delays, lack of processing or response to submittals that do not follow the specified guidelines in the CDSM.

## **NOTICE TO CONTRACTOR – Federal Wage Determinations (Davis Bacon Act)**

The following Federal Wage Determinations are applicable to this Federal- Aid contract and are hereby incorporated by reference. During the bid advertisement period, it is the bidder’s responsibility to obtain the latest Federal wage rates from the US Department of Labor website, as may be revised 10 days prior to bid opening. Any revisions posted 10 days prior to the bid opening shall be the wage determinations assigned to this contract.

<b>Check Applicable WD# (DOT Use Only)</b>	<b>WD#</b>	<b>Construction Type</b>	<b>Counties</b>
<b>X</b>	CT1	Highway	Fairfield, Litchfield, Middlesex, New Haven, Tolland, Windham
	CT2	Highway	New London
<b>X</b>	CT3	Highway	Hartford
	CT5	Heavy Dredging (Hopper Dredging)	Fairfield, Middlesex, New Haven, New London
	CT6	Heavy Dredging	Statewide
	CT13	Heavy	Fairfield
	CT14	Heavy	Hartford
	CT15	Heavy	Middlesex, Tolland
	CT16	Heavy	New Haven
	CT17	Heavy	New London
	CT26	Heavy	Litchfield, Windham
	CT18	Building	Litchfield
	CT19	Building	Windham
	CT20	Building	Fairfield
	CT21	Building	Hartford
	CT22	Building	Middlesex
	CT23	Building	New Haven
	CT24	Building	New London
	CT25	Building	Tolland
	CT4	Residential	Litchfield, Windham
	CT7	Residential	Fairfield
	CT8	Residential	Hartford
	CT9	Residential	Middlesex
	CT10	Residential	New Haven
	CT11	Residential	New London
	CT12	Residential	Tolland

The Federal wage rates (Davis-Bacon Act) applicable to this Contract shall be the Federal wage rates that are current on the US Department of Labor website (<http://www.wdol.gov/dba.aspx>) as may be revised 10 days prior to bid opening. The Department will no longer physically include revised Federal wage rates in the bid documents or as part of addenda documents. These applicable Federal wage rates will be incorporated in the final contract document executed by both parties. If a conflict exists between the Federal and State wage rates, the higher rate shall govern.

To obtain the latest Federal wage rates, go to the US Department of Labor website (link above). Under Davis-Bacon Act, choose “Selecting DBA WDs” and follow the instruction to search the latest wage rates for the State, County and Construction Type.

**NOTICE TO CONTRACTOR – USE OF STATE POLICE OFFICERS**

The Department will reimburse services of State Police Officers as a direct payment to the Department of Emergency Services and Public Protection. Payment for State Police Officers must be approved by the Engineer. Any State Police Officers used by the Contractor for its convenience is the responsibility of the Contractor. A separate payment item for State Police Officers is not included in this Contract.

Any costs associated with coordination and scheduling of State Police Officers shall be included in the lump sum bid price for Item No. 0971001A – Maintenance and Protection of Traffic.

## **NOTICE TO CONTRACTOR – PROCUREMENT OF MATERIALS**

Upon award, the Contractor shall proceed with shop drawings, working drawings, procurement of materials, and all other submittals required to complete the work in accordance with the contract documents.

The Contractor shall submit the following Contract Items for approval:

- ITS Contractor Qualifications including:
  - ITS Equipment Installer
  - Fiber Optic Cable Installation, Splicing and Testing Contractor
  - ITS System Integrator
  - ITS Structure Foundation Installer
- Item No. 1002214A – Traffic Control Foundation Controller – Type IV Modified
- Item No. 1002232A – Traffic Control Foundation – Span Pole – Type C
- Item No. 1002233A – Traffic Control Foundation – Span Pole – Type D
- Item No. 1008XXX – 2” and 3” Rigid Metal Conduit
- Item No. 1008XXXA – 4” Multiduct Conduit
- Item No. 1009016A – 18” x 12” x 8” Cast Iron Junction Box
- Item No. 1010011 – Concrete Handhole – Type I
- Item No. 10120XXA – Single Conductor Service Cable
- Item No. 1014503A – Transformer 5 KVA 240/120 Volt
- Item No. 1015041A – Pullbox
- Item No. 1015044A – Electric Vault (IMS)
- Item No. 1017032A – Service (Metered)
- Item No. 1017033A – Service Cabinet
- Item No. 105010XA – Motorist Aid Variable Message Sign
- Item No. 1108627A – Terminal (Port) Server
- Item No. 1108628A – Port Sharing Device
- Item No. 1108629A - Traffic Management System Mini Hub Cabinet
- Item No. 1108644A - Traffic Management System Cabinet
- Item No. 1108645A – Auxiliary Termination Cabinet
- Item No. 1108661A – 10/100 Base-TX Ethernet Switch
- Item No. 1108662A – Ethernet Media Converter
- Item No. 1108670A – Wireless Router
- Item No. 1108704A – Optical Video/Data Transmitter
- Item No. 1108707A – Rack Mount Optical Video/Data Receiver
- Item No. 1108826A – Optical Fiber Termination Patch Panels
- Item No. 1108841A – Multi-Channel Fiber Optic Video Multiplexer/Demultiplexer
- Item No. 1112210A – Camera Assembly
- Item No. 1112216A – Camera Lowering Device Assembly – Type A
- Item No. 1112217A – Camera Lowering Device Assembly – Type B
- Item No. 1112241A – Fiber Optic Cable Splice Enclosure
- Item No. 1112268A – Fiber Optic Directional Couplers

- Item No. 1113059A – Traffic Flow Monitor
- Item No. 11136XXA – Optical Fibercable, Single Mode, Loose Buffer Tube Cable, 6-144 Fiber
- Item No. 1113726A – No. 20 AWG, 6 Twisted Pair Communications Cable
- Item No. 1201216A – Overhead Cantilever Sign Support (Type VMS 1)
- Item No. 1201602A – Side Mounted VMS Support (Type 2)
- Item No. 1202247A – Overhead Cantilever Sign Support Foundation (Type VMS 1)
- Item No. 1203109A – Side Mounted Sign Foundation



**NOTICE TO CONTRACTOR – UTILITY SPECIFICATIONS**

The contractor is hereby notified that all utility specifications contained elsewhere herein shall be made a part of this contract, and that the contractor shall be bound to comply with all requirements of such specifications. The requirements and conditions set forth in the subject specifications shall be binding on the contractor just as any other specification would be.

## **NOTICE TO CONTRACTOR – 30-DAY SYSTEM OPERATIONAL TEST**

Upon successful completion of the installation and testing of the CCTV, TFM, VMS, Traffic Management System Cabinet, Traffic Management System Mini-Hub Cabinet equipment, and other items within this contract and as approved by the Engineer, a 30-day system operational test shall commence.

The Contractor shall not be permitted to start the 30-day system operational test until all manufacturers' equipment warranties, spare parts and as-built drawings have been received by the Engineer for all equipment listed in the item numbers below in this special provision.

During the course of this test, each item listed below must function in accordance with the specifications for the duration of the test. Each item listed below must be tested concurrently. The contractor shall refer to each item for additional testing, if required.

If a malfunction occurs within the stated time frame, then the Contractor shall make all necessary repairs to the system and re-establish proper operation. Upon approval of the Engineer, the 30-day system operational test will begin as new. The system must operate a full thirty (30) consecutive days without a malfunction before the system will be accepted by the Engineer. The Contractor shall coordinate the 30-day System Operational Test with other pertinent items in this specification and contract.

The Contractor shall maintain and submit to the Engineer a log of recording each 30-day system operational test until all items have successfully completed the 30-day test. The log shall contain a record of all 30-day system operational test start date, reported and recorded failures and repairs to remedy failures of any of the items, re-start dates, and 30-day system operational test completion dates. The log shall contain a list all of the sites on the plans. The Contractor shall submit to the Engineer a weekly status of the log to the Engineer for approval until all of the sites have successfully completed the test. The Contractor shall report to the Engineer each 30-day system operational test successful completion on the day the test is completed. The Contractor shall maintain the log on a daily basis. The Contractor shall provide a copy of the log at the Engineer's request at any time to clarify or resolve any issues with the 30-day system operational test. The Contractor shall submit to the Engineer a proposed log format prior to start of any 30-day system operational test for review and approval by the Engineer.

The Contractor shall be responsible for coordination of the 30-day system operational test with the Newington Operations Staff. The Contractor shall notify Mr. Robert Kennedy at 860-594-3458, in writing, when each system is to begin a 30-day system operational test. The Contractor shall make available a telephone number to the Engineer and the Newington Operations Staff for reporting failures. The Contractor shall be responsible for notifying Newington Operations when a restart and successful completion of each CCTV, TFM or VMS is made.

The Newington Operations Staff will report to the Contractor when the system experiences a failure. The Contractor is responsible for reporting any or all failures to the Engineer.

Upon successful completion of the 30-day System Operational Test and approval by the Engineer, the system shall be supported by Item #1112252A – Equipment Operations (Estimated Cost) until the successful completion of the entire construction project or as directed by the Engineer.

The Contractor shall coordinate the 30-day System Operational Test with other pertinent items in this contract and other ConnDOT contracts (If required). The 30-day System Operational Test will not be accepted until all As-Built drawings for IMS equipment installations have been submitted by the Contractor and accepted by the Engineer.

Item #	Description
1014503A	– Transformer 5 KVA 240/120 Volt
1050106A	– Motorist Aid Variable Message Sign – Type A
1050107A	– Motorist Aid Variable Message Sign – Type B
1108627A	– Terminal (Port) Server
1108628A	– Port Sharing Device
1108629A	– Traffic Management System Mini Hub Cabinet
1108644A	– Traffic Management System Cabinet
1108661A	– 10/100 Base-TX Ethernet Switch
1108662A	– Ethernet Media Converter
1108670A	– Wireless Router
1108704A	– Optical Video/Data Transmitter
1108707A	– Rack Mount Optical Video/Data Receiver
1108841A	– Multi-Channel Fiber Optic Video Multiplexer/Demultiplexer
1112210A	– Camera Assembly
1112268A	– Fiber Optic Directional Couplers
1113059A	– Traffic Flow Monitor

## **NOTICE TO CONTRACTOR – ILLUMINATION**

The Contractor is hereby notified that certain conditions pertaining to the installation of new conduit, handholes, pull boxes and vaults in the vicinity of Illumination light standard poles, direct burial illumination cable, illumination conduit and pullboxes are required as part of this contract.

The Contractor will be responsible for locating, verifying the location of and protecting all utilities below and above ground. Prior to the start of construction, the Contractor shall contact “Call Before You Dig” and all utilities within the towns within the project area. The Contractor shall contact Mr. Bradley J. Overturf of ConnDOT Planning and Inventory and Data at 860-594-2089 to mark out traffic monitoring stations. The Contractor shall also contact ConnDOT District Electrical to request a mark out of the underground illumination conduit and appurtenances:

District 1 Electrical    Augie Grazuna                    860-566-3156

In areas adjacent to the existing illumination circuitry or traffic monitoring circuitry, the Contractor is required to hand excavate. Any damage caused to the illumination cable and/or traffic-monitoring stations will be the responsibility of the Contractor, and will be replaced by the Contractor at his own expense, as directed by the Engineer. Mark out of the illumination and traffic monitoring stations will not relieve the Contractor of responsibility.

## **NOTICE TO CONTRACTOR – IMS ELECTRICAL SERVICES**

Procedures regarding Incident Management System (IMS) electrical service installations, removals, inspections and inventory documentation:

1. The contractor shall make all arrangements with the utility company, complete the required service requests for all electrical service locations and keep a record of the service request tracking numbers (such as the Work Request No. from ULI) provided by the utility company. All service requests shall include the six digit location number indicated on the plans. Billing for the monthly energy charges shall be to the following:

State of Connecticut Department of Transportation  
P.O. Box 317546  
Newington, CT 06131-7546

2. The contractor shall collect the applicable service information (service request tracking number, effective billing date, etc.) indicated on the IMS Service Log form contained herein for each IMS electrical service installation, and provide the information to the construction inspector. The construction inspector will forward the information to the Traffic Engineering Electrical Unit so that it will be entered into the IMS inventory log.
3. The construction inspector will contact the Property and Facilities - Code Inspection Services (P&FCIS) unit to schedule a code inspection for each IMS electrical service installation. The construction inspector will provide the P&FCIS unit a one (1) week notice prior to requiring them to perform an inspection. The construction inspector will provide P&FCIS with the service request tracking number for each electrical service in need of inspection.
4. The construction inspector will contact the Highway Operations unit to inform them when a new IMS system installation has been completed and is ready for their inspection.
5. When removing existing IMS systems, the contractor shall be required to notify the construction inspector 21 days in advance of required electrical service removal. The contractor shall provide the construction inspector with the applicable service information (meter number, meter address, service pole number, pole custodian, etc.) indicated on the IMS Service Log form. The construction inspector will forward the service information to the FDEE unit. The FDEE unit will prepare and submit a service removal request to the utility company to have the service de-energized and removed, and the service account terminated. The FDEE unit will inform the Traffic Engineering Electrical unit of the removal of the electrical service to have the IMS inventory log updated.

Office contacts and contact numbers:

Traffic Engineering Electrical unit – Jorge Kuljis (860) 594-2791  
Facilities Design Electrical Engineering (FDEE) – Edward Majcherek (860) 594-2795  
Property and Facilities Code Inspection Services (P&FCIS) – Michael LeBlanc (860) 594-2238  
Highway Operations unit – Robert Kennedy (860) 594-3458

**IMS Service Log,**  
To be filled out by the contractor.

Location: \_\_\_\_\_ Project No.: \_\_\_\_\_  
Town: \_\_\_\_\_ Loc No.: \_\_\_\_\_  
Route: \_\_\_\_\_

Service Request Tracking No.: \_\_\_\_\_  
(provided by the power company)

Effective Billing Date: \_\_\_\_\_  
(date power is connected & energized by the power company)

Removal Date: \_\_\_\_\_  
(date power is disconnected & de-energized by the power company)

Meter No.: \_\_\_\_\_

Meter Address: \_\_\_\_\_

Pole No.: \_\_\_\_\_

Pole Custodian: \_\_\_\_\_

Date submitted to Construction Inspector: \_\_\_\_\_

Contractor Initials: \_\_\_\_\_

## **NOTICE TO CONTRACTOR – INCIDENT MANAGEMENT SYSTEM EQUIPMENT INSTALLATIONS**

The Contractor is hereby notified that the I-91 Incident Management Systems (IMS) will be extended, upgraded or completed as part of this contract. The work will include the installation of the following equipment:

- Closed Circuit Television (CCTV) cameras
- Camera Lowering Device Assemblies
- Traffic Management System Cabinets (TMSC), including mini-hubs
- Traffic Flow Monitors (TFM)
- Variable Message Signs (VMS)
- VMS Supports and foundations
- Fiber Optic Cable
- Electrical service cabinets, conduit and conductor cable

### **Installation of Equipment**

The proposed project will install infrastructure for the expansion of the Incident Management System along the I-91 and I-691 corridors. The proposed system installations will include the following:

- Approximately 13 miles of new 144-fiber optic cable in new multicell conduit along I-91 southbound between Murdock Avenue in Meriden and the Route 9 interchange in Cromwell;
- Approximately 2.5 miles of new 144-fiber optic cable in new multicell conduit along Route 9 southbound from Route 5/15 in Berlin to I-91 in Cromwell;
- Approximately 2 miles of new 144-fiber optic cable in existing multicell conduit along I-91 southbound from the Route 9 interchange in Cromwell to West Street in Rocky Hill;
- Approximately 10 miles of new 72-fiber optic cable in new multicell conduit along I-691 and Route 66 between the I-84 interchange in Southington and Preston Avenue in Meriden;
- Approximately 4 miles of new 144-fiber optic cable in existing multicell conduit along Route 5/15 between the Newington Operations Center and the Route 9 interchange in Berlin;
- Approximately 3 miles of new 144-fiber optic cable in existing multicell conduit along Route 5/15 between the Route 9 interchange in Berlin and North Colony Road in Berlin;
- Approximately 3 miles of new 144-fiber optic cable in new multicell conduit along Route 5/15 between North Colony Road in Berlin and I-691 in Meriden;

These proposed fiber optic cable trunkline installations will extend fiber optic conduit and cable along I-91 and I-691 to connect existing and new CCTV camera sites and Variable Message Sign (VMS) sites back to the existing Main Fiber Hub located in Hartford at the I-84/I-91 interchange and Newington Operations Center.

In addition to the installation of this new fiber optic cable, the project will install new CCTV cameras and camera lowering device assemblies, new TFM's, new VMS's on new overhead cantilever and side-mounted sign structures, and new TMSC's and Traffic Management System Mini-Hub Cabinets (TSMHC).

The following tables summarize the locations of the proposed CCTV and VMS to be installed under this contract:

CCTV #	TOWN	DIR	LOCATION DESCRIPTION
<b>I-91</b>			
91S-01	Cromwell	SB	Route 372, Exit 21
91N-02	Middletown	NB	Median, South of Exit 21
91S-03	Middletown	SB	South of Exit 21
91S-04	Middletown	SB	North of Smit St, between Exits 20 & 21
91N-05	Middletown	NB	North of Smit St, between Exits 20 & 21
91S-06	Middletown	SB	Country Club Road, Exit 20
91N-07	Middletown	NB	Country Club Road, Exit 20
91N-08	Middletown	NB	Rest Area between Exits 19 & 20
91S-09	Middletown	SB	Median, North of Exit 19 (Baldwin Ave)
91N-10	Meriden	NB	Baldwin Avenue, Exit 19
91S-11	Meriden	SB	Rte 15 Northbound Ent. Ramp, Exit 17
91S-12	Meriden	SB	E. Main Street, between Exits 16 & 17
91S-13	Meriden	SB	Murdock Avenue, South of Exit 16
<b>ROUTE 15</b>			
15N-01	Meriden	NB	Paddock Avenue, South of Exit 67
<b>ROUTE 372</b>			
372W-01	Cromwell	WB	I-91 Interchange
<b>I-691</b>			
691W-01	Southington	WB	Peck Lane, between Exits 2 & 3
691E-02	Southington	EB	Highland Road, Exit 3
691W-03	Southington	WB	South End Road, between Exits 3 & 4
691E-04	Southington	EB	Pratt Street, West of Exit 4
691W-05	Meriden	WB	Route 322, Exit 4
691W-06	Meriden	WB	Hubbard Park Dr, between Exits 4 & 5
691E-07	Meriden	EB	Hubbard Park Dr, between Exits 4 & 5
691W-08	Meriden	WB	Route 71, Exit 5
691E-09	Meriden	EB	Colony Street, between Exits 6 & 7
691E-10	Meriden	EB	Broad Street (Rte 5), Exit 8
691W-11	Meriden	WB	Route 15, between Exits 8 & 9
691E-12	Meriden	EB	Route 15, Exit 10
691E-13	Meriden	EB	I-91, Exit 11
<b>ROUTE 66</b>			
66W-14	Meriden	WB	Preston Avenue, Exit 12



The following table summarizes the locations of the proposed VMS's:

VMS #	TOWN	DIR	SIGN SIZE	LOCATION DESCRIPTION
I-691				
691E-01	Southington	EB	B	East of Highland Road, Exit 3
691W-02	Meriden	WB	B	West of Rte 71, Exit 5
ROUTE 66				
66W-03 <sup>†</sup>	Middlefield	WB	A	West of Rte 147 (Baileyville Rd)

<sup>†</sup> Side-Mount, Two-Post structure.

### **Installation of the Communications System**

The installation of the Communication System involves the installation of TMSC's (CCTV sites), Mini-Hub's, 72 and 144 fiber optic trunk cable, 6 fiber optic drop cable and VMS-CCTV interconnect, and all equipment wiring and associated rack-mounted equipment. Video/Data/Audio from each of the CCTV and/or VMS sites is transmitted over fiber optic cable to the Mini-Hub sites for transport to the Newington Operations Center (NOC). Each TMSC shall splice four strands of the fiber optic drop cables (also called 'branch' cables) to the dedicated "local distribution" fiber strands of 72 or 144 fiber optic trunk cables. The "local distribution" fibers are terminated at Mini-Hub sites where the video and data signals over fiber are mixed and transported to the BOC on four strands of fiber dedicated to "mini-hub distribution". The buffer tubes of the fiber optic trunk cable are assigned for these drop-cable connections in sequential order relating to the buffer tube number, starting with buffer tube #1 (blue). All unused tubes are designated as "Spare".

### **SEQUENCE OF OPERATIONS:**

The Contractor shall conform to the following sequence of operations as written. The sequence for other incidental work (e.g. clearing & grubbing, fencing, guiderail, grading, etc.) at various locations shall be subject to the approval of the Engineer. The order in which the locations are constructed shall be at the Contractor's discretion, but shall be identified in advance and subject to the approval of the Bureau of Highway Operations.

- Install new conduit, pull boxes, and vaults for 72 and 144 fiber optic cable trunkline.
- Install foundations for field equipment at all CCTV and VMS sites.
- Install interconnecting conduit for electrical service, fiber optic cable and communications cable at all CCTV and VMS sites.
- Install Traffic Management System Cabinets, Mini-Hub Cabinets, VMS Cabinets, camera lowering devices with poles, camera assemblies, TFM's, VMS cantilever sign supports, and VMS.

- Install Video/Data communications equipment at NOC.
- Install new mainline and branch fiber optic cables, including splicing. For locations of existing conduit (e.g along Route 5/15) new mainline fiber cable will be installed within a spare innerduct of the existing conduit. Existing mainline cable within these existing conduits shall remain fully operational during this work.
- Install electrical service wiring for all CCTV and VMS sites. Electrical service will be installed in new conduit.
- Test new CCTV and VMS installations.
- Remove existing VMS's, as indicated on the plans.

The Contractor shall contact Mr. Robert Kennedy, ConnDOT Highway Operations at 860-594-3458 at least 48 hours prior to the scheduled installation of any new VMS and CCTV Camera Site.

The above Sequence of Construction is not intended to be a complete listing of all work included in the project and it is intended that some tasks may occur simultaneously. The recommended Sequence of Construction may be modified at the request of the Contractor and the approval of the Engineer.

## **NOTICE TO CONTRACTOR – SERVICE CONNECTIONS (UTILITIES)**

The Contractor is hereby notified that certain conditions pertaining to the installation of new telephone service and/or electrical service for the Traffic Management System Cabinets (CCTV Cameras) and Motorist Aid Variable Message Sign (VMS) Cabinets are required, as part of this contract.

Unless otherwise approved by the Engineer, the responsibilities for utility services for the CCTV Cameras and VMS Cabinets shall be as follows:

### Power:

Electrical service for the various locations within this project is provided by Eversource Energy (formerly CL&P). The Contractor shall contact the following representative 30 days prior to required work or services:

The Connecticut Light and Power Company dba Eversource Energy – Electric Distribution

Mr. Thomas Woronik

Supervisor – Construction Engineering

Phone: 860-267-3891

E-Mail: Thomas.woronik@eversource.com

All electrical service work shall be done in accordance with the following requirements of the service provider:

Eversource will provide electrical service cable from the service source, either utility pole, transformer or underground structure, to a meter socket on the cabinet. Eversource will also provide the service meter as described under Item #1017034A - Install Service. The Contractor shall install 3” (75mm) RMC Conduit to the base of the pole (including conduit sweep at base of pole) with approved conduit covers. Eversource will install the conduit riser and pull the service conductors through the installed conduit to the meter socket.

### Telephone:

Telephone service for the various locations within this project is provided by Frontier Communications of Connecticut. Frontier is to provide telephone conductors from the service source, either utility pole or underground structure, to an Auxiliary Termination Cabinet to be furnished and installed on the VMS Control Cabinet. The Contractor will install 2” conduit with pull string for Frontier personnel to install the conductors. Conduit sweeps and risers will be furnished and installed by the Contractor on the custodial utility pole for pulling conductors. The Contractor is responsible for coordinating the field installation for telephone service. The Contractor shall notify Robert Kennedy, 860-594-3458 forty-five (45) days prior to completion of work for ordering of the telephone circuits. The Contractor shall meet the telephone

representative at the sites to ensure installation is complete and operational. The Contractor shall notify the Engineer when the telephone installation at each site is complete.

The Contractor shall contact the following representative 30 days prior to required work or services:

Frontier (formerly Southern New England Telephone Company)

Ms. Lynne DeLucia

Manager – Engineering & Construction

Phone: 203-238-5000

E-Mail: [lynne.m.anastasio@ftr.com](mailto:lynne.m.anastasio@ftr.com)

## **NOTICE TO CONTRACTOR – TELECOMMUNICATIONS INSTALLATION**

Frontier is to provide telephone conductors from the service source, either utility pole or underground structure, to an Auxiliary Termination Cabinet on the cabinet. Conduit will be installed by the Contractor with pull string for Frontier personnel to install the conductors. Conduit risers will be provided by the Contractor on the custodial utility pole for pulling conductors. The Contractor is responsible for coordinating the telephone field installation with Frontier. The Contractor shall contact the Mr. Robert Kennedy (ConnDOT Highway Operations Unit) at (860) 594-3458 at least 45 days prior to the telephone installation so arrangements can be made with the telephone Contractor. The Engineer will advise the Contractor of the installation date. The Contractor shall meet the telephone representative at the sites to ensure installation is complete and operational. The Contractor shall notify the Engineer the telephone installation at each site is complete.

The Contractor shall contact the utility representatives listed on the plans in advance of the start of construction at each site.

The Contractor shall schedule a utility coordination meeting at the start of construction. The contractor shall notify the utility representatives shown on the plans at least 14 days prior to the utility meeting. The purpose of the utility meeting is to review the proposed service connection locations and to review the procedures that the contractor must follow to initiate the utility service connections.

## **NOTICE TO CONTRACTOR – ELECTRONIC ENGINEERING DATA (EED)**

The EED is an assembly of engineering data files that were used to produce the Contract plans.

**Electronic Engineering Data (EED) is provided for information purposes only. In case of conflict between the EED and the Contract plans and specifications, the contract plans and specifications shall govern.** The EED has been reviewed by the Department for quality control purposes, but it is the Contractor's responsibility to build the Project per the contract plans and specifications.

The EED is being provided to the Engineer for GPS/RTS inspection. The Contractor may use the EED to assist in bidding, layout and Automated Machine Control/Guidance.

The EED includes geospatially-correct 2D CAD files and may include horizontal and vertical alignment data files, 3D surface model files (break-line features and triangles) and a preference file. The data is being provided in two formats:

- Native Format
  - Bentley MicroStation CAD files (dgn)
  - Bentley SS2 InRoads Alignment Files (alg)
  - Bentley SS2 InRoads Digital Terrain Models (dtm)jk
  - Bentley SS2 InRoads Preference File (xin)
- Converted Format (for use in GPS/RTS Site equipment)
  - AutoCAD CAD files (dxf)
  - Alignment files (xml)
  - Surface Models (xml)

For a complete list of EED files, see the EED file manifest (PDF) located in the EED\_0171-0413.zip file which is posted with the contract PS&E's on the State Contracting portal.

## **NOTICE TO CONTRACTOR – EQUIPMENT OPERATION AND PROTECTION**

All trucks using any road designated as a Parkway must be equipped with two (2) amber strobe type flashers, visible from the rear only and with two (2) reflectorized slow moving vehicle triangles 14”Hx16”W (355 mm x 405 mm) mounted on the rear of the truck. The lights must show the full overall width of the vehicle and each shall be mounted on a hinged or telescoping post, so that the center of the light will not be less than 10 ft. above the ground when in an operating position. This signal system shall be in operation continuously while the vehicle is on the Parkway travelway.

During the course of the project and in accordance with Section 14-298-237(b) of the State Traffic Commission Regulations, the Contractor’s trucks and equipment may be authorized by the Engineer to travel over the portions of the Parkway from which they are normally excluded. However, it must be noted that no authorization will be given until;

- 1) The Contractor has contacted the Department’s Oversize/Overweight Permit Section at (860) 594-2880 and verified that the structures on the Parkway that he is planning to traverse with his equipment have sufficient vertical clearance and/or weight carrying capacity.
- 2) Each vehicle has been inspected by the Engineer and found to conform to the specifications herein.

Each driver of such equipment shall be given instructions by the Contractor concerning the manner of operation while on the Parkway. All vehicles shall be limited in travel between the nearest interchange and the work site.

The Engineer reserves the right to revoke authorization if the Contractor fails to abide by the regulations herein prescribed. The Contractor will not be permitted to park equipment on the median strip and will not be permitted to cross the median strip without specific permission of the Engineer.

**SECTION 1.02 – PROPOSAL REQUIREMENTS AND CONDITIONS**

**Article 1.02.04 – Examination of Plans, Specifications, Special Provisions and Site of Work:**

*Replace the third sentence of the last paragraph with:*

The Department cannot ensure a response to inquiries received later than ten (10) days prior to the original scheduled opening of the related bid.



## **SECTION 1.03 – AWARD AND EXECUTION OF CONTRACT**

### **Article 1.03.08 - Notice to Proceed and Commencement of Work:**

Change the first paragraph to read as follows:

"The Contractor shall commence and proceed with the Contract work on the date specified in a written notice to proceed issued by the Engineer to the Contractor. The date specified will be no later than 45 calendar days after the date of the execution of the Contract by the Department".

## **SECTION 1.05 – CONTROL OF THE WORK**

*Replace Article 1.05.02 with the following:*

### **1.05.02—Contractor Submittals, Working Drawings, Shop Drawings, Product Data, Submittal Preparation and Processing - Review Timeframes, Department’s Action:**

**1. Contractor Submittals:** The plans provided by the Department show the details necessary to give a comprehensive idea of the construction contemplated under the Contract. The plans will generally show the location, character, dimensions, and details necessary to complete the Project. If the plans do not show complete details, they will show the necessary dimensions and details, which when used along with the other Contract documents, will enable the Contractor to prepare working drawings, shop drawings or product data necessary to complete the Project.

The Contractor shall prepare submittals as Portable Document Format (PDF) files. The Contractor is also required to acquire, maintain access and use the Department’s document management system for delivery of submittals. The format, digital signing requirements, delivery processes and document tracking procedures shall be performed in accordance with this specification and the [Contractor’s Digital Submission Manual](#) (CDSM).

The submittals shall be sent to the Department’s reviewer(s), sufficiently in advance of the work detailed, to allow for their review in accordance with the review periods as specified herein (including any necessary revisions, resubmittal, and final review), and acquisition of materials, without causing a delay of the Project.

Each submittal shall include the name and contact information for an individual familiar with the submittal and who will be available to answer questions should they arise during the review.

**2. Working Drawings:** When required by the Contract or when ordered to do so by the Engineer, the Contractor shall prepare and submit the working drawings, signed, sealed and dated by a qualified Professional Engineer licensed to practice in the State of Connecticut, for review. The drawings shall be delivered sufficiently in advance of the work detailed, to allow for their review in accordance with the review periods specified herein (including any necessary revisions, resubmittal, and final review).

There will be no direct payment for furnishing any working drawings, procedures or supporting calculations, but the cost thereof shall be considered as included in the general cost of the work.

a. Working Drawings for Permanent Construction: The Contractor shall supply to the Assistant District Engineer a certificate of insurance in accordance with 1.03.07 at the time that the working drawings for the Project are submitted.

The Contractor’s designer, who prepares the working drawings, shall secure and maintain at no direct cost to the State a Professional Liability Insurance Policy for errors and omissions in the

minimum amount of \$2,000,000 per error or omission. The Contractor's designer may elect to obtain a policy containing a maximum \$250,000 deductible clause, but if the Contractor's designer should obtain a policy containing such a clause, they shall be liable to the extent of at least the deductible amount. The Contractor's designer shall obtain the appropriate and proper endorsement of its Professional Liability Policy to cover the indemnification clause in this Contract, as the same relates to negligent acts, errors or omissions in the Project work performed by them. The Contractor's designer shall continue this liability insurance coverage for a period of

- (i) 3 years from the date of acceptance of the work by the Engineer, as evidenced by a State of Connecticut, Department of Transportation form entitled "Certificate of Acceptance of Work," issued to the Contractor; or
- (ii) 3 years after the termination of the Contract, whichever is earlier, subject to the continued commercial availability of such insurance.

b. Working Drawings for Temporary Construction: The Contractor shall submit drawings, calculations, procedures and other supporting data to the Assistant District Engineer.

**3. Shop Drawings:** When required by the Contract, or when ordered to do so by the Engineer, the Contractor shall prepare and deliver shop drawings to the Designer for review. Review timeframes and submission locations are as specified herein.

When required by the contract documents or when ordered by the Engineer, the Contractor shall prepare and submit in digital format complete set(s) of shop drawings, catalog cuts, data sheets and other descriptive literature for all Incident Management System (IMS) related items to the Bureau of Highway Operations for approval before fabrication. IMS related items include multiduct conduit, pullboxes, fiber optic and communications cables, cabinets, cameras, camera lowering devices, variable message signs (VMS), traffic flow monitors (TFM) and telecommunications related equipment.

The packaged set of catalog cuts, working drawings and/or shop drawings shall be submitted either in paper (hard copy) form or in an electronic portable document format (.pdf). The package submitted in paper form shall include one (1) set. Catalog cuts shall be printed on ANSI A (8 1/2" x 11"; 216 mm x 279mm; letter) sheets. Working drawings and shop drawings shall be printed on ANSI B (11" x 17"; 279 mm x 432 mm; ledger/tabloid) sheets.

Please forward to:

Mr. John F. Korte  
 Connecticut Department of Transportation  
 Highway Operations Section  
 2800 Berlin Turnpike  
 P.O. Box 317546  
 Newington, Connecticut 06131-7546  
 (860) 594-3459  
 John.Korte@ct.gov

There will be no direct payment for furnishing any shop drawings, but the cost thereof shall be considered as included in the general cost of the work.

**4. Product Data:** When required by the Contract, or when ordered to do so by the Engineer, the Contractor shall prepare and deliver complete set(s) of product data, including but not limited to shop drawings, catalog cuts, data sheets and other descriptive literature for all Incident Management System (IMS) related items to the Bureau of Highway Operations for approval before fabrication. IMS related items include multiduct conduit, pullboxes, fiber optic and communications cables, cabinets, cameras, camera lowering devices, variable message signs (VMS), traffic flow monitors (TFM) and telecommunications related equipment.

The Contractor shall submit the product data in a single submittal for each element or group of elements of construction.

The Contractor shall mark each copy of the product data submittal to show applicable choices and options. Where product data includes information on several products that are not required, copies shall be marked to indicate the applicable information. Product data shall include the following information and confirmation of conformance with the Contract to the extent applicable: manufacturer's printed recommendations, compliance with recognized trade association standards, compliance with recognized testing agency standards, application of testing agency labels and seals, notation of coordination requirements, Contract item number, and any other information required by the individual Contract provisions.

The packaged set of catalog cuts, working drawings and/or shop drawings shall be submitted either in paper (hard copy) form or in an electronic portable document format (.pdf). The package submitted in paper form shall include one (1) set. Catalog cuts shall be printed on ANSI A (8 1/2" x 11"; 216 mm x 279mm; letter) sheets. Working drawings and shop drawings shall be printed on ANSI B (11" x 17"; 279 mm x 432 mm; ledger/tabloid) sheets.

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There will be no direct payment for furnishing any product data, but the cost thereof shall be considered as included in the general cost of the work.

**5. Submittal Preparation and Processing – Review Timeframes:** The Contractor shall allow 30 calendar days for submittal review by the Department, from the date receipt is acknowledged by the Department’s reviewer. For any submittals marked with “Revise and Resubmit” or “Rejected,” the Department is allowed an additional 20 calendar days for review of any resubmissions.

An extension of Contract time will not be authorized due to the Contractor’s failure to transmit submittals sufficiently in advance of the work to permit processing.

The furnishing of shop drawings, working drawings or product data, or any comments or suggestions by the Designer or Engineer concerning shop drawings, working drawings or product data, shall not relieve the Contractor of any of its responsibility for claims by the State or by third parties, as per 1.07.10.

The furnishing of the shop drawings, working drawings and product data shall not serve to relieve the Contractor of any part of its responsibility for the safety or the successful completion of the Project construction.

**6. Department’s Action:** The Designer or Engineer will review each submittal, mark each with a self-explanatory action stamp, and return the stamped submittal promptly to the Contractor. The Contractor shall not proceed with the part of the Project covered by the submittal until the submittal is marked “No Exceptions Noted” or “Exceptions as Noted” by the Designer or Engineer. The Contractor shall retain sole responsibility for compliance with all Contract requirements. The stamp will be marked as follows to indicate the action taken:

- a. If submittals are marked “No Exceptions Noted,” the Designer or Engineer has not observed any statement or feature that appears to deviate from the Contract requirements. This disposition is contingent on being able to execute any manufacturer’s written warranty in compliance with the Contract provisions.
- b. If submittals are marked “Exceptions as Noted” the considerations or changes noted by the Department’s Action are necessary for the submittal to comply with Contract requirements. The Contractor shall review the required changes and inform the Designer or Engineer if they feel the changes violate a provision of the Contract or would lessen the warranty coverage.
- c. If submittals are marked “Revise and Resubmit,” the Contractor shall revise the submittals to address the deficiencies or provide additional information as noted by the Designer or Engineer. The Contractor shall allow an additional review period as specified in 1.05.02-5.
- d. If submittals are marked “Rejected,” the Contractor shall prepare and submit a new submittal in accordance with the Designer’s or Engineer’s notations. The resubmissions require an additional review and determination by the Designer or Engineer. The Contractor shall allow an additional review period as specified in 1.05.02-5.

If the Contractor proposes a revision of a previously-submitted shop drawing that has been stamped "No Exceptions Noted" the Contractor shall submit in digital format the revised drawing incorporating any original Engineers notes for the Engineer’s review. Any such resubmitted shop drawing shall clearly indicate, in a revision block, the date and precise nature

of the revision, as well as its location on the revised drawing.

**Article 1.05.07 – Coordination with Work by Other Parties:** is supplemented as follows:

The Contractor shall be aware that other projects will be on-going adjacent to and within the Contract project limits, before, during, and after the contract construction. The following project(s) are, or may be, under construction concurrently with this project:

<b>Project No.</b>	<b>Description</b>
171-304	Update Signs I-84 Ext. 30-39A
118-170	Replace and Upgrade CTSS Equipment
093-210	DOT Highway Operations Center Expansion and Renovation

The Contractor is also required to fully coordinate his operations with and cooperate with all other adjacent projects, activities, and property owners; utility construction; and vehicular and/or pedestrian traffic.

The Contractor will be required to attend coordination meetings for and with the adjacent Program projects (as required) and will be required to fully coordinate operations, including traffic control signing patterns for temporary lane and/or shoulder closures, temporary traffic shifts and temporary detours on any roadway on the project with the adjacent project(s). The Contractor shall be required to account for coordination with adjacent project(s) in the CPM Schedule for the project.

The Contractor's attention is specifically directed to the fact that the construction shall be completed in conformance with the Special Provisions including but not limited to the following Special Provisions:

- Contract Time and Liquidated Damages
- Notice to Contractor – Incident Management System Equipment Installation
- 1.05 – Control of Work
- 1.08 – Prosecution and Progress

- Item #971001A – Maintenance and Protection of Traffic
- Item #0969030A - Project Coordinator (Minimum Bid)

## **SECTION 1.06 – CONTROL OF MATERIALS**

Add the following:

### **General:**

The Special Provisions contain the description of various items which must be submitted to the Engineer by the Contractor for review and approval. These items are in addition to other requirements described in the Specifications. Unless otherwise noted, the Contractor shall provide all required submissions as detailed in Section 1.05 – Control of the Work, and elsewhere in these specifications.

The State will complete its review of the material within thirty (30) calendar days from the date of receipt of the submission. The State shall advise the Contractor, in writing, as to the acceptability of the material submitted. The State may determine that the item is approved, in which case no further submittal is required by the Contractor, or the item may be partially or totally rejected in which case the Contractor shall be required to modify or clarify the submittal as required by the State and resubmit the item within fifteen (15) days. At this time, the review and approval cycle described above shall begin again. Approval by the Engineer of equipment and materials lists, catalogue cuts, and/or shop drawings shall not relieve the Contractor of any of his responsibility under the Contract for the successful completion of the work in conformity with the requirements of the Special Provisions.

### **Article 1.06.01 - Source of Supply and Quality is amended as follows:**

Delete the last paragraph and replace with the following:

For the following items the Contractor shall submit either in paper (hard copy) form or in an electronic portable document format (.pdf) a complete description of the item, complete set(s) of shop drawings, catalog cuts, data sheets and other descriptive literature which completely illustrates such items presented for formal approval.

Approval of the Shop Drawings and catalog cuts shall not change the requirements for a Certified Test Report, Materials Certificate and Certificate of Compliance as may be called for.

Shop drawings shall be submitted on 8-1/2 inch by 11 inch sheets or on 24 inch by 36 inch standard plan sheets. Shop drawings and data sheets shall be required for, but not limited to the following:

#### **Incident Management System:**

- Surface Mounted Conduit and Appurtenances
- Pullbox, pullbox covers
- Vault, vault covers

- Conduit, supports, brackets, hangers, clamps and any hardware involved with the supports and including complete fabrication details.
- Field fastener details including chemical and mechanical anchors
- Hand holes and covers
- Variable Message Signs (VMS)
- VMS supports
- Overhead Cantilever Sign Support
- Ground Mounted (2-Post) Sign Supports
- VMS Cabinets
- VMS Controllers
- VMS support foundations
- Fiber Optic Modems
- Camera Assembly. Schematics of the wiring between the camera and the equipment cabinet shall also be provided.
- Camera power supply
- Camera Video Cables, Data Cables, Power Cables and Connectors
- Remote Processing Unit (RPU), RPU Tower and Cabinet
- Ethernet Media Converter
- Terminal (Port) Server
- Port Sharing Device
- Traffic Flow Monitor
- Sensor Wire and Communication Cable
- Cast Iron Handhole Cover
- Cast Iron Junction Box
- Traffic Management System Mini Hub Cabinets
- Traffic Management System Cabinets
- Transformers
- Auxiliary Termination Cabinets
- Steel CCTV Poles
- Camera Lowering Device Assembly Type A and B
- Meter Sockets
- Conductors
- Outdoor Fiber Optic Splice Enclosures
- Fiber Optic Cable
- Fiber Patch Cords
- Fiber Optic Connectors
- Optical Fiber Termination Patch Panels
- Optical Video/Data Transmitter
- 10/100 Base-TX Ethernet Switch
- Multi-Channel Multiplexer/Demultiplexer
- Wireless Router
- Rack Mount Optical Video/Data Receiver
- Ring Ethernet Equipment
- Ethernet Switch Equipment



- Controller Interface Communications Unit (CICU)
- Central Communications Equipment (CCE)
- Cat 6 Cable
- RG-U59 Coax Cable
- RG-U59 Coax Cable Connectors
- High Density Patch Panels
- RJ 45 and RJ 48 Connectors
- Single Mode Optical Fiber Directional Coupler

Required catalog cuts for all items listed above shall be submitted in one package at the same time. All approvals or disapprovals and comments will be returned in one package.

Please forward to:

Mr. John F. Korte  
Connecticut Department of Transportation  
Highway Operations Section  
2800 Berlin Turnpike  
Newington, Connecticut 06131-7546

Mr. Donald L. Ward, P.E.  
Connecticut Department of Transportation  
District 1 Construction  
1107 Cromwell Avenue  
Rocky Hill, Connecticut 06067

Mr. Thomas Daley, P.E.  
Gannett Fleming, Inc.  
333 Elm Street, Suite 215  
Dedham, MA 02026

**Article 1.06.05 - Shipping Materials:** Add the following:

All vehicles transporting materials on highways and bridges in the State shall comply with all the vehicle regulations of the Connecticut General Statutes and regulations of Connecticut State Agencies as they apply to vehicle length, width, height and weight.

Any vehicle, either loaded or unloaded, will not be allowed to travel across any bridge or on any highway when such vehicle exceeds the legal limits or posted limits of such bridge or highway without a permit. The owner of the vehicle must apply to the Department for a permit for such travel, as provided in the statutes.

The General Statutes include the following limitations:

Vehicle Width (Section 14-262(a)(1)) - The width of a vehicle and combination vehicle and trailer, including its load, is limited to 8.5 ft. (2,590 mm), without a permit.

Vehicle Length (Section 14-262(c)) - The length of the semitrailer portion of a tractor-trailer unit, including its load, is limited to 50 ft. (14,630 mm), without a permit.

Vehicle Height (Section 14-264) - The height of a vehicle, with its load, is limited to 13.5 ft. (4110 mm), without a permit.

Vehicle Weight (Section 14-267a(b)(7)) - The gross vehicle weight (weight of vehicle including its load) is limited to 80,000 lbs. (36,280 kg) on 5 axles for vehicles with a 50 ft. (15 540 mm) wheelbase, without a permit.

Axle Weights of Vehicles (Section 14-267a) – For the above five axle vehicle, weight on a single axle may not exceed 22,400 lbs. (10,160 kg) or in the case of axles spaced less than 6 ft. (1,828 mm) apart, 18,000 lbs. (8,160 kg).

On Department projects, in accordance with the Commissioner’s policy, any member or component, either temporary or permanent, that measures 120 ft. (36,570 mm) or less and weighs no greater than 120,000 lbs. (54,430 kg), is transportable via an authorized permit route established by the Department provided the individual axle weights on the vehicle and trailer transporting the member or component do not exceed 20,000 lbs. (9,070 kg).

Members and components, shown in the contract documents, that exceed the above length and weight limits have been reviewed by the Department’s Oversize and Overweight Permits Section and are transportable via an authorized permit route established by the Department provided the individual axle weights on the vehicle and trailer transporting the member or component do not exceed 20,000 lbs. (9,070 kg).

All permits to transport materials are subject to shipping times established by the Department’s Oversize and Overweight Permits Section.

Applications for permits, required to transport materials, shall be submitted a minimum of two weeks prior to their required use, to the Department's Oversize and Overweight Permits Sections.

#### **Article 1.06.07 - Certified Test Reports and Materials Certificate**

##### **Incident Management System (IMS) Items:**

- 1) For the materials in the following Incident Management System items, a Materials Certificate will be required confirming their conformance to the requirements set forth in these plans or specifications or both.
  - Structural Steel (Poles and Sign Supports)
  - Structural Tubing
  - Galvanizing (certifying compliance with ASTM)

- Zinc Rich Primer
- Neoprene Gasket
- Polyurethane Sealant
- Grounding Rods
- Copper Wire
- Rigid Metal Conduit
- Anchor Bolts
- Handholes
- Pull Box
- Pull Box Cover
- Lowering Device Assembly
- Fiber Optic Cable
- Fiber Optic Cable Connectors
- Single Mode Optical Fiber Directional Coupler

2) For the materials in the following Incident Management System items, a Certified Test Report will be required confirming their conformance to the requirements set forth in these plans or specifications or both.

- Anchor Bolt and Hardware
- Structural Steel (Poles and Sign Supports)
- Structural Tubing
- Welds
- Conduit
- Fiber Optic Cable
- Fiber Optic Cable Connectors
- Conductors
- Service Cabinet
- Transformer
- VMS Cables
- Camera Cables
- Structural Steel (Poles)

3) The Contractor shall submit to the Engineer all Warranties and guarantees prior to final acceptance.

## **SECTION 1.07 – LEGAL RELATIONS AND RESPONSIBILITIES**

### **Article 1.07.10 - Contractor’s Duty to Indemnify the State against Claims for Injury or Damage:**

*Add the following after the only paragraph:*

“It is further understood and agreed by the parties hereto, that the Contractor shall not use the defense of Sovereign Immunity in the adjustment of claims or in the defense of any suit, including any suit between the State and the Contractor, unless requested to do so by the State.”

### **Article 1.07.11 Opening of Section of project to Traffic or Occupancy:**

*Add the following sentence to the last paragraph;*

“In cases in which guiderail is damaged by the traveling public, repair or replacement will be reimbursable as contained elsewhere herein.”

**SECTION 1.08 – PROSECUTION AND PROGRESS**

**Article 1.08.04 – Limitations of Operations - Add the following:**

In order to provide for traffic operations as outlined in the Special Provision “Maintenance and Protection of Traffic”, the Contractor will not be permitted to perform any work which will interfere with the described traffic operations on all project roadways as follows:

**I-91, I-691, I-84, Route 66, Route 15 and Route 9**

On the following State observed Legal Holidays:

- New Year’s Day
- Good Friday, Easter\*
- Memorial Day
- Independence Day
- Labor Day
- Thanksgiving Day\*\*
- Christmas Day

The following restrictions also apply:

On the day before and the day after any of the above Legal Holidays.

On the Friday, Saturday and Sunday immediately preceding any of the above Holidays celebrated on a Monday.

On the Saturday, Sunday and Monday immediately following any of the above Holidays celebrated on a Friday.

\* From 6:00 AM the Thursday before the Holiday to 8:00 PM the Monday after the Holiday.

\*\* From 6:00 AM the Wednesday before the Holiday to 8:00 PM the Monday after the Holiday.

During all other times, the Contractor shall maintain and protect traffic as shown on the accompanying “Limitation of Operations” charts, which dictate the minimum number of lanes that must remain open for each day of the week.

At locations VMS-91S-045, VMS-95S-075, and VMS-796N-126 the Contractor will be allowed to halt traffic for a period not to exceed 10 minutes to perform necessary work on the VMS signs, as approved by the Engineer, between 12:01 a.m. and 5:00 a.m. on all non-Holiday days.

Limitation of Operations Chart

Route: 9 Southbound							
Location: Between Route 15 and I-91 Interchanges							
Number of Through Lanes: 2							
Hour Beginning	Mon	Tue	Wed	Thu	Fri	Sat	Sun
Mid	1	1	1	1	1	1	1
1 AM	1	1	1	1	1	1	1
2 AM	1	1	1	1	1	1	1
3 AM	1	1	1	1	1	1	1
4 AM	1	1	1	1	1	1	1
5 AM	1	1	1	1	1	1	1
6 AM	2	2	2	2	2	2	2
7 AM	2	2	2	2	2	2	2
8 AM	2	2	2	2	2	2	2
9 AM	2	2	2	2	2	2	2
10 AM	2	2	2	2	2	2	2
11 AM	2	2	2	2	2	2	2
Noon	2	2	2	2	2	2	2
1 PM	2	2	2	2	2	2	2
2 PM	2	2	2	2	2	2	2
3 PM	2	2	2	2	2	2	2
4 PM	2	2	2	2	2	2	2
5 PM	2	2	2	2	2	2	2
6 PM	2	2	2	2	2	2	2
7 PM	1	1	1	1	1	1	1
8 PM	1	1	1	1	1	1	1
9 PM	1	1	1	1	1	1	1
10 PM	1	1	1	1	1	1	1
11 PM	1	1	1	1	1	1	1

**On Holidays and within Holiday Periods, all Hours shall be ‘E.’**

**‘E’ = maintain existing traffic operations = all available travel lanes, including exit only lanes, climbing lanes and all available shoulder widths shall be open to traffic during this period**

Route: 15 Northbound Location: Hamden/New Haven Town Line to Exit 68W Number of Through Lanes: 2							
Hour Beginn- ing	Mon	Tue	Wed	Thu	Fri	Sat	Sun
Mid	1	1	1	1	1	1	1
1 AM	1	1	1	1	1	1	1
2 AM	1	1	1	1	1	1	1
3 AM	1	1	1	1	1	1	1
4 AM	1	1	1	1	1	1	1
5 AM	1	1	1	1	1	1	1
6 AM	2	2	2	2	2	1	1
7 AM	E	E	E	E	E	1	1
8 AM	2	2	2	2	2	1	1
9 AM	2	2	2	2	2	1	1
10 AM	2	2	2	2	2	2	1
11 AM	2	2	2	2	2	2	2
Noon	2	2	2	2	2	2	2
1 PM	2	2	2	2	2	2	2
2 PM	2	2	2	2	2	2	2
3 PM	2	2	2	2	2	2	2
4 PM	2	2	2	2	2	2	2
5 PM	2	2	2	2	2	2	1
6 PM	2	2	2	2	2	1	1
7 PM	1	1	1	1	1	1	1
8 PM	1	1	1	1	1	1	1
9 PM	1	1	1	1	1	1	1
10 PM	1	1	1	1	1	1	1
11 PM	1	1	1	1	1	1	1

**On Holidays and within Holiday Periods, all Hours shall be ‘E.’**

**‘E’ = maintain existing traffic operations = all available travel lanes, including exit only lanes, climbing lanes and all available shoulder widths shall be open to traffic during this period**

Route: 15 Southbound							
Location: Start of Expressway to I-691 On Ramp							
Number of Through Lanes: 2							
Hour Beginning	Mon	Tue	Wed	Thu	Fri	Sat	Sun
Mid	1	1	1	1	1	1	1
1 AM	1	1	1	1	1	1	1
2 AM	1	1	1	1	1	1	1
3 AM	1	1	1	1	1	1	1
4 AM	1	1	1	1	1	1	1
5 AM	1	1	1	1	1	1	1
6 AM	1	1	1	1	1	1	1
7 AM	1	1	1	1	1	1	1
8 AM	1	1	1	1	1	1	1
9 AM	1	1	1	1	1	1	1
10 AM	1	1	1	1	1	1	1
11 AM	1	1	1	1	1	1	1
Noon	1	1	1	1	1	1	1
1 PM	1	1	1	1	1	1	1
2 PM	1	1	1	1	1	1	1
3 PM	1	1	1	1	1	1	1
4 PM	1	1	1	1	2	1	1
5 PM	1	1	1	1	2	1	1
6 PM	1	1	1	1	1	1	1
7 PM	1	1	1	1	1	1	1
8 PM	1	1	1	1	1	1	1
9 PM	1	1	1	1	1	1	1
10 PM	1	1	1	1	1	1	1
11 PM	1	1	1	1	1	1	1

**On Holidays and within Holiday Periods, all Hours shall be ‘E.’**

**‘E’ = maintain existing traffic operations = all available travel lanes, including exit only lanes, climbing lanes and all available shoulder widths shall be open to traffic during this period**



Route: 15 Southbound Location: On Ramp from I-691 to Hamden/North Haven Town Line Number of Through Lanes: 2							
Hour Beginn- ing	Mon	Tue	Wed	Thu	Fri	Sat	Sun
Mid	1	1	1	1	1	1	1
1 AM	1	1	1	1	1	1	1
2 AM	1	1	1	1	1	1	1
3 AM	1	1	1	1	1	1	1
4 AM	1	1	1	1	1	1	1
5 AM	1	1	1	1	1	1	1
6 AM	1	1	1	1	1	1	1
7 AM	1	1	1	1	1	1	1
8 AM	1	1	1	1	1	1	1
9 AM	1	1	1	1	1	1	1
10 AM	1	1	1	1	1	1	1
11 AM	1	1	1	1	1	1	1
Noon	1	1	1	1	1	1	1
1 PM	1	1	1	1	1	1	1
2 PM	1	1	1	1	1	1	1
3 PM	1	1	1	1	1	1	1
4 PM	1	1	1	1	2	1	1
5 PM	1	1	1	1	2	1	1
6 PM	1	1	1	1	1	1	1
7 PM	1	1	1	1	1	1	1
8 PM	1	1	1	1	1	1	1
9 PM	1	1	1	1	1	1	1
10 PM	1	1	1	1	1	1	1
11 PM	1	1	1	1	1	1	1

**On Holidays and within Holiday Periods, all Hours shall be ‘E.’**

**‘E’ = maintain existing traffic operations = all available travel lanes, including exit only lanes, climbing lanes and all available shoulder widths shall be open to traffic during this period**

Route: 66 Westbound Location: Start of Expressway to On Ramp from Route I-91N Number of Through Lanes: 2							
Hour Beginn- ing	Mon	Tue	Wed	Thu	Fri	Sat	Sun
Mid	1	1	1	1	1	1	1
1 AM	1	1	1	1	1	1	1
2 AM	1	1	1	1	1	1	1
3 AM	1	1	1	1	1	1	1
4 AM	1	1	1	1	1	1	1
5 AM	1	1	1	1	1	1	1
6 AM	1	1	1	1	1	1	1
7 AM	1	1	1	1	1	1	1
8 AM	1	1	1	1	1	1	1
9 AM	1	1	1	1	1	1	1
10 AM	1	1	1	1	1	1	1
11 AM	1	1	1	1	1	1	1
Noon	1	1	1	1	1	1	1
1 PM	1	1	1	1	1	1	1
2 PM	1	1	1	1	1	1	1
3 PM	1	1	1	1	1	1	1
4 PM	2	2	2	2	2	1	1
5 PM	2	2	2	2	2	1	1
6 PM	1	1	1	1	1	1	1
7 PM	1	1	1	1	1	1	1
8 PM	1	1	1	1	1	1	1
9 PM	1	1	1	1	1	1	1
10 PM	1	1	1	1	1	1	1
11 PM	1	1	1	1	1	1	1

**On Holidays and within Holiday Periods, all Hours shall be ‘E.’**

**‘E’ = maintain existing traffic operations = all available travel lanes, including exit only lanes, climbing lanes and all available shoulder widths shall be open to traffic during this period**

Route: 84 Eastbound							
Location: Near the Burritt Street Overpass							
Number of Through Lanes: 3							
Hour Beginning	Mon	Tue	Wed	Thu	Fri	Sat	Sun
Mid	1	1	1	1	1	1	1
1 AM	1	1	1	1	1	1	1
2 AM	1	1	1	1	1	1	1
3 AM	1	1	1	1	1	1	1
4 AM	1	1	1	1	1	1	1
5 AM	1	1	1	1	1	1	1
6 AM	3	3	3	3	3	1	1
7 AM	3	3	3	3	3	1	1
8 AM	3	3	3	3	3	2	2
9 AM	2	2	2	2	2	2	2
10 AM	2	2	2	2	2	2	2
11 AM	2	2	2	2	3	3	3
Noon	2	2	2	2	3	3	3
1 PM	2	2	2	2	3	3	3
2 PM	2	2	2	2	3	2	2
3 PM	3	3	3	3	3	2	2
4 PM	3	3	3	3	3	2	2
5 PM	3	3	3	3	3	2	2
6 PM	2	2	2	2	3	2	2
7 PM	2	2	2	2	2	2	2
8 PM	1	1	1	2	2	2	2
9 PM	1	1	1	1	2	1	1
10 PM	1	1	1	1	1	1	1
11 PM	1	1	1	1	1	1	1

**On Holidays and within Holiday Periods, all Hours shall be ‘E.’**

**‘E’ = maintain existing traffic operations = all available travel lanes, including exit only lanes, climbing lanes and all available shoulder widths shall be open to traffic during this period**

Route: 84 Westbound							
Location: Near the Burritt Street Overpass							
Number of Through Lanes: 3							
Hour Beginning	Mon	Tue	Wed	Thu	Fri	Sat	Sun
Mid	1	1	1	1	1	1	1
1 AM	1	1	1	1	1	1	1
2 AM	1	1	1	1	1	1	1
3 AM	1	1	1	1	1	1	1
4 AM	1	1	1	1	1	1	1
5 AM	1	1	1	1	1	1	1
6 AM	3	3	3	3	3	1	1
7 AM	3	3	3	3	3	1	1
8 AM	3	3	3	3	3	2	2
9 AM	2	2	2	2	2	2	2
10 AM	2	2	2	2	2	2	2
11 AM	2	2	2	2	2	3	3
Noon	2	2	2	2	2	3	3
1 PM	2	2	2	2	2	3	3
2 PM	2	2	2	3	3	2	2
3 PM	3	3	3	3	3	2	2
4 PM	3	3	3	3	3	2	2
5 PM	3	3	3	3	3	2	2
6 PM	2	2	2	2	3	2	2
7 PM	2	2	2	2	2	2	2
8 PM	2	2	2	2	2	2	2
9 PM	1	1	1	1	2	1	1
10 PM	1	1	1	1	1	1	1
11 PM	1	1	1	1	1	1	1

**On Holidays and within Holiday Periods, all Hours shall be ‘E.’**

**‘E’ = maintain existing traffic operations = all available travel lanes, including exit only lanes, climbing lanes and all available shoulder widths shall be open to traffic during this period**

Route: 91 Northbound							
Location: Exit 19 to Exit 22							
Number of Through Lanes: 3							
Hour Beginning	Mon	Tue	Wed	Thu	Fri	Sat	Sun
Mid	1	1	1	1	1	1	1
1 AM	1	1	1	1	1	1	1
2 AM	1	1	1	1	1	1	1
3 AM	1	1	1	1	1	1	1
4 AM	1	1	1	1	1	1	1
5 AM	1	1	1	1	1	1	1
6 AM	3	3	3	3	3	1	1
7 AM	3	3	3	3	3	1	1
8 AM	3	3	3	3	3	2	1
9 AM	2	2	2	2	2	2	1
10 AM	2	2	2	2	2	2	2
11 AM	2	2	2	2	2	2	2
Noon	2	2	2	2	3	2	2
1 PM	2	2	2	2	3	2	2
2 PM	2	2	2	2	3	2	2
3 PM	3	3	3	3	3	2	2
4 PM	3	3	3	3	3	2	2
5 PM	3	3	3	3	3	2	2
6 PM	2	2	2	2	3	2	2
7 PM	1	1	2	2	2	2	2
8 PM	1	1	1	2	2	2	1
9 PM	1	1	1	1	1	1	1
10 PM	1	1	1	1	1	1	1
11 PM	1	1	1	1	1	1	1

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Route: 91 Southbound							
Location: Exit 23 Off Ramp to Exit 22 Off Ramp							
Number of Through Lanes: 4							
Hour Beginning	Mon	Tue	Wed	Thu	Fri	Sat	Sun
Mid	1	1	1	1	1	1	1
1 AM	1	1	1	1	1	1	1
2 AM	1	1	1	1	1	1	1
3 AM	1	1	1	1	1	1	1
4 AM	1	1	1	1	1	1	1
5 AM	2	2	2	2	2	1	1
6 AM	3	3	3	3	3	2	1
7 AM	4	4	4	4	4	2	1
8 AM	4	4	4	4	4	2	2
9 AM	3	3	3	3	3	3	2
10 AM	3	3	3	3	3	3	3
11 AM	3	3	3	3	4	3	3
Noon	3	3	3	3	4	4	4
1 PM	3	3	3	3	4	4	4
2 PM	3	4	4	4	4	4	4
3 PM	4	4	4	4	E	4	4
4 PM	E	E	E	E	E	3	4
5 PM	E	E	E	E	E	3	4
6 PM	3	3	4	4	4	3	3
7 PM	2	2	2	3	3	2	3
8 PM	2	2	2	2	3	2	3
9 PM	2	2	2	2	2	2	2
10 PM	1	1	1	2	2	2	2
11 PM	1	1	1	1	1	2	1

**On Holidays and within Holiday Periods, all Hours shall be ‘E.’**

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Route: 91 Southbound							
Location: Exit 22 Off Ramp to Exit 17 Off Ramp							
Number of Through Lanes: 3							
Hour Beginning	Mon	Tue	Wed	Thu	Fri	Sat	Sun
Mid	1	1	1	1	1	1	1
1 AM	1	1	1	1	1	1	1
2 AM	1	1	1	1	1	1	1
3 AM	1	1	1	1	1	1	1
4 AM	1	1	1	1	1	1	1
5 AM	1	1	1	1	1	1	1
6 AM	2	2	2	2	2	1	1
7 AM	3	3	3	3	3	2	1
8 AM	3	3	3	3	3	2	1
9 AM	3	3	3	3	3	2	2
10 AM	3	3	3	3	3	3	2
11 AM	3	3	3	3	3	3	2
Noon	3	3	3	3	3	3	3
1 PM	3	3	3	3	3	3	3
2 PM	3	3	3	3	3	3	3
3 PM	3	3	E	E	E	3	3
4 PM	E	E	E	E	E	3	3
5 PM	E	E	E	E	E	3	3
6 PM	3	3	3	3	3	2	3
7 PM	2	2	2	2	3	2	3
8 PM	2	2	2	2	2	2	2
9 PM	1	2	1	2	2	2	2
10 PM	1	1	1	1	2	2	1
11 PM	1	1	1	1	1	1	1

**On Holidays and within Holiday Periods, all Hours shall be ‘E.’**

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Route: 91 Southbound Location: Exit 17 Off Ramp to On Ramp from Route 15 Number of Through Lanes: 2							
Hour Beginning	Mon	Tue	Wed	Thu	Fri	Sat	Sun
Mid	1	1	1	1	1	1	1
1 AM	1	1	1	1	1	1	1
2 AM	1	1	1	1	1	1	1
3 AM	1	1	1	1	1	1	1
4 AM	1	1	1	1	1	1	1
5 AM	1	1	1	1	1	1	1
6 AM	1	1	1	1	1	1	1
7 AM	2	2	2	2	2	1	1
8 AM	2	2	2	2	2	1	1
9 AM	2	2	2	2	2	1	1
10 AM	2	2	2	2	2	2	1
11 AM	2	2	2	2	2	2	1
Noon	2	2	2	2	2	2	2
1 PM	2	2	2	2	2	2	2
2 PM	2	2	2	2	2	2	2
3 PM	2	2	2	2	2	2	2
4 PM	2	2	2	2	2	2	2
5 PM	2	2	2	2	2	2	2
6 PM	2	2	2	2	2	1	2
7 PM	1	1	1	1	1	1	1
8 PM	1	1	1	1	1	1	1
9 PM	1	1	1	1	1	1	1
10 PM	1	1	1	1	1	1	1
11 PM	1	1	1	1	1	1	1

**On Holidays and within Holiday Periods, all Hours shall be ‘E.’**

**‘E’ = maintain existing traffic operations = all available travel lanes, including exit only lanes, climbing lanes and all available shoulder widths shall be open to traffic during this period**



Route: 91 Southbound Location: On Ramp from Route 15 to Murdock Ave. Overpass Number of Through Lanes: 3							
Hour Beginn- ing	Mon	Tue	Wed	Thu	Fri	Sat	Sun
Mid	1	1	1	1	1	1	1
1 AM	1	1	1	1	1	1	1
2 AM	1	1	1	1	1	1	1
3 AM	1	1	1	1	1	1	1
4 AM	1	1	1	1	1	1	1
5 AM	1	1	1	1	1	1	1
6 AM	2	2	2	2	2	1	1
7 AM	2	2	2	2	2	1	1
8 AM	2	2	2	2	2	2	1
9 AM	2	2	2	2	2	2	1
10 AM	2	2	2	2	2	2	2
11 AM	2	2	2	2	2	2	2
Noon	2	2	2	2	2	2	2
1 PM	2	2	2	2	2	2	2
2 PM	2	2	2	2	2	2	2
3 PM	3	3	3	3	3	2	2
4 PM	3	3	3	3	3	2	2
5 PM	3	3	3	3	3	2	2
6 PM	2	2	2	2	2	2	2
7 PM	1	1	1	1	1	1	1
8 PM	1	1	1	1	1	1	1
9 PM	1	1	1	1	1	1	1
10 PM	1	1	1	1	1	1	1
11 PM	1	1	1	1	1	1	1

**On Holidays and within Holiday Periods, all Hours shall be ‘E.’**

**‘E’ = maintain existing traffic operations = all available travel lanes, including exit only lanes, climbing lanes and all available shoulder widths shall be open to traffic during this period**

Route: I-691 Eastbound							
Location: On Ramp from I-84 to Lane Add at Exit 7							
Number of Through Lanes: 2							
Hour Beginning	Mon	Tue	Wed	Thu	Fri	Sat	Sun
Mid	1	1	1	1	1	1	1
1 AM	1	1	1	1	1	1	1
2 AM	1	1	1	1	1	1	1
3 AM	1	1	1	1	1	1	1
4 AM	1	1	1	1	1	1	1
5 AM	1	1	1	1	1	1	1
6 AM	2	2	2	2	2	1	1
7 AM	E	E	E	E	E	1	1
8 AM	E	E	E	E	E	2	1
9 AM	2	2	2	2	2	2	2
10 AM	2	2	2	2	2	2	2
11 AM	2	2	2	2	2	2	2
Noon	2	2	2	2	2	2	2
1 PM	2	2	2	2	2	2	2
2 PM	2	2	2	2	2	2	2
3 PM	2	2	2	2	2	2	2
4 PM	2	2	E	E	E	2	2
5 PM	2	E	E	E	E	2	2
6 PM	2	2	2	2	2	2	2
7 PM	1	1	2	2	2	1	1
8 PM	1	1	1	1	1	1	1
9 PM	1	1	1	1	1	1	1
10 PM	1	1	1	1	1	1	1
11 PM	1	1	1	1	1	1	1

**On Holidays and within Holiday Periods, all Hours shall be ‘E.’**

**‘E’ = maintain existing traffic operations = all available travel lanes, including exit only lanes, climbing lanes and all available shoulder widths shall be open to traffic during this period**

Route: I-691 Eastbound Location: Lane Add at Exit 7 to Lane Drop at Exit 10 Number of Through Lanes: 3							
Hour Beginning	Mon	Tue	Wed	Thu	Fri	Sat	Sun
Mid	1	1	1	1	1	1	1
1 AM	1	1	1	1	1	1	1
2 AM	1	1	1	1	1	1	1
3 AM	1	1	1	1	1	1	1
4 AM	1	1	1	1	1	1	1
5 AM	1	2	2	2	1	1	1
6 AM	3	3	3	3	3	1	1
7 AM	E	E	E	E	E	2	1
8 AM	3	3	3	3	3	2	2
9 AM	2	2	2	2	2	2	2
10 AM	2	2	2	2	2	2	2
11 AM	2	2	2	2	2	3	2
Noon	2	2	2	2	2	3	2
1 PM	2	2	2	2	2	2	2
2 PM	2	2	2	2	3	2	2
3 PM	3	3	3	3	3	2	2
4 PM	3	3	3	3	3	2	2
5 PM	3	3	3	3	3	2	2
6 PM	2	2	2	3	2	2	2
7 PM	2	2	2	2	2	2	2
8 PM	1	1	2	2	2	2	2
9 PM	1	1	1	1	1	1	1
10 PM	1	1	1	1	1	1	1
11 PM	1	1	1	1	1	1	1

**On Holidays and within Holiday Periods, all Hours shall be ‘E.’**

**‘E’ = maintain existing traffic operations = all available travel lanes, including exit only lanes, climbing lanes and all available shoulder widths shall be open to traffic during this period**

Route: I-691 Eastbound							
Location: Lane Drop at Exit 10 to I-91 Off Ramp							
Number of Through Lanes: 2							
Hour Beginning	Mon	Tue	Wed	Thu	Fri	Sat	Sun
Mid	1	1	1	1	1	1	1
1 AM	1	1	1	1	1	1	1
2 AM	1	1	1	1	1	1	1
3 AM	1	1	1	1	1	1	1
4 AM	1	1	1	1	1	1	1
5 AM	1	1	1	1	1	1	1
6 AM	2	2	2	2	2	1	1
7 AM	2	2	2	2	2	1	1
8 AM	2	2	2	2	2	1	1
9 AM	1	1	2	2	1	1	1
10 AM	1	1	1	1	1	2	1
11 AM	1	1	1	1	1	2	1
Noon	1	1	1	1	1	2	2
1 PM	1	1	1	1	2	2	1
2 PM	1	2	2	2	2	2	1
3 PM	2	2	2	2	2	2	1
4 PM	2	2	2	2	2	2	1
5 PM	2	2	2	2	2	1	1
6 PM	2	2	2	2	2	1	1
7 PM	1	1	1	1	1	1	1
8 PM	1	1	1	1	1	1	1
9 PM	1	1	1	1	1	1	1
10 PM	1	1	1	1	1	1	1
11 PM	1	1	1	1	1	1	1

**On Holidays and within Holiday Periods, all Hours shall be ‘E.’**

**‘E’ = maintain existing traffic operations = all available travel lanes, including exit only lanes, climbing lanes and all available shoulder widths shall be open to traffic during this period**

Route: I-691 Westbound Location: Route I-91 On Ramp to On Ramp From 15 NB Number of Through Lanes: 2							
Hour Beginn- ing	Mon	Tue	Wed	Thu	Fri	Sat	Sun
Mid	1	1	1	1	1	1	1
1 AM	1	1	1	1	1	1	1
2 AM	1	1	1	1	1	1	1
3 AM	1	1	1	1	1	1	1
4 AM	1	1	1	1	1	1	1
5 AM	1	1	1	1	1	1	1
6 AM	1	1	1	1	1	1	1
7 AM	2	2	2	2	2	1	1
8 AM	2	2	2	2	2	1	1
9 AM	1	1	1	1	1	1	1
10 AM	1	1	1	1	1	1	1
11 AM	1	1	1	1	1	2	1
Noon	1	1	1	1	1	2	2
1 PM	1	1	1	1	2	2	2
2 PM	2	2	2	2	2	2	2
3 PM	2	2	2	2	2	2	2
4 PM	2	2	2	2	2	2	2
5 PM	2	2	2	2	2	2	1
6 PM	2	2	2	2	2	1	1
7 PM	1	1	1	1	1	1	1
8 PM	1	1	1	1	1	1	1
9 PM	1	1	1	1	1	1	1
10 PM	1	1	1	1	1	1	1
11 PM	1	1	1	1	1	1	1

**On Holidays and within Holiday Periods, all Hours shall be ‘E.’**

**‘E’ = maintain existing traffic operations = all available travel lanes, including exit only lanes, climbing lanes and all available shoulder widths shall be open to traffic during this period**

Route: I-691 Westbound Location: On Ramp From 15 NB to Exit 5 On Ramp Number of Through Lanes: 3							
Hour Beginning	Mon	Tue	Wed	Thu	Fri	Sat	Sun
Mid	1	1	1	1	1	1	1
1 AM	1	1	1	1	1	1	1
2 AM	1	1	1	1	1	1	1
3 AM	1	1	1	1	1	1	1
4 AM	1	1	1	1	1	1	1
5 AM	1	1	1	1	1	1	1
6 AM	2	2	2	2	2	1	1
7 AM	3	3	3	3	3	1	1
8 AM	3	3	3	3	3	2	1
9 AM	2	2	2	2	2	2	2
10 AM	2	2	2	2	2	2	2
11 AM	2	2	2	2	2	2	2
Noon	2	2	2	2	2	2	2
1 PM	2	2	2	2	2	2	2
2 PM	2	2	2	3	3	2	2
3 PM	3	3	3	3	3	2	2
4 PM	3	3	3	3	3	2	2
5 PM	3	3	3	3	3	2	2
6 PM	2	2	2	2	2	2	2
7 PM	2	2	2	2	2	2	2
8 PM	2	2	2	2	2	2	2
9 PM	1	1	1	1	1	2	1
10 PM	1	1	1	1	1	1	1
11 PM	1	1	1	1	1	1	1

**On Holidays and within Holiday Periods, all Hours shall be ‘E.’**

**‘E’ = maintain existing traffic operations = all available travel lanes, including exit only lanes, climbing lanes and all available shoulder widths shall be open to traffic during this period**

Route: I-691 Westbound							
Location: Exit 5 On Ramp to I-84 Off Ramps							
Number of Through Lanes: 2							
Hour Beginning	Mon	Tue	Wed	Thu	Fri	Sat	Sun
Mid	1	1	1	1	1	1	1
1 AM	1	1	1	1	1	1	1
2 AM	1	1	1	1	1	1	1
3 AM	1	1	1	1	1	1	1
4 AM	1	1	1	1	1	1	1
5 AM	1	1	1	1	1	1	1
6 AM	2	2	2	2	2	1	1
7 AM	2	2	2	2	2	1	1
8 AM	2	2	2	2	2	1	1
9 AM	2	2	2	2	2	2	1
10 AM	2	2	2	2	2	2	2
11 AM	2	2	2	2	2	2	2
Noon	2	2	2	2	2	2	2
1 PM	2	2	2	2	2	2	2
2 PM	2	2	2	2	2	2	2
3 PM	2	E	E	E	2	2	2
4 PM	E	E	E	E	E	2	2
5 PM	2	E	E	E	E	2	2
6 PM	2	2	2	2	2	2	2
7 PM	2	2	2	2	2	2	2
8 PM	1	1	1	1	1	1	1
9 PM	1	1	1	1	1	1	1
10 PM	1	1	1	1	1	1	1
11 PM	1	1	1	1	1	1	1

**On Holidays and within Holiday Periods, all Hours shall be ‘E.’**

**‘E’ = maintain existing traffic operations = all available travel lanes, including exit only lanes, climbing lanes and all available shoulder widths shall be open to traffic during this period**

**Ramps and Turning Roadways**

Monday through Friday between 6:00 AM and 9:00 AM and between 3:00 PM and 6:00 PM.

The Contractor will be allowed to halt traffic on the entrance and exit ramps for a period not to exceed 10 minutes to perform necessary work for trenching and conduit installation across the ramp pavement, as approved by the Engineer, between 12:01 a.m. and 5:00 a.m. on all non-Holiday days.

**Route 5 and Route 372****VMS-1W-087**

Monday through Friday between 6:00 AM and 9:00 PM.

Saturday and Sunday between 10:00 AM and 9:00 PM.

The Contractor will be allowed to halt traffic along Route 5 and Route 372 for a period not to exceed 10 minutes to perform necessary work for trenching and conduit installation across the roadway, as approved by the Engineer, between 12:01 a.m. and 5:00 a.m. on all non-Holiday days.

**All Other Roadways**

Monday through Friday between 6:00 AM and 9:00 AM and between 3:00 PM and 6:00 PM.

Saturday and Sunday between 10:00 AM and 6:00 PM

The Contractor will be allowed to halt traffic along the local roadway for a period not to exceed 10 minutes to perform necessary work for trenching and conduit installation across the roadway, as approved by the Engineer, between 12:01 a.m. and 5:00 a.m. on all non-Holiday days.

**Additional Lane Closure Restrictions**

It is anticipated that work on adjacent projects may be ongoing simultaneously with this project. The Contractor shall be aware of those projects and anticipate that coordination will be required to maintain proper traffic flow at all times on all project roadways, in a manner consistent with these specifications and acceptable to the Engineer.

The Contractor will not be allowed to perform any work that will interfere with existing traffic operations on a roadway when traffic operations are being restricted on that same roadway, unless there is at least a one mile clear area length where the entire roadway is open to traffic or the closures have been coordinated and are acceptable to the Engineer. The one mile clear length shall be measured from the end of the first work area to the beginning of the signing pattern for the next work area.



## **INCIDENT MANAGEMENT SYSTEM**

The Contractor will not be allowed to perform any work that will disrupt the normal operation of the Incident Management System (IMS) as follows:

On Monday through Friday from 5:00 AM to 9:00 PM and on Saturday and Sunday.

On any of the days identified above under the "I-91, I-691, I-84, Route 66, Route 15 and Route 9" section.

In order to maintain continuous operation of the Incident Management System, the Contractor shall adhere to the requirements in the special provision and "Notice to Contractor – Installation Qualifications" and "Notice to Contractor – Incident Management System Equipment Installations".

### **Article 1.08.07 - Determination of Contract Time:**

*Delete the second, third and fourth paragraphs and replace them with the following:*

When the contract time is on a calendar day basis, it shall be the number of consecutive calendar days stated in the contract, **INCLUDING** the time period from December 1 through March 31 of each year. The contract time will begin on the effective date of the Engineer's order to commence work, and it will be computed on a consecutive day basis, including all Saturdays, Sundays, Holidays, and non-work days.

### **1.08.08 - Extension of Time:**

*Delete the sixth paragraph, "If an approved extension of Contract time.... the following April 1".*

### **Article 1.08.09 - Failure to Complete Work on Time:**

*Delete the second paragraph, "If the last day...the project is substantially completed" and replace it with "Liquidated damages as specified in the Contract shall be assessed against the Contractor per calendar day from that day until the date on which the project is substantially completed."*

## **SECTION 1.10 – ENVIRONMENTAL COMPLIANCE**

### **In Article 1.10.03--Water Pollution Control: BEST MANAGEMENT PRACTICES**

*Add the following after Required Best Management Practices Number 13:*

14. The Contractor is hereby notified that the location of the Project occurs within a public watershed, well head protection area, aquifer protection area (APA), or sole source aquifer (SSA). The Contractor is hereby notified that the location of Project Nos. 171-413 & 171-414 occur within one of these sensitive areas. The protected areas encompass the area of contribution and recharge for the protected resource, as depicted on the graphical map. Please note that the Office of Environmental Planning will provide the graphical map to the District after the Project has been awarded as this information is considered proprietary. As a result of this location, special requirements must be followed for cleaning machinery, storage of materials, and servicing/fueling equipment.
- a. All Contractors and their employees must be informed of the sensitive area that they are working in. No pollutants may be discharged that could have adverse effects on the public drinking water supply. Any fuel or other hazardous chemical spills must be reported immediately to the DEEP Oil and Chemical Spills Unit at (860) 424-3338, the Department of Public Health's Drinking Water Division at 860-509-7333, and Middletown Water Department (Mount Higby Reservoir Watershed) at (860) 638-3500, South Central Regional Water Authority ( North Cheshire APA) at (203) 562-4020, Meriden Water Division (Columbus Park APA) at (203) 630-4256 , **no exceptions**.

When working within the Pootatuck SSA in *Newtown* or within the Pawcatuck SSA in *North Stonington* which also encompasses areas in *Sterling*, *Stonington* and *Voluntown*, Mr. Jeff Butensky from the Environmental Protection Agency (EPA) must be contacted at (617) 918-1665. Mr. Robert Adler from the EPA must also be contacted at (617) 918-1396, if a Project is near the Rhode Island state border.

- b. Contractors must adhere to specialized cleanup procedures while working within the watershed, well head protection area, APA or SSA. No cleaning of any machinery shall be performed within one hundred (100) feet of any water body within the sensitive area.
- i. Specifically for cleanup associated with pavers, material transfer vehicles (MTV) and concrete mixers, the Contractor must move the equipment off line onto a tarp. The tarp must be in an acceptable condition so as to prevent liquids and solids from passing through to the ground beneath, when the area is used for paving operations. The cleanup area shall have

- oil absorbent pads placed on the tarp. The equipment shall be cleaned over the absorbent pads in a manner that will allow the pads to collect any liquids that are used for cleanup.
- ii. Specifically for cleanup associated with dump trucks, a liquid tight five gallon pail shall be placed at each corner of the dump body below the lower hinges to capture any materials generated during the cleanup.
- c. All materials generated during the cleanup procedures shall be removed off-site at the end of each day and disposed of in a manner consistent with all applicable laws and regulations. These materials shall not be buried outside of the roadway limits.
  - d. Servicing and fueling of equipment shall be conducted outside of a public watershed area, APA, SSA, and/or well head protection area.
    - i. If equipment cannot be serviced and refueled outside of the watershed area, well head protection area, APA, or SSA then the Contractor shall utilize the proper spoils handling areas that are identified on the plans.
    - ii. Servicing and fueling of equipment is not permitted within a 500 foot radius of a non-community well and within a 1000 foot radius of a community well.
    - iii. Any fuel and/or hazardous materials that must be kept within these sensitive areas during working hours shall be stored in an enclosed spill proof container.
    - iv. Spill containment systems must be utilized during fueling operations, and shall be manufactured by Sentry Lite Berms, Collapse-a-tainer, or approved equal. It shall have a minimum capacity of 80-gallons and shall be made of plastic or vinyl which is inert to all fuel types.
    - v. Fuel spill remediation kits shall be stored on-site so that spills may be contained and cleaned quickly.
  - e. Construction staging and laydown areas are prohibited within a watershed area, APA, SSA, and/or well head protection area. The Contractor shall submit to the Engineer the desired location of trailer(s), construction staging/laydown areas, containment systems, and sedimentation control systems for review and approval prior to the start of construction.
  - f. Millings may be re-used as asphalt material. Disposal of excess millings must be performed off-site in a manner consistent with all applicable laws and regulations. At no time can millings be dumped or buried outside of the roadway limits.

## **SECTION 4.06 BITUMINOUS CONCRETE**

Section 4.06 is being deleted in its entirety and replaced with the following:

### **4.06.01—Description**

### **4.06.02—Materials**

### **4.06.03—Construction Methods**

### **4.06.04—Method of Measurement**

### **4.06.05—Basis of Payment**

**4.06.01—Description:** Work under this section shall include the production, delivery, placement, and compaction of an uniform textured, non-segregated, smooth bituminous concrete pavement to the grade and cross section shown on the plans.

The terms listed below as used in this specification are defined as:

Bituminous Concrete: A composite material consisting of prescribed amounts of asphalt binder, and aggregates. Asphalt binder may also contain additives engineered to modify specific properties and/or behavior of the composite material. References to bituminous concrete apply to all of its forms, such as those identified as hot-mix asphalt (HMA), or polymer-modified asphalt (PMA).

Bituminous Concrete Plant (Plant): A structure where aggregates and asphalt binder are combined in a controlled fashion into a bituminous concrete mixture suitable for forming pavements and other paved surfaces.

Course: A continuous layer (a lift or multiple lifts) of the same bituminous concrete mixture placed as part of the pavement structure.

Density Lot: The total tonnage of all bituminous concrete placed in a single lift and as defined in Article 4.06.03.

Disintegration: Erosion or fragmentation of the pavement surface which can be described as polishing, weathering-oxidizing, scaling, spalling, raveling, or formation of potholes.

Dispute Resolution: A procedure used to resolve conflicts between the Engineer and the Contractor's test results that may affect payment.

Hot Mix Asphalt (HMA): A bituminous concrete mixture typically produced at 325°F.

Job Mix Formula (JMF): A recommended aggregate gradation and asphalt binder content to achieve the required mixture properties.

Lift: An application of a bituminous concrete mixture placed and compacted to a specified thickness in a single paver pass.

Percent Within Limits (PWL): The percentage of the lot falling between the Upper Specification Limit (USL) and the Lower Specification Limit (LSL).

Polymer-Modified Asphalt (PMA): A bituminous concrete mixture containing a polymer modified asphalt binder and using a qualified warm mix technology.

Production Lot: The total tonnage of a bituminous concrete mixture from a single source that may receive an adjustment.

Production Sub Lot: Portion of the production lot typically represented by a single sample.

Quality Assurance (QA): All those planned and systematic actions necessary to provide ConnDOT the confidence that a Contractor will perform the work as specified in the Contract.

Quality Control (QC): The sum total of activities performed by the vendor (Producer, Manufacturer, and Contractor) to ensure that a product meets contract specification requirements.

Superpave: A bituminous concrete mix design used in mixtures designated as “S\*” Where “S” indicates Superpave and \* indicates the sieve related to the nominal maximum aggregate size of the mix.

Segregation: A non-uniform distribution of a bituminous concrete mixture in terms of gradation, temperature, or volumetric properties.

Warm Mix Asphalt (WMA) Technology: A qualified additive or technology that may be used to produce a bituminous concrete at reduced temperatures and/or increase workability of the mixture.

**4.06.02—Materials:** All materials shall conform to the requirements of Section M.04.

**1. Materials Supply:** The bituminous concrete mixture must be from one source of supply and originate from one Plant unless authorized by the Engineer.

**2. Recycled Materials:** Reclaimed Asphalt Pavement (RAP), Crushed Recycled Container Glass (CRCG), Recycled Asphalt Shingles (RAS), or crumb rubber (CR) from recycled tires may be incorporated in bituminous concrete mixtures in accordance with Project Specifications.

**4.06.03—Construction Methods:**

**1. Material Documentation:** All vendors producing bituminous concrete must have Plants with automated vehicle-weighting scales, storage scales, and material feeds capable of producing a delivery ticket containing the information below.

- a. "State of Connecticut" printed on ticket.
- b. Name of producer, identification of Plant, and specific storage silo if used.
- c. Date and time.
- d. Mixture Designation; Mix type and level Curb mixtures for machine-placed curbing must state "curb mix only".
- e. If WMA Technology is used, the additive name and dosage rate or water injection rate must be listed.
- f. Net weight of mixture loaded into the vehicle (When RAP and/or RAS is used the moisture content shall be excluded from mixture net weight).
- g. Gross weight (equal to the net weight plus the tare weight or the loaded scale weight).
- h. Tare weight of vehicle (Daily scale weight of the empty vehicle).
- i. Project number, purchase order number, name of Contractor (if Contractor other than Producer).
- j. Vehicle number - unique means of identification vehicle.
- k. For Batch Plants, individual aggregate, recycled materials, and virgin asphalt max/target/min weights when silos are not used.
- l. For every mixture designation the running daily total delivered and sequential load number.

The net weight of mixture loaded into the vehicle must be equal to the cumulative measured weights of its components.

The Contractor must notify the Engineer immediately if, during production, there is a malfunction of the weight recording system in the automated Plant. Manually written tickets containing all required information will be allowed for no more than one hour.

The State reserves the right to have an inspector present to monitor batching and /or weighing operations.

**2. Transportation of Mixture:** The mixture shall be transported in vehicles that are clean of all foreign material, excessive coating or cleaning agents, and, that have no gaps through which mixture might spill. Any material spilled during the loading or transportation process shall be quantified by re-weighing the vehicle. The Contractor shall load vehicles uniformly so that segregation is minimized. Loaded vehicles shall be tightly covered with waterproof covers acceptable to the Engineer. Mesh covers are prohibited. The cover must minimize air infiltration. Vehicles found not to be in conformance shall not be loaded.

Vehicles with loads of bituminous concrete being delivered to State projects must not exceed the statutory or permitted load limits referred to as gross vehicle weight (GVW). The Contractor shall furnish a list and allowable weights of all vehicles transporting mixture.

The State reserves the right to check the gross and tare weight of any vehicle. If the gross or tare weight varies from that shown on the delivery ticket by more than 0.4 percent, the Engineer will recalculate the net weight. The Contractor shall correct the discrepancy to the satisfaction of the Engineer.

If a vehicle delivers mixture to the project and the delivery ticket indicates that the vehicle is overweight, the load may not be rejected but a “Measured Weight Adjustment” will be taken in accordance with Article 4.06.04.

Vehicle body coating and cleaning agents must not have a deleterious effect on the mixture. The use of solvents or fuel oil, in any concentration, is prohibited for the coating of vehicle bodies.

For each delivery, the Engineer shall be provided a clear, legible copy of the delivery ticket.

**3. Paving Equipment:** The Contractor shall have the necessary paving and compaction equipment at the project site to perform the work. All equipment shall be in good working order and any equipment that is worn, defective or inadequate for performance of the work shall be repaired or replaced by the Contractor to the satisfaction of the Engineer. During the paving operation, the use of solvents or fuel oil, in any concentration, is prohibited as a release agent or cleaner on any paving equipment (i.e., rollers, pavers, transfer devices, etc.).

Refueling or cleaning of equipment is prohibited in any location on the project where fuel or solvents might come in contact with paved areas or areas to be paved. Solvents used in cleaning mechanical equipment or hand tools shall be stored off of areas paved or to be paved.

Pavers: Each paver shall have a receiving hopper with sufficient capacity to provide for a uniform spreading operation and a distribution system that places the mix uniformly, without segregation. The paver shall be equipped with and use a vibratory screed system with heaters or burners. The screed system shall be capable of producing a finished surface of the required evenness and texture without tearing, shoving, or gouging the mixture. Pavers with extendible screed units as part of the system shall have auger extensions and tunnel extenders as necessary. Automatic screed controls for grade and slope shall be used at all times unless otherwise authorized by the Engineer. The controls shall automatically adjust the screed to compensate for irregularities in the preceding course or existing base. The controls shall maintain the proper transverse slope and be readily adjustable, and shall operate from a fixed or moving reference such as a grade wire or floating beam.

Rollers: All rollers shall be self-propelled and designed for compaction of bituminous concrete. Rollers types shall include steel-wheeled, pneumatic or a combination thereof. Rollers that operate in a dynamic mode shall have drums that use a vibratory or oscillatory system or combination of. Vibratory rollers shall be equipped with indicators for amplitude, frequency and speed settings/readouts to measure the impacts per foot during the compaction process. Oscillatory rollers shall be equipped with frequency indicators. Rollers can operate in the dynamic mode using the oscillatory system on concrete structures such as bridges and catch basins if at the lowest frequency setting.

Pneumatic tire rollers shall be equipped with wide-tread compaction tires capable of exerting an average contact pressure from 60 to 90 pounds per square inch uniformly over the surface, The Contractor shall furnish documentation to the Engineer regarding tire size; pressure and loading

to confirm that the proper contact pressure is being developed and that the loading and contact pressure is uniform for all wheels.

**Lighting:** For paving operations, which will be performed during hours of darkness, the paving equipment shall be equipped with lighting fixtures as described below, or with an approved equal. Lighting shall minimize glare to passing traffic. The lighting options and minimum number of fixtures are listed in Tables 4.06-1 and 4.06-2:

**TABLE 4.06-1: Minimum Paver Lighting**

Option	Fixture Configuration	Fixture Quantity	Requirement
1	Type A	3	Mount over screed area
	Type B (narrow) or Type C (spot)	2	Aim to auger and guideline
	Type B (wide) or Type C (flood)	2	Aim 25 feet behind paving machine
2	Type D Balloon	2	Mount over screed area

**TABLE 4.06-2: Minimum Roller Lighting**

Option	Fixture Configuration*	Fixture Quantity	Requirement
1	Type B (wide)	2	Aim 50 feet in front of and behind roller
	Type B (narrow)	2	Aim 100 feet in front of and behind roller
2	Type C (flood)	2	Aim 50 feet in front of and behind roller
	Type C (spot)	2	Aim 100 feet in front of and behind roller
3	Type D Balloon	1	Mount above the roller

\*All fixtures shall be mounted above the roller.

Type A: Fluorescent fixture shall be heavy-duty industrial type. Each fixture shall have a minimum output of 8,000 lumens. The fixtures shall be mounted horizontally, and be designed for continuous row installation.

Type B: Each floodlight fixture shall have a minimum output of 18,000 lumens.

Type C: Each fixture shall have a minimum output of 19,000 lumens.

Type D: Balloon light: Each balloon light fixture shall have a minimum output of 50,000 lumens, and emit light equally in all directions.

**Material Transfer Vehicle (MTV):** A MTV shall be used when placing a bituminous concrete surface course as indicated in the contract documents.

The MTV must be a vehicle specifically designed for the purpose of delivering the bituminous concrete mixture from the delivery vehicle to the paver. The MTV must continuously remix the bituminous concrete mixture throughout the placement process.



The use of a MTV will be subject to the requirements stated in Article 1.07.05- Load Restrictions. The Engineer may limit the use of the vehicle if it is determined that the use of the MTV may damage highway components, utilities, or bridges. The Contractor shall submit to the Engineer at time of pre-construction the following information:

- The make and model of the MTV.
- The individual axle weights and axle spacing for each piece of paving equipment (haul vehicle, MTV and paver).
- A working drawing showing the axle spacing in combination with all pieces of equipment that will comprise the paving echelon.

**4. Test Section:** The Engineer may require the Contractor to place a test section whenever the requirements of this specification or Section M.04 are not met.

The Contractor shall submit the quantity of mixture to be placed and the location of the test section for review and approval by the Engineer. The same equipment used in the construction of a passing test section shall be used throughout production.

If a test section fails to meet specifications, the Contractor shall stop production, make necessary adjustments to the job mix formula, Plant operations, or procedures for placement and compaction. The Contractor shall construct test sections, as allowed by the Engineer, until all the required specifications are met. All test sections shall also be subject to removal as set forth in Article 1.06.04.

**5. Transitions for Roadway Surface:** Transitions shall be formed at any point on the roadway where the pavement surface deviates, vertically, from the uniform longitudinal profile as specified on the plans. Whether formed by milling or by bituminous concrete mixture, all transition lengths shall conform to the criteria below unless otherwise specified.

Permanent Transitions: Defined as any gradual change in pavement elevation that remains as a permanent part of the work.

A transition shall be constructed no closer than 75 feet from either side of a bridge expansion joint or parapet. All permanent transitions, leading and trailing, shall meet the following length requirements:

- a) Posted speed limit is greater than 35 MPH: 30 feet per inch of elevation change.
- b) Posted speed limit is 35 MPH or less: 15 feet per inch of elevation change.

In areas where it is impractical to use the above described permanent transition lengths the use of a shorter permanent transition length may be permitted when approved by the Engineer.

**Temporary Transitions:** A temporary transition is defined as a transition that does not remain a permanent part of the work. All temporary transitions shall meet the following length requirements:

- a) Posted speed limit is greater than 50 MPH
  - (1) Leading Transitions = 15 feet per inch of vertical change (thickness)
  - (2) Trailing Transitions = 6 feet per inch of vertical change (thickness)
- b) Posted speed limit is 40, 45, or 50 MPH
  - (1) Leading and Trailing = 4 feet per inch of vertical change (thickness)
- c) Posted speed limit is 35 MPH or less
  - (1) Leading and Trailing = 3 feet per inch of vertical change (thickness)

**Note:** Any temporary transition to be in-place over the winter shutdown period or during extended periods of inactivity (more than 14 calendar days) shall conform to the greater than 50 MPH requirements shown above.

**6. Spreading and Finishing of Mixture:** Prior to the placement of the mixture, the underlying base course shall be brought to the plan grade and cross section within the allowable tolerance.

Immediately before placing a bituminous concrete lift, a uniform coating of tack coat shall be applied to all existing underlying pavement surfaces and on the exposed surface of a wedge joint. Such surfaces shall be clean and dry. Sweeping or other means acceptable to the Engineer shall be used.

The mixture shall not be placed whenever the surface is wet or frozen.

The Engineer may verify the mixture temperature by means of a probe or infrared type of thermometer. The Engineer may reject the load based on readings from a probe type thermometer and the specify temperature in the quality control plan (QCP) for placement.

**Tack Coat Application:** The tack coat shall be applied by a pressurized spray system that results in uniform overlapping coverage at an application rate of 0.03 to 0.05 gallons per square yard for a non-milled surface and an application rate of 0.05 to 0.07 gallons per square yard for a milled surface. For areas where both milled and un-milled surfaces occur, the tack coat shall be an application rate of 0.03 to 0.05 gallons per square yard. The Engineer must approve the equipment and the method of measurement prior to use. The material for tack coat shall not be heated in excess of 160°F and shall not be further diluted.

Tack coat shall be allowed sufficient time to break prior to any paving equipment or haul vehicles driving on it.

The Contractor may request to omit the tack coat application between bituminous concrete layers that have not been exposed to traffic and are placed during the same work shift. Requests to omit tack coat application on the exposed surface of a wedge joint will not be considered.

**Placement:** The mixture shall be placed and compacted to provide a smooth, dense surface with a uniform texture and no segregation at the specified thickness and dimensions indicated in the plans and specifications.

When unforeseen weather conditions prevent further placement of the mixture, the Engineer is not obligated to accept or place the bituminous concrete mixture that is in transit from the Plant.

In advance of paving, traffic control requirements shall be set up, maintained throughout placement, and shall not be removed until all associated work including density testing is completed.

The Contractor shall inspect the newly placed pavement for defects in the mixture or placement before rolling is started. Any deviation from standard crown or section shall be immediately remedied by placing additional mixture or removing surplus mixture. Such defects shall be corrected to the satisfaction of the Engineer.

Where it is impractical due to physical limitations to operate the paving equipment, the Engineer may permit the use of other methods or equipment. Where hand spreading is permitted, the mixture shall be placed by means of suitable shovels and other tools, and in a uniformly loose layer at a thickness that will result in a completed pavement meeting the designed grade and elevation.

**Placement Tolerances:** Each lift of bituminous concrete placed at a specified thickness shall meet the following requirements for thickness and area. Any pavement exceeding these limits shall be subject to an adjustment or removal. Lift tolerances will not relieve the Contractor from meeting the final designed grade. Lifts of specified non-uniform thickness, i.e. wedge or shim course, shall not be subject to thickness and area adjustments.

- a) Thickness- Where the average thickness of the lift exceeds that shown on the plans beyond the tolerances shown in Table 4.06-3, the Engineer will calculate the thickness adjustment in accordance with Article 4.06.04.

**TABLE 4.06-3: Thickness Tolerances**

Mixture Designation	Lift Tolerance
S1	+/- 3/8 inch
S0.25, S0.375, S0.5	+/- 1/4 inch

Where the thickness of the lift of mixture is less than that shown on the plans beyond the tolerances shown in Table 4.06-3, the Contractor, with the approval of the Engineer, shall take corrective action in accordance with this specification.

- b) Area- Where the width of the lift exceeds that shown on the plans by more than the specified thickness, the Engineer will calculate the area adjustment in accordance with Article 4.06.04.

- c) **Delivered Weight of Mixture** - When the delivery ticket shows that the vehicle exceeds the allowable gross weight for the vehicle type, the Engineer will calculate the weight adjustment in accordance with Article 4.06.04.

**Transverse Joints:** All transverse joints shall be formed by saw-cutting to expose the full thickness of the lift. Tack coat shall be applied to the sawn face immediately prior to additional mixture being placed.

**Compaction:** The Contractor shall compact the mixture to meet the density requirements as stated in Article 4.06.03 and eliminate all roller marks without displacement, shoving, cracking, or aggregate breakage.

When placing a lift with a specified thickness less than one and one-half (1 ½) inches, or a wedge course, the Contractor shall provide a minimum rolling pattern as determined by the development of a compaction curve. The procedure to be used shall be documented in the Contractor's QCP for placement and demonstrated on the first day of placement.

The use of the vibratory system on concrete structures is prohibited. When approved by the Engineer, the Contractor may operate a roller using an oscillatory system at the lowest frequency setting.

If the Engineer determines that the use of compaction equipment in the dynamic mode may damage highway components, utilities, or adjacent property, the Contractor shall provide alternate compaction equipment. The Engineer may allow the Contractor to operate rollers in the dynamic mode using the oscillatory system at the lowest frequency setting.

Rollers operating in the dynamic mode shall be shut off when changing directions.

These allowances will not relieve the Contractor from meeting pavement compaction requirements.

**Surface Requirements:**

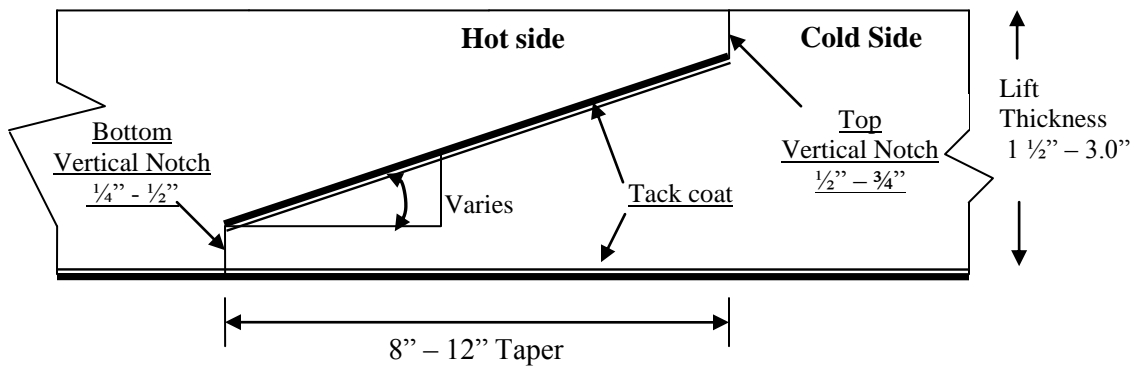
Each lift of the surface course shall not vary more than ¼ inch from a Contractor-supplied 10 foot straightedge. For all other lifts, the tolerance shall be ⅜ inch. Such tolerance will apply to all paved areas.

Any surface that exhibits these characteristics or exceeds these tolerances shall be corrected by the Contractor at its own expense.

**7. Longitudinal Joint Construction Methods:** The Contractor shall use Method I- Notched Wedge Joint (see Figure 4.06-1) when constructing longitudinal joints where lift thicknesses are between 1½ and 3 inches. S1.0 mixtures shall be excluded from using Method I. Method II Butt Joint (see Figure 4.06-2) shall be used for lifts less than 1½ inches or greater than or equal to 3 inches. During placement of multiple lifts, the longitudinal joint shall be constructed in such a

manner that it is located at least 6 inches from the joint in the lift immediately below. The joint in the final lift shall be at the centerline or at lane lines. Each longitudinal joint shall maintain a consistent offset from the centerline of the roadway along its entire length. The difference in elevation between the two faces of any completed longitudinal joint shall not exceed  $\frac{1}{4}$  inch in any location.

**Method I - Notched Wedge Joint:**



**FIGURE 4.06-1: Notched Wedge Joint**

A notched wedge joint shall be constructed as shown in Figure 4.06-1 using a device that is attached to the paver screed and is capable of independently adjusting the top and bottom vertical notches. The device shall have an integrated vibratory system.

The taper portion of the wedge joint must be placed over the longitudinal joint in the lift immediately below. The top vertical notch must be located at the centerline or lane line in the final lift. The requirement for paving full width “curb to curb” as described in Method II may be waived if addressed in the QC plan and approved by the Engineer.

The taper portion of the wedge joint shall be evenly compacted using equipment other than the paver or notch wedge joint device.

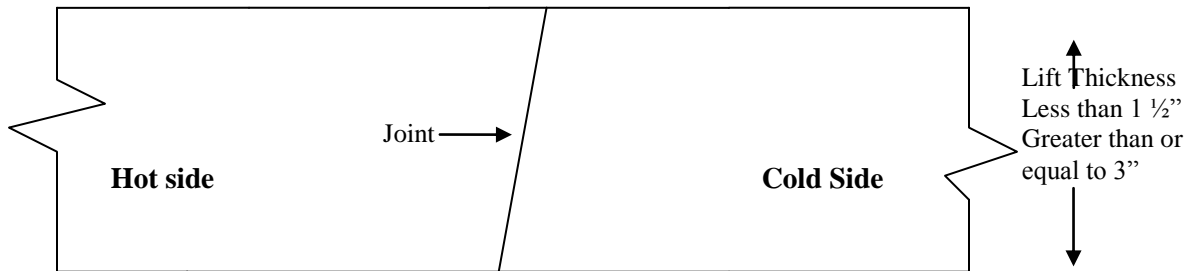
The taper portion of the wedge joint shall not be exposed to traffic for more than 5 calendar days.

Any exposed wedge joint must be located to allow for the free draining of water from the road surface.

The Engineer reserves the right to define the paving limits when using a wedge joint that will be exposed to traffic.

If Method I, Notched Wedge Joint cannot be used on lifts between 1.5 and 3 inches, Method III Butt Joint may be substituted according to the requirements below for “Method III – Butt Joint with Hot Pour Rubberized Asphalt Treatment.”

**Method II - Butt Joint:**

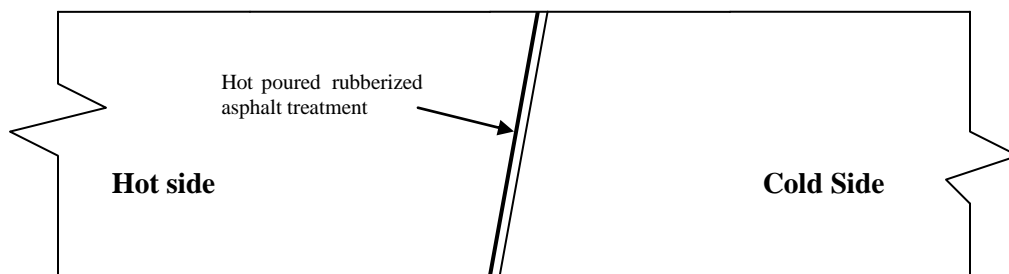


**FIGURE 4.06-2: Butt Joint**

When adjoining passes are placed, the Contractor shall utilize equipment that creates a near vertical edge (refer to Figure 4.06-2). The completing pass (hot side) shall have sufficient mixture so that the compacted thickness is not less than the previous pass (cold side). The end gate on the paver should be set so there is an overlap onto the cold side of the joint.

The Contractor shall not allow any butt joint to be incomplete at the end of a work shift unless otherwise allowed by the Engineer. When using this method, the Contractor is not allowed to leave a vertical edge exposed at the end of a work shift and must complete paving of the roadway full width “curb to curb.”

**Method III- Butt Joint with Hot Poured Rubberized Asphalt Treatment:** If Method I Wedge Joint cannot be used due to physical constraints in certain limited locations; the contractor may submit a request in writing for approval by the Engineer, to utilize Method III Butt Joint as a substitution in those locations. There shall be no additional measurement or payment made when the Method III Butt Joint is substituted for the Method I Notched Wedge Joint. When required by the contract or approved by the Engineer, Method III (see Figure 4.06-3) shall be used.



**FIGURE 4.06-3: Butt Joint with Hot Poured Rubberized Asphalt Treatment**

All of the requirements of Method II must be met with Method III. In addition, the longitudinal vertical edge must be treated with a rubberized joint seal material meeting the requirements of ASTM D 6690, Type 2. The joint sealant shall be placed on the face of the “cold side” of the butt joint as shown above prior to placing the “hot side” of the butt joint. The joint seal material shall be applied in accordance with the manufacturer’s recommendation so as to provide a uniform coverage and avoid excess bleeding onto the newly placed pavement.

**8. Contractor Quality Control (QC) Requirements:** The Contractor shall be responsible for maintaining adequate quality control procedures throughout the production and placement operations. Therefore, the Contractor must ensure that the materials, mixture and work provided by Subcontractors, Suppliers and Producers also meet contract specification requirements.

This effort must be documented in Quality Control Plans and address the actions, inspection, or sampling and testing necessary to keep the production and placement operations in control, to determine when an operation has gone out of control and to respond to correct the situation in a timely fashion.

The Standard QCP for production shall consist of the quality control program specific to the production facility.

There are three components to the QCP for placement: a Standard QCP, a Project Summary Sheet that details project specific information, and if applicable a separate Extended Season Paving Plan as required in Section 9 “Temperature and Seasonal Requirements”.

The Standard QCP for both production and placement shall be submitted to the Department for approval each calendar year and at a minimum of 30 days prior to production or placement.

Production or placement shall not occur until all QCP components have been approved by the Engineer.

Each QCP shall include the name and qualifications of a Quality Control Manager (QCM). The QCM shall be responsible for the administration of the QCP, and any modifications that may become necessary. The QCM shall have the ability to direct all Contractor personnel on the project during paving operations. All Contractor sampling, inspection and test reports shall be reviewed and signed by the QCM prior to submittal to the Engineer. The QCPs shall also include the name and qualifications of any outside testing laboratory performing any QC functions on behalf of the Contractor.

Approval of the QCP does not relieve the Contractor of its responsibility to comply with the project specifications. The Contractor may modify the QCPs as work progresses and must document the changes in writing prior to resuming operations. These changes include but are not limited to changes in quality control procedures or personnel. The Department reserves the right to deny significant changes to the QCPs.

QCP for Production: Refer to Section M.04.03-1.

QCP for Placement: The Standard QCP, Project Summary Sheet, and Extended Season Paving Plan shall conform to the format provided by the Engineer. The format is available at [http://www.ct.gov/dot/lib/dot/documents/dconstruction/pat/qcp\\_outline\\_hma\\_placement.pdf](http://www.ct.gov/dot/lib/dot/documents/dconstruction/pat/qcp_outline_hma_placement.pdf).

The Contractor shall perform all quality control sampling and testing, provide inspection, and exercise management control to ensure that placement conforms to the requirements as outlined in its QCP during all phases of the work. The Contractor shall document these activities for each day of placement.

The Contractor shall submit complete field density testing and inspection records to the Engineer within 48 hours in a manner acceptable to the Engineer.

The Contractor may obtain one (1) mat core and one (1) joint core per day for process control, provided this process is detailed in the QCP. The results of these process control cores shall not be used to dispute the Department determinations from the acceptance cores. The Contractor shall submit the location of each process control core to the Engineer for approval prior to taking the core. The core holes shall be filled to the same requirements described in sub-article 4.06.03-10.

**9. Temperature and Seasonal Requirements:** Paving, including placement of temporary pavements, shall be divided into two seasons, “In-Season” and “Extended-Season”. In-Season paving occurs from May 1 – October 14, and Extended Season paving occurs from October 15- April 30. The following requirements shall apply unless otherwise authorized or directed by the Engineer:

- Mixtures shall not be placed when the air or sub base temperature is less than 40°F regardless of the season.
- Should paving operations be scheduled during the Extended Season, the Contractor must submit an Extended Season Paving Plan for the project that addresses minimum delivered mix temperature considering WMA, PMA or other additives, maximum paver speed, enhanced rolling patterns and the method to balance mixture delivery and placement operations. Paving during Extended Season shall not commence until the Engineer has approved the plan.

**10. Obtaining Bituminous Concrete Cores:** This Section describes the methodology and sampling frequency the Contractor shall use to obtain pavement cores.

Coring shall be performed on each lift specified to a thickness of one and one-half (1 ½) inches or more within 5 days of placement. The Contractor shall extract cores (4 or 6 inch diameter for S0.25, S0.375 and S0.5 mixtures 6 inch diameter for S1.0 mixtures) from locations determined



by the Engineer. The Engineer must witness the extraction, labeling of cores and filling of the core holes.

A density lot will be complete when the full designed paving width and length of the lot has been placed and shall include all longitudinal joints between the curb lines. HMA S1 mixes are excluded from the longitudinal joint density requirements.

A standard density lot is the quantity of material placed within the defined area exclusive of any structures. A combo density lot is the quantity of material placed within the defined area inclusive of structures less than or equal to 500 feet long. A bridge density lot is the quantity of material placed on a structure larger than 500 feet in length.

Prior to paving, the type and number of lot (s) shall be determined by the Engineer. The number of cores per lot shall be determined in accordance to Tables 4.06-4, 4.06-5A and 4.06-5B. Noncontiguous areas such as highway ramps may be combined to create one lot. Combined areas should be set up to target a 2000 ton lot size. The longitudinal locations of mat cores within a lot containing multiple paving passes will be determined using the total distance covered by the paver. The locations of the joint cores will be determined using the total length of longitudinal joints within the lot.

Sampling is in accordance with the following tables:

**TABLE 4.06-4: Bridge Density Lot(s)**

Length of Each Structure (Feet)	No. of Mat Cores	No. of Joint Cores
≤ 500'	See Table 4.06-5(A or B)	See Table 4.06-5(A or B)
501' – 1500'	3	3
1501' – 2500'	4	4
2501' and greater	5	5

All material placed on structures less than or equal to 500 feet in length shall be included as part of a standard lot as follows:

**TABLE 4.06-5A: Standard and Combo Density Lot(s) ≥ 500 Tons**

Lot Type	No. of Mat Cores		No. of Joint Cores		Target Lot Size (Tons)
Standard Lot / Without Bridge (s)	4		4		2000
Combo Lot / Lot With Bridge(s) <sup>(1)</sup>	4 plus	1 per structure (≤ 300')	4 plus	1 per structure (≤ 300')	2000
		2 per structure (301' – 500')		2 per structure (301' – 500')	

**TABLE 4.06-5B: Standard and Combo Density Lot < 500 Tons**

Lot Type	No. of Mat Cores		No. of Joint Cores	
Standard Lot / Without Bridge (s)	3		3	
Combo Lot / Lot With Bridge(s) <sup>(1)</sup>	2 plus	1 per structure	2 plus	1 per structure

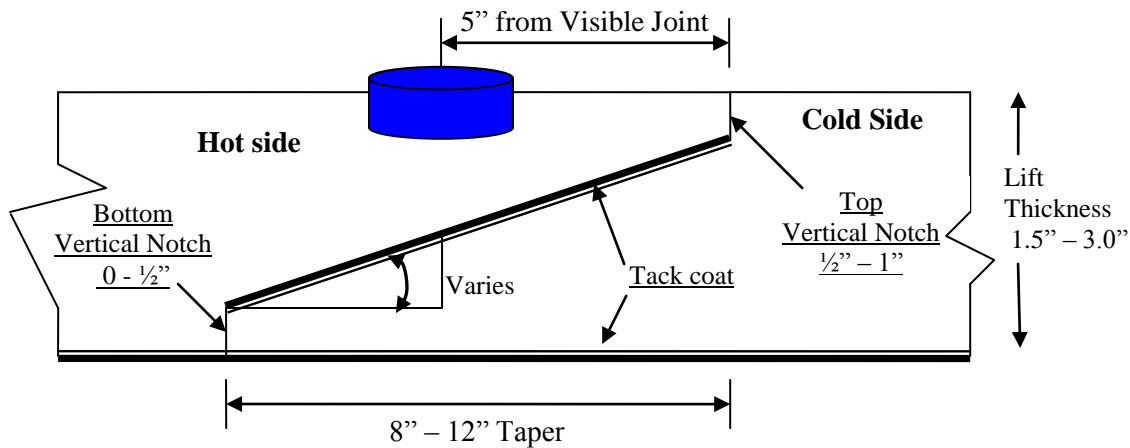
Note:

<sup>(1)</sup> If a combo lot mat or joint core location randomly falls on a structure, the core is to be obtained on the structure in addition to the core(s) required on the structure.

After the lift has been compacted and cooled, the Contractor shall cut cores to a depth equal to or greater than the lift thickness and remove them without damaging the lift(s) to be tested. Any core that is damaged or obviously defective while being obtained will be replaced with a new core from a location within 2 feet measured in a longitudinal direction.

A mat core shall not be located any closer than one foot from the edge of a paver pass. If a random number locates a core less than one foot from any edge, the location will be adjusted by the Engineer so that the outer edge of the core is one foot from the edge of the paver pass.

Method I, Notched Wedge Joint cores shall be taken so that the center of the core is 5 inches from the visible joint on the hot mat side (Figure 4.06-5).

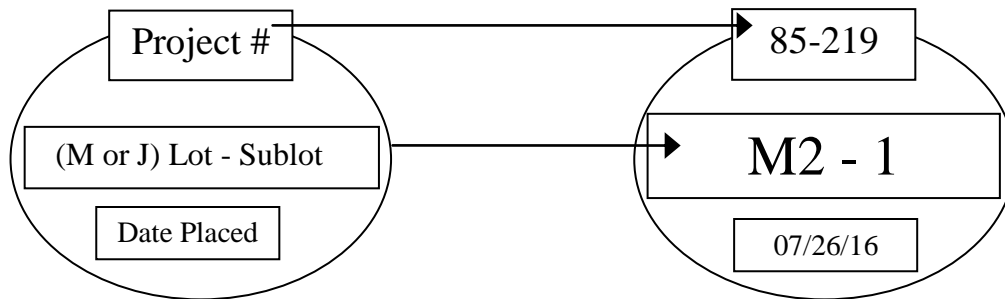


**FIGURE 4.06-5: Notched Wedge Joint Cores**

When Method II or Method III Butt Joint is utilized, cores shall be taken from the hot side so the edge of the core is within 1 inch of the longitudinal joint.

The cores shall be labeled by the Contractor with the project number, date placed, lot number and sub-lot number. The core's label shall, include "M" for a mat core and "J" for a joint core. A mat core from the second lot and first sub-lot shall be labeled "M2 - 1" (Figure 4.06-4). The Engineer shall fill out a MAT-109 to accompany the cores. The Contractor shall deliver the

cores and MAT-109 to the Department's Central Lab. The Contractor shall use a container approved by the Engineer. The container shall have a lid capable of being locked shut and tamper proof. The Contractor shall use foam, bubble wrap, or another suitable material to prevent the cores from being damaged during handling and transportation. Once the cores and MAT-109 are in the container the Engineer will secure the lid using a security seal. The security seal's identification number must be documented on the MAT-109. Central Lab personnel will break the security seal and take possession of the cores.



**FIGURE 4.06-4: Labeling of Cores**

Each core hole shall be filled within four hours upon core extraction. Prior to being filled, the hole shall be prepared by removing any free water and applying tack coat using a brush or other means to uniformly cover the cut surface. The core hole shall be filled using a bituminous concrete mixture at a minimum temperature of 240°F containing the same or smaller nominal maximum aggregate size and compacted with a hand compactor or other mechanical means to the maximum compaction possible. The bituminous concrete shall be compacted to 1/8 inch above the finished pavement.

**11. Acceptance Sampling and Testing:** Sampling and testing shall be performed at a frequency not less than the minimum frequency specified in Section M.04 and sub-article 4.06.03-10.

Sampling shall be performed in accordance with ASTM D 3665, or a statistically based procedure of stratified random sampling approved by the Engineer.

Plant Material Acceptance: The Contractor shall provide the required sampling and testing during all phases of the work in accordance with Section M.04. The Department will verify the Contractor's acceptance test results. Should any test results exceed the specified tolerances in the Department's current QA Program for Materials, the Contractor test results for a subject lot or sub lot may be replaced with the Department's results for the purpose of calculating adjustments. The verification procedure is included in the Department's current QA Program for Materials.

Density Acceptance: The Engineer will perform all acceptance testing in accordance with AASHTO T 331. The density of each core will be determined using the daily production's

average maximum theoretical specific gravity (Gmm) established during the testing of the parent material at the Plant. When there was no testing of the parent material or any Gmm exceeds the specified tolerances in the Department's current QA Program for Materials, the Engineer will determine the maximum theoretical density value to be used for density calculations.

**12. Density Dispute Resolution Process:** The Contractor and Engineer will work in partnership to avoid potential conflicts and to resolve any differences that may arise during quality control or acceptance testing for density. Both parties will review their sampling and testing procedures and results and share their findings. If the Contractor disputes the Engineer's test results, the Contractor must submit in writing a request to initiate the Dispute Resolution Process within 7 calendar days of the notification of the test results. No request for dispute resolution will be allowed unless the Contractor provides quality control results within the timeframe described in sub-article 4.06.03-9 supporting its position. No request for Dispute Resolution will be allowed for a Density Lot in which any core was not taken within the required 5 calendar days of placement. Should the dispute not be resolved through evaluation of existing testing data or procedures, the Engineer may authorize the Contractor to obtain a new set of core samples per disputed lot. The core samples must be extracted no later than 14 calendar days from the date of Engineer's authorization.

The number and location (mat, joint, or structure) of the cores taken for dispute resolution must reflect the number and location of the original cores. The location of each core shall be randomly located within the respective original sub lot. All such cores shall be extracted and the core hole filled using the procedure outlined in Article 4.06.03. The dispute resolution results shall be added to the original results and averaged for determining the final in-place density value.

**13. Corrective Work Procedure:**

If pavement placed by the Contractor does not meet the specifications, and the Engineer requires its replacement or correction, the Contractor shall:

- a) Propose a corrective procedure to the Engineer for review and approval prior to any corrective work commencing. The proposal shall include:
  - Limits of pavement to be replaced or corrected, indicating stationing or other landmarks that are readily distinguishable.
  - Proposed work schedule.
  - Construction method and sequence of operations.
  - Methods of maintenance and protection of traffic.
  - Material sources.
  - Names and telephone numbers of supervising personnel.
  
- b) Any corrective courses placed as the final wearing surface shall match the specified lift thickness after compaction.

**14. Protection of the Work:** The Contractor shall protect all sections of the newly finished pavement from damage that may occur as a result of the Contractor's operations for the duration of the Project.

**15. Cut Bituminous Concrete Pavement:** Work under this item shall consist of making a straight-line cut in the pavement to the lines delineated on the plans or as directed by the Engineer. The cut shall provide a straight, clean, vertical face with no cracking, tearing or breakage along the cut edge.

**4.06.04—Method of Measurement:**

**1. HMA S\* or PMA S\*:** The quantity of bituminous concrete measured for payment will be determined by the documented net weight in tons accepted by the Engineer in accordance with this specification and Section M.04.

**2. Adjustments:** Adjustments may be applied to bituminous concrete quantities and will be measured for payment using the following formulas:

**Yield Factor** for Adjustment Calculation = 0.0575 Tons/SY/inch

**Actual Area** = [(Measured Length (ft)) x (Avg. of width measurements (ft))]

**Actual Thickness (t)** = Total tons delivered / [Actual Area (SY) x 0.0575 Tons/SY/inch]

- a) Area: If the average width exceeds the allowable tolerance, an adjustment will be made using the following formula. The tolerance for width is equal to the specified thickness (in.) of the lift being placed.

**Tons Adjusted for Area (T<sub>A</sub>)** = [(L x W<sub>adj</sub>)/9] x (t) x 0.0575 Tons/SY/inch = (-) Tons

Where: L = Length (ft)

(t) = Actual thickness (inches)

W<sub>adj</sub> = (Designed width (ft) + tolerance /12) - Measured Width)

- b) Thickness: If the actual average thickness is less than the allowable tolerance, the Contractor shall submit a repair procedure to the Engineer for approval. If the actual thickness exceeds the allowable tolerance, an adjustment will be made using the following formula:

**Tons Adjusted for Thickness (T<sub>T</sub>)** = A x t<sub>adj</sub> x 0.0575 = (-) Tons

Where: A = Area = {[L x (Designed width + tolerance (lift thickness)/12)] / 9}

t<sub>adj</sub> = Adjusted thickness = [(Dt + tolerance) - Actual thickness]

Dt = Designed thickness (inches)

- c) **Weight:** If the quantity of bituminous concrete representing the mixture delivered to the project is in excess of the allowable gross vehicle weight (GVW) for each vehicle, an adjustment will be made using the following formula:

$$\text{Tons Adjusted for Weight (T}_w\text{)} = \text{GVW} - \text{DGW} = (-) \text{Tons}$$

Where: DGW = Delivered gross weight as shown on the delivery ticket or measured on a certified scale.

- d) **Mixture Adjustment:** The quantity of bituminous concrete representing the production lot at the Plant will be adjusted as follow:

- i. Non-PWL Production Lot (less than 3500 tons):

The adjustment values in Table 4.06-6 and 4.06-7 shall be calculated for each sub lot based on the Air Void (AV) and Asphalt Binder Content (PB) test results for that sub lot. The total adjustment for each day's production (lot) will be computed using tables and the following formulas:

$$\text{Tons Adjusted for Superpave Design (T}_{SD}\text{)} = [(\text{AdjAV}_t + \text{AdjPB}_t) / 100] \times \text{Tons}$$

$$\text{Percent Adjustment for Air Voids} = \text{AdjAV}_t = [\text{AdjAV}_1 + \text{AdjAV}_2 + \text{AdjAV}_i + \dots + \text{AdjAV}_n] / n$$

Where: AdjAV<sub>t</sub> = Total percent air void adjustment value for the lot

AdjAV<sub>i</sub> = Adjustment value from Table 4.06-7 resulting from each sub lot or the average of the adjustment values resulting from multiple tests within a sub lot, as approved by the Engineer.

n = number of sub lots based on Table M.04.03-2

**TABLE 4.06-6: Adjustment Values for Air Voids**

Adjustment Value (AdjAV <sub>i</sub> ) (%)	S0.25, S0.375, S0.5, S1 Air Voids (AV)
+2.5	3.8 - 4.2
+3.125*(AV-3)	3.0 - 3.7
-3.125*(AV-5)	4.3 - 5.0
20*(AV-3)	2.3 - 2.9
-20*(AV-5)	5.1 - 5.7
-20.0	≤ 2.2 or ≥ 5.8

$$\text{Percent Adjustment for Asphalt Binder} = \text{AdjPB}_t = [(\text{AdjPB}_1 + \text{AdjPB}_2 + \text{AdjPB}_i + \dots + \text{AdjPB}_n) / n]$$

Where: AdjPB<sub>t</sub> = Total percent asphalt binder adjustment value for the lot

AdjPB<sub>i</sub> = Adjustment value from Table 4.06-7 resulting from each sub lot

n = number of binder tests in a production lot

**TABLE 4.06-7: Adjustment Values for Binder Content**

<b>Adjustment Value (AdjAV<sub>i</sub>) (%)</b>	<b><u>S0.25, S0.375, S0.5, S1</u> Pb</b>
0.0	JMF Pb ± 0.3
- 10.0	≤ JMF Pb - 0.4 or ≥ JMF Pb + 0.4

ii. PWL Production Lot (3500 tons or more):

For each lot, the adjustment values shall be calculated based on PWL for AV, VMA and PB test results. The lot will be considered as being normally distributed and all applicable equations in AASHTO R9 and AASHTO R42 Appendix X4 will apply.

Only one test result will be considered for each sub lot. The specification limits are listed in Section M.04.

For AV, PB and voids in mineral aggregate (VMA), the individual material quality characteristic adjustment (Adj) will be calculated as follow:

For PWL between 50 and 90%: Adj(AV<sub>t</sub> or PB<sub>t</sub> or VMA<sub>t</sub>)= (55 + 0.5 PWL) - 100

For PWL at and above 90%: Adj(AV<sub>t</sub> or PB<sub>t</sub> or VMA<sub>t</sub>)= (77.5 + 0.25 PWL) - 100

Where:

AdjAV<sub>t</sub>= Total percent AV adjustment value for the lot

AdjPB<sub>t</sub>= Total percent PB adjustment value for the lot

AdjVMA<sub>t</sub>= Total percent VMA adjustment value for the lot

Lots with PWL less than 50% in any of the three individual material quality characteristics will be evaluated under 1.06.04.

The total adjustment for each production lot will be computed using the following formula:

$$\text{Tons Adjusted for Superpave Design (T}_{SD}) = [(0.5\text{AdjAV}_t + 0.25\text{AdjPB}_t + 0.25\text{AdjVMA}_t) / 100] \times \text{Tons}$$

iii. Partial Lots:

Lots with less than 4 sublots will be combined with the prior lot. If there is no prior lot with equivalent material or if the last test result of the prior lot is over 30 calendar days old, the adjustment will be calculated as indicated in 4.06.04-2.d.i.

Lots with 4 or more sublots will be calculated as indicated in 4.06.04-2.d.ii.

- e) **Density Adjustment:** The quantity of bituminous concrete measured for payment in a lift of pavement specified to be 1½ inches or greater may be adjusted for density. Separate density adjustments will be made for each lot and will not be combined to establish one density adjustment. The final lot quantity shall be the difference between the total payable tons for the project and the sum of the previous lots. If either the Mat or Joint adjustment value is “remove and replace”, the density lot shall be removed and replaced (curb to curb).

No positive adjustment will be applied to a Density Lot in which any core was not taken within the required 5 calendar days of placement.

**Tons Adjusted for Density ( $T_D$ )** =  $[(P_{AM} \times .50) + (P_{AJ} \times .50)] / 100$  X Density Lot Tons

Where:  $T_D$  = Total tons adjusted for density for each lot

$P_{AM}$  = Mat density percent adjustment from Table 4.06-9

$P_{AJ}$  = Joint density percent adjustment from Table 4.06-10

**TABLE 4.06-9: Adjustment Values for Pavement Mat density**

Average Core Result Percent Mat Density	Percent Adjustment (Bridge and Non-Bridge) <sup>(1)(2)</sup>
97.1 - 100	-1.667*(ACRPD-98.5)
94.5 – 97.0	+2.5
93.5 – 94.4	+2.5*(ACRPD-93.5)
92.0 – 93.4	0
90.0 – 91.9	-5*(92-ACRPD)
88.0 – 89.9	-10*(91-ACRPD)
87.0 – 87.9	-30
86.9 or less	Remove and Replace (curb to curb)



**TABLE 4.06-10: Adjustment Values for Pavement Joint Density**

<b>Average Core Result Percent Joint Density</b>	<b>Percent Adjustment (Bridge and Non-Bridge) <sup>(1)(2)</sup></b>
97.1 – 100	-1.667*(ACRPD-98.5)
93.5 – 97.0	+2.5
92.0 – 93.4	+1.667*(ACRPD-92)
91.0 – 91.9	0
89.0 – 90.9	-7.5*(91-ACRPD)
88.0 – 88.9	-15*(90-ACRPD)
87.0 – 87.9	-30
86.9 or less	Remove and Replace (curb to curb)

<sup>(1)</sup> ACRPD = Average Core Result Percent Density

<sup>(2)</sup> All Percent Adjustments to be rounded to the second decimal place. For example, 1.667 is to be rounded to 1.67.

**3. Transitions for Roadway Surface:** The installation of permanent transitions shall be measured under the appropriate item used in the formation of the transition.

The quantity of material used for the installation of temporary transitions shall be measured for payment under the appropriate item used in the formation of the transition. The installation and removal of a bond breaker, and the removal and disposal of any temporary transition formed by milling or with bituminous concrete pavement is not measured for payment.

**4. Cut Bituminous Concrete Pavement:** The quantity of bituminous concrete pavement cut will be measured in accordance with Article 2.02.04.

**5. Material for Tack Coat:** The quantity of tack coat will be measured for payment by the number of gallons furnished and applied on the Project and approved by the Engineer. No tack coat material shall be included that is placed in excess of the tolerance described in Article 4.06.03.

- a. Container Method- Material furnished in a container will be measured to the nearest ½ gallon. The volume will be determined by either measuring the volume in the original container by a method approved by the Engineer or using a separate graduated container capable of measuring the volume to the nearest ½ gallon. The container in which the material is furnished must include the description of material, including lot number or batch number and manufacturer or product source.

b. Vehicle Method-

i. Measured by Weight: The number of gallons furnished will be determined by weighing the material on calibrated scales furnished by the Contractor. To convert weight to gallons, one of the following formulas will be used:

$$\text{Tack Coat (gallons at } 60^{\circ}\text{F)} = \frac{\text{Measured Weight (pounds)}}{\text{Weight per gallon at } 60^{\circ}\text{F}}$$

$$\text{Tack Coat (gallons at } 60^{\circ}\text{F)} = \frac{0.996 \times \text{Measured Weight (pounds)}}{\text{Weight per gallon at } 77^{\circ}\text{F}}$$

ii. Measured by automated metering system on the delivery vehicle:

Tack Coat (gallons at 60°F) = Factor (from Table 4.06-11) multiplied by the measured gallons.

**TABLE 4.06-11: Factor to Convert Volume of Tack Coat to 60°F**

<b>Tack Coat Application Temperature (°F)</b>	<b>Factor</b>	<b>Tack Coat Application Temperature (°F)</b>	<b>Factor</b>
75	0.996	120	0.985
80	0.995	125	0.984
85	0.994	130	0.983
90	0.993	135	0.982
95	0.991	140	0.980
100	0.990	145	0.979
105	0.989	150	0.978
110	0.988	155	0.977
115	0.986	160	0.976

**6. Material Transfer Vehicle (MTV):** The furnishing and use of a MTV will be measured separately for payment based on the actual number of surface course tons delivered to a paver using the MTV.

**4.06.05—Basis of Payment:**

**1. HMA S\* or PMA S\*:** The furnishing and placing of bituminous concrete will be paid for at the Contract unit price per ton for “HMA S\*” or “PMA S\*”.

- All costs associated with providing illumination of the work area are included in the general cost of the work.
- All costs associated with cleaning the surface to be paved, including mechanical sweeping, are included in the general cost of the work. All costs associated with constructing longitudinal joints are included in the general cost of the work.

- All costs associated with obtaining cores for acceptance testing and dispute resolution are included in the general cost of the work.

**2. Bituminous Concrete Adjustment Costs:** The adjustment will be calculated using the formulas shown below if all of the measured adjustments in Article 4.06.04 are not equal to zero. A positive or negative adjustment will be applied to monies due the Contractor.

**Production Lot:**  $[T_T + T_A + T_W + T_{SD}] \times \text{Unit Price} = \text{Est. (P)}$

**Density Lot:**  $T_D \times \text{Unit Price} = \text{Est. (D)}$

Where: Unit Price = Contract unit price per ton per type of mixture

$T_*$  = Total tons of each adjustment calculated in Article 4.06.04

Est. ( ) = Pay Unit represented in dollars representing incentive or disincentive.

The Bituminous Concrete Adjustment Cost item if included in the bid proposal or estimate is not to be altered by the Contractor.

**3. Transitions for Roadway Surface:** The installation of permanent transitions shall be paid under the appropriate item used in the formation of the transition. The quantity of material used for the installation of temporary transitions shall be paid under the appropriate pay item used in the formation of the transition. The installation and removal of a bond breaker, and the removal and disposal of any temporary transition formed by milling or with bituminous concrete pavement is included in the general cost of the work.

**4.** The cutting of bituminous concrete pavement will be paid in accordance with Article 2.02.05.

**5.** Material for tack coat will be paid for at the Contract unit price per gallon at 60°F for "Material for Tack Coat".

**6.** The Material Transfer Vehicle (MTV) will be paid at the Contract unit price per ton for a "Material Transfer Vehicle".

<u>Pay Item*</u>	<u>Pay Unit*</u>
HMA S*	ton
PMA S*	ton
Bituminous Concrete Adjustment Cost	est.
Material for Tack Coat	gal.
Material Transfer Vehicle	ton

\*For contracts administered by the State of Connecticut, Department of Administrative Services, the pay items and pay units are as shown in contract award price schedule.

**SECTION 18.03 – IMPACT ATTENUATION SYSTEM, TEMPORARY**  
**IMPACT ATTENUATION SYSTEM**

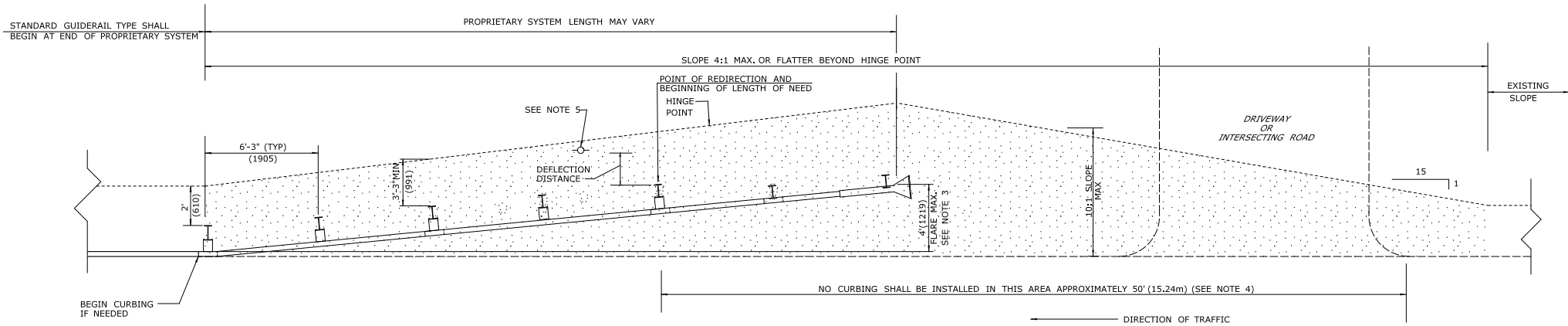
**Article 18.03.03 – Construction Methods:**

*Add the following:*

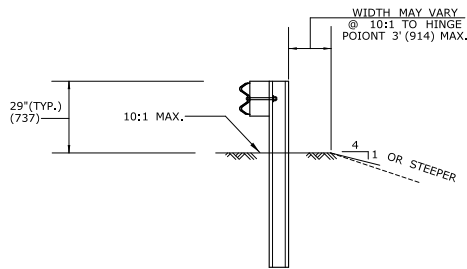
“The impact attenuation system shall be constructed in accordance with the attached drawings and based on the system type being installed.”

**GENERAL NOTES:**

1. THIS GRADING PLAN APPLIES TO THE LATEST VERSION OF DEPARTMENT APPROVED PROPRIETARY IMPACT ATTENUATION SYSTEM FLARED TYPES CHOSEN FROM THE DEPARTMENT'S QUALIFIED PRODUCTS LIST.
2. A MINIMUM AREA OF 75' (22.9m) LONG BY THE DESIGNATED CLEAR ZONE WIDTH IMMEDIATELY BEHIND AND BEYOND THE TERMINAL SHOULD BE FREE OF FIXED OBJECTS.
3. SEE CONSTRUCTION PLANS FOR APPROPRIATE OFFSET FOR NOSE OF SYSTEM. THE FLARE IS BASED ON THE OFFSET DESIGNATED ON THE PLANS.
4. WHEN A DRIVEWAY OR INTERSECTING ROAD IS WITHIN 5' OF THE SYSTEM, AND CURB EXISTS REMOVE CURBING UP TO POST 3. REDIRECTION BEGINS AT POST 3.
5. IF A UTILITY POLE OR FIXED OBJECT EXISTS NEAR END OF SYSTEM, THE SYSTEM SHALL BE INSTALLED SUCH THAT THE POINT OF REDIRECTION OCCURS PRIOR TO UTILITY POLE OR OBJECT. IN ADDITION, THE DEFLECTION DISTANCE NOTED IS 4'-3" FOR STANDARD W-BEAM STRONG POST GUIDERAIL INSTALLED @ A 6'-3" POST SPACING AND SHALL BE MAINTAINED. A CLEAR RUN-OUT LENGTH BEHIND THE SYSTEM FREE OF FIXED OBJECTS IS ESSENTIAL TO PROPER FUNCTIONING OF A PROPRIETARY GATING IMPACT ATTENUATION SYSTEM AND SHOULD BE STRIVED FOR.



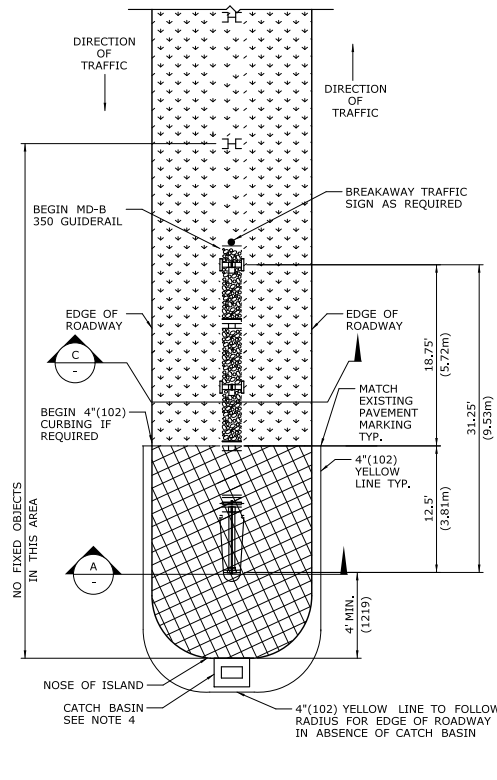
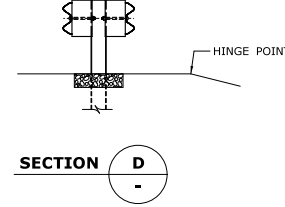
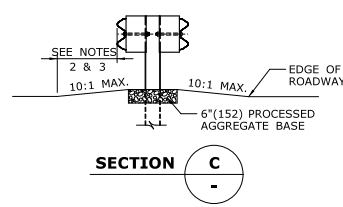
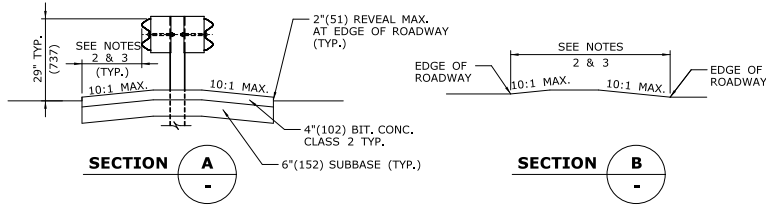
**PLAN VIEW  
FLARE**



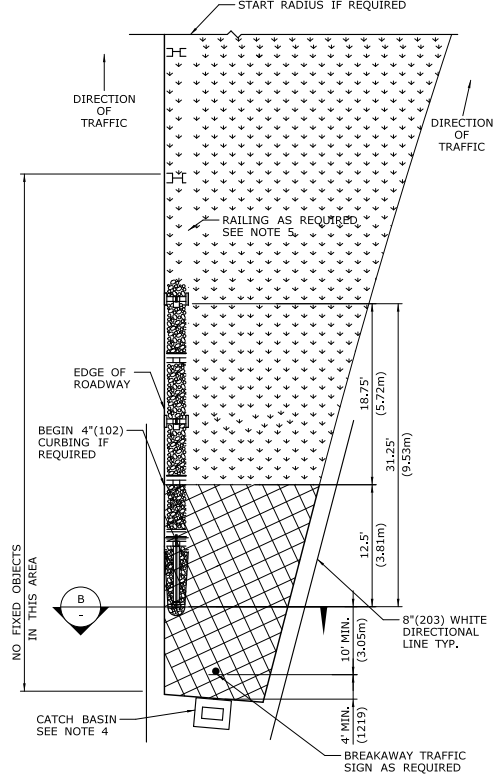
**TYPICAL SECTION**

**GENERAL NOTES:**

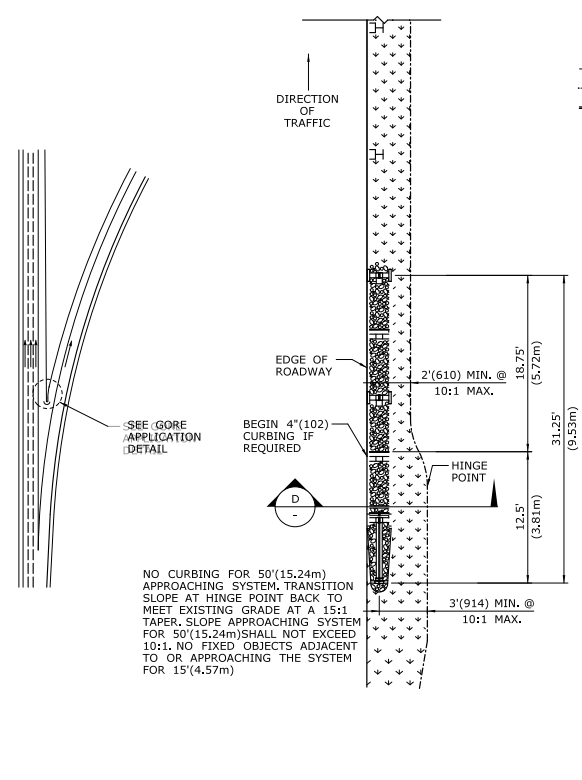
1. THIS GRADING PLAN APPLIES TO THE LATEST VERSION OF DEPARTMENT APPROVED PROPRIETARY IMPACT ATTENUATION SYSTEM MEDIAN/GORE TYPES CHOSEN FROM THE DEPARTMENT'S QUALIFIED PRODUCTS LIST.
2. WHEN THE DISTANCE FROM THE EDGE OF ROADWAY IS BETWEEN 0 AND 11.5'(3.51m) ON ONE OR BOTH SIDES OF THE SYSTEM, THE SLOPE SHALL NOT BE GREATER THAN 10:1 FOR THE ENTIRE LENGTH INCLUDING GORE OR NOSE OF ISLAND IN THE FRONT OF THE SYSTEM. IF THE SYSTEM IS A BRAKE MASTER, THE DISTANCE FROM THE EDGE OF TRAVEL WAY TO THE CENTER LINE OF THE SYSTEM ON BOTH SIDES MUST BE A MINIMUM OF 10'(3.05m).
3. WHEN THE DISTANCE FROM THE EDGE OF THE ROADWAY IS GREATER THAN 11.5'(3.51m) ON ONE OR BOTH SIDES OF THE SYSTEM, THE SLOPE SHALL NOT BE GREATER THAN 6:1 FOR THE ENTIRE LENGTH.
4. CATCH BASIN AT THIS LOCATION IF NEEDED, MUST HAVE A TYPE "C-L" TOP.
5. RAIL ON LEFT SIDE OF RAMP MAY NOT ALWAYS BE REQUIRED. IF NEEDED ON THE RAMP, IT SHOULD BE A 50'(15.24m) RADIUS OR GREATER.
6. WORK WILL BE MEASURED AND PAID FOR AT CONTRACT UNIT PRICES FOR THE VARIOUS ITEMS INVOLVED.
7. DELINEATE THE NOSE OF THE TERMINAL WITH A TYPE III RETROREFLECTIVE SHEETING IN CONFORMANCE WITH SECTION M18.09 OR AS PROVIDED BY THE MANUFACTURER.



**MEDIAN ISLAND APPLICATION**



**GORE APPLICATION**



**SHOULDER APPLICATION**

**LEGEND**

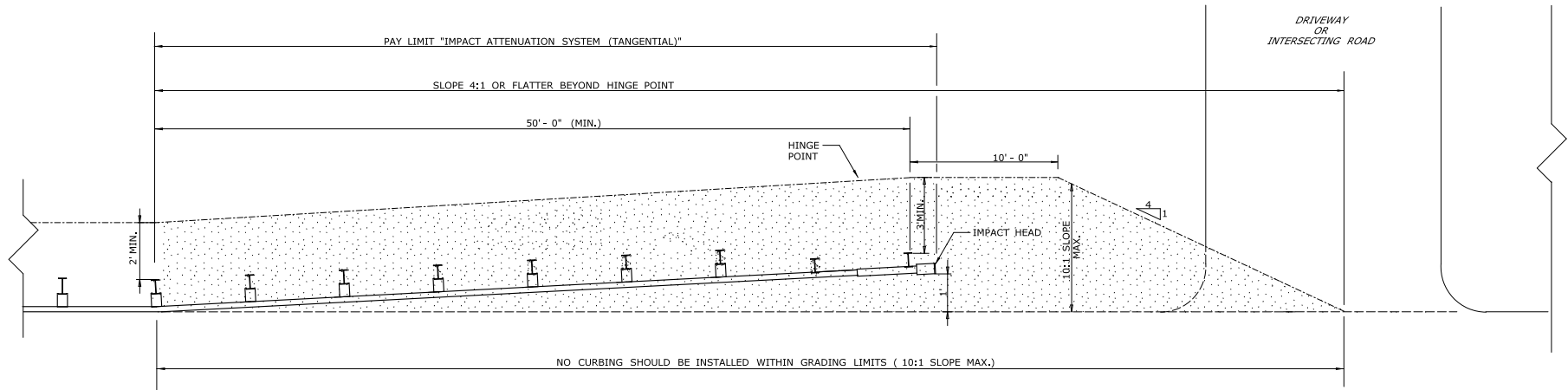
	NO CURBING
	2"(51) REVEAL MAX.
	4"(102) CURBING MAX.
	TURF ESTABLISHMENT
	PROCESSED AGGREGATE WELL COMPACTED
	PAVEMENT

**GRADING PLAN FOR IMPACT ATTENUATION SYSTEM (MEDIAN/GORE)**

ALL METRIC DIMENSIONS ARE IN MILLIMETERS (mm) UNLESS OTHERWISE NOTED.

**GENERAL NOTE:**

1. SEE TR-1205-01 FOR ATTENUATOR REFLECTOR SIGN #50-5032 TO BE INSTALLED ON THE NOSE OF THE IMPACT HEAD, THE HEIGHT AND WIDTH OF THE SHEET VARIES DEPENDING ON THE SIZE OF THE NOSE OF THE IMPACT HEAD. REFLECTOR SIGN SHALL COVER THE ENTIRE SURFACE AREA OF THE IMPACT HEAD.



**Plan**

**IMPACT ATTENUATION SYSTEM (TANGENTIAL)**

## **SECTION M.04 BITUMINOUS CONCRETE MATERIALS**

Section M.04 is being deleted in its entirety and replaced with the following:

### **M.04.01—Bituminous Concrete Materials and Facilities**

### **M.04.02—Mix Design and Job Mix Formula (JMF)**

### **M.04.03—Production Requirements**

**M.04.01—Bituminous Concrete Materials and Facilities:** Each source of component material, Plant and laboratory used to produce and test bituminous concrete must be qualified on an annual basis by the Engineer. AASHTO or ASTM Standards noted with an (M) have been modified and are detailed in Table M.04.03-6.

Aggregates from multiple sources of supply must not be blended or stored in the same stockpile.

#### **1. Coarse Aggregate:**

All coarse aggregate shall meet the requirements listed in Section M.01.

#### **2. Fine Aggregate:**

All fine aggregate shall meet the requirements listed in Section M.01

#### **3. Mineral Filler:**

Mineral filler shall conform to the requirements of AASHTO M 17.

#### **4. Performance Graded (PG) Asphalt Binder:**

##### **a. General:**

i. PG asphalt binder shall be uniformly mixed and blended and be free of contaminants such as fuel oils and other solvents. Binder shall be properly heated and stored to prevent damage or separation.

ii. The binder shall meet the requirements of AASHTO M 332 and shall be graded or verified in accordance with AASHTO R 29. The Contractor shall submit a Certified Test Report and bill of lading representing each delivery in accordance with AASHTO R 26(M). The Certified Test Report must also indicate the binder specific gravity at 77°F; rotational viscosity at 275°F and 329°F and the mixing and compaction viscosity-temperature chart for each shipment.

iii. The Contractor shall submit the name(s) of personnel responsible for receipt, inspection, and record keeping of PG binder. Contractor plant personnel shall document specific storage tank(s) where binder will be transferred and stored until used, and provide binder samples to the Engineer upon request. The person(s) shall assure that each shipment is accompanied by a statement certifying that the transport vehicle was inspected before loading and was found acceptable for the material



shipped, and, that the binder is free of contamination from any residual material, along with two (2) copies of the bill of lading.

iv. The blending or combining of PG binders in one storage tank at the Plant from different suppliers, grades, or additive percentages is prohibited.

b. Basis of Approval:

The request for approval of the source of supply shall list the location where the material will be manufactured, and the handling and storage methods, along with necessary certification in accordance with AASHTO R 26(M). Only suppliers/refineries that have an approved "Quality Control Plan for Performance Graded Binders" formatted in accordance with AASHTO R 26(M) may supply PG binders to Department projects.

c. Standard Performance Grade (PG) Binder:

i. Standard PG binder shall be defined as "Neat". Neat PG binders shall be free from modification with: fillers, extenders, reinforcing agents, adhesion promoters, thermoplastic polymers, acid modification and other additives such as re-refined motor oil, and shall indicate such information on each bill of lading and certified test report.

ii. The standard asphalt binder grade shall be PG 64S-22.

d. Modified Performance Grade (PG) Binder:

The modified asphalt binder shall be Performance Grade PG 64E-22 asphalt modified solely with a Styrene-Butadiene-Styrene (SBS) polymer. The polymer modifier shall be added at either the refinery or terminal and delivered to the bituminous concrete production facility as homogenous blend. The stability of the modified binder shall be verified in accordance with ASTM D7173 using the Dynamic Shear Rheometer (DSR). The DSR  $G^*/\sin(\delta)$  results from the top and bottom sections of the ASTM D7173 test shall not differ by more than 10%. The results of ASTM D7173 shall be included on the Certified Test Report. The binder shall meet the requirements of AASHTO M 332 (including Appendix X1) and AASHTO R 29.

e. Warm Mix Additive or Technology:

i. The warm mix additive or technology must be listed on the North East Asphalt User Producer Group (NEAUPG) Qualified Warm Mix Asphalt (WMA) Technologies List at the time of bid, which may be accessed online at <http://www.neaupg.uconn.edu>.

ii. The warm mix additive shall be blended with the asphalt binder in accordance with the manufacturer's recommendations.

iii. The blended binder shall meet the requirements of AASHTO M 332 and shall be graded or verified in accordance with AASHTO R 29 for the specified binder grade. The Contractor shall submit a Certified Test Report showing the results of the testing demonstrating the binder grade. In addition, it must include the grade of the virgin

binder, the brand name of the warm mix additive, the manufacturer's suggested rate for the WMA additive, the water injection rate (when applicable) and the WMA Technology manufacturer's recommended mixing and compaction temperature ranges.

## 5. Emulsified Asphalts:

### a. General:

- i. The emulsified asphalt shall meet the requirements of AASHTO M 140 or AASHTO M 208 as applicable.
- ii. The emulsified asphalts shall be free of contaminants such as fuel oils and other solvents.
- iii. The blending at mixing plants of emulsified asphalts from different suppliers is prohibited.

### b. Basis of Approval

- i. The request for approval of the source of supply shall list the location where the material is manufactured, the handling and storage methods, and certifications in accordance with AASHTO PP 71. Only suppliers that have an approved "Quality Control Plan for Emulsified Asphalt" formatted in accordance with AASHTO PP 71 and submit monthly split samples per grade to the Engineer may supply emulsified asphalt to Department projects.
- ii. Each shipment of emulsified asphalt delivered to the project site shall be accompanied with the corresponding Certified Test Report listing Saybolt viscosity, residue by evaporation, penetration of residue, and weight per gallon at 77°F and Material Certificate.
- iii. Anionic emulsified asphalts shall conform to the requirements of AASHTO M-140. Materials used for tack coat shall not be diluted and meet grade RS-1 or RS-1H. When ambient temperatures are 80°F and rising, grade SS-1 or SS-1H may be substituted if permitted by the Engineer.
- iv. Cationic emulsified asphalt shall conform to the requirements of AASHTO M-208. Materials used for tack coat shall not be diluted and meet grade CRS-1. The settlement and demulsibility test will not be performed unless deemed necessary by the Engineer. When ambient temperatures are 80°F and rising, grade CSS-1 or CSS-1H may be substituted if permitted by the Engineer.

**6. Reclaimed Asphalt Pavement (RAP):**

- a. General: RAP is a material obtained from the cold milling or removal and processing of bituminous concrete pavement. RAP material shall be crushed to 100% passing the ½ inch sieve and free from contaminants such as joint compound, wood, plastic, and metals.
- b. Basis of Approval: The RAP material will be accepted on the basis of one of the following criteria:
  - i. When the source of all RAP material is from pavements previously constructed on Department projects, the Contractor shall provide a Materials Certificate listing the detailed locations and lengths of those pavements and that the RAP is only from those locations listed.
  - ii. When the RAP material source or quality is not known, the Contractor shall request for approval to the Engineer at least 30 calendar days prior to the start of the paving operation. The request shall include a Material Certificate and applicable test results stating that the RAP consists of aggregates that meet the specification requirements of sub articles M.04.01-1 through 3, and, that the binder in the RAP is substantially free of solvents, tars and other contaminants. The Contractor is prohibited from using unapproved material on Department projects and shall take necessary action to prevent contamination of approved RAP stockpiles. Stockpiles of unapproved material shall remain separate from all other RAP materials at all times. The request for approval shall include the following:
    - 1. A 50-pound sample of the RAP to be incorporated into the recycled mixture.
    - 2. A 25-pound sample of the extracted aggregate from the RAP.

**7. Crushed Recycled Container Glass (CRCG):**

- a. Requirements: The Contractor may propose to use clean and environmentally-acceptable CRCG in an amount not greater than 5% by weight of total aggregate.
- b. Basis of Approval: The Contractor shall submit to the Engineer a request to use CRCG. The request shall state that the CRCG contains no more than 1% by weight of contaminants such as paper, plastic and metal and conform to the following gradation:

<b>CRCG Grading Requirements</b>	
<u>Sieve Size</u>	<u>Percent Passing</u>
3/8-inch	100
No. 4	35-100
No. 200	0.0-10.0

The Contractor shall submit a Materials Certificate to the Engineer stating that the CRCG complies with all the applicable requirements in this specification.

## 8. Joint Seal Material:

- a. Requirements: Joint seal material must meet the requirements of ASTM D 6690 – Type 2. The Contractor shall submit a Material Certificate in accordance with Article 1.06.07 certifying that the joint seal material meets the requirements of this specification.

## 9. Recycled Asphalt Shingles (RAS)

- a. Requirements: RAS shall consist of processed asphalt roofing shingles from post-consumer asphalt shingles or from manufactured shingle waste. The RAS material under consideration for use in bituminous concrete mixtures must be certified as being asbestos free and shall be entirely free of whole, intact nails. The RAS material shall meet the requirements of AASHTO MP 23.

The producer shall test the RAS material to determine the asphalt content and the gradation of the RAS material. The producer shall take necessary action to prevent contamination of RAS stockpiles.

The Contractor shall submit a Materials Certificate to the Engineer stating that the RAS complies with all the applicable requirements in this specification.

## 10. Plant Requirements:

- a. General: The Plant producing bituminous concrete shall comply with AASHTO M 156.
- b. Storage Silos: The Contractor may use silos for short-term storage with the approval of the Engineer. A silo must have heated cones and an unheated silo cylinder if it does not contain a separate internal heating system. When multiple silos are filled, the Contractor shall discharge one silo at a time. Simultaneous discharge of multiple silos for the same Project is not permitted.

<u>Type of silo cylinder</u>	<u>Maximum storage time for all classes (hr)</u>	
	HMA	WMA/PMA
Open Surge	4	Mfg Recommendations*
Unheated – Non-insulated	8	Mfg Recommendations*
Unheated – Insulated	18	Mfg Recommendations*
Heated – No inert gas	TBD by the Engineer	

\*Not to exceed HMA limits

- c. Documentation System: The mixing plant documentation system shall include equipment for accurately proportioning the components of the mixture by weight and in the proper order, controlling the cycle sequence and timing the mixing operations. Recording equipment shall monitor the batching sequence of each component of the

mixture and produce a printed record of these operations on each Plant ticket, as specified herein.

If recycled materials are used, the Plant tickets shall include their dry weight, percentage and daily moisture content.

If a WMA Technology is added at the Plant, the Plant tickets shall include the actual dosage rate.

For drum Plants, the Plant ticket shall be produced at 5 minute intervals and maintained by the vendor for a period of three years after the completion of the project.

For batch Plants, the Plant ticket shall be produced for each batch and maintained by the vendor for a period of three years after the completion of the project. In addition, an asterisk (\*) shall be automatically printed next to any individual batch weight(s) exceeding the following tolerances:

Each Aggregate Component	±1.5% of individual or cumulative target weight for each bin
Mineral Filler	±0.5% of the total batch
Bituminous Material	±0.1% of the total batch
Zero Return (Aggregate)	±0.5% of the total batch
Zero Return (Bituminous Material)	±0.1% of the total batch

The entire batching and mixing interlock cut-off circuits shall interrupt and stop the automatic batching operations when an error exceeding the acceptable tolerance occurs in proportioning.

The scales shall not be manually adjusted during the printing process. In addition, the system shall be interlocked to allow printing only when the scale has come to a complete rest. A unique printed character (m) shall automatically be printed on the ticket when the automatic batching sequence is interrupted or switched to auto-manual or full manual during proportioning.

- d. Aggregates: Aggregate stockpiles shall be managed to prevent segregation and cross contamination. For drum plants only, the percent moisture content at a minimum prior to production and half way through production shall be determined.
- e. Mixture: The dry and wet mix times shall be sufficient to provide a uniform mixture and a minimum particle coating of 95% as determined by AASHTO T 195(M) .

Bituminous concrete mixtures shall contain no more than 0.5% moisture when tested in accordance with AASHTO T 329.

- f. RAP: RAP moisture content shall be determined a minimum of twice daily (prior to production and halfway through production).
- g. Asphalt Binder: A binder log shall be submitted to the Department's Central Lab on a monthly basis.
- h. Warm mix additive: For mechanically foamed WMA, the water injection rate shall be monitored during production and not exceed 2.0% by total weight of binder. For additive added at the Plant, the dosage rate shall be monitored during production.
- i. Plant Laboratory: The Contractor shall maintain a laboratory at the production facility to test bituminous concrete mixtures during production. The laboratory shall have a minimum of 300 square feet, have a potable water source and drainage in accordance with the CT Department of Public Health Drinking Water Division, and be equipped with all necessary testing equipment as well as with a PC, printer, and telephone with a dedicated hard-wired phone line. In addition, the PC shall have internet connection and a functioning web browser with unrestricted access to <https://ctmail.ct.gov>. This equipment shall be maintained in working order at all times and be made available for use by the Engineer.

The laboratory shall be equipped with a heating system capable of maintaining a minimum temperature of 65°F. It shall be clean and free of all materials and equipment not associated with the laboratory. Sufficient light and ventilation must be provided. During summer months, adequate cooling or ventilation must be provided so the indoor air temperature shall not exceed the ambient outdoor temperature.

The laboratory testing apparatus, supplies, and safety equipment shall be capable of performing all tests in their entirety that are referenced in AASHTO R 35 and AASHTO M 323. The Contractor shall ensure that the Laboratory is adequately supplied at all times during the course of the project with all necessary testing supplies and equipment.

The Contractor shall maintain a list of laboratory equipment used in the acceptance testing processes including but not limited to, balances, scales, manometer/vacuum gauge, thermometers, gyratory compactor, clearly showing calibration and/or inspection dates, in accordance with AASHTO R 18. The Contractor shall notify the Engineer if any modifications are made to the equipment within the laboratory. The Contractor shall take immediate action to replace, repair, and/or recalibrate any piece of equipment that is out of calibration, malfunctioning, or not in operation.

#### **M.04.02—Mix Design and Job Mix Formula (JMF)**

##### **1. Curb Mix:**

- a. Requirements: The Contractor shall use bituminous concrete that meets the requirements of Table M.04.02-1. RAP may be used in 5% increments by weight up to 30%.

- b. **Basis of Approval:** Annually, an approved JMF based on a mix design for curb mix must be on file with the Engineer prior to use. .  
Any change in component source of supply or consensus properties must be approved by the Engineer. A revised JMF shall be submitted prior to use.

**TABLE M.04.02 – 1:  
Control Points for Curb Mix Mixtures**

<b>Notes:</b> (a) Compaction Parameter 50gyration $N_{des}$ . (b) The percent passing the #200 sieve shall not exceed the percentage of bituminous asphalt binder.		
<b>Mix</b>	<b>Curb Mix</b>	<b>Production Tolerances from JMF target</b>
<b>Grade of PG Binder content %</b>	<b>PG 64S-22 6.5 - 9.0</b>	<b>0.4</b>
<b>Sieve Size</b>		
# 200	3.0 – 8.0 (b)	2.0
# 50	10 - 30	4
# 30	20 - 40	5
# 8	40 - 70	6
# 4	65 - 87	7
1/4"		
3/8 "	95 - 100	8
1/2 "	100	8
3/4"		8
1"		
2"		
<b>Additionally, the fraction of material retained between any two consecutive sieves shall not be less than 4%</b>		
<b>Mixture Temperature</b>		
<b>Binder</b>	325°F maximum	
<b>Aggregate</b>	280-350° F	
<b>Mixtures</b>	265-325° F	
<b>Mixture Properties</b>		
<b>Air Voids (VA) %</b>	0 – 4.0 (a)	

## 2. Superpave Design Method – S0.25, S0.375, S0.5, and S1

- a. **Requirements:** All designated mixes shall be designed using the Superpave mix design method in accordance with AASHTO R 35. A JMF based on the mix design shall meet the requirements of Tables M.04.02-2 through Table M.04.02-5. Each JMF must be submitted no less than seven (7) days prior to production and must be approved by the Engineer prior to use. All approved JMFs expire at the end of the calendar year.

All aggregate component consensus properties and tensile strength ratio (TSR) specimens shall be tested at an AASHTO Materials Reference Laboratory (AMRL) by NETTCP certified technicians.

All bituminous concrete mixes shall be tested for stripping susceptibility by performing the tensile strength ratio (TSR) test procedure in accordance with AASHTO T 283(M) at a minimum every 36 months. The compacted specimens may be fabricated at the Plant and then tested at an AMRL accredited facility. TSR specimens, and corresponding JMF shall be submitted with each test report.

i. Superpave Mixtures with RAP: RAP may be used with the following conditions:

- RAP amounts up to 15% may be used with no binder grade modification.
- RAP amounts up to 20% may be used provided a new JMF is approved by the Engineer. The JMF submittal shall include the grade of virgin binder added. The JMF shall be accompanied by a blending chart and supporting test results in accordance with AASHTO M 323 Appendix X1, or by testing that shows the combined binder (recovered binder from the RAP, virgin binder at the mix design proportions, warm mix asphalt additive and any other modifier if used) meets the requirements of the specified binder grade.
- Two representative samples of RAP shall be obtained. Each sample shall be split and one split sample shall be tested for binder content in accordance with AASHTO T 164 and the other in accordance AASHTO T 308.
- RAP material shall not be used with any other recycling option.

ii. Superpave Mixtures with RAS: RAS may be used solely in HMA S1 mixtures with the following conditions:

- RAS amounts up to 3% may be used.
- RAS total binder replacement up to 15% may be used with no binder grade modification.
- RAS total binder replacement up to 20% may be used provided a new JMF is approved by the Engineer. The JMF submittal shall include the grade of virgin binder added. The JMF shall be accompanied by a blending chart and supporting test results in accordance to AASHTO M 323 appendix X1 or by testing that shows the combined binder (recovered binder from the RAP, virgin binder at the mix design proportions, warm mix asphalt additive and any other modifier if used) meets the requirements of the specified binder grade.
- Superpave Mixtures with RAS shall meet AASHTO PP 78 design considerations. The RAS asphalt binder availability factor (F) used in AASHTO PP 78 shall be 0.85.

iii. Superpave Mixtures with CRCG: CRCG may be used solely in HMA S1 mixtures. One percent of hydrated lime, or other accepted non-stripping agent, shall be added to all mixtures containing CRCG. CRCG material shall not be used with any other recycling option.



- b. Basis of Approval: The following information must be included with the JMF submittal:
- Gradation, consensus properties and specific gravities of the aggregate, RAP or RAS.
  - Average asphalt content of the RAP or RAS by AASHTO T 164.
  - Source of RAP or RAS, and percentage to be used.
  - Warm mix Technology, manufacturer's recommended additive rate and tolerances and manufacturer recommended mixing and compaction temperatures.
  - TSR test report and anti-strip manufacturer and recommended dosage rate if applicable.
  - Mixing and compaction temperature ranges for the mix with and without the warm-mix technology incorporated.
  - JMF ignition oven correction factor by AASHTO T 308.

With each JMF submittal, the following samples shall be submitted to the Division of Materials Testing:

- 4 - one quart cans of PG binder, with corresponding Safety Data Sheet (SDS)
- 1 - 50 lbs bag of RAP
- 2 - 50 lbs bag of plant blended virgin aggregate

A JMF may not be approved if any of the properties of the aggregate components or mix do not meet the verification tolerances as described in the Department's current QA Program for Materials, Acceptance and Assurance Testing Policies and Procedures.

Any material based on a JMF, once approved, shall only be acceptable for use when it is produced by the designated plant, it utilizes the same components, and the production of material continues to meet all criteria as specified herein, and component aggregates are maintained within the tolerances shown in Table M.04.02-2. A new JMF must be submitted to the Engineer for approval whenever a new component source is proposed.

Only one mix with one JMF will be approved for production at any one time. Switching between approved JMF mixes with different component percentages or sources of supply is prohibited.

- c. Mix Status: Each facility will have each type of mixture rated based on the results of the previous year's production. Mix Status will be provided to each bituminous concrete producer annually prior to the beginning of the paving season.

The rating criteria are based on compliance with Air Voids and Voids in Mineral Aggregate (VMA) as indicated in Table M.04.03-4 and are calculated as follows:

Criteria A: Percentage of acceptance test results with compliant air voids.

Criteria B: The average of the percentage of acceptance test results with compliant VMA, and percentage of acceptance test results with compliant air voids.

The final rating assigned will be the lower of the rating obtained with Criteria A or B.

Mix status is defined as:

“A” – Approved:

Assigned to each mixture type from a production facility with a current rating of 70% or greater, or to each mixture type completing a successful PPT.

“PPT” – Pre-Production Trial:

Temporarily assigned to each mixture type from a production facility when:

1. there are no compliant acceptance production test results submitted to the Department from the previous year;
2. there is a source change in one or more aggregate components
3. there is a component percentage change of more than 5% by weight;
4. there is a change in RAP percentage;
5. the mixture has a rating of less than 70% from the previous season;
6. a new JMF not previously submitted.

Bituminous concrete mixtures with a “PPT” status cannot be used on Department projects. Testing shall be performed by the Producer with NETTCP certified personnel on material under this status. Test results must confirm that specifications requirements in Table M.04.02-2 and Table M.04.02-5 are met before material can be used. One of the following methods must be used to verify the test results:

Option A: Schedule a day when a Department Inspector can be at the facility to witness testing or,

Option B: When the Contractor or their representative performs testing without being witnessed by an Inspector, the Contractor shall submit the test results and a split sample including 2 gyratory molds, 5,000 grams of boxed bituminous concrete, and 5,000 grams of cooled loose bituminous concrete for verification testing and approval.

Option C: When the Contractor or their representative performs testing without being witnessed by a Department Inspector, the Engineer may verify the mix in the Contractor’s laboratory.

Witnessing or verifying by the Department of compliant test results will change the mix’s status to an “A”.

The differences between the Department’s test results and the Contractor’s must be within the “C” tolerances included in the Department’s QA Program for Materials, Acceptance and Assurance Testing Policies and Procedures in order to be verified.

“U” – Not Approved:

Status assigned to a type of mixture that does not have an approved JMF. . Bituminous concrete mixtures with a “U” status cannot be used on Department projects.

**TABLE M.04.02– 2: Superpave Mixture Design Criteria**

Notes: <sup>(1)</sup> For all mixtures using a WMA technology, the mix temperature shall meet PG binder and WMA manufacturer's recommendations.								
Sieve	S0.25		S0.375		S0.5		S1	
	CONTROL POINTS		CONTROL POINTS		CONTROL POINTS		CONTROL POINTS	
inches	Min (%)	Max (%)	Min (%)	Max (%)	Min (%)	Max (%)	Min (%)	Max (%)
2.0	-	-	-	-	-	-	-	-
1.5	-	-	-	-	-	-	100	-
1.0	-	-	-	-	-	-	90	100
3/4	-	-	-	-	100	-	-	90
1/2	100	-	100	-	90	100	-	-
3/8	97	100	90	100	-	90	-	-
#4	75	90	-	75	-	-	-	-
#8	32	67	32	67	28	58	19	45
#16	-	-	-	-	-	-	-	-
#30	-	-	-	-	-	-	-	-
#50	-	-	-	-	-	-	-	-
#100	-	-	-	-	-	-	-	-
#200	2.0	10.0	2.0	10.0	2.0	10.0	1.0	7.0
VMA (%)	16.5 ± 1		16.0 ± 1		15.0 ± 1		13.0 ± 1	
VA (%)	4.0 ± 1		4.0 ± 1		4.0 ± 1		4.0 ± 1	
Gse	JMF value		JMF value		JMF value		JMF value	
Gmm	JMF ± 0.030		JMF ± 0.030		JMF ± 0.030		JMF ± 0.030	
Dust / binder	0.6 – 1.2		0.6 – 1.2		0.6 – 1.2		0.6 – 1.2	
Mix Temp <sup>(1)</sup>	265 – 325°F		265 – 325°F		265 – 325°F		265 – 325°F	
TSR	≥ 80%		≥ 80%		≥ 80%		≥ 80%	
T-283 Stripping	Minimal, as determined by the Engineer							

**TABLE M.04.02–3: Superpave Consensus Properties Requirements for Combined Aggregate**

Notes: (1) 95/90 denotes that a minimum of 95% of the coarse aggregate, by mass, shall have one fractured face and that a minimum of 90% shall have two fractured faces.. (2) Criteria presented as maximum Percent by mass of flat and elongated particles of materials retained on the #4 sieve, determined at 5:1 ratio.					
Traffic Level	Design ESALs (80 kN), Millions	Coarse Aggregate Angularity <sup>(1)</sup> ASTM D 5821, Minimum %	Fine Aggregate Angularity AASHTO T 304, Method A Minimum %	Flat and Elongated Particles <sup>(2)</sup> ASTM D 4791, Maximum %	Sand Equivalent AASHTO T 176, Minimum %
1	< 0.3	55/- -	40	10	40
2	0.3 to < 3.0	75/- -	40	10	40
3	≥ 3.0	95/90	45	10	45

**TABLE M.04.02– 4: Superpave Traffic Levels and Design Volumetric Properties**

Traffic Level	Design ESALs	Number of Gyration by Superpave Gyrotory Compactor			Percent Density of Gmm from HMA/WMA specimen			Voids Filled with Asphalt (VFA) Based on Nominal mix size – inch			
	(million)	Nini	Ndes	Nmax	Nini	Ndes	Nmax	0.25	0.375	0.5	1
1	< 0.3	6	50	75	≤ 91.5	96.0	≤ 98.0	70 - 80	70 - 80	70 - 80	67 - 80
2	0.3 to < 3.0	7	75	115	≤ 90.5	96.0	≤ 98.0	65 - 78	65 - 78	65 - 78	65 - 78
3	≥ 3.0	8	100	160	≤ 90.0	96.0	≤ 98.0	65 - 77	73 - 76	65 - 75	65 - 75

**TABLE M.04.02– 5:  
Superpave Minimum Binder Content by Mix Type and Level**

<b>Mix Type</b>	<b>Level</b>	<b>Binder Content Minimum</b>
S0.25	1	5.70
S0.25	2	5.60
S0.25	3	5.50
S0.375	1	5.70
S0.375	2	5.60
S0.375	3	5.50
S0.5	1	5.10
S0.5	2	5.00
S0.5	3	4.90
S1	1	4.60
S1	2	4.50
S1	3	4.40

**M.04.03— Production Requirements:**

**1. Standard Quality Control Plan (QCP) for Production:**

The QCP for production shall describe the organization and procedures which the Contractor shall use to administer quality control. The QCP shall include the procedures used to control the production process, to determine when immediate changes to the processes are needed, and to implement the required changes. The QCP must detail the inspection, sampling and testing protocols to be used, and the frequency for each.

Control Chart(s) shall be developed and maintained for critical aspect(s) of the production process as determined by the Contractor. The control chart(s) shall identify the material property, applicable upper and lower control limits, and be updated with current test data. As a minimum, the following quality characteristics shall be included in the control charts: percent passing #4 sieve, percent passing #200 sieve, binder content, air voids, Gmm and VMA. The control chart(s) shall be used as part of the quality control system to document variability of the bituminous concrete production process. The control chart(s) shall be submitted to the Engineer the first day of each month.

The QCP shall also include the name and qualifications of a Quality Control Manager. The Quality Control Manager shall be responsible for the administration of the QCP, including compliance with the plan and any plan modifications.

The Contractor shall submit complete production testing records to the Engineer within 24 hours in a manner acceptable to the Engineer.

The QCP shall also include the name and qualifications of any outside testing laboratory performing any QC functions on behalf of the Contractor. The QCP must also include a list of sampling & testing methods and frequencies used during production, and the names of all Quality Control personnel and their duties.

Approval of the QCP does not imply any warranty by the Engineer that adherence to the plan will result in production of bituminous concrete that complies with these specifications. The Contractor shall submit any changes to the QCP as work progresses.

## **2. Acceptance Requirements:**

### **i. General:**

Acceptance samples shall be obtained from the hauling vehicles and tested by the Contractor at the Plant.

The Contractor shall submit all acceptance tests results to the Engineer within 24 hours or prior to the next day's production. All acceptance test specimens and supporting documentation must be retained by the Contractor and may be disposed of with the approval of the Engineer. All quality control specimens shall be clearly labeled and separated from the acceptance specimens.

Contractor personnel performing acceptance sampling and testing must be present at the facility prior to, during, and until completion of production, and be certified as a NETTCP HMA Plant Technician or Interim HMA Plant Technician and be in good standing. Production of material for use on State projects must be suspended by the Contractor if such personnel are not present. Technicians found by the Engineer to be non-compliant with NETTCP policies and procedures or Department policies may be removed by the Engineer from participating in the acceptance testing process for Department projects until their actions can be reviewed.

Anytime during production that testing equipment becomes defective or inoperable, production can continue for a maximum of 1 hour. The Contractor shall obtain box sample(s) in accordance with Table M.04.03-2 to satisfy the daily acceptance testing requirement for the quantity shipped to the project. The box sample(s) shall be tested once the equipment issue has been resolved to the satisfaction of the Engineer. Production beyond 1 hour may be considered by the Engineer. Production will not be permitted beyond that day until the subject equipment issue has been resolved.

Verification testing will be performed by the Engineer in accordance with the Department's QA Program for Materials.

Should the Department be unable to verify the Contractor's acceptance test result(s) due to a failure of the Contractor to retain acceptance test specimens or supporting documentation, the Contractor shall review its quality control plan, determine the cause of the nonconformance and

respond in writing within 24 hours to the Engineer describing the corrective action taken. In addition, the Contractor must provide supporting documentation or test results to validate the subject acceptance test result(s). The Engineer may invalidate any adjustments for material corresponding to the subject acceptance test(s). Failure of the Contractor to adequately address quality control issues at a facility may result in suspension of production for Department projects at that facility.

**ii. Curb Mix Acceptance Sampling and Testing Procedures:**

Curb Mix shall be tested in accordance to Table M.04.03-1 by the Contractor at a frequency of one test per every 250 tons of cumulative production, regardless of the day of production.

**TABLE M.04.03 – 1: Curb Mix Acceptance Test Procedures**

<b>Protocol</b>	<b>Reference</b>	<b>Description</b>
<b>1</b>	<b>AASHTO T 30(M)</b>	Mechanical Analysis of Extracted Aggregate
<b>2</b>	<b>AASHTO T 168</b>	Sampling of Bituminous Concrete
<b>3</b>	<b>AASHTO T 308</b>	Binder content by Ignition Oven method (adjusted for aggregate correction factor)
<b>4</b>	<b>AASHTO T 209(M)<sup>(2)</sup></b>	Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures
<b>5</b>	<b>AASHTO T 312<sup>(2)</sup></b>	<sup>(1)</sup> Superpave Gyration molds compacted to N <sub>des</sub>
<b>6</b>	<b>AASHTO T 329</b>	Moisture Content of Hot-Mix Asphalt (HMA) by Oven Method

**Notes:** <sup>(1)</sup> One set equals two six-inch molds. Molds to be compacted to 50 gyrations  
<sup>(2)</sup> Once per year or when requested by the Engineer

- a. Determination of Off-Test Status:
  - i. Curb Mix is considered “off test” when the test results indicate that any single value for bitumen content or gradation are not within the tolerances shown in Table M.04.02-1. If the mix is “off test”, the Contractor must take immediate actions to correct the deficiency and a new acceptance sample shall be tested on the same day or the following day of production.
  - ii. When multiple silos are located at one site, mixture supplied to one project is considered as coming from one source for the purpose of applying the “off test” status.
  - iii. The Engineer may cease supply from the plant when test results from three consecutive samples are not within the JMF tolerances or the test results from two consecutive samples not within the control points indicated in Table M.04.02-1 regardless of production date.

b. JMF revisions

- i. If a test indicates that the bitumen content or gradation are outside the tolerances, the Contractor may make a single JMF revision as allowed by the Engineer prior to any additional testing. Consecutive test results outside the requirements of Table M.04.02-1 JMF tolerances may result in rejection of the mixture.
- ii. Any modification to the JMF shall not exceed 50% of the JMF tolerances indicated in Table M.04.02-1 for any given component of the mixture without approval of the Engineer. When such an adjustment is made to the bitumen, the corresponding production percentage of bitumen shall be revised accordingly.

**iii. Superpave Mix Acceptance:**

a. Sampling and Testing Procedures

Production Lot: The Lot will be defined as one of the following types:

- Non-PWL Production Lot for total estimated project quantities per mixture less than 3500 tons: All mixture placed during a single continuous paving operation.
- PWL Production Lot for total estimated project quantities per mixture of 3500 tons or more: Each 3500 tons of mixture produced within 30 calendar days.

Production Sub Lot:

- For Non-PWL: As defined in Table M.04.03 – 2
- For PWL: 500 tons (the last Sub Lot may be less than 500 tons)

Partial Production Lots (For PWL only): A Lot with less than 3500 tons due to:

- completion of the Course
- a Job Mix Formula revision due to changes in:
  - o cold feed percentages over 5%
  - o target combined gradation over 5%
  - o target binder over 0.15%
  - o any component specific gravity
- a Lot spanning 30 calendar days

The acceptance sample(s) location(s) shall be selected using stratified – random sampling in accordance with ASTM D 3665 based on:

- the total daily estimated tons of production for non-PWL lots, or
- the total lot size for PWL lots.

One acceptance sample shall be obtained and tested per Sub Lot. The Engineer may direct that additional acceptance samples be obtained. For non-PWL lots, one acceptance test shall always be performed in the last sub-lot based on actual tons of material produced.



For Non-PWL lots, quantities of the same mixture per plant may be combined daily for multiple State projects to determine the number of sub lots.

The payment adjustment will be calculated as described in 4.06.

**TABLE M.04.03 – 2:  
Superpave Acceptance Testing Frequency per Type/Level/Plant for Non-PWL lots**

Daily quantity produced in tons (lot)	Number of Sub Lots/Tests
0 to 150	0, Unless requested by the Engineer
151 to 500	1
501 to 1,000	2
1,001 to 2,000	3
2,001 or greater	1 per 500 tons or portions thereof

The following test procedures shall be used for acceptance:

**TABLE M.04.03– 3: Superpave Acceptance Testing Procedures**

Protocol	Procedure	Description
1	AASHTO T 168	Sampling of bituminous concrete
2	AASHTO R 47	Reducing samples to testing size
3	AASHTO T 308	Binder content by ignition oven method (adjusted for aggregate correction factor)
4	AASHTO T 30(M)	Gradation of extracted aggregate for bituminous concrete mixture
5	AASHTO T 312	<sup>(1)</sup> Superpave gyratory molds compacted to N <sub>des</sub>
6	AASHTO T 166	<sup>(2)</sup> Bulk specific gravity of bituminous concrete
7	AASHTO R 35	<sup>(2)</sup> Air voids, VMA
8	AASHTO T 209(M)	Maximum specific gravity of bituminous concrete (average of two tests)
9	AASHTO T 329	Moisture content of bituminous concrete

**Notes:** <sup>(1)</sup> One set equals two six-inch molds. Molds to be compacted to N<sub>max</sub> for PPTs and to N<sub>des</sub> for production testing. The first subplot of the year will be compacted to N<sub>max</sub>

<sup>(2)</sup> Average value of one set of six-inch molds.

If the average ignition oven corrected binder content differs by 0.3% or more from the average of the Plant ticket binder content in five (5) consecutive tests regardless of the production date (moving average), the Contractor shall immediately investigate, determine an assignable cause and correct the issue. When two consecutive moving average differences are 0.3% or more and no assignable cause has been established, the Engineer may require a new ignition oven aggregate correction factor to be performed or to adjust the current factor by the average of the differences between the corrected binder content and production Plant ticket for the last five (5) acceptance results.

The test specimen must be placed in an ignition oven for testing in accordance with AASHTO T 308 within thirty minutes of being obtained from the hauling vehicle and the test shall start immediately after.

The Contractor shall perform TSR testing within 30 days after the start of production for all design levels of HMA- and PMA- S0.5 plant-produced mixtures, in accordance with AASHTO T 283(M). The TSR test shall be performed at an AMRL certified laboratory by NETTCP certified technicians. The compacted specimens may be fabricated at the Plant and then tested at an AMRL accredited facility. The test results and specimens shall be submitted to the Engineer for review. Superpave mixtures that require anti-strip additives (either liquid or mineral) shall continue to meet all requirements specified herein for binder and bituminous concrete. The Contractor shall submit the name, manufacturer, percent used, technical datasheet and SDS for the anti-strip additive (if applicable) to the Engineer.

b. Determination of Off-Test Status:

- i. Superpave mixes shall be considered “*off test*” when any Control Point Sieve, binder content, VA, VMA, or Gmm value is outside of the limits specified in Table M.04.03-4 or the target binder content at the Plant is below the minimum binder content stated in Table M.04.02-5. Note that further testing of samples or portions of samples not initially tested for this purpose cannot be used to change the status.
- ii. Any time the bituminous concrete mixture is considered Off-test:
  1. The Contractor shall notify the Engineer when the Plant is “*off test*” for any mix design that is delivered to the project in any production day. When multiple silos are located at one site, mixture supplied to one project is considered as coming from one source for the purpose of applying the “*off test*” determination.
  2. The Contractor must take immediate actions to correct the deficiency, minimize “*off test*” production to the project, and obtain an additional Process Control (PC) test after any corrective action to verify production is in conformance to the specifications. A PC test will not be used for acceptance and is solely for the use of the Contractor in its quality control process.

c. Cessation of Supply for Superpave Mixtures in non-PWL lots:

A mixture shall not be used on Department’s projects when it is “off test” for:

- i. four (4) consecutive tests in any combination of VA, VMA or Gmm, regardless of date of production, or,
- ii. two (2) consecutive tests in the Control Point sieves in one production shift.

As a result of cessation of supply, the mix status will be changed to PPT.

d. JMF revisions:

JMF revisions are only permitted prior to or after a production shift. A JMF revision is effective from the time it was submitted and is not retroactive to the previous test(s).

JMF revisions shall be justified by a documented trend of test results.

Revisions to aggregate and RAP specific gravities are only permitted when testing is performed at an AMRL certified laboratory by NETTCP certified technicians.

A JMF revision is required when the Plant target RAP and/or bin percentage deviates by more than 5% and/or the Plant target binder content deviates by more than 0.15% from the active JMF.

**TABLE M.04.03– 4: Superpave Mixture Production Requirements**

<b>Notes:</b> (1) 300°F minimum after October 15. (2) JMF tolerances shall be defined as the limits for production compliance. (3) For all mixtures with WMA technology, changes to the minimum aggregate temperature will require Engineer's approval. (4) For PMA and mixtures with WMA technology, the mix temperature shall meet manufacturer's recommendations. In addition, for all mixtures with WMA technology, the maximum mix temperature shall not exceed 325°F.(5) 0.4 for PWL lots (6) 1.3 for PWL lots (7) 1.2 for PWL lots									
	<b>S0.25</b>		<b>S0.375</b>		<b>S0.5</b>		<b>S1</b>		<b>Tolerances</b>
Sieve	CONTROL POINTS		CONTROL POINTS		CONTROL POINTS		CONTROL POINTS		<b>From JMF Targets (2)</b>
inches	Min(%)	Max(%)	Min(%)	Max(%)	Min(%)	Max(%)	Min(%)	Max(%)	±Tol
1.5	-	-	-	-	-	-	100	-	
1.0	-	-	-	-	-	-	90	100	
3/4	-	-	-	-	100	-	-	90	
1/2	100	-	100	-	90	100	-	-	
3/8	97	100	90	100	-	90	-	-	
#4	75	90	-	75	-	-	-	-	
#8	32	67	32	67	28	58	19	45	
#16	-	-	-	-	-	-	-	-	
#200	2.0	10.0	2.0	10.0	2.0	10.0	1.0	7.0	
Pb	JMF value		JMF value		JMF value		JMF value		0.3 <sup>(5)</sup>
VMA (%)	16.5		16.0		15.0		13.0		1.0 <sup>(6)</sup>
VA (%)	4.0		4.0		4.0		4.0		1.0 <sup>(7)</sup>
Gmm	JMF value		JMF value		JMF value		JMF value		0.030
Agg. Temp <sup>(3)</sup>	280 – 350F		280 – 350F		280 – 350F		280 – 350F		
Mix Temp <sup>(4)</sup>	265 – 325 F <sup>(1)</sup>		265 – 325 F <sup>(1)</sup>		265 – 325 F <sup>(1)</sup>		265 – 325 F <sup>(1)</sup>		
Prod. TSR	N/A		N/A		≥80%		N/A		
T-283 Stripping	N/A		N/A		Minimal as determined by the Engineer		N/A		

**TABLE M.04.03– 5:  
Superpave Traffic Levels and Design Volumetric Properties**

Traffic Level	Design ESALs	Number of Gyration by Superpave Gyratory Compactor	
	(million)	Nini	Ndes
1	< 0.3	6	50
2	0.3 to < 3.0	7	75
3	≥3.0	8	100

**TABLE M.04.03-6:  
Modifications to Standard AASHTO and ASTM Test Specifications and Procedures**

AASHTO Standard Method of Test	
Reference	Modification
<b>T 30</b>	Section 7.2 thru 7.4 Samples are not routinely washed for production testing
<b>T 168</b>	<p>Samples are taken at one point in the pile. Samples from a hauling vehicle are taken from only one point instead of three as specified.</p> <p>Selection of Samples: Sampling is equally important as the testing, and the sampler shall use every precaution to obtain samples that are truly representative of the bituminous mixture.</p> <p>Box Samples: In order to enhance the rate of processing samples taken in the field by construction or maintenance personnel the samples will be tested in the order received and data processed to be determine conformance to material specifications and to prioritize inspections by laboratory personnel.</p>
<b>T 195</b>	Section 4.3 only one truck load of mixture is sampled. Samples are taken from opposite sides of the load.
<b>T 209</b>	<p>Section 7.2 The average of two bowls is used proportionally in order to satisfy minimum mass requirements.</p> <p>8.3 Omit Pycnometer method.</p>
<b>T 283</b>	When foaming technology is used, the material used for the fabrication of the specimens shall be cooled to room temperature, and then reheated to the manufactures recommended compaction temperature prior to fabrication of the specimens.

<b>AASHTO Standard Recommended Practices</b>	
<b>Reference</b>	<b>Modification</b>
<b>R 26</b>	<p>All laboratory technician(s) responsible for testing PG-binders be certified or Interim Qualified by the New England Transportation Technician Certification Program (NETTCP) as a PG Asphalt Binder Lab Technician.</p> <p>All laboratories testing binders for the Department are required to be accredited by the AASHTO Materials Reference Laboratory (AMRL).</p> <p>Sources interested in being approved to supply PG-binders to the Department by use of an “in-line blending system,” must record properties of blended material, and additives used.</p> <p>Each source of supply of PG-binder must indicate that the binders contain no additives used to modify or enhance their performance properties. Binders that are manufactured using additives, modifiers, extenders etc., shall disclose the type of additive, percentage and any handling specifications/limitations required.</p> <p>All AASHTO M 320 references shall be replaced with AASHTO M 332.</p> <p>Once a month, one split sample and test results for each asphalt binder grade and each lot shall be submitted by the PG binder supplier to the Department’s Central Lab. Material remaining in a certified lot shall be re-certified no later than 30 days after initial certification. Each April and September, the PG binder supplier shall submit test results for two (2) BBR tests at two (2) different temperatures in accordance with AASHTO R 29.</p>

**SECTION M.10 – RAILING AND FENCE**

**M.10.02 – Metal Beam-Type Rail and Anchorages:**

**9. Plastic Blockouts:**

Replace *NCHRP Report 350* with *MASH*

## **ON-THE-JOB TRAINING (OJT) WORKFORCE DEVELOPMENT PILOT**

### **Description**

To provide construction industry related job opportunities to minorities, women and economically disadvantaged individuals; and to increase the likelihood of a diverse and inclusive workforce on Connecticut Department of Transportation (ConnDOT) projects.

All contractors (existing and newcomers) will be automatically placed in the Workforce Development Pilot. Standard OJT requirements typically associated with individual projects will no longer be applied at the project level for new projects. Instead, these requirements will be applicable on an annual basis for each contractor performing work on ConnDOT projects.

The OJT Workforce Development Pilot will allow a contractor to train employees on Federal, State and privately funded projects located in Connecticut. However, contractors should give priority to training employees on ConnDOT Federal-Aid funded projects.

### **Funding**

The Department will establish an OJT fund annually from which contractors may bill the Department directly for eligible trainee hours. The funds for payment of trainee hours on federal-aid projects will be allocated from the ½ of 1% provided for OJT funding, and will be based on hours trained, not to exceed a maximum of \$25,000.00 per year; per contractor.

### **Minorities and Women**

Developing, training and upgrading of minorities, women and economically disadvantaged individuals toward journeyman level status is the primary objective of this special training provision. Accordingly, the Contractor shall make every effort to enroll minority, women and economically disadvantaged individuals as trainees to the extent that such persons are available within a reasonable area of recruitment. This training commitment is not intended, and shall not be used, to discriminate against any applicant for training whether a member of a minority group or not.

### **Assigning Training Goals**

The Department, through the OJT Program Coordinator, will assign training goals for a calendar year based on the contractor's past two year's activities and the contractor's anticipated upcoming year's activity with the Department. At the beginning of each year, all contractors eligible will be contacted by the Department to determine the number of trainees that will be assigned for the upcoming calendar year. At that time, the Contractor shall enter into an agreement with the Department to provide a self-imposed on-the-job training program for the calendar year. This agreement will include a specific number of annual training goals agreed to by both parties. The number of training assignments may range from one (1) to six (6) per



contractor per calendar year. Each January, a summary of the trainees required and the OJT Workforce Development Pilot package will be sent to participating contractors. The number of trainees assigned to each contractor in the summary will increase proportionately not to exceed 6, as shown in the following table. This package will also be provided to contractors as they become newly eligible for the OJT Workforce Development Pilot throughout the remainder of the year. Projects awarded after September 30 will be included in the following year's Program.

The dollar thresholds for training assignments are as follows:

\$4.5 – 8 million=	1 trainee
\$ 9 – 15 million=	2 trainees
\$16 – 23 million=	3 trainees
\$24 – 30 million=	4 trainees
\$31 – 40 million=	5 trainees
\$41 – and above=	6 trainees

### **Training Classifications**

Preference shall be given to providing training in the following skilled work classifications. However, the classifications established are not all-inclusive:

Equipment Operators	Electricians
Laborers	Painters
Carpenters	Iron / Reinforcing Steel Workers
Concrete Finishers	Mechanics
Pipe Layers	Welders

The Department has on file common training classifications and their respective training requirements; that may be used by the contractors. Contractors shall submit new classifications for specific job functions that their employees are performing. The Department will review and recommend for acceptance the new classifications proposed by contractors, if applicable. New classifications shall meet the following requirements:

Proposed training classifications are reasonable and realistic based on the job skill classification needs, and the number of training hours specified in the training classification is consistent with common practices and provides enough time for the trainee to obtain journeyman level status.

Where feasible, 25% percent of apprentices or trainees in each occupation shall be in their first year of apprenticeship or training. The number of trainees shall be distributed among the work classifications on the basis of the contractor's needs and the availability of journeymen in the various classifications within a reasonable area of recruitment.

No employee shall be employed as a trainee in any classification in which they have successfully completed a training course leading to journeyman level status or in which they have been employed as a journeyman.

## **Records and Reports**

The Contractor shall maintain enrollment in the program and submit all required reports documenting company compliance under these contract requirements. These documents and any other information shall be submitted to the OJT Program Coordinator as requested.

Upon the trainee's completion and graduation from the program, the Contractor shall provide each trainee with a certification Certificate showing the type and length of training satisfactorily completed.

## **Trainee Interviews**

In order to determine the continued effectiveness of the OJT Program in Connecticut, the department will periodically conduct personal interviews with current trainees and may survey recent graduates of the program. This enables the OJT Program Coordinator to modify and improve the program as necessary. Trainee interviews are generally conducted at the job site to ensure that the trainees' work and training is consistent with the approved training program.

## **Trainee Wages**

Contractors shall compensate trainees on a graduating pay scale based upon a percentage of the prevailing minimum journeyman wages (Davis-Bacon Act). Minimum pay shall be as follows:

60 percent	of the journeyman wage for the first half of the training period
75 percent	of the journeyman wage for the third quarter of the training period
90 percent	of the journeyman wage for the last quarter of the training period

*In no case, will the trainee be paid less than the prevailing rate for general laborer as shown in the contract wage decision (must be approved by the Department of Labor).*

## **Achieving or Failing to Meet Training Goals**

The Contractor will be credited for each trainee currently enrolled or who becomes enrolled in the approved training program and providing they receive the required training under the specific training program. Trainees will be allowed to be transferred between projects if required by the Contractor's schedule and workload. The OJT Program Coordinator must be notified of transfers within five (5) days of the transfer or reassignments by e-mail ([Phylisha.Coles@ct.gov](mailto:Phylisha.Coles@ct.gov)).

Where a contractor does not or cannot achieve its annual training goal with female or minority trainees, they must produce adequate Good Faith Efforts documentation. Good Faith Efforts are those designed to achieve equal opportunity through positive, aggressive, and continuous result-oriented measures. 23 CFR § 230.409(g) (4). Contractors should request minorities and females from unions when minorities and females are under-represented in the contractor's workforce.

Whenever a contractor requests ConnDOT approval of someone other than a minority or female, the contractor must submit documented evidence of its Good Faith Efforts to fill that position with a minority or female. When a non-minority male is accepted, a contractor must continue to attempt to meet its remaining annual training goals with females and minorities.

Where a contractor has neither attained its goal nor submitted adequate Good Faith Efforts documentation, ConnDOT will issue a letter of non-compliance. Within thirty (30) days of receiving the letter of non-compliance, the contractor must submit a written Corrective Action Plan (CAP) outlining the steps that it will take to remedy the non-compliance. The CAP must be approved by ConnDOT. Failure to comply with the CAP may result in your firm being found non-responsive for future projects.

### **Measurement and Payment**

Optional reimbursement will be made to the contractor for providing the required training under this special provision on ConnDOT Federal-Aid funded projects only.

Contractor will be reimbursed at \$0.80 for each hour of training given to an employee in accordance with an approved training or apprenticeship program. This reimbursement will be made even though the Contractor receives additional training program funds from other sources, provided such other source does not specifically prohibit the contractor from receiving other reimbursement.

Reimbursement for training is made annually or upon the trainees completion and not on a monthly basis. No payment shall be made to the Contractor if either the failure to provide the required training, or the failure to hire the trainee as a journeyman, is caused by the Contractor.

Program reimbursements will be made directly to the prime contractor on an annual basis. To request reimbursement, prime contractors must complete the Voucher for OJT Workforce Development Pilot Hourly Reimbursement for each trainee in the OJT Program. This form is included in the OJT Workforce Development Pilot package and is available on the Department's web site at:

[www.ct.gov/dot](http://www.ct.gov/dot)

The completed form must be submitted to the Office of Contract Compliance for approval. The form is due on the 15<sup>th</sup> day of January for each trainee currently enrolled and for hours worked on ConnDOT Federal-Aid funded projects only.

## D.B.E. SUBCONTRACTORS AND MATERIAL SUPPLIERS OR MANUFACTURERS

**January 2013**

### **I. ABBREVIATIONS AND DEFINITIONS AS USED IN THIS SPECIAL PROVISION**

A. *CTDOT* means the Connecticut Department of Transportation.

B. *USDOT* means the U.S. Department of Transportation, including the Office of the Secretary, the Federal Highway Administration (“FHWA”), the Federal Transit Administration (“FTA”), and the Federal Aviation Administration (“FAA”).

C. *Broker* means a party acting as an agent for others in negotiating Contracts, Agreements, purchases, sales, etc., in return for a fee or commission.

D. *Contract, Agreement or Subcontract* means a legally binding relationship obligating a seller to furnish supplies or services (including but not limited to, construction and professional services) and the buyer to pay for them. For the purposes of this provision, a lease for equipment or products is also considered to be a Contract.

E. *Contractor* means a consultant, second party or any other entity under Contract to do business with CTDOT or, as the context may require, with another Contractor.

F. *Disadvantaged Business Enterprise (“DBE”)* means a for profit small business concern:

1. That is at least 51 percent owned by one or more individuals who are both socially and economically disadvantaged or, in the case of a corporation, in which 51 percent of the stock is owned by one or more such individuals; and
2. Whose management and daily business operations are controlled by one or more of the socially and economically disadvantaged individuals who own it; and
3. Certified by CTDOT under Title 49 of the Code of Federal Regulations, Part 26, (Title 49 CFR Part 23 of the Code of Federal Regulations for Participation of Disadvantaged Business Enterprise in Airport Concessions)

G. *USDOT-assisted Contract* means any Contract between CTDOT and a Contractor (at any tier) funded in whole or in part with USDOT financial assistance.

H. *Good Faith Efforts (“GFE”)* means all necessary and reasonable steps to achieve a DBE goal or other requirement which by their scope, intensity, and appropriateness to the objective, can reasonably be expected to fulfill the program requirement.

I. *Small Business Concern* means, with respect to firms seeking to participate as DBEs in USDOT-assisted Contracts, a small business concern as defined pursuant to Section 3 of the Small Business Act and Small Business Administration (“SBA”) regulations implementing it (13 CFR Part 121) that also does not exceed the cap on average annual gross receipts in 49 CFR Part 26, Section 26.65(b).

J. *Socially and Economically Disadvantaged Individual* means any individual who is a citizen (or lawfully admitted permanent resident) of the United States and who is:

1. Any individual who CTDOT finds, on a case-by-case basis, to be a socially and economically disadvantaged individual.
2. Any individuals in the following groups, members of which are rebuttably presumed to be socially and economically disadvantaged:
  - “Black Americans”, which includes persons having origins in any of the Black racial groups of Africa;
  - “Hispanic Americans”, which includes persons of Mexican, Puerto Rican, Cuban, Dominican, Central or South American, or other Spanish or Portuguese culture or origin, regardless of race;
  - “Native Americans”, which includes persons who are American Indians, Eskimos, Aleuts, or Native Hawaiians.
  - “Asian-Pacific Americans”, which includes persons whose origins are from Japan, China, Taiwan, Korea, Burma (Myanmar), Vietnam, Laos, Cambodia (Kampuchea), Thailand, Malaysia, Indonesia, the Philippines, Brunei, Samoa, Guam, the U.S. Trust Territories of the Pacific Islands (Republic of Palau), the Commonwealth of the Northern Marianas Islands, Macao, Fiji, Tonga, Kiribati, Juvalu, Nauru, or Federated States of Micronesia;
  - “Subcontinent Asian Americans”, which includes persons whose origins are from India, Pakistan, Bangladesh, Bhutan, the Maldives Islands, Nepal or Sri Lanka;
  - Women;
  - Any additional groups whose members are designated as socially and economically disadvantaged by the SBA, at such time as the SBA designation becomes effective.

K. *Commercially Useful Function (“CUF”)* means the DBE is responsible for the execution of the work of the contract and is carrying out its responsibilities by actually performing, managing, and supervising the work involved with its own forces and equipment. The DBE must be responsible for procuring, determining quantity, negotiating price, determining quality and paying for all materials (where applicable) associated with their work. The DBE must also perform at least 30% of the total cost of its contract with its own workforce.

## **II. ADMINISTRATIVE REQUIREMENTS**

### **A. General Requirements**

A DBE goal percentage equaling **10** percent (10%) of the Contract value has been established for Project No. 171-413. A DBE goal percentage equaling **10** percent (10%) of the Contract value has been established for Project No. 171-414. This DBE goal percentage will be applied to the final Contract value to ultimately determine the required DBE goal. If additional work is required, DBE firms should be provided the appropriate opportunities to achieve the required DBE goal.

In order to receive credit toward the Contract DBE goal, the firms utilized as DBE subcontractors or suppliers must be certified as DBEs in the type of work to be counted for credit by CTDOT’s Office of Contract Compliance prior to the date of the execution of the subcontract. Neither CTDOT nor the State of Connecticut’s Unified Certification Program (UCP) makes any representation as to any DBE’s technical or financial ability to perform the work. Prime contractors are solely responsible for performing due diligence in hiring DBE subcontractors.

All DBEs shall perform a CUF for the work that is assigned to them. The Contractor shall monitor and ensure that the DBE is in compliance with this requirement. The Connecticut DBE UPC Directory of certified firms can be found on the CTDOT website <http://www.ct.gov/dot>. The directory lists certified DBE firms with a description of services that they are certified to perform. Only work identified in this listing may be counted towards the

project's DBE goal. A DBE firm may request to have services added at any time by contacting CTDOT's Office of Contract Compliance. No credit shall be counted for any DBE firm found not to be performing a CUF.

Once a Contract is awarded, all DBEs that were listed on the pre-award DBE commitment document must be utilized. The Contractor is obligated to provide the value and items of the work originally established in the pre-award documentation to the DBE firms listed in the pre-award documentation. Any modifications to the pre-award commitment must follow the procedure established in Section II-C.

The Contractor shall designate a liaison officer who will administer the Contractor's DBE program. Upon execution of this Contract, the name of the liaison officer shall be furnished in writing to CTDOT's unit administering the Contract, CTDOT's Office of Contract Compliance and CTDOT's Office of Construction ("OOC"). Contact information for the designated liaison officer shall be furnished no later than the scheduled date for the pre-construction meeting.

**The Contractor shall submit a bi-monthly report to the appropriate CTDOT unit administering the Contract. This report shall indicate what work has been performed to date, with the dollars paid and percentage of DBE goal completed.**

**Verified payments made to DBEs shall be included in this bi-monthly report. A sample form is included on the CTDOT website.**

In addition, the report shall include:

1. A projected time frame of when the remaining work is to be completed for each DBE.
2. A statement by the Contractor either confirming that the approved DBEs are on schedule to meet the Contract goal, or that the Contractor is actively pursuing a GFE.
3. If retainage is specified in the Contract specifications, then a statement of certification that the subcontractors' retainage is being released in accordance with 1.08.01 (Revised or supplemented).

Failure by the Contractor to provide the required reports may result in CTDOT withholding an amount equal to one percent (1%) of the monthly estimate until the required documentation is received.

The Contractor shall receive DBE credit when a DBE, or any combination of DBEs, perform work under the Contract in accordance with this specification.

Only work actually performed by and/or services provided by DBEs which are certified for such work and/or services, as verified by CTDOT, can be counted toward the DBE goal. Supplies and equipment a DBE purchases or leases from the Contractor or its affiliate cannot be counted toward the goal.

Monitoring of the CUF will occur by CTDOT throughout the life of the project. If it is unclear that the DBE is performing the work specified in its subcontract with the prime Contractor, further review may be required. If it is determined that the DBE is not performing a CUF, then the work performed by that DBE will not be counted towards the DBE goal percentage.

## **B. Subcontract Requirements**

The Contractor shall submit to CTDOT's OOC all requests for subcontractor approvals on the standard CLA-12 forms provided by CTDOT. The dollar amount and items of work identified on the CLA-12 form must, at minimum, equal the dollar value submitted in the pre-award commitment. CLA-12 forms can be found at

<http://www.ct.gov/dot/construction> under the “Subcontractor Approval” section. All DBE subcontractors must be identified on the CLA-12 form, regardless of whether they are being utilized to meet a Contract goal percentage. A copy of the legal Contract between the Contractor and the DBE subcontractor/supplier, a copy of the Title VI Contractor Assurances and a copy of the Required Contract Provision for Federal Aid Construction Contracts (Form FHWA-1273) (Federal Highway Administration projects only) must be submitted along with a request for subcontractor approval. These attachments cannot be substituted by reference.

If retainage is specified in the Contract specifications, then the subcontract agreement must contain a prompt payment mechanism that acts in accordance with Article 1.08.01 (Revised or supplemented).

If the Contract specifications do not contain a retainage clause, the Contractor shall not include a retainage clause in any subcontract agreement, and in this case, if a Contractor does include a retainage clause, it shall be deemed unenforceable.

In addition, the following documents are to be included with the CLA-12, if applicable:

- An explanation indicating who will purchase material.
- A statement explaining any method or arrangement for utilization of the Contractor’s equipment.

The subcontract must show items of work to be performed, unit prices and, if a partial item, the work involved by all parties. If the subcontract items of work or unit prices are modified, the procedure established in Section II-C must be followed.

Should a DBE subcontractor further sublet items of work assigned to it, only lower tier subcontractors who are certified as a DBE firm will be counted toward the DBE goal. If the lower tier subcontractor is a non-DBE firm, the value of the work performed by that firm will not be counted as credit toward the DBE goal.

The use of joint checks between a DBE firm and the Contractor is acceptable, provided that written approval is received from the OOC prior to the issuance of any joint check. Should it become necessary to issue a joint check between the DBE firm and the Contractor to purchase materials, the DBE firm must be responsible for negotiating the cost, determining the quality and quantity, ordering the material and installing (where applicable), and administering the payment to the supplier. The Contractor should not make payment directly to suppliers.

Each subcontract the Contractor signs with a subcontractor must contain the following assurance:

“The subcontractor/supplier/manufacturer shall not discriminate on the basis of race, color, national origin, or sex in the performance of this contract. The contractor shall carry out applicable requirements of 49 CFR Part 26 in the award and administration of DOT-assisted contracts. Failure by the contractor/subcontractor/supplier/manufacturer to carry out these requirements is a material breach of this contract, which may result in the termination of this contract or such other remedy as the recipient deems appropriate.”

### **C. Modification to Pre-Award Commitment**

Contractors may not terminate for convenience any DBE subcontractor or supplier that was listed on the pre-award DBE commitment without prior written approval of the OOC. This includes, but is not limited to, instances in which a Contractor seeks to perform work originally designated for a DBE subcontractor with its own forces or those of an affiliate, a non-DBE firm, or with another DBE firm. Prior to approval, the Contractor must demonstrate to the satisfaction of the OOC, that it has good cause, as found in 49CFR Part 26.53 (f)(3), for termination of the DBE firm.

Before transmitting its request for approval to terminate pre-award DBE firms to the OOC, the Contractor must give written notice to the DBE subcontractor and include a copy to the OOC of its notice to terminate and/or substitute, and the reason for the notice.

The Contractor must provide five (5) days for the affected DBE firm to respond. This affords the DBE firm the opportunity to advise the OOC and the Contractor of any reasons why it objects to the termination of its subcontract and why the OOC should not approve the Contractor's action.

Once the Contract is awarded, should there be any amendments or modifications of the approved pre-award DBE submission other than termination of a DBE firm, the Contractor shall follow the procedure below that best meets the criteria associated with the reason for modification:

1. If the change is due to a scope of work revision or non-routine quantity revision by CTDOT, the Contractor must notify CTDOT's OOC in writing or via electronic mail that their DBE participation on the project may be impacted as soon as they are aware of the change. In this case, a release of work from the DBE firm may not be required; however the Contractor must concurrently notify the DBE firm in writing, and copy the OOC for inclusion in the project DBE file. This does not relieve the Contractor of its obligation to meet the Contract specified DBE goal, or of any other responsibility found in this specification.
2. If the change is due to a factor other than a CTDOT directive, a request for approval in writing or via electronic mail of the modification from the OOC must be submitted, along with an explanation of the change(s), prior to the commencement of work. The Contractor must also obtain a letter of release from the originally named DBE indicating their concurrence with the change, and the reason(s) for their inability to perform the work. In the event a release cannot be obtained, the Contractor must document all efforts made to obtain it.
3. In the event a DBE firm that was listed in the pre-award documents is **unable** or **unwilling** to perform the work assigned, the Contractor shall:
  - Notify the OOC Division Chief immediately and make efforts to obtain a release of work from the firm.
  - Submit documentation that will provide a basis for the change to the OOC for review and approval prior to the implementation of the change.
  - Use the DBE Directory to identify and contact firms certified to perform the type of work that was assigned to the unable or unwilling DBE firm. The Contractor should also contact CTDOT's Office of Contract Compliance for assistance in locating additional DBE firms to the extent needed to meet the contract goal.

Should a DBE subcontractor be terminated or fail to complete work on the Contract for any reason, the Contractor must make a GFE to find another DBE subcontractor to substitute for the original DBE. The DBE replacement shall be given every opportunity to perform at least the same amount of work under the Contract as the original DBE subcontractor.

If the Contractor is unable to find a DBE replacement:



- The Contractor should identify other contracting opportunities and solicit DBE firms in an effort to meet the Contract DBE goal requirement, if necessary, and provide documentation to support a GFE. (Refer to GFE in Section III.)
- The Contractor must demonstrate that the originally named DBE, who is unable or unwilling to perform the work assigned, is in default of its subcontract, or identify other issues that affected the DBE firm's ability to perform the assigned work. **The Contractor's ability to negotiate a more advantageous agreement with another subcontractor is not a valid basis for change.**

### **III. GOOD FAITH EFFORTS**

The DBE goal is **NOT** reduced or waived for projects where the Contractor receives a Pre-Award GFE determination from the Office of Contract Compliance prior to the award of the Contract. It remains the responsibility of the Contractor to make a continuing GFE to achieve the specified Contract DBE goal. The Contractor shall pursue every available opportunity to obtain additional DBE firms and document all efforts made in such attempts.

At the completion of all Contract work, the Contractor shall submit a final report to CTDOT's unit administering the Contract indicating the work done by and the dollars paid to DBEs. Only verified payments made to DBEs performing a CUF will be counted towards the Contract goal.

Goal attainment is based on the total Contract value, which includes all construction orders created during the Contract. If the Contractor does not achieve the specified Contract goal for DBE participation or has not provided the value of work to the DBE firms originally committed to in the pre-award submission, the Contractor shall submit documentation to CTDOT's unit administering the Contract detailing the GFE made during the performance of the Contract to satisfy the goal.

A GFE should consist of the following, where applicable (CTDOT reserves the right to request additional information):

1. A detailed statement of the efforts made to replace an unable or unwilling DBE firm, and a description of any additional subcontracting opportunities that were identified and offered to DBE firms in order to increase the likelihood of achieving the stated goal.
2. A detailed statement, including documentation of the efforts made to contact and solicit bids from certified DBEs, including the names, addresses, and telephone numbers of each DBE firm contacted; the date of contact and a description of the information provided to each DBE regarding the scope of services and anticipated time schedule of work items proposed to be subcontracted and the response from firms contacted.
3. Provide a detailed explanation for each DBE that submitted a subcontract proposal which the Contractor considered to be unacceptable stating the reason(s) for this conclusion.
4. Provide documentation, if any, to support contacts made with CTDOT requesting assistance in satisfying the specified Contract goal.
5. Provide documentation of all other efforts undertaken by the Contractor to meet the defined goal. Additional documentation of efforts made to obtain DBE firms may include but will not be limited to:

- Negotiations held in good faith with interested DBE firms, not rejecting them without sound reasons.
- Written notice provided to a reasonable number of specific DBE firms in sufficient time to allow effective participation.
- Those portions of work that could be performed by readily available DBE firms.

**In instances where the Contractor can adequately document or substantiate its GFE and compliance with other DBE Program requirements, the Contractor will have satisfied the DBE requirement and no administrative remedies will be imposed.**

#### **IV. PROJECT COMPLETION**

At the completion of all Contract work, the Contractor shall:

1. Submit a final report to CTDOT's unit administering the Contract indicating the work done by, and the dollars paid to DBEs.
2. Submit verified payments made to all DBE subcontractors for the work that was completed.
3. Submit documentation detailing any changes to the DBE pre-award subcontractors that have not met the original DBE pre-award commitment, including copies of the Department's approvals of those changes.
4. Retain all records for a period of three (3) years following acceptance by CTDOT of the Contract and those records shall be available at reasonable times and places for inspection by authorized representatives of CTDOT and Federal agencies. If any litigation, claim, or audit is started before the expiration of the three (3) year period, the records shall be retained until all litigation, claims, or audit findings involving the records are resolved.

If the Contractor does not achieve the specified Contract goal for DBE participation in addition to meeting the dollar value committed to the DBE subcontractors identified in the pre-award commitment, the Contractor shall submit documentation to CTDOT's unit administering the Contract detailing the GFE made during the performance of the Contract to satisfy the goal.

#### **V. SHORTFALLS**

##### **A. Failure to meet DBE goals**

**As specified in (II-A) above, attainment of the Contract DBE goal is based on the final Contract value.** The Contractor is expected to achieve the amount of DBE participation originally committed to at the time of award; however, additional efforts must be made to provide opportunities to DBE firms in the event a Contract's original value is increased during the life of the Contract.

The Contractor is expected to utilize the DBE subcontractors originally committed in the DBE pre-award documentation for the work and dollar value that was originally assigned.

If a DBE is terminated or is unable or unwilling to complete its work on a Contract, the Contractor shall make a GFE to replace that DBE with another certified DBE to meet the Contract goal.

The Contractor shall immediately notify the OOC of the DBE's inability or unwillingness to perform, and provide reasonable documentation and make efforts to obtain a release of work from the firm.

If the Contractor is unable to find a DBE replacement, then the Contractor should identify other contracting opportunities and solicit DBE firms in an effort to meet the Contract DBE goal requirement, if necessary, and provide documentation to support a GFE.

When a DBE is unable or unwilling to perform, or is terminated for just cause, the Contractor shall make a GFE to find other DBE opportunities to increase DBE participation to the extent necessary to at least satisfy the Contract goal.

For any DBE pre-award subcontractor that has been released appropriately from the project, no remedy will be assessed, provided that the Contractor has met the criteria described in Section II-C.

### **B. Administrative Remedies for Non-Compliance:**

In cases where the Contractor has failed to meet the Contract specified DBE goal or the DBE pre-award commitment, and where no GFE has been demonstrated, then one or more of the following administrative remedies will be applied:

1. A reduction in Contract payments to the Contractor as determined by CTDOT, not to exceed the shortfall amount of the **DBE goal**. The maximum shortfall will be calculated by multiplying the Contract DBE goal (adjusted by any applicable GFE) by the final Contract value, and subtracting any verified final payments made to DBE firms by the Contractor.
2. A reduction in Contract payments to the Contractor determined by CTDOT, not to exceed the shortfall amount of the **pre-award commitment**. The maximum shortfall will be calculated by subtracting any verified final payments made by the Contractor to each DBE subcontractor from the amount originally committed to that subcontractor in the pre-award commitment.
3. A reduction in Contract payments to the Contractor determined by CTDOT for any pre-award DBE subcontractor who has not obtained the dollar value of work identified in the DBE pre-award commitment and has not followed the requirements of Section II-C or for any DBE firm submitted for DBE credit that has not performed a CUF.
4. The Contractor being required to submit a written DBE Program Corrective Action Plan to CTDOT for review and approval, which is aimed at ensuring compliance on future projects.
5. The Contractor being required to attend a Non-Responsibility Meeting on the next contract where it is the apparent low bidder.
6. The Contractor being suspended from bidding on contracts for a period not to exceed six (6) months.

## **VI. CLASSIFICATIONS OTHER THAN SUBCONTRACTORS**

### **A. Material Manufacturers**

Credit for DBE manufacturers is 100% of the value of the manufactured product. A manufacturer is a firm that operates or maintains a factory or establishment that produces on the premises the materials or supplies obtained by the Contractor.

If the Contractor elects to utilize a DBE manufacturer to satisfy a portion of, or the entire specified DBE goal, the Contractor must provide the OOC with:

- Subcontractor Approval Form (CLA-12) indicating the firm designation,
- An executed "Affidavit for the Utilization of Material Suppliers or Manufacturers" (sample attached), and
- Substantiation of payments made to the supplier or manufacturer for materials used on the project.

### **B. Material Suppliers (Dealers)**

Credit for DBE dealers/suppliers is limited to 60% of the value of the material to be supplied, provided such material is obtained from an approved DBE dealer/supplier.

In order for a firm to be considered a regular dealer, the firm must own, operate, or maintain a store, warehouse, or other establishment in which the materials, supplies, articles or equipment of the general character described by the specifications and required under the contract are bought, kept in stock, and regularly sold or leased to the public in the usual course of business. At least one of the following criteria must apply:

- To be a regular dealer, the firm must be an established, regular business that engages, as its principal business and under its own name, in the purchase and sale or lease of the products in question.
- A person may be a regular dealer in such bulk items as petroleum products, steel, cement, gravel, stone, or asphalt without owning, operating or maintaining a place of business if the person both owns and operates distribution equipment for the products. Any supplementing of the regular dealers' own distribution equipment shall be by long term lease agreement, and not on an ad hoc or contract to contract basis.
- Packers, brokers, manufacturers' representatives, or other persons who arrange or expedite transactions are not regular dealers within the meaning of this paragraph.

If the Contractor elects to utilize a DBE supplier to satisfy a portion or the entire specified DBE goal, the Contractor must provide the OOC with:

- Subcontractor Approval Form (CLA-12) indicating the firm designation,
- An executed "Affidavit for the Utilization of Material Suppliers or Manufacturers" (sample attached), and
- Substantiation of payments made to the supplier or manufacturer for materials used on the project.

### **C. Brokering**

- Brokering of work for DBE firms who have been listed by the Department as certified brokers is allowed. Credit for those firms shall be applied following the procedures in Section VI-D.
- Brokering of work by DBEs who have been approved to perform subcontract work with their own workforce and equipment is not allowed, and is a Contract violation.
- Firms involved in the brokering of work, whether they are DBEs and/or majority firms who engage in willful falsification, distortion or misrepresentation with respect to any facts related to the project shall be

referred to the U.S. DOT, Office of the Inspector General for prosecution under Title 18, U.S. Code, Part I, Chapter 47, Section 1020.

#### **D. Non-Manufacturing or Non-Supplier DBE Credit**

Contractors may count towards their DBE goals the following expenditures with DBEs that are not manufacturers or suppliers:

- Reasonable fees or commissions charged for providing a bona fide service such as professional, technical, consultant or managerial services and assistance in the procurement of essential personnel, facilities, equipment materials or supplies necessary for the performance of the Contract, provided that the fee or commission is determined by the OOC to be reasonable and consistent with fees customarily allowed for similar services.
- The fees charged only for delivery of materials and supplies required on a job site when the hauler, trucker, or delivery service is a DBE, and not the manufacturer, or regular dealer of the materials and supplies, and provided that the fees are determined by the OOC to be reasonable and not excessive as compared with fees customarily allowed for similar services.
- The fees or commissions charged for providing bonds or insurance specifically required for the performance of the Contract, provided that the fees or commissions are determined by CTDOT to be reasonable and not excessive as compared with fees customarily allowed for similar services.

#### **E. Trucking**

While technically still considered a subcontractor, the rules for counting credit for DBE trucking firms are as follows:

- The DBE must own and operate at least one fully licensed, insured, and operational truck used on the Contract.
- The DBE receives credit for the total value of the transportation services it provides on the Contract using trucks it owns, insures and operates using drivers it employs.
- The DBE may lease trucks from another DBE firm, including an owner-operator who is certified as a DBE. The DBE who leases trucks from another DBE receives credit for the total value of the transportation services the lessee DBE provides on the Contract.
- The DBE may lease trucks from a non-DBE firm; however the DBE may only receive credit for any fees or commissions received for arranging transportation services provided by the non-DBE firms. Additionally, the DBE firm must demonstrate that they are in full control of the trucking operation for which they are seeking credit.

#### **VII. Suspected DBE Fraud**

In appropriate cases, CTDOT will bring to the attention of the USDOT any appearance of false, fraudulent, or dishonest conduct in connection with the DBE program, so that USDOT can take the steps, e.g. referral to the Department of Justice for criminal prosecution, referral to USDOT Inspector General, action under suspension and debarment or Program Fraud and Civil Penalties rules provided in 49 CFR Part 31.

**CONNECTICUT DEPARTMENT OF TRANSPORTATION  
(OFFICE OF CONSTRUCTION)  
BUREAU OF ENGINEERING AND CONSTRUCTION**

This affidavit must be completed by the State Contractor's DBE notarized and attached to the contractor's request to utilize a DBE supplier or manufacturer as a credit towards its DBE contract requirements; failure to do so will result in not receiving credit towards the contract DBE requirement.

State Contract No.

Federal Aid Project No.

Description of Project

I, \_\_\_\_\_, acting in behalf of \_\_\_\_\_,  
(Name of person signing Affidavit) (DBE person, firm, association or corporation)

of which I am the \_\_\_\_\_ certify and affirm that \_\_\_\_\_  
(Title of Person) (DBE person, firm, association or corporation)

is a certified Connecticut Department of Transportation DBE. I further certify and affirm that I have read and understand 49 CFR, Sec. 26.55(e)(2), as the same may be revised.

I further certify and affirm that \_\_\_\_\_ will assume the actual and  
(DBE person, firm, association or Corporation)

for the provision of the materials and/or supplies sought by \_\_\_\_\_.

If a manufacturer, I operate or maintain a factory or establishment that produces, on the premises, the materials, supplies, articles or equipment required under the contract an of the general character described by the specifications.

If a supplier, I perform a commercially useful function in the supply process. As a regular dealer, I, at a minimum, own and operate the distribution equipment for bulk items. Any supplementing of my distribution equipment shall be by long-term lease agreement, and not on an ad hoc or contract-by-contract basis.

I understand that false statements made herein are punishable by Law (Sec. 53a-157), CGS, as revised).

(Name of Corporation or Firm)

(Signature & Title of Official making the Affidavit)

Subscribed and sworn to before me, this \_\_\_\_\_ day of \_\_\_\_\_ 20 \_\_\_\_\_.

Notary Public (Commissioner of the Superior Court)

My Commission Expires \_\_\_\_\_

**CERTIFICATE OF CORPORATION**

I, \_\_\_\_\_, certify that I am the \_\_\_\_\_  
(Official) (President)

of the Corporation named in the foregoing instrument; that I have been duly authorized to affix the seal of the Corporation to such papers as require the seal; that \_\_\_\_\_, who signed said instrument on behalf of the Corporation, was then \_\_\_\_\_ of said corporation; that said instrument was duly signed for and in behalf of said Corporation by authority of its governing body and is within the scope of its corporation powers.

\_\_\_\_\_  
(Signature of Person Certifying)

\_\_\_\_\_  
(Date)

**ITEM #0651592A – HORIZONTAL DIRECTIONAL DRILLING, 6” HDPE****DESCRIPTION:**

This section specifies the acceptable methods and materials for installing casing pipes for fiber optic cables and copper communications/low voltage power 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/cm<sup>3</sup> 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 <sup>3</sup>	< 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 evaluating 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 and any other materials identified from the test pit explorations.
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 #0913000A – REMOVE CHAIN LINK FENCE****Description:**

Work under this item shall consist of removing and disposing or salvaging of the existing chain link fence, including gates at the locations shown on the plans.

**Construction Methods:**

All removed fence components shall be delivered to the State for salvage if directed by the Engineer in the field, or shall be properly disposed of off-site. Care shall be taken so as not to damage any fence components to be salvaged for the State.

**Method of Measurement:**

This work shall be measured for payment, prior to removal, as the number of linear feet of existing fence to be removed, measured from outside to outside of terminal (end) posts.

**Basis of Payment:**

This work will be paid for at the contract unit price per linear foot for “Remove Chain Link Fence”, following complete removal, which price shall include all equipment, tools and labor incidental to the removal and delivery to salvage or disposal of existing chain link fence identified for removal on the plans.



## **ITEM #0913835A – REMOVE AND RESET CHAIN LINK FENCE**

### **Description:**

Work under this item shall consist of removing and resetting existing chain link fence at the location(s) shown on the plan or as directed by the Engineer and in accordance with these specifications

### **Construction Methods:**

The Contractor shall exercise care in the removal of the fence to avoid damage. Any section of the fence damaged by the Contractor during the removal or the installation of the fence, shall be replaced by the Contractor at no cost to the State.

Any part of the existing fence that is missing, defective, or would impair the security of such reset portions as determined by the Engineer, will be replaced by the Contractor. The material shall be compatible with the existing chain link fence and of the same commercial grade. The new material will not be measured for payment, but shall be included in the cost to reset the fence.

Any material which is not suitable for use in the resetting of the fence becomes the property of the Contractor and must be properly disposed of.

Posts shall be reset and all fastenings made in accordance with the best commercial practice for this type of work, and all reset fence shall present a neat, workmanlike appearance comparable with the adjacent portions of said fence.

### **Method of Measurement:**

Remove and Reset Chain Link Fence shall be measured in place after resetting and shall be the horizontal length measured between the last undisturbed post to the last reset post.

### **Basis of Payment:**

The work will be paid for at the contract unit price per meter for "Remove and Reset Chain Link Fence," complete in place, which price shall include all materials, tools, equipment, and labor incidental thereto, also all excavation, backfilling, and disposal of surplus material. Parts of fence damaged by the Contractor's operations shall be replaced at his own expense.

## **ITEM #0917010A – REPAIR GUIDERAIL**

**Description:** Work under this item shall consist of the repair of newly installed guiderail. It shall be repaired in the locations originally installed and fabricated in conformity with the lines, designations, dimensions, and details shown on the plans or as ordered by the Engineer.

**Materials:** The material for guiderail shall meet the requirements as specified within the original applicable contract items.

When repairing guiderail, the Contractor shall reuse any undamaged existing guiderail elements, timber rail, wire rope, appropriate posts, delineators, lap bolts, and other hardware within the project limits as approved by the Engineer to repair the guiderail. The Contractor shall use new materials when any components of the existing railing are damaged or missing and cannot be obtained from other guiderail systems being removed or converted within the Project limits.

**Construction Methods:** The repair of guiderail shall be in accordance with contraction methods as specified within the original applicable contract items.

Guiderail, including end anchors, which has been installed in final condition and accepted by the Engineer, shall be eligible for reimbursement for repairs subject to the conditions described below. If multiple runs are to be installed in a single stage as indicated in the contract documents, determination for reimbursement shall be made when all runs within the stage are complete and accepted as previously described. On projects without designated stages, guiderail installations must be complete and serving the intended function as determined by the Engineer.

When newly installed guiderail is damaged by public traffic, the following conditions must be satisfied prior to reimbursement for payment;

1. The damage must have been caused solely by the traveling public.
2. The contractor shall provide satisfactory evidence that such damage was caused by public traffic. Such as accident reports obtained from the Connecticut Department of Public Safety, police agencies or insurance companies; statements by reliable, unbiased eyewitnesses; or identification of the vehicle involved in the accident.
3. The contractor shall attempt to collect the costs from the person or persons responsible for the damage and provide documentation of those efforts to the satisfaction of the Engineer.
4. If such evidence cannot be obtained, the Engineer may determine that the damage was not caused by the Contractor and reimbursement for payment is warranted.

This repair provision does not relieve the Contractor of the requirements of Section 1.07, any other contractual requirements for maintenance and protection of traffic and final acceptance and relief of responsibility for the project.

The contractor shall remain responsible for the safety and integrity of the guiderail system for the duration of the project. In the event the guiderail is damaged, the Contractor shall provide sufficient cones, drums and other traffic control devices to provide safe passage by the public. When ordered by the Engineer, the Contractor shall furnish replacement parts and immediately repair the guiderail, but in no case more than 24 hours after notification from the Engineer. In non-emergency situations, the guiderail shall be repaired within 72 hours. The repaired guiderail or anchorages, when completed, shall conform to these specifications for a new system. The Contractor shall be responsible for the removal and the proper disposal of all damaged material and debris.

**Method of Measurement:** Guiderail damaged solely by the traveling public will be measured for payment. Damage caused by the Contractor's equipment or operations will not be measured for payment.

The sum of money shown on the estimate and in the itemized proposal as "Estimated Cost" for repair of guiderail will be considered the price bid even though payment will be made only for actual work performed. The estimated cost figure is not to be altered in any manner by the bidder. Should the bidder alter the amount shown, the altered figures will be disregarded and the original price will be used to determine the total amount bid for the contract.

**Basis of Payment:** Repair of guiderail will be paid for in accordance with Article 1.09.04 as required to restore the rail to its full working condition in conformance with these specifications for a new system. There will be no payment for maintenance and protection of traffic for work associated with this item unless, in the opinion of the Engineer, the sole purpose of the maintenance and protection of traffic is for repair of the guiderail.

<u>Pay Item</u>	<u>Pay Unit</u>
Repair Guiderail	est. (est.)

## **ITEM #0952001A – SELECTIVE CLEARING AND THINNING**

**Description:** This work shall conform to Section 9.52, supplemental as follows:

Construction Methods – Description is amended as follows:

Add the following:

Where the Contractor is directed by the Engineer or shown on the plans, materials to be cut, trimmed or removed shall be as follows:

Those items that obstruct the sight lines of the CCTV and VMS locations. The Contractor shall refer to the plans for approximate location and limits of the sight line clearing for each site. The Contractor shall not conduct any selective clearing and thinning work, unless directed by the Engineer, until such time that the proposed CCTV and VMS equipment is operational so that the sight lines can be verified by the Engineer and the Highway Operations Center. Final limits shall be determined in the field and coordinated with the Highway Operations Center following the installation and testing of the proposed CCTV and VMS devices and equipment.

All trees scheduled to be cleared, thinned or removed shall be visibly marked or flagged by the Contractor at least five (5) business days prior to scheduled work.

The Engineer will inspect the identified trees with the Contractor and the limits of the clearing and thinning prior to the Contractor proceeding with cutting operations.

**ITEM #0969030A – PROJECT COORDINATOR (MINIMUM BID)**

*Article 1.05.08 – Schedules and Reports of the Standard Specifications is hereby amended by the following:*

*Add the following:*

**Description:** Under this item the Contractor shall furnish the services of an administrative employee, entitled the Project Coordinator, for this Project, to coordinate and expedite all phases of the work required for the Project and to ensure that the construction schedule is maintained.

The minimum lump sum bid for this item shall be equal to 0.5% of the Contractor's total bid. Failure of the Contractor to bid at least the minimum amount will result in the Department adjusting the Contractor's bid to include the minimum bid amount for this item.

The Project Coordinator's resume shall be submitted for approval by name, in writing, within seven (7) calendar days of the award of the Contract, and shall not be changed without prior written notice to the Department.

This resume must demonstrate the Project Coordinator is experienced and versatile in the preparation, interpretation and modification of Critical Path Method (CPM) construction schedules. This must include successful completion of at least three (3) construction projects of similar complexity, where they served in a lead scheduling capacity. If the Contractor does not have a person in their company that has these skills, then the Contractor shall engage the services of a Consultant, subject to the approval of the Engineer, for the scheduling work required. If a Consultant is engaged, they shall be present at the first meeting, along with the Project Contractor, prepared to discuss, in detail, the methods and techniques they propose to use. Thereafter, the Project Coordinator or the Consultant responsible for updating the CPM Schedule shall attend all meetings between the Contractor, its Subcontractors, and any other meetings, which will affect the CPM schedule. The Contractor shall prepare CPM Schedules utilizing the latest version of Primavera Project Planner software.

When the Contract is administered under Section 1.20, the following requirement shall also apply:

The Project Coordinator shall have, in addition to the above noted requirements, a minimum of eight (8) years' experience related to commercial/industrial building construction as a Project Coordinator performing duties similar to those required herein. The Project Coordinator shall have knowledge of all trades involved in the construction, including civil/site work, environmental work, concrete work, masonry work, steel work, wood work, electrical work, and mechanical work. Other combinations of experience and education totaling ten (10) years in commercial building construction will be considered subject to the approval of the Engineer.

**Computer Software and Printer:** The Contractor shall provide the following equipment with all the required maintenance and repairs (to include labor and parts) throughout the Contract life. The Engineer reserves the right to expand or relax the specification to adapt to the software and hardware limitations and availability.

The Contractor shall provide the Engineer with a licensed copy registered in the Department's name of the latest versions of the software listed and maintain customer support services offered by the software producer for the duration of the project. The Contractor shall deliver to the Engineer all supporting documentation for the software and hardware including any instructions or manuals.

**Software – Minimum Specification:** The Contractor shall provide the Engineer with a licensed copy of the latest version of the Oracle Primavera Contractor – Deluxe Version scheduling software, registered in the Department's name, and maintain the Primavera customer support service contract over the duration of the project.

**Printer:** An addition printer shall be provided that meets the printer specifications noted under contract item for "Construction Field Office" and is compatible with the software.

The Contractor is responsible for service and repairs to all computer hardware. All repairs must be performed within 24 hours. If the repairs require more than a 24 hours then a replacement must be provided.

**Construction Methods:** The Project Coordinator shall attend all meetings between the Contractor and the Department, the Contractor and its Subcontractors, and any other meetings that affect the progress of the job. The Project Coordinator shall be knowledgeable of the status of all parts of the work throughout the length of the Contract.

*Please delete any reference to Bar Chart under 1.05.08 – Schedule and Reports and replace with the following:*

Critical Path Method (CPM)

*Please add the following:*

Proper relationship between all major activities shall be indicated. Node numbers shall be coded such that the major activities shown on the Critical Path Schedule shall be easily referenced to the Detailed Project Schedule when it is developed. Break down the work covered under each Special Provision, or Division and Section of Article 1.20 of the Standard Specifications, into individual activities required and logically group related activities together within the CPM.

All documents, which require approval by the Department, shall be clearly identified within the schedule. The Department and any outside agency shall be allocated a minimum number of calendar days in accordance with Article 1.20-1.05.02. If Article 1.20 does not apply, then the Department shall be allocated a minimum of thirty (30) calendar days (exclusive of weekends

and holidays) for review and approval of each submittal. Any submittals requiring approval by an outside Agency (ConnDEEP, Coast Guard, Army Corps of Engineers, etc.) shall be allocated a minimum of sixty (60) calendar days. The Department shall not be held responsible for any delay associated with the approval or rejection of any substitution or other revisions proposed by the Contractor.

The schedule shall indicate the logic of the work for the major elements and components of work under the Contract, such as the planned mobilization of plant and equipment, sequences of operations, procurement of materials and equipment, duration of activities, type of relationship, lag time (if any), and such other information as it is necessary to present a clear statement of the intended activities.

The schedules shall consist of a network technique of planning, scheduling and control, shall be a clear statement of the logical sequence of work to be done, and shall be prepared in such a manner that the Contractor's work sequence shall be optimized between early start and late start restraints. The Contractor shall use the same criteria in a consistent manner throughout the term of the project. If, at any time, the Contractor alters logic, original durations, and descriptions, adds activities or activity codes or in any way modifies the Baseline Schedule, they must notify the Engineer of the change, in writing, presenting in detail the reasons for the change. The Engineer reserves the right to approve or reject any such change.

The critical path of the project must be identified on the CPM schedule. The critical path is the longest-duration path through the network. The significance of the critical path is that the activities that lie on it cannot be delayed without delaying the project. Because of its impact on the entire project, critical path analysis is an important aspect of project planning.

The critical path can be identified by determining the following four parameters for each activity:

1. ES - Earliest Start Time: the earliest time at which the activity can start given that its precedent activities must be completed first.
2. EF - Earliest Finish Time: equal to the earliest start time for the activity plus the time required to complete the activity.
3. LF - Latest Finish Time: the latest time at which the activity can be completed without delaying the project.
4. LS - Latest Start Time: equal to the latest finish time minus the time required to complete the activity.

The *float time* for an activity is the time between its earliest and latest start time, or between its earliest and latest finish time. Float is the amount of time that an activity can be delayed past its earliest start or earliest finish without delaying the project. Delays to activities on the critical path through the project network in which no float exists, that is, where  $ES=LS$  and  $EF=LF$  will delay the project.

Float available in the schedule, at any time shall not be considered for the exclusive use of either the Department or the Contractor. During the course of Contract, any float generated due to the efficiencies of either party is not for the sole use of the party generating the float; rather it is a shared commodity to be reasonably used by either party. Project float will be a resource available to both the Department and the Contractor.

Each CPM Schedule submittal shall be in the form of an activity on node diagram (precedence diagramming method) and shall include at a minimum; an Early Start computer sort, a Total Float computer sort, an Activity Number computer sort, a Schedule Diagram in the Time Scaled Logic format and a backup data CD-ROM which includes all Primavera project files. The diagrams may be requested printed out by the Department and shall be on 22" x 34" sheets. Additional, more detailed diagrams for important aspects or phases of the work may be required on large or complex projects.

Activity I.D. numbers shall be keyed to the item numbers assigned on the detailed estimate sheet. The first three digits (four digits for highway illumination, signing, traffic signals and utility work) of the activity I.D. number shall be identical to the first three digits of the item number in the Contract. The remaining digits may be used to provide unique, orderly and sequential I.D. numbers for each activity.

Activity codes shall be added to the schedule dictionary at the direction of the Engineer. At a minimum, activity codes for responsibility (prime, subcontractor by name), location of work (bridge #, span #, sta. #, site, building, type of work, etc.) and stage or phase number should be included.

1. Recovery Schedules: If, in the opinion of the Engineer, the updated schedule indicates that the Project has fallen behind schedule, or that a revision in sequence of operations may be necessary for any other reason, absent a justifiable time extension, the Contractor shall immediately institute all necessary steps to improve the Project's progress and shall submit such revised network diagrams, tabulations and operational plans, as may be deemed necessary by the Engineer, to demonstrate the manner in which an acceptable rate of progress will be regained.

Should the Contractor not demonstrate an ability to regain an acceptable rate of progress, the Engineer shall require the schedule to be resource loaded with the next monthly update. No additional compensation will be allowed for resource loading the schedule.

2. As-Built Schedules: Within thirty (30) days of completion of the project, including all corrective work, the Contractor shall submit an "As-Built Schedule" showing the actual progress of work. The Contractor shall submit three prints of this final CPM Schedule and one project backup data CD-ROM which include all Primavera project files for the Engineer's exclusive use.

The following shall also apply to Contracts administered under Section 1.20:



3. Daily Construction Reports: The Project Coordinator shall assist the Engineer in the preparation of a daily construction report by ensuring that each of the Contractor's employees and subcontractors working on the Project Site on a given day signs the Engineer's sign-in sheet for that day; and by keeping and providing to the Engineer its own daily list of employees and subcontractors who worked on the Project Site on that day.

**Method of Measurement:** Within ten (10) calendar days of the award of the Contract, the Contractor shall submit to the Engineer for approval a breakdown of its lump sum bid price for this item detailing:

1. The development cost to prepare the Baseline Schedule in accordance with these specifications. Development costs shall not exceed 25% of the total cost of the item and shall include costs to furnish and install all specified hardware.
2. The cost to provide the services of the Project Coordinator, including costs to prepare and submit the Monthly Updates and Narrative; furnish and submit any Recovery Schedules; furnish and submit Two Week Look Ahead Schedules and maintenance of and supplies for the specified hardware noted above. A per month cost will be derived by taking this cost divided by the number of Contract months remaining from the date of acceptance of the Baseline Schedule.
3. The cost of submission and certification of the As-Built Schedule in accordance with these specifications. The submission and certification costs shall be no less than 2% of the total cost of the item.
4. Substantiation showing that the costs submitted are reasonable based on the Contractor's lump sum bid.

Upon approval of the payment schedule by the Engineer, payments for work performed will be made as follows:

1. Upon approval of the "Baseline" Schedule by the Engineer, the lump sum development cost will be certified for payment.
2. Upon receipt of each monthly narrative and update of the "Baseline" Schedule, the per month cost for the services of the Project Coordinator will be certified for payment.
3. Upon approval of the As-Built Schedule by the Engineer, the lump sum submission and certification cost will be certified for payment.

**Basis of Payment:** This service will be paid for at the Contract lump sum price for "Project Coordinator" complete, which price shall include the preparation and submission of all schedules, narratives, updates, reports and submittals. The lump sum price shall also include the

cost of providing a complete, licensed copy of the Primavera software which will remain the property of the Engineer, and all materials, equipment, labor and work incidental of this service.

The lump sum price will be certified for payment as described in "Method of Measurement" subject to the following conditions:

1. Any month where the monthly update of the "Baseline" CPM schedule is submitted late, without authorization from the Engineer, will result in the following actions:
  - a. The monthly payment for the Project Coordinator item will be deferred to the next monthly payment estimate. If any monthly submittal is more than thirty (30) calendar days late, there will be no monthly payment for the services of the Project Coordinator.
  - b. The greater of 5% of the monthly payment estimate or \$25,000 will be retained from the monthly payment estimate until such time as the Contractor submits all required reports.
  - c. If in the opinion of the Engineer, the Contractor is not in compliance with this specification, the Engineer may withhold all Contract payments.
2. In the event the Contract time extends beyond the original completion date by more than thirty (30) calendar days, and a time extension is granted to the Contractor, the Department may require additional CPM updates which will be paid for at the per month cost for the services of the Project Coordinator.
3. If the Contractor is not in compliance with this specification or has failed to submit a "Baseline" schedule, monthly update, or a Recovery Schedule for any portion of the work, the Engineer will withhold all Contract payments until the schedule is submitted to, and approved by, the Engineer.

Pay Item

Project Coordinator

Pay Unit

L.S.

## **ITEM #0969062A – CONSTRUCTION FIELD OFFICE, MEDIUM**

**Description:** Under the item included in the bid document, adequate weatherproof office quarters with related furnishings, materials, equipment and other services, shall be provided by the Contractor for the duration of the work, and if necessary, for a close-out period determined by the Engineer. The office, furnishings, materials, equipment, and services are for the exclusive use of CTDOT forces and others who may be engaged to augment CTDOT forces with relation to the Contract. The office quarters shall be located convenient to the work site and installed in accordance with Article 1.08.02. This office shall be separated from any office occupied by the Contractor. Ownership and liability of the office quarters shall remain with the Contractor.

**Furnishings/Materials/Supplies/Equipment:** All furnishings, materials, equipment and supplies shall be in like new condition for the purpose intended and require approval of the Engineer.

**Office Requirements:** The Contractor shall furnish the office quarters and equipment as described below:

Description \ Office Size	Small	Med.	Large	Extra Large
Minimum Sq. Ft. of floor space with a minimum ceiling height of 7 ft.	400	400	1000	2000
Minimum number of exterior entrances.	2	2	2	2
Minimum number of parking spaces.	7	7	10	15

**Office Layout:** The office shall have a minimum square footage as indicated in the table above, and shall be partitioned as shown on the building floor plan as provided by the Engineer.

**Tie-downs and Skirting:** Modular offices shall be tied-down and fully skirted to ground level.

**Lavatory Facilities:** For field offices sizes Small and Medium the Contractor shall furnish a toilet facility at a location convenient to the field office for use by CTDOT personnel and such assistants as they may engage; and for field offices sizes Large and Extra Large the Contractor shall furnish two (2) separate lavatories with toilet (men and women), in separately enclosed rooms that are properly ventilated and comply with applicable sanitary codes. Each lavatory shall have hot and cold running water and flush-type toilets. For all facilities the Contractor shall supply lavatory and sanitary supplies as required.

**Windows and Entrances:** The windows shall be of a type that will open and close conveniently, shall be sufficient in number and size to provide adequate light and ventilation, and shall be fitted with locking devices, blinds and screens. The entrances shall be secure, screened, and fitted with a lock for which four keys shall be furnished. All keys to the construction field office shall be furnished to the CTDOT and will be kept in their possession while State personnel are using the office. Any access to the entrance ways shall meet applicable building codes, with appropriate handrails. Stairways shall be ADA/ABA compliant and have non-skid tread surfaces. An ADA/ABA compliant ramp with non-skid surface shall be provided with the Extra-Large field office.

Lighting: The Contractor shall equip the office interior with electric lighting that provides a minimum illumination level of 100 foot-candles at desk level height, and electric outlets for each desk and drafting table. The Contractor shall also provide exterior lighting that provides a minimum illumination level of 2 foot-candles throughout the parking area and for a minimum distance of 10 ft. on each side of the field office.

Parking Facility: The Contractor shall provide a parking area, adjacent to the field office, of sufficient size to accommodate the number of vehicles indicated in the table above. If a paved parking area is not readily available, the Contractor shall construct a parking area and driveway consisting of a minimum of 6 inches of processed aggregate base graded to drain. The base material will be extended to the office entrance.

Field Office Security: Physical Barrier Devices - This shall consist of physical means to prevent entry, such as: 1) All windows shall be barred or security screens installed; 2) All field office doors shall be equipped with dead bolt locks and regular day operated door locks; and 3) Other devices as directed by the Engineer to suit existing conditions.

Electric Service: The field office shall be equipped with an electric service panel, wiring, outlets, etc., to serve the electrical requirements of the field office, including: lighting, general outlets, computer outlets, calculators etc., and meet the following minimum specifications:

- A. 120/240 volt, 1 phase, 3 wire
- B. Ampacity necessary to serve all equipment. Service shall be a minimum 100 amp dedicated to the construction field office.
- C. The electrical panel shall include a main circuit breaker and branch circuit breakers of the size and quantity required.
- D. Additional 120 volt, single phase, 20 amp, isolated ground dedicated power circuit with dual NEMA 5-20 receptacles will be installed at each desk and personal computer table (workstation) location.
- E. Additional 120 volt, single phase, 20 amp, isolated ground dedicated power circuit with dual NEMA 5-20 receptacles will be installed, for use by the Telephone Company.
- F. Additional 120-volt circuits and duplex outlets as required meeting National Electric Code requirements.
- G. One exterior (outside) wall mounted GFI receptacle, duplex, isolated ground, 120 volt, straight blade.
- H. After work is complete and prior to energizing, the State's CTDOT electrical inspector, must be contacted at 860-594-2240. (Do Not Call Local Town Officials)
- I. Prior to field office removal, the CTDOT Office of Information Systems (CTDOT OIS) must be notified to deactivate the communications equipment.

Heating, Ventilation and Air Conditioning (HVAC): The field office shall be equipped with sufficient heating, air conditioning and ventilation equipment to maintain a temperature range of 68°-80° Fahrenheit within the field office.

Telephone Service: The Contractor shall provide telephone service with unlimited nation-wide calling plan. For a Small, Medium and Large field office this shall consist of the installation of two

(2) telephone lines: one (1) line for phone/voice service and one (1) line dedicated for the facsimile machine. For an Extra-Large field office this shall consist of four (4) telephone lines: three (3) lines for phone/voice service and one (1) line dedicated for facsimile machine. The Contractor shall pay all charges.

Data Communications Facility Wiring: Contractor shall install a Category 6 568B patch panel in a central wiring location and Cat 6 cable from the patch panel to each PC station, Smart Board location, Multifunction Laser Printer/Copier/Scanner/Fax, terminating in a (Category 6 568B) wall or surface mount data jack. The central wiring location shall also house either the data circuit with appropriate power requirements or a category 5 cable run to the location of the installed data circuit. The central wiring location will be determined by the CTDOT OIS staff in coordination with the designated field office personnel as soon as the facility is in place.

For Small, Medium and Large field offices the Contractor shall run a CAT 6 LAN cable a minimum length of 25 feet for each CTDOT networked device (including but not limited to: smartboards and Multi-Function Laser Printer/Copier/Scanner/Fax) to LAN switch area leaving an additional 10 feet of cable length on each side with terminated RJ45 connectors. For an Extra-Large field office the Contractor shall run CAT 6 LAN cables from workstations, install patch panel in data circuit demark area and terminate runs with RJ45 jacks at each device location. Terminate runs to patch panel in LAN switch area. Each run / jack shall be clearly labeled with an identifying Jack Number.

The Contractor shall supply cables to connect the Wi-Fi printer to the Contractor supplied internet router and to workstations/devices as needed. These cables shall be separate from the LAN cables and data Jacks detailed above for the CTDOT network.

The number of networked devices anticipated shall be at least equal to the number of personal computer tables, Multi-Function Laser Printer/Copier/Scanner/Fax, and smartboards listed below.

The installation of a data communication circuit between the field office and the CTDOT OIS in Newington will be coordinated between the CTDOT District staff, CTDOT OIS staff and the local utility company once the Contractor supplies the field office phone numbers and anticipated installation date. The Contractor shall provide the field office telephone number(s) to the CTDOT Project Engineer within 10 calendar days after the signing of the Contract as required by Article 1.08.02. This is required to facilitate data line and computer installations.

Additional Equipment, Facilities and Services: The Contractor shall provide at the field Office at least the following to the satisfaction of the Engineer:

Furnishing Description	Office Size			
	Small	Med.	Large	Extra Large
	Quantity			
Office desk (2.5 ft. x 5 ft.) with drawers, locks, and matching desk chair that have pneumatic seat height adjustment and dual wheel casters on the base.	1	3	5	8
Standard secretarial type desk and matching desk chair that has pneumatic seat height adjustment and dual wheel casters on the base.	-	-	-	1
Personal computer tables (4 ft. x 2.5 ft.).	2	3	5	8
Drafting type tables (3 ft. x 6 ft.) and supported by wall brackets and legs; and matching drafters stool that have pneumatic seat height adjustment, seat back and dual wheel casters on the base.	1	1	1	2
Conference table, 3 ft. x 12 ft.	-	-	-	1
Table – 3 ft. x 6 ft.	-	-	-	1
Office Chairs.	2	4	8	20
Mail slot bin – legal size.	-	-	1	1
Non-fire resistant cabinet.	-	-	2	4
Fire resistant cabinet (legal size/4 drawer), locking.	1	1	2	3
Storage racks to hold 3 ft. x 5 ft. display charts.	-	-	1	2
Vertical plan racks for 2 sets of 2 ft. x 3 ft. plans for each rack.	1	1	2	2
Double door supply cabinet with 4 shelves and a lock – 6 ft. x 4 ft.	-	-	1	2
Case of cardboard banker boxes (Min 10 boxes/case)	1	1	2	3
Open bookcase – 3 shelves – 3 ft. long.	-	-	2	2
White Dry-Erase Board, 36" x 48" min. with markers and eraser.	1	1	1	1
Interior partitions – 6 ft. x 6 ft., soundproof type, portable and freestanding.	-	-	6	6
Coat rack with 20 coat capacity.	-	-	-	1
Wastebaskets - 30 gal., including plastic waste bags.	1	1	1	2
Wastebaskets - 5 gal., including plastic waste bags.	1	3	6	10
Electric wall clock.	-	-	-	2
Telephone.	1	1	1	-
Full size stapler 20 (sheet capacity, with staples)	1	2	5	8
Desktop tape dispensers (with Tape)	1	2	5	8
8 Outlet Power Strip with Surge Protection	3	4	6	9
Rain Gauge	1	1	1	1

Business telephone system for three lines with ten handsets, intercom capability, and one speaker phone for conference table.	-	-	-	1
Mini refrigerator - 3.2 c.f. min.	1	1	1	1
Hot and cold water dispensing unit. Disposable cups and bottled water shall be supplied by the Contractor for the duration of the project.	1	1	1	1
Microwave, 1.2 c.f. , 1000W min.	1	1	1	1
Fire extinguishers - provide and install type and *number to meet applicable State and local codes for size of office indicated, including a fire extinguisher suitable for use on a computer terminal fire.	*	*	*	*
Electric pencil sharpeners.	1	2	2	2
Electronic office type printing calculators capable of addition, subtraction, multiplication and division with memory and a supply of printing paper.	1	1	2	4
Small Multi-Function Laser Printer/Copier/Scanner/Fax combination unit, network capable, as specified below under <u>Computer Related Hardware and Software</u> .	1	1		
Large Multi-Function Laser Printer/Copier/Scanner/Fax combination unit, network capable, as specified below under <u>Computer Related Hardware and Software</u> .			1	1
Field Office Wi-Fi Connection as specified below under <u>Computer Related Hardware and Software</u>	1	1	1	1
Wi-Fi Printer as specified below under <u>Computer Related Hardware and Software</u> .	1	1	1	1
Digital Camera as specified below under <u>Computer Related Hardware and Software</u> .	1	1	3	3
Video Projector as specified below under <u>Computer Related Hardware and Software</u> .	-	-	-	1
Smart Board as specified below under <u>Computer Related Hardware and Software</u> .	-	-	-	1
Infrared Thermometer, including annual third party certified calibration, case, and cleaning wipes.	1	1	1	2
Concrete Curing Box as specified below under Concrete Testing Equipment.	1	1	1	1
Concrete Air Meter and accessories as specified below under Concrete Testing Equipment as specified below. Contractor shall provide third party calibration on a quarterly basis.	1	1	1	1
Concrete Slump Cone and accessories as specified below under Concrete Testing Equipment.	1	1	1	1
First Aid Kit	1	1	1	1

Flip Phones as specified under <u>Computer Related Hardware and Software.</u>	-	-	-	-
Smart Phones as specified under <u>Computer Related Hardware and Software.</u>	-	-	-	-

The furnishings and equipment required herein shall remain the property of the Contractor. Any supplies required to maintain or operate the above listed equipment or furnishings shall be provided by the Contractor for the duration of the project.

Computer Related Hardware and Software: The CTDOT will supply by its own means the actual Personal Computers for the CTDOT representatives. The Contractor shall supply the Field Office Wi-Fi Connection, Wi-Fi Printer, Digital Camera(s), Flip Phones, Smart Phones, Multifunction Laser Printer/Copier/Scanner/Fax, Video Projectors, and Smart Board(s) as well as associated hardware and software, must meet the requirements of this specification as well as the latest minimum specifications posted, as of the project advertising date, at CTDOTs web site <http://www.ct.gov/dot/cwp/view.asp?a=1410&q=563904>

Within 10 calendar days after the signing of the Contract but before ordering/purchasing the Wi-Fi Printer (separate from the Multifunction Laser Printer/Copier/Scanner/Fax), Field Office Wi-Fi, Digital Camera(s), Flip Phones, Smart Phones, Multifunction Laser Printer/Copier/Scanner/Fax, Video Projector(s) and Smart Board(s) as well as associated hardware, the Contractor must submit a copy of their proposed order(s) with catalog cuts and specifications to the Administering CTDOT District for review and approval. The Wi-Fi Printer, Wi-Fi Router, Flip Phones, Smart Phones, digital cameras, Projector(s) and Smart Board(s) will be reviewed by CTDOT District personnel. The Multifunction Laser Printer/Copier/Scanner/Fax will be reviewed by the CTDOT OIS. The Contractor shall not purchase the hardware, software, or services until the Administering CTDOT District informs them that the proposed equipment, software, and services are approved. The Contractor will be solely responsible for the costs of any hardware, software, or services purchased without approval.

The Contractor and/or their internet service provider shall be responsible for the installation and setup of the field office Wi-Fi, Wi-Fi printer, and the configuration of the wireless router as directed by the CTDOT. Installation will be coordinated with CTDOT District and Project personnel.

After the approval of the hardware and software, the Contractor shall contact the designated representatives of the CTDOT administering District, a minimum of 2 working days in advance of the proposed delivery or installation of the Field Office Wi-Fi Connection, Wi-Fi Printer, Digital Camera(s), Flip Phones, Smart Phones, Multifunction Laser Printer/Copier/Scanner/Fax, Video Projectors and Smart Board(s), as well as associated hardware, software, supplies, and support documentation.

The Contractor shall provide all supplies, paper, maintenance, service and repairs (including labor and parts) for the Wi-Fi printers, copiers, field office Wi-Fi, fax machines and other equipment and facilities required by this specification for the duration of the Contract. All repairs must be performed with-in 48 hours. If the repairs require more than a 48 hours then an equal or better replacement must be provided.



Once the Contract has been completed, the hardware and software will remain the property of the Contractor.

First Aid Kit: The Contractor shall supply a first aid kit adequate for the number of personnel expected based on the size of the field office specified and shall keep the first aid kit stocked for the duration that the field office is in service.

Rain Gauge: The Contractor shall supply install and maintain a rain gauge for the duration of the project, meeting these minimum requirements. The rain gauge shall be installed on the top of a post such that the opening of the rain gauge is above the top of the post an adequate distance to avoid splashing of rain water from the top of the post into the rain gauge. The Location of the rain gauge and post shall be approved by the Engineer. The rain gauge shall be made of a durable material and have graduations of 0.1 inches or less with a minimum total column height of 5 inches. If the rain gauge is damaged the Contractor shall replace it prior to the next forecasted storm event at no additional cost.

Concrete Testing Equipment: If the Contract includes items that require compressive strength cylinders for concrete, in accordance with the Schedule of Minimum Testing Requirements for Sampling Materials for Test, the Contractor shall provide the following equipment.

- A) Concrete Cylinder Curing Box – meeting the requirements of Section 6.12 of the Standard Specifications.
- B) Air Meter – The air meter provided shall be in good working order and meet the requirements of AASHTO T 152.
- C) Slump Cone Mold – Slump cone, base plate, and tamping rod shall be provided in like-new condition and meet the requirements of AASHTO T119, Standard Test Method for Slump of Hydraulic-Cement Concrete.

All testing equipment will remain the property of the Contractor at the completion of the project.

Insurance Policy: The Contractor shall provide a separate insurance policy, with no deductible, in the minimum amount of five thousand dollars (\$5,000) in order to insure all State-owned data equipment and supplies used in the office against all losses. The Contractor shall be named insured on that policy, and the CTDOT shall be an additional named insured on the policy. These losses shall include, but not be limited to: theft, fire, and physical damage. The CTDOT will be responsible for all maintenance costs of CTDOT owned computer hardware. In the event of loss, the Contractor shall provide replacement equipment in accordance with current CTDOT equipment specifications, within seven days of notice of the loss. If the Contractor is unable to provide the required replacement equipment within seven days, the CTDOT may provide replacement equipment and deduct the cost of the equipment from monies due or which may become due the Contractor under the Contract or under any other contract. The Contractor's financial liability under this paragraph shall be limited to the amount of the insurance coverage required by this paragraph. If the cost of equipment replacement required by this paragraph should exceed the required amount

of the insurance coverage, the CTDOT will reimburse the Contractor for replacement costs exceeding the amount of the required coverage.

**Maintenance:** During the occupancy by the CTDOT, the Contractor shall maintain all facilities and furnishings provided under the above requirements, and shall maintain and keep the office quarters clean through the use of weekly professional cleaning to include, but not limited to, washing & waxing floors, cleaning restrooms, removal of trash, etc. Exterior areas shall be mowed and clean of debris. A trash receptacle (dumpster) with weekly pickup (trash removal) shall be provided. Snow removal, sanding and salting of all parking, walkway, and entrance ways areas shall be accomplished during a storm if on a workday during work hours, immediately after a storm and prior to the start of a workday. If snow removal, salting and sanding are not completed by the specified time, the State will provide the service and all costs incurred will be deducted from the next payment estimate.

**Method of Measurement:** The furnishing and maintenance of the construction field office will be measured for payment by the number of calendar months that the office is in place and in operation, rounded up to the nearest month.

There will not be any price adjustment due to any change in the minimum computer related hardware and software requirements.

**Basis of Payment:** The furnishing and maintenance of the Construction Field Office will be paid for at the Contract unit price per month for “Construction Field Office, (Type),” which price shall include all material, equipment, labor, service contracts, licenses, software, repair or replacement of hardware and software, related supplies, utility services, parking area, external illumination, trash removal, snow and ice removal, and work incidental thereto, as well as any other costs to provide requirements of this specified this specification.

<u>Pay Item</u>	<u>Pay Unit</u>
Construction Field Office, (Type)	Month

## **ITEM #0971001A – MAINTENANCE AND PROTECTION OF TRAFFIC**

### **Article 9.71.01 – Description is supplemented by the following:**

The Contractor shall maintain and protect traffic as described by the following and as limited in the Special Provision "Prosecution and Progress":

#### **I-91, I-691, I-84, Route 66, Route 15 and Route 9**

The Contractor shall maintain and protect the minimum number of through lanes and shoulders as dictated in the Special Provision for Section 1.08 - Prosecution and Progress "Limitations of Operations - Minimum Number of Lanes to Remain Open" Chart, on a paved travel path not less than 12 feet in width per lane.

#### **Ramps and Turning Roadways**

The Contractor shall maintain and protect existing traffic operations.

Excepted therefrom will be those periods, during the allowable periods, when the Contractor is actively working, at which time the Contractor shall be allowed to maintain and protect a minimum of one lane of traffic, on a paved travel path not less than 12 feet in width.

The Contractor will be allowed to halt traffic on the entrance and exit ramps for a period not to exceed 10 minutes to perform necessary work for trenching and conduit installation across the ramp pavement. If more than one 10-minute period is required, the Contractor shall allow all stored vehicles to proceed through the work area prior to the next stoppage.

#### **Route 5 and Route 372**

The Contractor shall maintain and protect a minimum of one lane of traffic in each direction, each lane on a paved travel path not less than 11 feet in width.

Where turn lanes exist, the Contractor shall provide an additional 10 feet of paved travel path to be used for turning vehicles only. This additional 10 feet of travel path shall be a minimum length of 150 feet. It shall be implemented so that sufficient storage, taper length, and turning radius are provided.

#### **All Other Roadways**

The Contractor shall maintain and protect a minimum of one lane of traffic in each direction, each lane on a paved travel path not less than 11 feet in width.

Excepted therefrom will be those periods, during the allowable periods, when the Contractor is actively working, at which time the Contractor shall maintain and protect at least an alternating one-

way traffic operation, on a paved travel path not less than 11 feet in width. The length of the alternating one-way traffic operation shall not exceed 300 feet and there shall be no more than one alternating one-way traffic operation within the project limits without prior approval of the Engineer.

Where turn lanes exist, the Contractor shall provide an additional 10 feet of paved travel path to be used for turning vehicles only. This additional 10 feet of travel path shall be a minimum length of 150 feet. It shall be implemented so that sufficient storage, taper length, and turning radius are provided.

The Contractor will be allowed to halt traffic along the local roadways for a period not to exceed 10 minutes to perform necessary work for trenching and conduit installation across the roadway. If more than one 10-minute period is required, the Contractor shall allow all stored vehicles to proceed through the work area prior to the next stoppage.

### **Commercial and Residential Driveways**

The Contractor shall maintain access to and egress from all commercial and residential driveways throughout the project limits. The Contractor will be allowed to close said driveways to perform the required work during those periods when the businesses are closed, unless permission is granted from the business owner to close the driveway during business hours. If a temporary closure of a residential driveway is necessary, the Contractor shall coordinate with the owner to determine the time period of the closure.

### **Article 9.71.03 - Construction Method is supplemented as follows:**

#### **General**

When the Contractor is excavating adjacent to the roadway, the Contractor shall provide a 3-foot shoulder between the work area and travel lanes, with traffic drums spaced every 50 feet. At the end of the workday, if the vertical drop-off exceeds 3 inches, the Contractor shall provide a temporary traversable slope of 4:1 or flatter that is acceptable to the Engineer.

The Contractor, during the course of active construction work on overhead signs and structures, shall close the lanes directly below the work area for the entire length of time overhead work is being undertaken. At no time shall an overhead sign be left partially removed or installed.

If applicable, when an existing sign is removed, it shall be either relocated or replaced by a new sign during the same working day.

The Contractor shall not store any material on-site which would present a safety hazard to motorists or pedestrians (e.g. fixed object or obstruct sight lines).

The field installation of a signing pattern shall constitute interference with existing traffic operations and shall not be allowed, except during the allowable periods.

Construction vehicles entering travel lanes at speeds less than the posted speed are interfering with traffic, and shall not be allowed without a lane closure. The lane closure shall be of sufficient length to allow vehicles to enter or exit the work area at posted speeds, in order to merge with existing traffic.

### **Existing Signing**

The Contractor shall maintain all existing overhead and side-mounted signs throughout the project limits during the duration of the project. The Contractor shall temporarily relocate signs and sign supports as many times as deemed necessary, and install temporary sign supports if necessary and as directed by the Engineer.

### **Requirements for Winter**

The Contractor shall schedule a meeting with representatives from the Department including the offices of Maintenance and Traffic, and the Town/City to determine what interim traffic control measures the Contractor shall accomplish for the winter to provide safety to the motorists and permit adequate snow removal procedures. This meeting shall be held prior to October 31 of each year and will include, but not be limited to, discussion of the status and schedule of the following items: lane and shoulder widths, pavement restoration, traffic signal work, pavement markings, and signing.

### **Signing Patterns**

The Contractor shall erect and maintain all signing patterns in accordance with the traffic control plans contained herein. Proper distances between advance warning signs and proper taper lengths are mandatory.

### **Pavement Markings - Limited Access Highways, Turning Roadways and Ramps**

During construction, the Contractor shall maintain all pavement markings throughout the limits of the project.

### **Pavement Markings -Non-Limited Access Multilane Roadways, Secondary and Local Roadways**

During construction, the Contractor shall maintain all pavement markings on paved surfaces on all roadways throughout the limits of the project.

## **TRAFFIC CONTROL DURING CONSTRUCTION OPERATIONS**

The following guidelines shall assist field personnel in determining when and what type of traffic control patterns to use for various situations. These guidelines shall provide for the safe and efficient movement of traffic through work zones and enhance the safety of work forces in the work area.

### **TRAFFIC CONTROL PATTERNS**

Traffic control patterns shall be used when a work operation requires that all or part of any vehicle or work area protrudes onto any part of a travel lane or shoulder. For each situation, the installation of traffic control devices shall be based on the following:

- Speed and volume of traffic
- Duration of operation
- Exposure to hazards

Traffic control patterns shall be uniform, neat and orderly so as to command respect from the motorist.

In the case of a horizontal or vertical sight restriction in advance of the work area, the traffic control pattern shall be extended to provide adequate sight distance for approaching traffic.

If a lane reduction taper is required to shift traffic, the entire length of the taper should be installed on a tangent section of roadway so that the entire taper area can be seen by the motorist.

Any existing signs that are in conflict with the traffic control patterns shall be removed, covered, or turned so that they are not readable by oncoming traffic.

When installing a traffic control pattern, a Buffer Area should be provided and this area shall be free of equipment, workers, materials and parked vehicles.

Typical traffic control plans 19 through 25 may be used for moving operations such as line striping, pot hole patching, mowing, or sweeping when it is necessary for equipment to occupy a travel lane.

Traffic control patterns will not be required when vehicles are on an emergency patrol type activity or when a short duration stop is made and the equipment can be contained within the shoulder. Flashing lights and appropriate trafficperson shall be used when required.

Although each situation must be dealt with individually, conformity with the typical traffic control plans contained herein is required. In a situation not adequately covered by the typical traffic control plans, the Contractor must contact the Engineer for assistance prior to setting up a traffic control pattern.

**PLACEMENT OF SIGNS**

Signs must be placed in such a position to allow motorists the opportunity to reduce their speed prior to the work area. Signs shall be installed on the same side of the roadway as the work area. On multi-lane divided highways, advance warning signs shall be installed on both sides of the highway. On directional roadways (on-ramps, off-ramps, one-way roads), where the sight distance to signs is restricted, these signs should be installed on both sides of the roadway.

**ALLOWABLE ADJUSTMENT OF SIGNS AND DEVICES SHOWN ON THE TRAFFIC CONTROL PLANS**

The traffic control plans contained herein show the location and spacing of signs and devices under ideal conditions. Signs and devices should be installed as shown on these plans whenever possible.

The proper application of the traffic control plans and installation of traffic control devices depends on actual field conditions.

Adjustments to the traffic control plans shall be made only at the direction of the Engineer to improve the visibility of the signs and devices and to better control traffic operations. Adjustments to the traffic control plans shall be based on safety of work forces and motorists, abutting property requirements, driveways, side roads, and the vertical and horizontal curvature of the roadway.

The Engineer may require that the traffic control pattern be located significantly in advance of the work area to provide better sight line to the signing and safer traffic operations through the work zone.

Table I indicates the minimum taper length required for a lane closure based on the posted speed limit of the roadway. These taper lengths shall only be used when the recommended taper lengths shown on the traffic control plans cannot be achieved.

**TABLE I – MINIMUM TAPER LENGTHS**

POSTED SPEED LIMIT MILES PER HOUR	MINIMUM TAPER LENGTH IN FEET FOR A SINGLE LANE CLOSURE
30 OR LESS	180
35	250
40	320
45	540
50	600
55	660
65	780

## **SECTION 1. WORK ZONE SAFETY MEETINGS**

- 1.a) Prior to the commencement of work, a work zone safety meeting will be conducted with representatives of DOT Construction, Connecticut State Police (Local Barracks), Municipal Police, the Contractor (Project Superintendent) and the Traffic Control Subcontractor (if different than the prime Contractor) to review the traffic operations, lines of responsibility, and operating guidelines which will be used on the project. Other work zone safety meetings during the course of the project should be scheduled as needed.
- 1.b) A Work Zone Safety Meeting Agenda shall be developed and used at the meeting to outline the anticipated traffic control issues during the construction of this project. Any issues that can't be resolved at these meetings will be brought to the attention of the District Engineer and the Office of Construction. The agenda should include:
  - Review Project scope of work and time
  - Review Section 1.08, Prosecution and Progress
  - Review Section 9.70, Trafficpersons
  - Review Section 9.71, Maintenance and Protection of Traffic
  - Review Contractor's schedule and method of operations.
  - Review areas of special concern: ramps, turning roadways, medians, lane drops, etc.
  - Open discussion of work zone questions and issues
  - Discussion of review and approval process for changes in contract requirements as they relate to work zone areas

## **SECTION 2. GENERAL**

- 2.a) If the required minimum number of signs and equipment (i.e. one High Mounted Internally Illuminated Flashing Arrow for each lane closed, two TMAs, Changeable Message Sign, etc.) are not available; the traffic control pattern shall not be installed.
- 2.b) The Contractor shall have back-up equipment (TMAs, High Mounted Internally Illuminated Flashing Arrow, Changeable Message Sign, construction signs, cones/drums, etc.) available at all times in case of mechanical failures, etc. The only exception to this is in the case of sudden equipment breakdowns in which the pattern may be installed but the Contractor must provide replacement equipment within 24 hours.
- 2.c) Failure of the Contractor to have the required minimum number of signs, personnel and equipment, which results in the pattern not being installed, shall not be a reason for a time extension or claim for loss time.
- 2.d) In cases of legitimate differences of opinion between the Contractor and the Inspection staff, the Inspection staff shall err on the side of safety. The matter shall be brought to



the District Office for resolution immediately or, in the case of work after regular business hours, on the next business day.

### **SECTION 3. INSTALLING AND REMOVING TRAFFIC CONTROL PATTERNS**

- 3.a) Lane Closures shall be installed beginning with the advance warning signs and proceeding forward toward the work area.
- 3.b) Lane Closures shall be removed in the reverse order, beginning at the work area, or end of the traffic control pattern, and proceeding back toward the advance warning signs.
- 3.c) Stopping traffic may be allowed:
- As per the contract for such activities as blasting, steel erection, etc.
  - During paving, milling operations, etc. where, in the middle of the operation, it is necessary to flip the pattern to complete the operation on the other half of the roadway and traffic should not travel across the longitudinal joint or difference in roadway elevation.
  - To move slow moving equipment across live traffic lanes into the work area.
- 3.d) Temporary road closures using Rolling Road Blocks (RRB) may be allowed on limited access highways for operations associated with the installation and removal of temporary lane closures. RRB may be allowed for the installation and removal of lead signs and lane tapers only and shall meet the following requirements:
- RRB may not start prior to the time allowed in the contract Limitations of Operation for sign pattern installation. Sign pattern removal must be complete prior to the time indicated in the Limitations of Operation for restoring the lanes to traffic.
  - On limited access highways with 4 lanes or more, a RRB may not start until the Limitations of Operation Chart allows a 2 lane closure. In areas with good sight lines and full shoulders, opposite side lead signs should be installed in a separate operation.
  - Truck-Mounted Impact Attenuators (TMAs) equipped with arrow boards shall be used to slow traffic to implement the RRB. State Police Officers in marked vehicles may be used to support the implementation of the RRB. The RRB shall start by having all vehicles, including Truck-Mounted Impact Attenuators TMAs and police vehicles leave the shoulder or on-ramp and accelerate to a normal roadway speeds in each lane, then the vehicles will position themselves side by side and decelerate to the RRB speed on the highway.
  - An additional Truck-Mounted Impact Attenuator TMAs equipped with a Portable Changeable Message Sign shall be utilized to advise the motorists that sign pattern installation / removal is underway. The Pre-Warning Vehicle (PWV) should be initially positioned in the right shoulder ½ mile prior to the RRB operation. If a traffic queue reaches the PWV's initial location, the contractor shall slowly reverse the PWV along the shoulder to position itself prior to the new back of queue. A Pre-

Warning Vehicle, as specified elsewhere in the contract, shall be utilized to advise the motorists that sign pattern installation / removal is underway.

- The RRB duration shall not exceed 15 minutes from start of the traffic block until all lanes are opened as designated in the Limitation of Operation chart. If the RRB duration exceeds 15 minutes on 2 successive shifts, no further RRB will be allowed until the Contractor obtains approval for a revised installation procedure from the respective construction District.
- RRB should not be utilized to expand a lane closure pattern to an additional lane during the shift. The workers and equipment required to implement the additional lane closure should be staged from within the closed lane. Attenuator trucks (and State Police if available) should be used to protect the workers installing the taper in the additional lane.
- Exceptions to these work procedures may be submitted to the District Office for consideration. A minimum of 2 business days should be allowed for review and approval by the District.
- The RRB procedures (including any approved exceptions) will be reviewed and discussed by the inspection team and the Contractor in advance of the work. The implementation of the agreed upon plan will be reviewed with the State Police during the Work Zone Safety meeting held before each shift involving temporary lane closures. If the State Police determine that alternative procedures should be implemented for traffic control during the work shift, the Department and Contractor will attempt to resolve any discrepancies with the duty sergeant at the Troop. If the discrepancies are unable to be resolved prior to the start of the shift, the work will proceed as recommended by the Department Trooper. Any unresolved issues will be addressed the following day.

- 3.e) The Contractor must adhere to using the proper signs, placing the signs correctly, and ensuring the proper spacing of signs.
- 3.f) Additional devices are required on entrance ramps, exit ramps, and intersecting roads to warn and/or move traffic into the proper travel path prior to merging/exiting with/from the main line traffic. This shall be completed before installing the mainline pattern past the ramp or intersecting roadway.
- 3.g) Prior to installing a pattern, any conflicting existing signs shall be covered with an opaque material. Once the pattern is removed, the existing signs shall be uncovered.
- 3.h) On limited access roadways, workers are prohibited from crossing the travel lanes to install and remove signs or other devices on the opposite side of the roadway. Any signs or devices on the opposite side of the roadway shall be installed and removed separately.

**SECTION 4. USE OF HIGH MOUNTED INTERNALLY ILLUMINATED FLASHING ARROW**

- 4.a) On limited access roadways, one Flashing Arrow shall be used for each lane that is closed. The Flashing Arrow shall be installed concurrently with the installation of the traffic control pattern and its placement shall be as shown on the traffic control plan. For multiple lane closures, one Flashing Arrow is required for each lane closed. If conditions warrant, additional Flashing Arrows should be employed (i.e.: curves, major ramps, etc.).
- 4.b) On non-limited access roadways, the use of a Flashing Arrow for lane closures is optional. The roadway geometry, sight line distance, and traffic volume should be considered in the decision to use the Flashing Arrow.
- 4.c) The Flashing Arrow shall not be used on two lane, two-way roadways for temporary alternating one-way traffic operations.
- 4.d) The Flashing Arrow board display shall be in the “arrow” mode for lane closure tapers and in the “caution” mode (four corners) for shoulder work, blocking the shoulder, or roadside work near the shoulder. The Flashing Arrow shall be in the “caution” mode when it is positioned in the closed lane.
- 4.e) The Flashing Arrow shall not be used on a multi-lane roadway to laterally shift all lanes of traffic, because unnecessary lane changing may result.

**SECTION 5. USE OF TRUCK MOUNTED IMPACT ATTENUATOR VEHICLES (TMAs)**

- 5.a) For lane closures on limited access roadways, a minimum of two TMAs shall be used to install and remove traffic control patterns. If two TMAs are not available, the pattern shall not be installed.
- 5.b) On non-limited access roadways, the use of TMAs to install and remove patterns closing a lane(s) is optional. The roadway geometry, sight line distance, and traffic volume should be considered in the decision to utilize the TMAs.
- 5.c) Generally, to establish the advance and transition signing, one TMA shall be placed on the shoulder and the second TMA shall be approximately 1,000 feet ahead blocking the lane. The flashing arrow board mounted on the TMA should be in the “flashing arrow” mode when taking the lane. The sign truck and workers should be immediately ahead of the second TMA. In no case shall the TMA be used as the sign truck or a work truck. Once the transition is in place, the TMAs shall travel in the closed lane until all Changeable Message Signs, signs, Flashing Arrows, and cones/drums are installed. The flashing arrow board mounted on the TMA should be in the “caution” mode when traveling in the closed lane.
- 5.d) A TMA shall be placed prior to the first work area in the pattern. If there are multiple work areas within the same pattern, then additional TMAs shall be positioned at each

additional work area as needed. The flashing arrow board mounted on the TMA should be in the “caution” mode when in the closed lane.

- 5.e) TMAs shall be positioned a sufficient distance prior to the workers or equipment being protected to allow for appropriate vehicle roll-ahead in the event that the TMA is hit, but not so far that an errant vehicle could travel around the TMA and into the work area. For additional placement and use details, refer to the specification entitled “Type ‘D’ Portable Impact Attenuation System”. Some operations, such as paving and concrete repairs, do not allow for placement of the TMA(s) within the specified distances. In these situations, the TMA(s) should be placed at the beginning of the work area and shall be advanced as the paving or concrete operations proceed.
- 5.f) TMAs should be paid in accordance with how the unit is utilized. When it is used as a TMA and is in the proper location as specified, and then it should be paid at the specified hourly rate for “Type ‘D’ Portable Impact Attenuation System”. When the TMA is used as a Flashing Arrow, it should be paid at the daily rate for “High Mounted Internally Illuminated Flashing Arrow”. If a TMA is used to install and remove a pattern and then is used as a Flashing Arrow, the unit should be paid as a “Type ‘D’ Portable Impact Attenuation System” for the hours used to install and remove the pattern, typically 2 hours (1 hour to install and 1 hour to remove), and is also paid for the day as a “High Mounted Internally Illuminated Flashing Arrow”.

## **SECTION 6. USE OF TRAFFIC DRUMS AND TRAFFIC CONES**

- 6.a) Traffic drums shall be used for taper channelization on limited-access roadways, ramps, and turning roadways and to delineate raised catch basins and other hazards.
- 6.b) Traffic drums shall be used in place of traffic cones in traffic control patterns that are in effect for more than a 36-hour duration.
- 6.c) Traffic Cones less than 42 inches in height shall not be used on limited-access roadways or on non-limited access roadways with a posted speed limit of 45 mph and above.
- 6.d) Typical spacing of traffic drums and/or cones shown on the Traffic Control Plans in the Contract are maximum spacings and may be reduced to meet actual field conditions as required.

## **SECTION 7. USE OF (REMOTE CONTROLLED) CHANGEABLE MESSAGE SIGNS (CMS)**

- 7.a) For lane closures on limited access roadways, one CMS shall be used in advance of the traffic control pattern. Prior to installing the pattern, the CMS shall be installed and in operation, displaying the appropriate lane closure information (i.e.: Left Lane Closed - Merge Right). The CMS shall be positioned ½ - 1 mile ahead of the lane closure taper. If the nearest Exit ramp is greater than the specified ½ - 1 mile distance, than an additional

CMS shall be positioned a sufficient distance ahead of the Exit ramp to alert motorists to the work and therefore offer them an opportunity to take the exit.

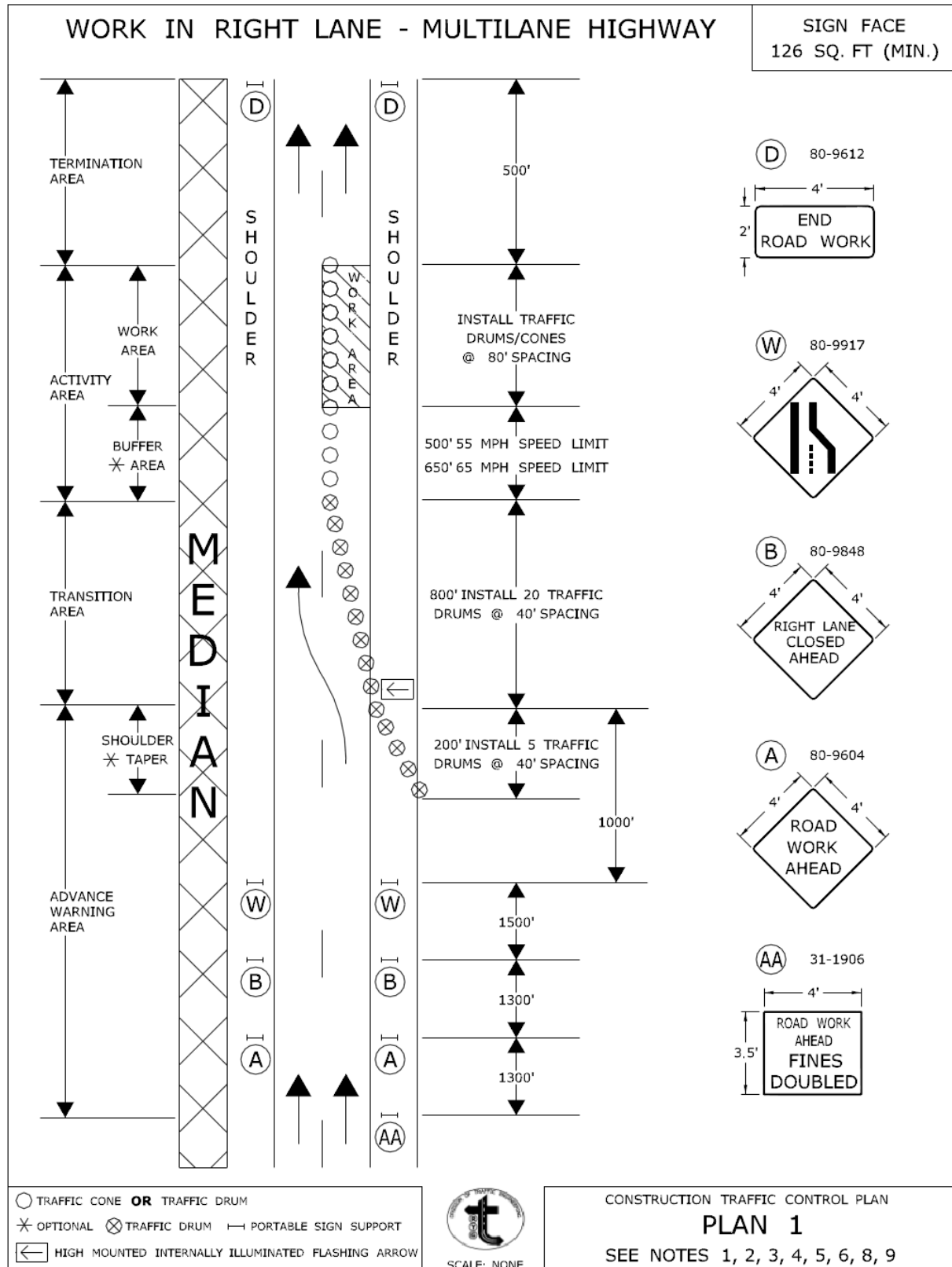
- 7.b) CMS should not be installed within 1000 feet of an existing CMS.
- 7.c) On non-limited access roadways, the use of CMS for lane closures is optional. The roadway geometry, sight line distance, and traffic volume should be considered in the decision to use the CMS.
- 7.d) The advance CMS is typically placed off the right shoulder, 5 feet from the edge of pavement. In areas where the CMS cannot be placed beyond the edge of pavement, it may be placed on the paved shoulder with a minimum of five (5) traffic drums placed in a taper in front of it to delineate its position. The advance CMS shall be adequately protected if it is used for a continuous duration of 36 hours or more.
- 7.e) When the CMS are no longer required, they should be removed from the clear zone and have the display screen cleared and turned 90° away from the roadway.
- 7.f) The CMS generally should not be used for generic messages (ex: Road Work Ahead, Bump Ahead, Gravel Road, etc.).
- 7.g) The CMS should be used for specific situations that need to command the motorist's attention which cannot be conveyed with standard construction signs (Examples include: Exit 34 Closed Sat/Sun - Use Exit 35, All Lanes Closed - Use Shoulder, Workers on Road - Slow Down).
- 7.h) Messages that need to be displayed for long periods of time, such as during stage construction, should be displayed with construction signs. For special signs, please coordinate with the Office of Construction and the Division of Traffic Engineering for the proper layout/dimensions required.
- 7.i) The messages that are allowed on the CMS are as follows:

<u>Message No.</u>	<u>Frame 1</u>	<u>Frame 2</u>	<u>Message No.</u>	<u>Frame 1</u>	<u>Frame 2</u>
1	LEFT LANE CLOSED	MERGE RIGHT	9	LANES CLOSED AHEAD	REDUCE SPEED
2	2 LEFT LANES CLOSED	MERGE RIGHT	10	LANES CLOSED AHEAD	USE CAUTION
3	LEFT LANE CLOSED	REDUCE SPEED	11	WORKERS ON ROAD	REDUCE SPEED
4	2 LEFT LANES CLOSED	REDUCE SPEED	12	WORKERS ON ROAD	SLOW DOWN
5	RIGHT LANE CLOSED	MERGE LEFT	13	EXIT XX CLOSED	USE EXIT YY
6	2 RIGHT LANES CLOSED	MERGE LEFT	14	EXIT XX CLOSED USE YY	FOLLOW DETOUR
7	RIGHT LANE CLOSED	REDUCE SPEED	15	2 LANES SHIFT AHEAD	USE CAUTION
8	2 RIGHT LANES CLOSED	REDUCE SPEED	16	3 LANES SHIFT AHEAD	USE CAUTION

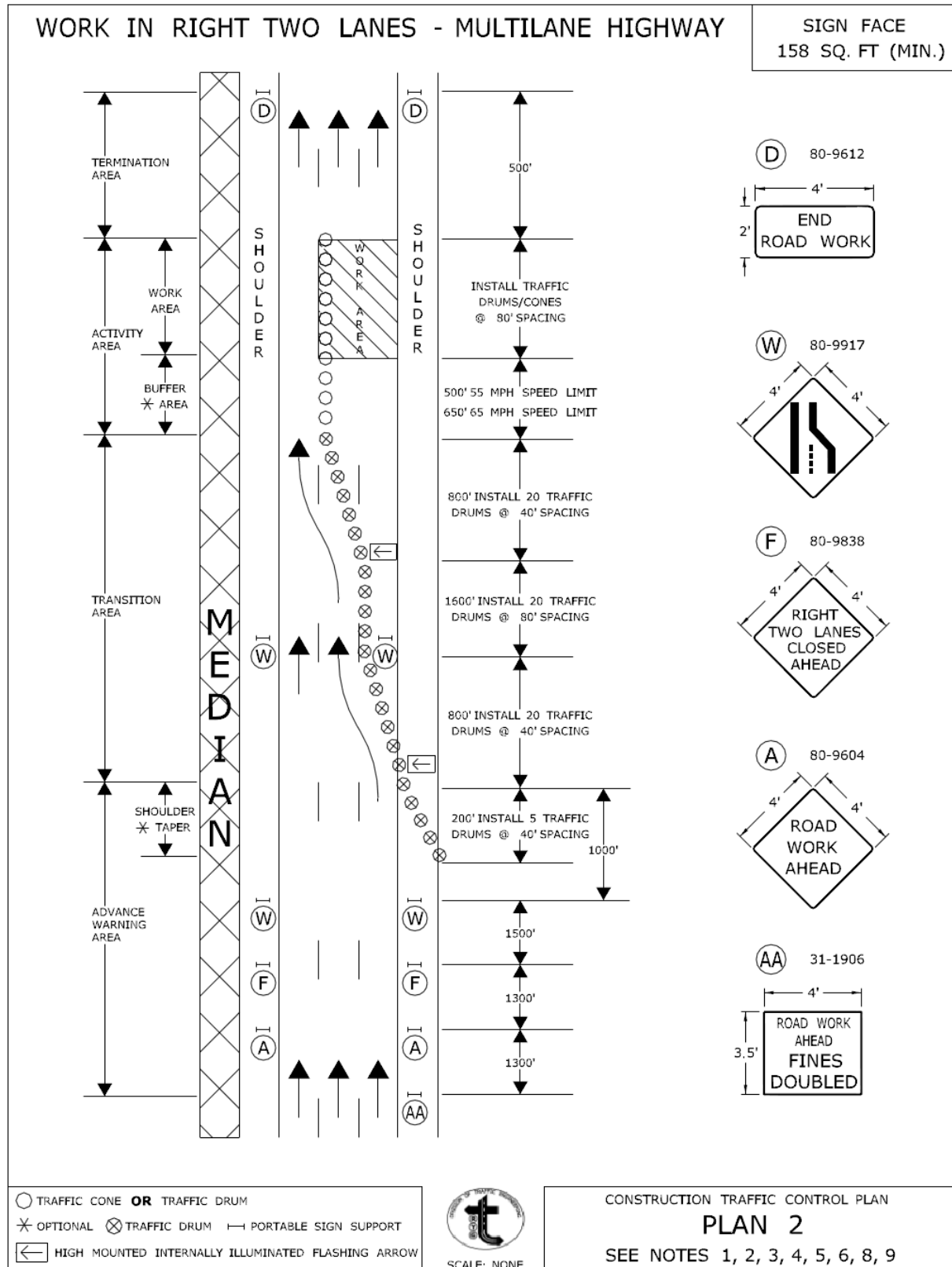
For any other message(s), approval must be received from the Office of Construction prior to their use. No more than two (2) displays shall be used within any message cycle.

## **SECTION 8. USE OF STATE POLICE OFFICERS**

- 8.a) State Police may be utilized only on limited access highways and secondary roadways under their primary jurisdiction. One Officer may be used per critical sign pattern. Shoulder closures and right lane closures can generally be implemented without the presence of a State Police Officer. Likewise in areas with moderate traffic and wide, unobstructed medians, left lane closures can be implemented without State Police presence. Under some situations it may be desirable to have State Police presence, when one is available. Examples of this include: nighttime lane closures; left lane closures with minimal width for setting up advance signs and staging; lane and shoulder closures on turning roadways/ramps or mainline where sight distance is minimal; and closures where extensive turning movements or traffic congestion regularly occur, however they are not required.
- 8.b) Once the pattern is in place, the State Police Officer should be positioned in a non-hazardous location in advance of the pattern. If traffic backs up beyond the beginning of the pattern, then the State Police Officer shall be repositioned prior to the backup to give warning to the oncoming motorists. The State Police Officer and TMA should not be in proximity to each other.
- 8.c) Other functions of the State Police Officer(s) may include:
- Assisting entering/exiting construction vehicles within the work area.
  - Enforcement of speed and other motor vehicle laws within the work area, if specifically requested by the project.
- 8.d) State Police Officers assigned to a work site are to only take direction from the Engineer.

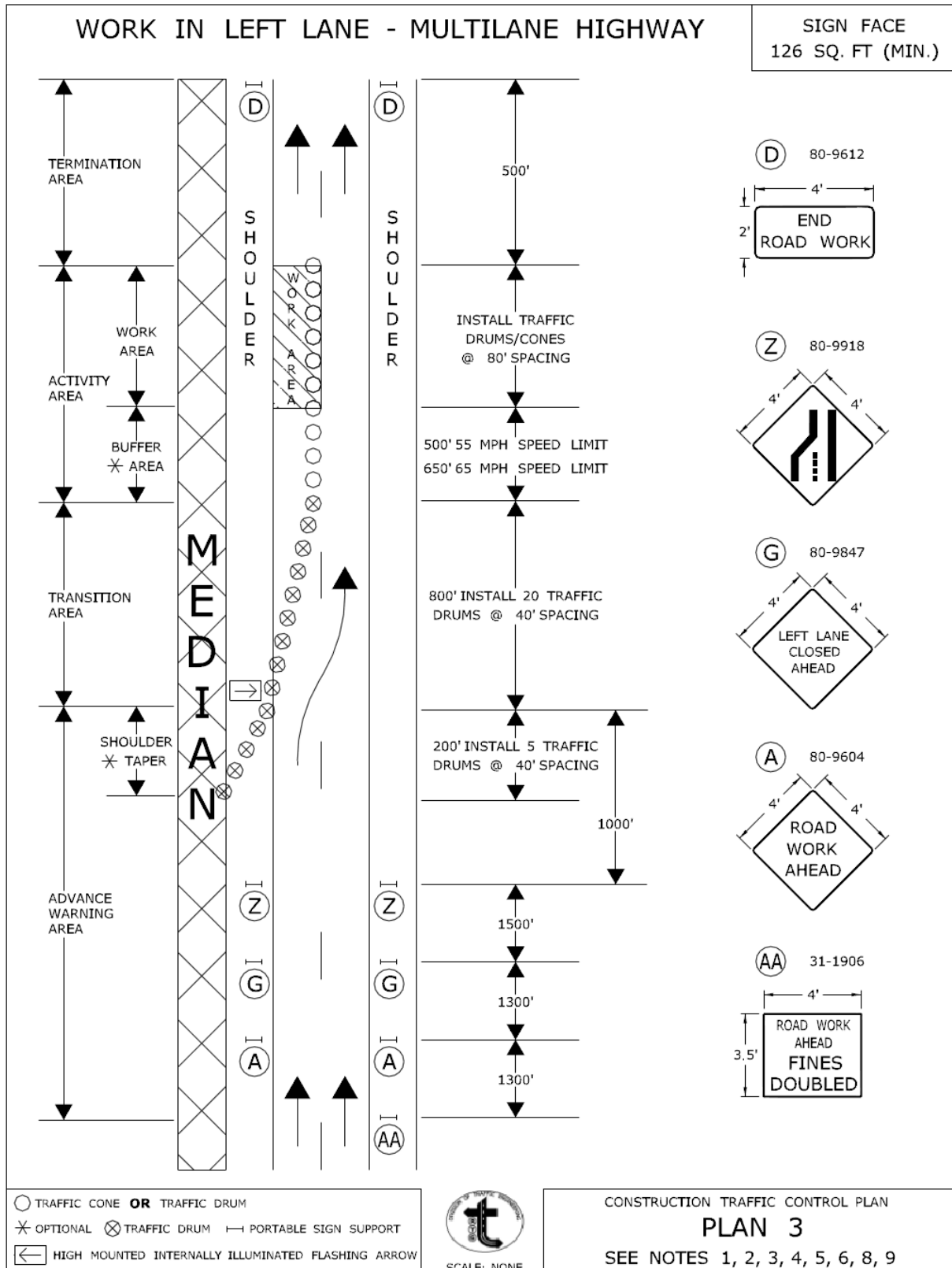






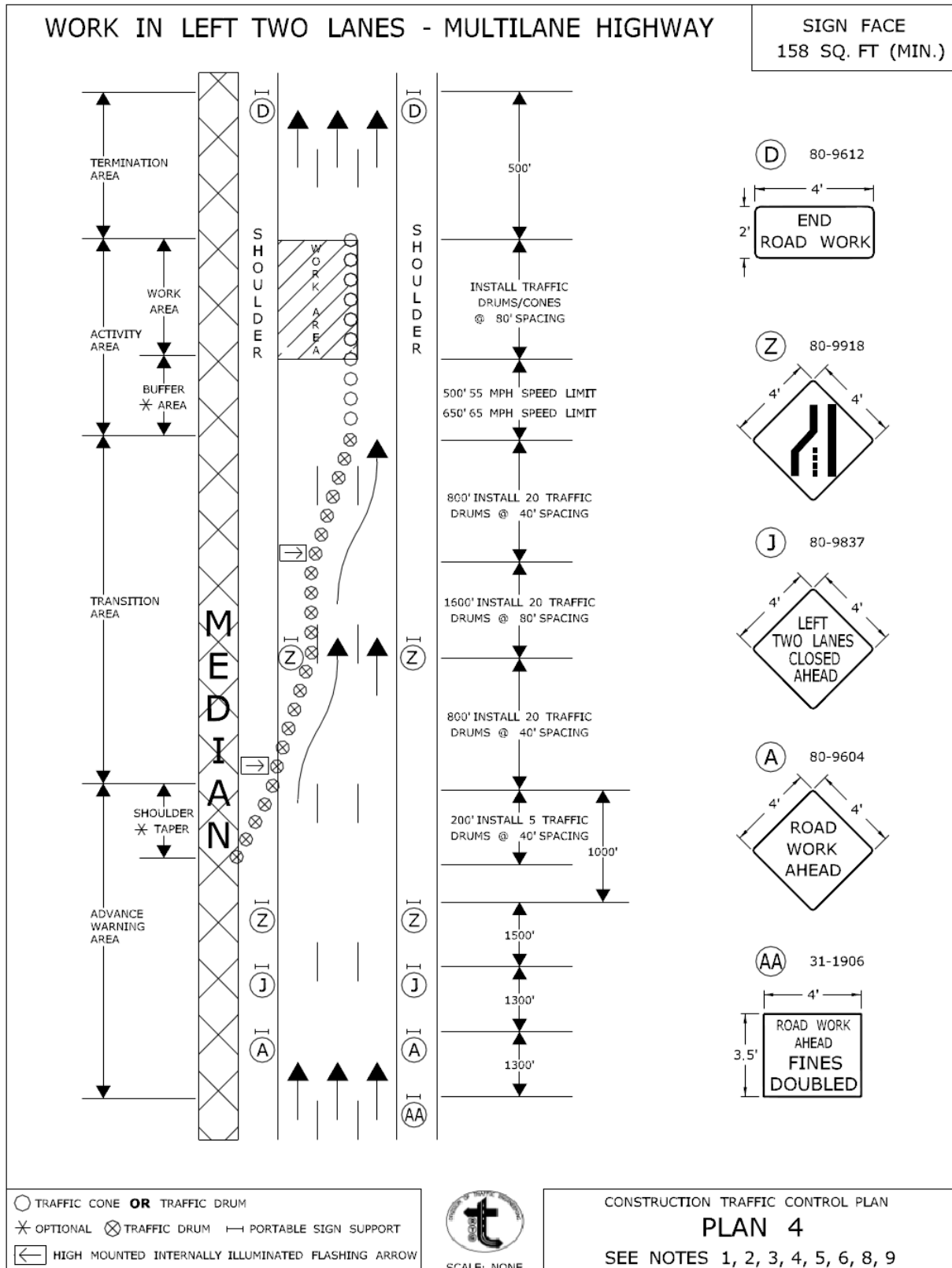
CONNECTICUT DEPARTMENT OF TRANSPORTATION  
BUREAU OF ENGINEERING & CONSTRUCTION

APPROVED *Charles S. Harlow*  
PRINCIPAL ENGINEER  
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CONNECTICUT DEPARTMENT OF TRANSPORTATION  
BUREAU OF ENGINEERING & CONSTRUCTION

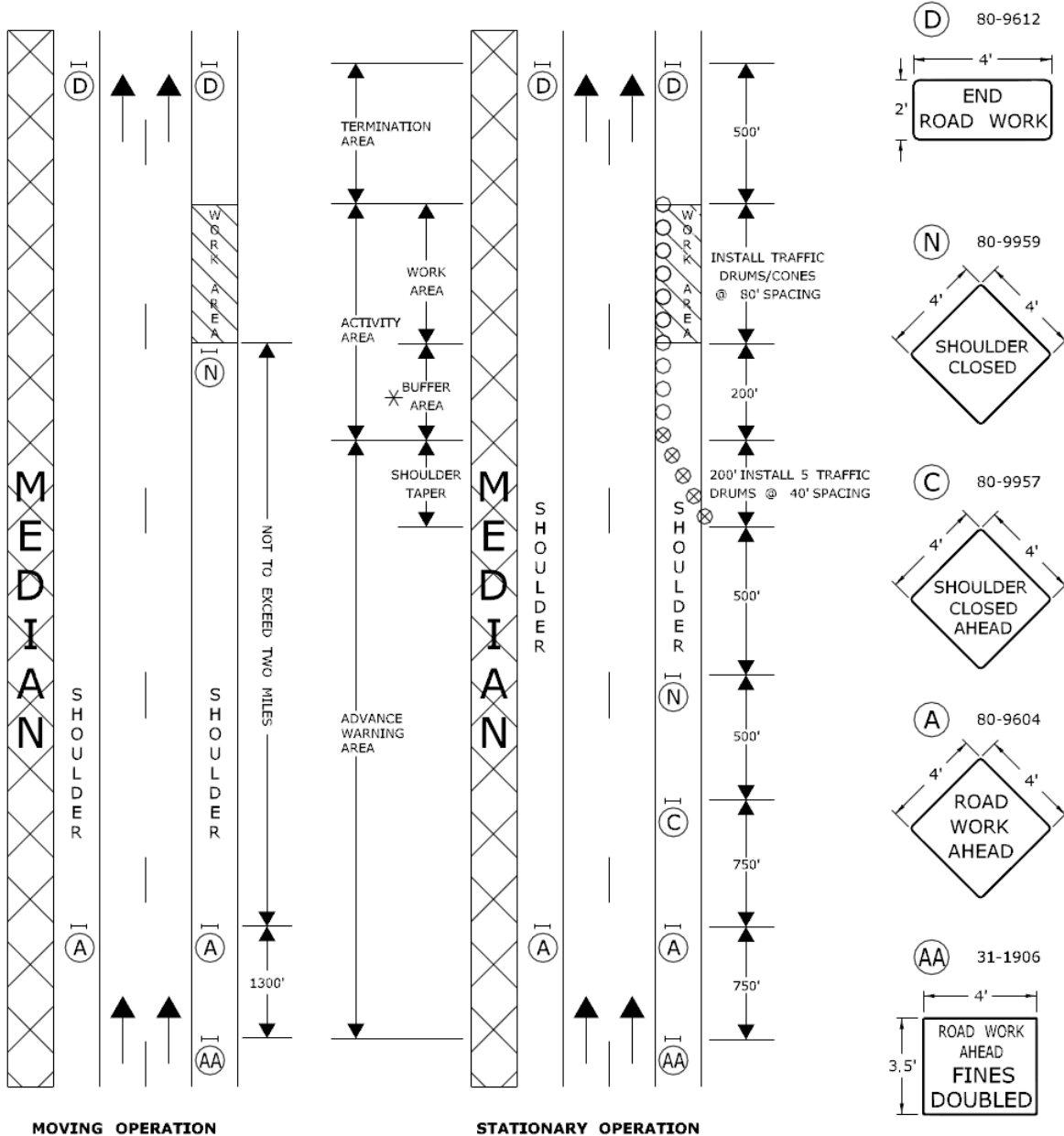
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 Charles S. Harlow  
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 PRINCIPAL ENGINEER



APPROVED *Charles S. Harlow*  
 Charles S. Harlow  
 2012.06.05 15:52:10-0400  
 PRINCIPAL ENGINEER

# WORK IN SHOULDER AREA - MULTILANE HIGHWAY

SIGN FACE  
94 SQ. FT (MIN.)



- TRAFFIC CONE **OR** TRAFFIC DRUM
- ✱ OPTIONAL ⊗ TRAFFIC DRUM — PORTABLE SIGN SUPPORT
- ◀ HIGH MOUNTED INTERNALLY ILLUMINATED FLASHING ARROW



SCALE: NONE

CONSTRUCTION TRAFFIC CONTROL PLAN

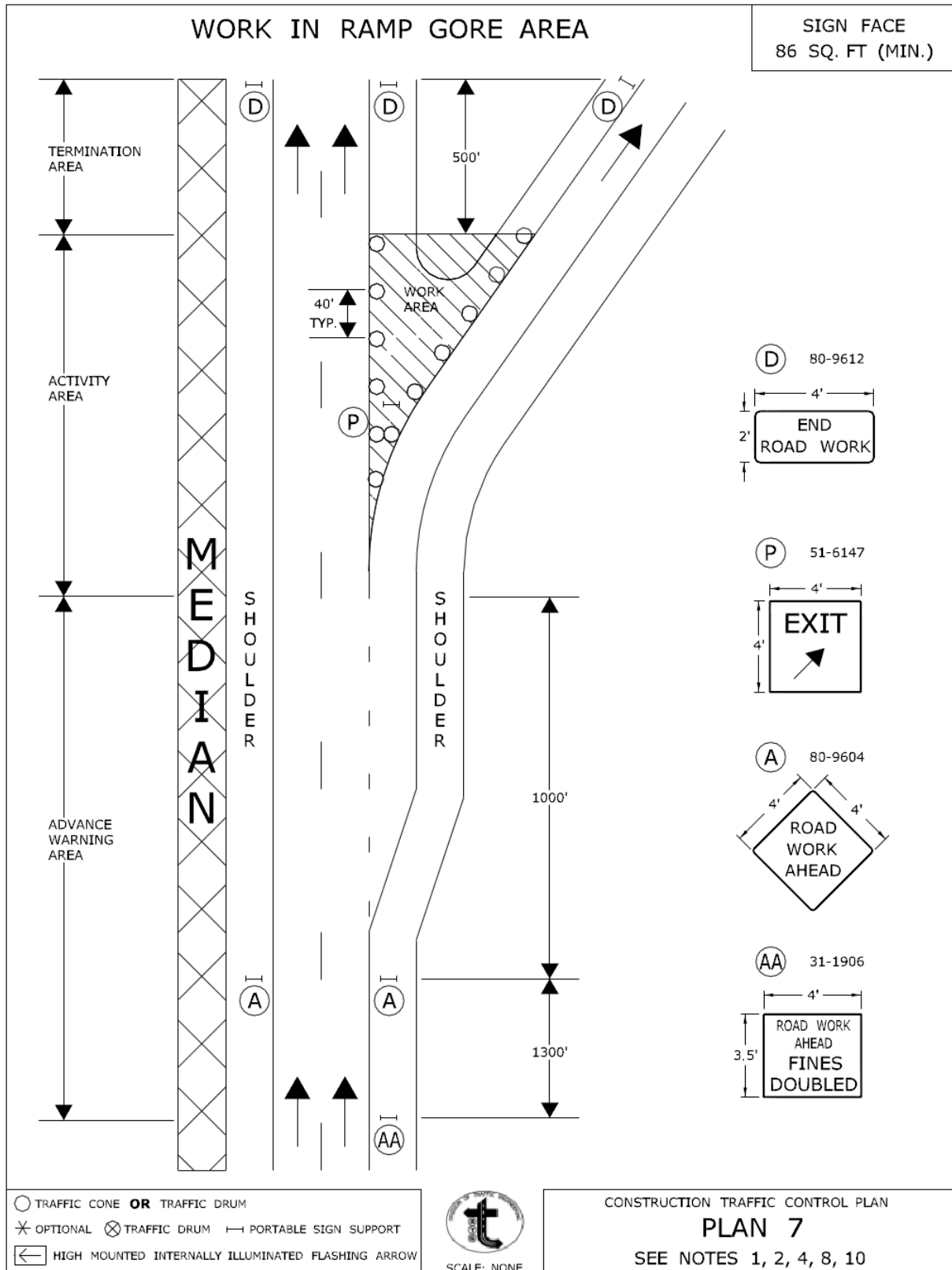
## PLAN 6

SEE NOTES 1, 2, 4, 8

CONNECTICUT DEPARTMENT OF TRANSPORTATION  
BUREAU OF ENGINEERING & CONSTRUCTION

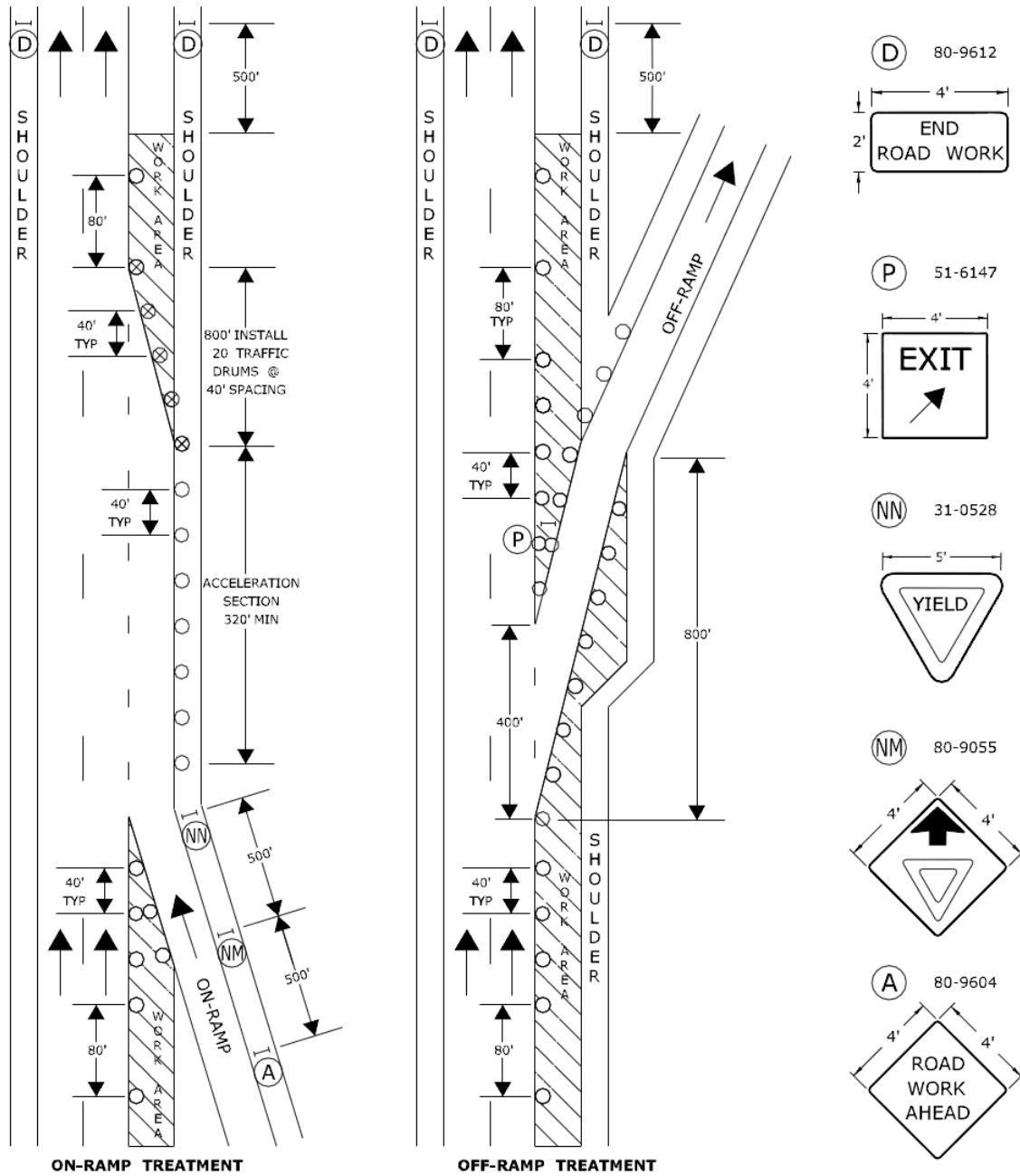
APPROVED *Charles S. Harlow*  
PRINCIPAL ENGINEER

Charles S. Harlow  
2012.06.05 15:52:38-04'00"



## TYPICAL RAMP TREATMENTS FOR MAINLINE LANE CLOSURE - MULTILANE HIGHWAY

SIGN FACE SQ. FT VARIES



**ON-RAMP TREATMENT**

**OFF-RAMP TREATMENT**

USE TRAFFIC CONTROL PLAN 1 TO CLOSE THE RIGHT LANE

- TRAFFIC CONE **OR** TRAFFIC DRUM
- ✱ OPTIONAL ⊗ TRAFFIC DRUM — PORTABLE SIGN SUPPORT
- ◀ HIGH MOUNTED INTERNALLY ILLUMINATED FLASHING ARROW



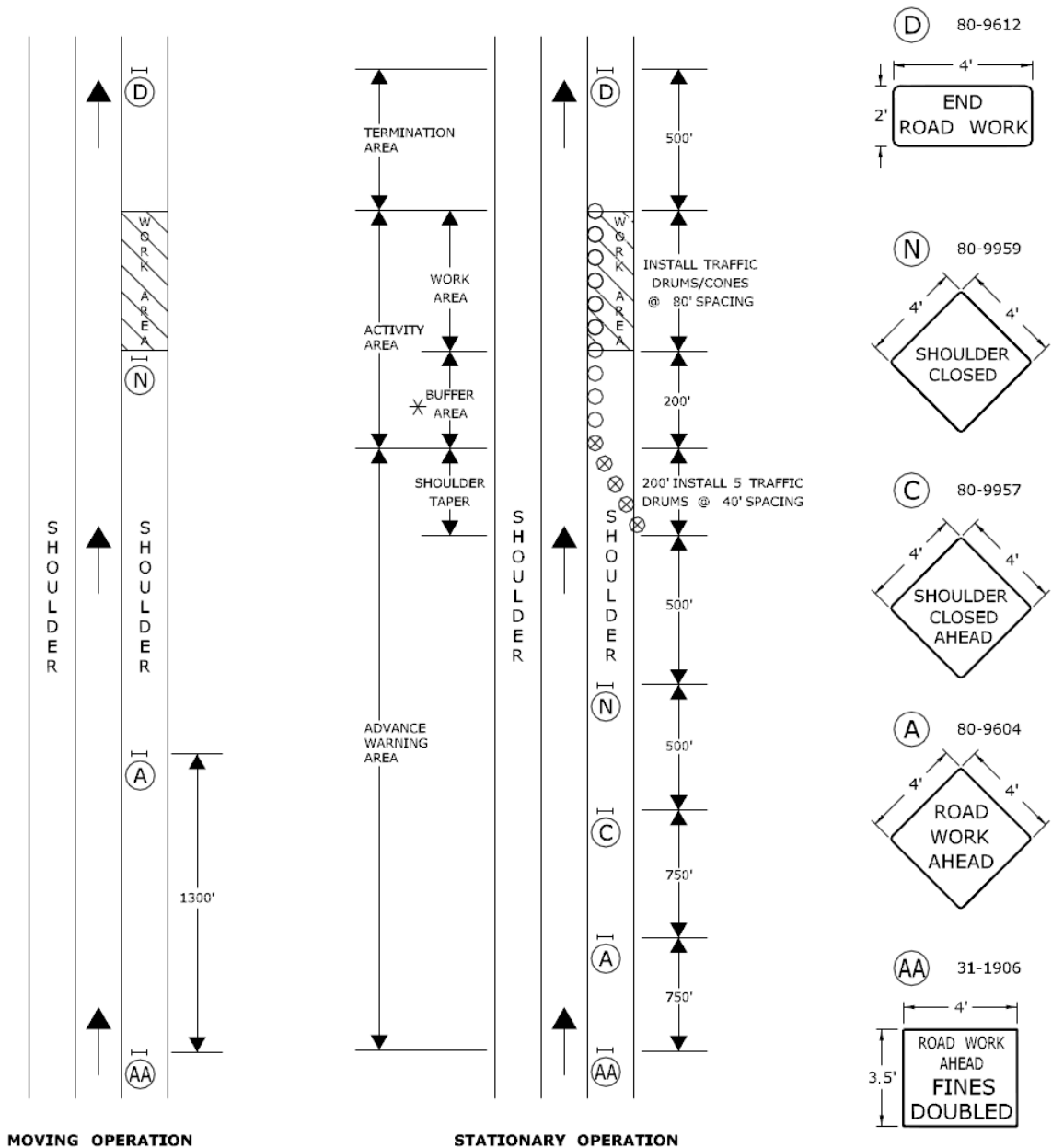
CONSTRUCTION TRAFFIC CONTROL PLAN  
**PLAN 8**  
 SEE NOTES 1, 2, 3, 4, 5, 6, 8, 9, 10

CONNECTICUT DEPARTMENT OF TRANSPORTATION  
 BUREAU OF ENGINEERING & CONSTRUCTION

APPROVED *Charles S. Harlow*  
 PRINCIPAL ENGINEER  
 Charles S. Harlow  
 2012.06.05 15:53:31-0400'

WORK IN SHOULDER AREA - TURNING ROADWAYS / RAMPS

SIGN FACE  
70 SQ. FT (MIN.)



- TRAFFIC CONE OR TRAFFIC DRUM
- ✱ OPTIONAL ⊗ TRAFFIC DRUM — PORTABLE SIGN SUPPORT
- ◀ HIGH MOUNTED INTERNALLY ILLUMINATED FLASHING ARROW



SCALE: NONE

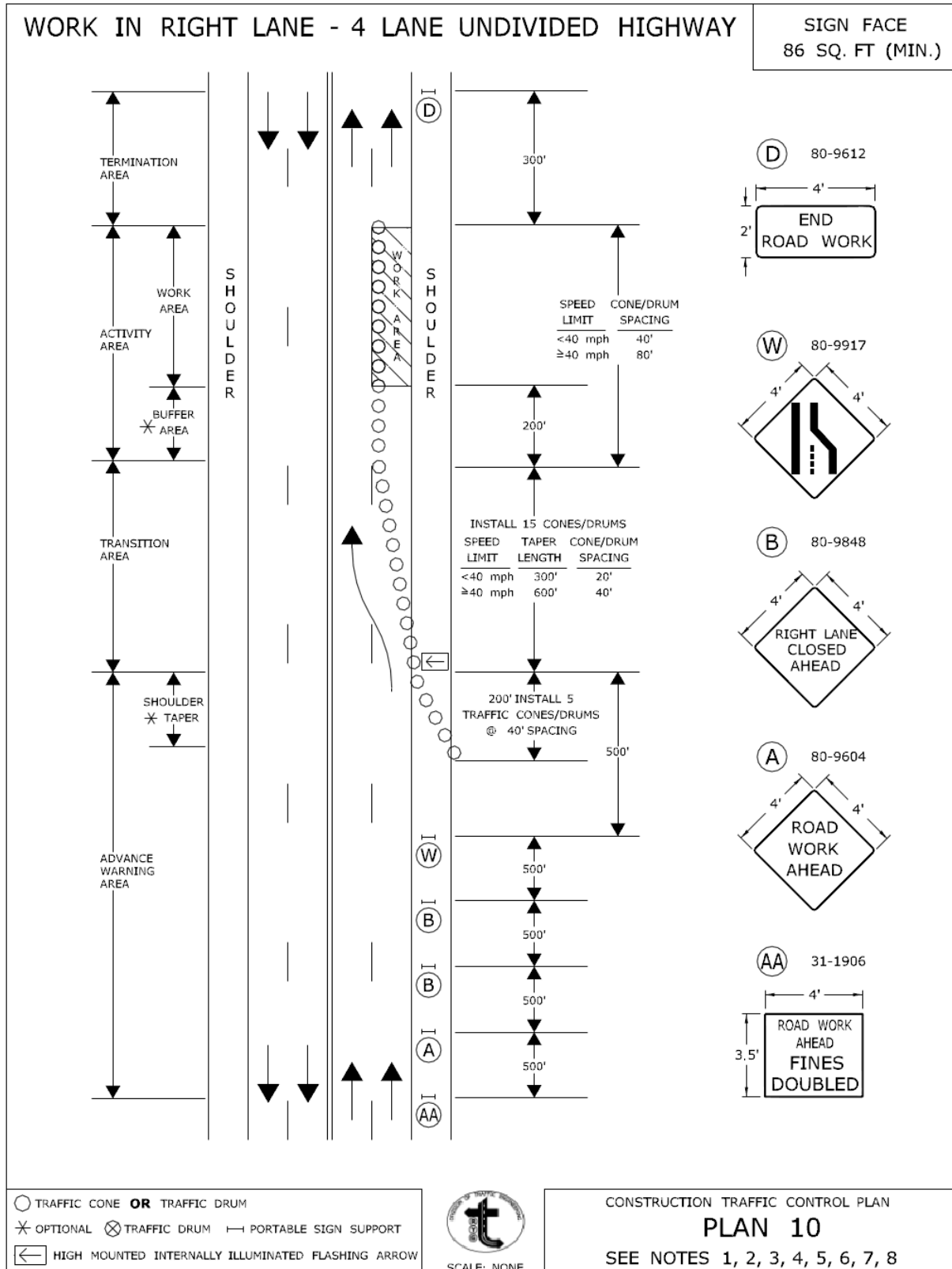
CONSTRUCTION TRAFFIC CONTROL PLAN

PLAN 9

SEE NOTES 1, 2, 4, 8

CONNECTICUT DEPARTMENT OF TRANSPORTATION  
BUREAU OF ENGINEERING & CONSTRUCTION

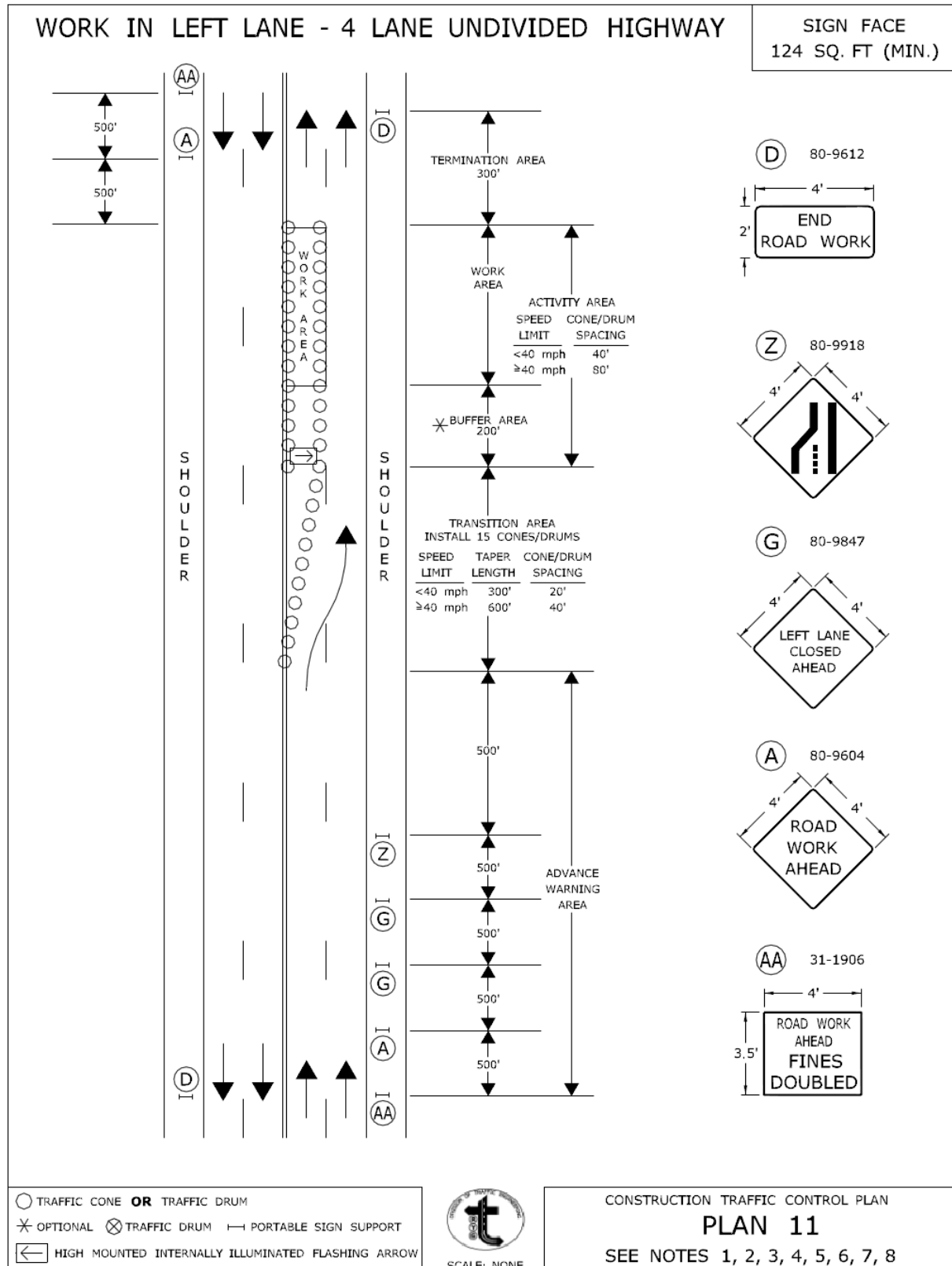
APPROVED *Charles S. Harlow*  
PRINCIPAL ENGINEER  
Charles S. Harlow  
2012.06.05 15:53:53-0400'



APPROVED *Charles S. Harlow* Charles S. Harlow  
2012.06.05 15:54:15-0400  
PRINCIPAL ENGINEER

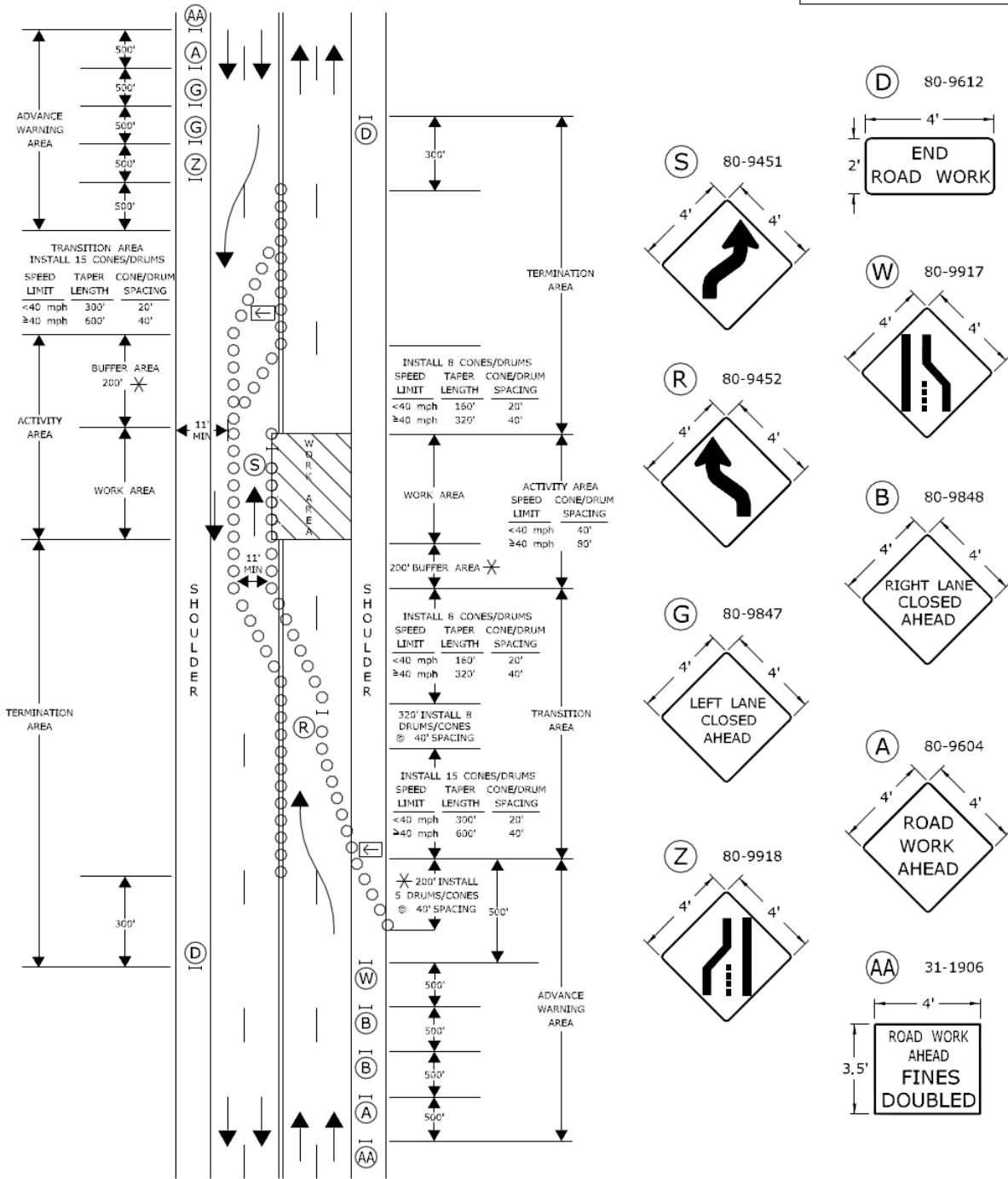
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BUREAU OF ENGINEERING & CONSTRUCTION





# WORK IN BOTH LANES - 4 LANE UNDIVIDED HIGHWAY

SIGN FACE  
204 SQ. FT. (MIN.)



- TRAFFIC CONE OR TRAFFIC DRUM
- ✱ OPTIONAL ⊗ TRAFFIC DRUM — PORTABLE SIGN SUPPORT
- ← HIGH MOUNTED INTERNALLY ILLUMINATED FLASHING ARROW

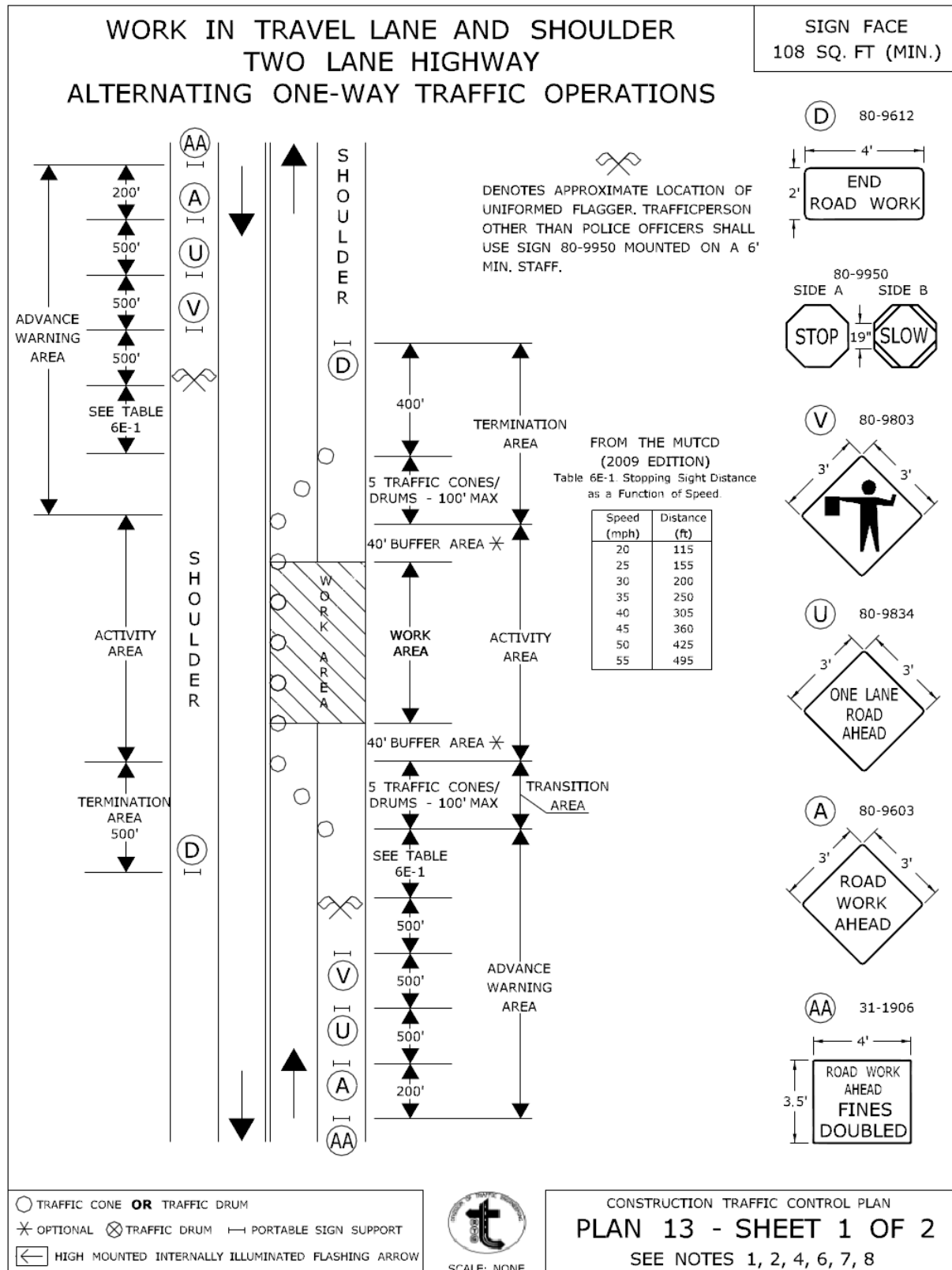


CONSTRUCTION TRAFFIC CONTROL PLAN  
**PLAN 12**  
SEE NOTES 1, 2, 3, 4, 5, 6, 7, 8

SCALE: NONE

CONNECTICUT DEPARTMENT OF TRANSPORTATION  
BUREAU OF ENGINEERING & CONSTRUCTION

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PRINCIPAL ENGINEER  
Charles S. Harlow  
2012.06.05 15:55:01-0400'



- TRAFFIC CONE **OR** TRAFFIC DRUM
- ✱ OPTIONAL ⊗ TRAFFIC DRUM — PORTABLE SIGN SUPPORT
- ← HIGH MOUNTED INTERNALLY ILLUMINATED FLASHING ARROW



SCALE: NONE

CONSTRUCTION TRAFFIC CONTROL PLAN  
**PLAN 13 - SHEET 1 OF 2**  
SEE NOTES 1, 2, 4, 6, 7, 8

CONNECTICUT DEPARTMENT OF TRANSPORTATION  
BUREAU OF ENGINEERING & CONSTRUCTION

APPROVED *Charles S. Harlow* Charles S. Harlow  
2012.06.05 15:55:23-04'00"  
PRINCIPAL ENGINEER

# WORK IN TRAVEL LANE AND SHOULDER TWO LANE HIGHWAY ALTERNATING ONE-WAY TRAFFIC OPERATIONS

SIGN FACE  
108 SQ. FT (MIN.)

## HAND SIGNAL METHODS TO BE USED BY UNIFORMED FLAGGERS

THE FOLLOWING METHODS FROM SECTION 6E.07, FLAGGER PROCEDURES, IN THE "MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES," SHALL BE USED BY UNIFORMED FLAGGERS WHEN DIRECTING TRAFFIC THROUGH A WORK AREA. THE STOP/SLOW SIGN PADDLE (SIGN NO. 80-9950) SHOWN ON THE TRAFFIC STANDARD SHEET TR-1220 01 ENTITLED, "SIGNS FOR CONSTRUCTION AND PERMIT OPERATIONS" SHALL BE USED.

**A. TO STOP TRAFFIC**

TO STOP ROAD USERS, THE FLAGGER SHALL FACE ROAD USERS AND AIM THE STOP PADDLE FACE TOWARD ROAD USERS IN A STATIONARY POSITION WITH THE ARM EXTENDED HORIZONTALLY AWAY FROM THE BODY. THE FREE ARM SHALL BE HELD WITH THE PALM OF THE HAND ABOVE SHOULDER LEVEL TOWARD APPROACHING TRAFFIC.



**B. TO DIRECT TRAFFIC TO PROCEED**

TO DIRECT STOPPED ROAD USERS TO PROCEED, THE FLAGGER SHALL FACE ROAD USERS WITH THE SLOW PADDLE FACE AIMED TOWARD ROAD USERS IN A STATIONARY POSITION WITH THE ARM EXTENDED HORIZONTALLY AWAY FROM THE BODY. THE FLAGGER SHALL MOTION WITH THE FREE HAND FOR ROAD USERS TO PROCEED.



**C. TO ALERT OR SLOW TRAFFIC**

TO ALERT OR SLOW TRAFFIC, THE FLAGGER SHALL FACE ROAD USERS WITH THE SLOW PADDLE FACE AIMED TOWARD ROAD USERS IN A STATIONARY POSITION WITH THE ARM EXTENDED HORIZONTALLY AWAY FROM THE BODY. TO FURTHER ALERT OR SLOW TRAFFIC, THE FLAGGER HOLDING THE SLOW PADDLE FACE TOWARD ROAD USERS MAY MOTION UP AND DOWN WITH THE FREE HAND, PALM DOWN.



- TRAFFIC CONE **OR** TRAFFIC DRUM
- \* OPTIONAL ⊗ TRAFFIC DRUM — PORTABLE SIGN SUPPORT
- ◀ HIGH MOUNTED INTERNALLY ILLUMINATED FLASHING ARROW

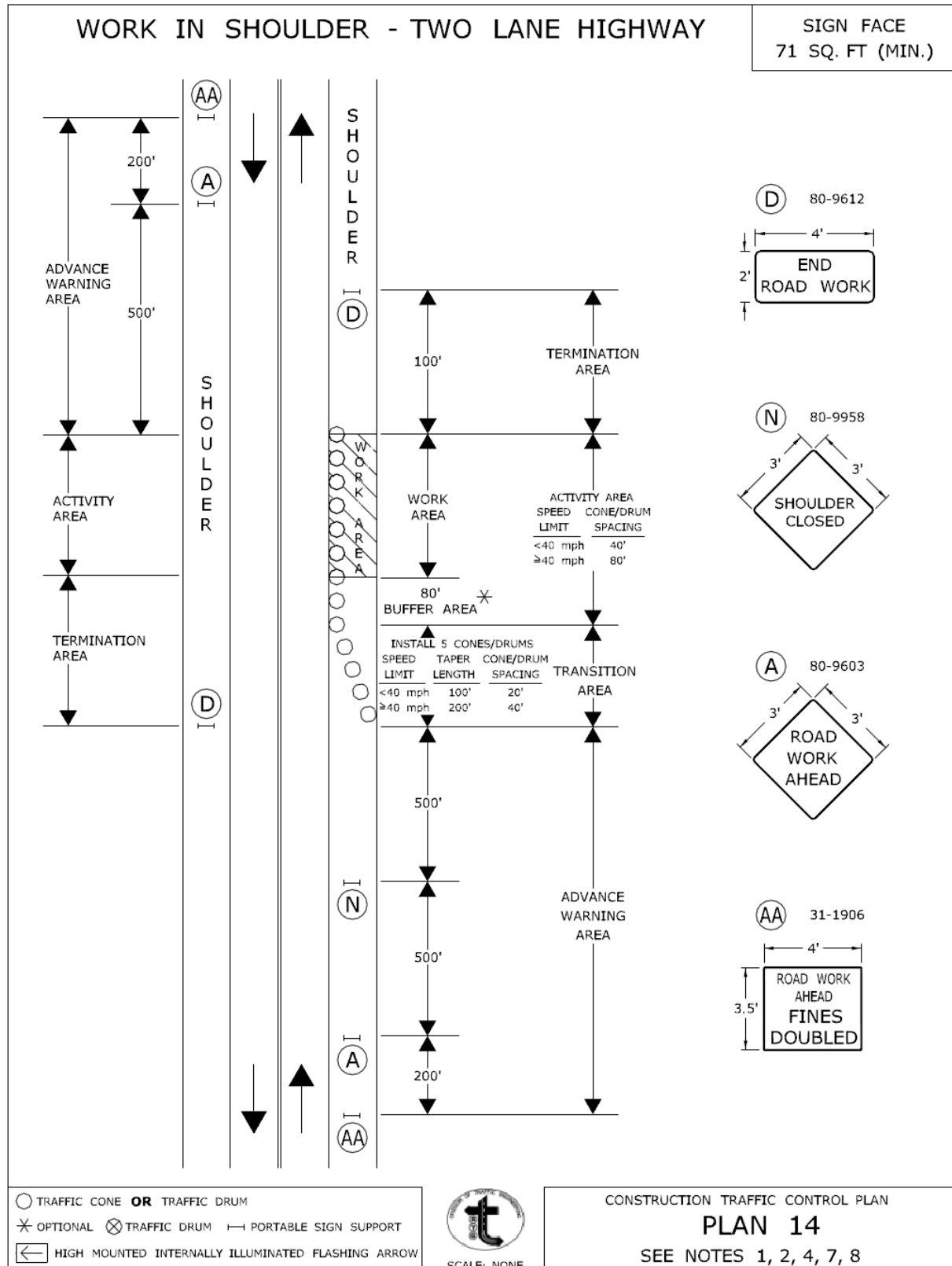


SCALE: NONE

CONSTRUCTION TRAFFIC CONTROL PLAN  
**PLAN 13 - SHEET 2 OF 2**  
SEE NOTES 1, 2, 4, 6, 7, 8

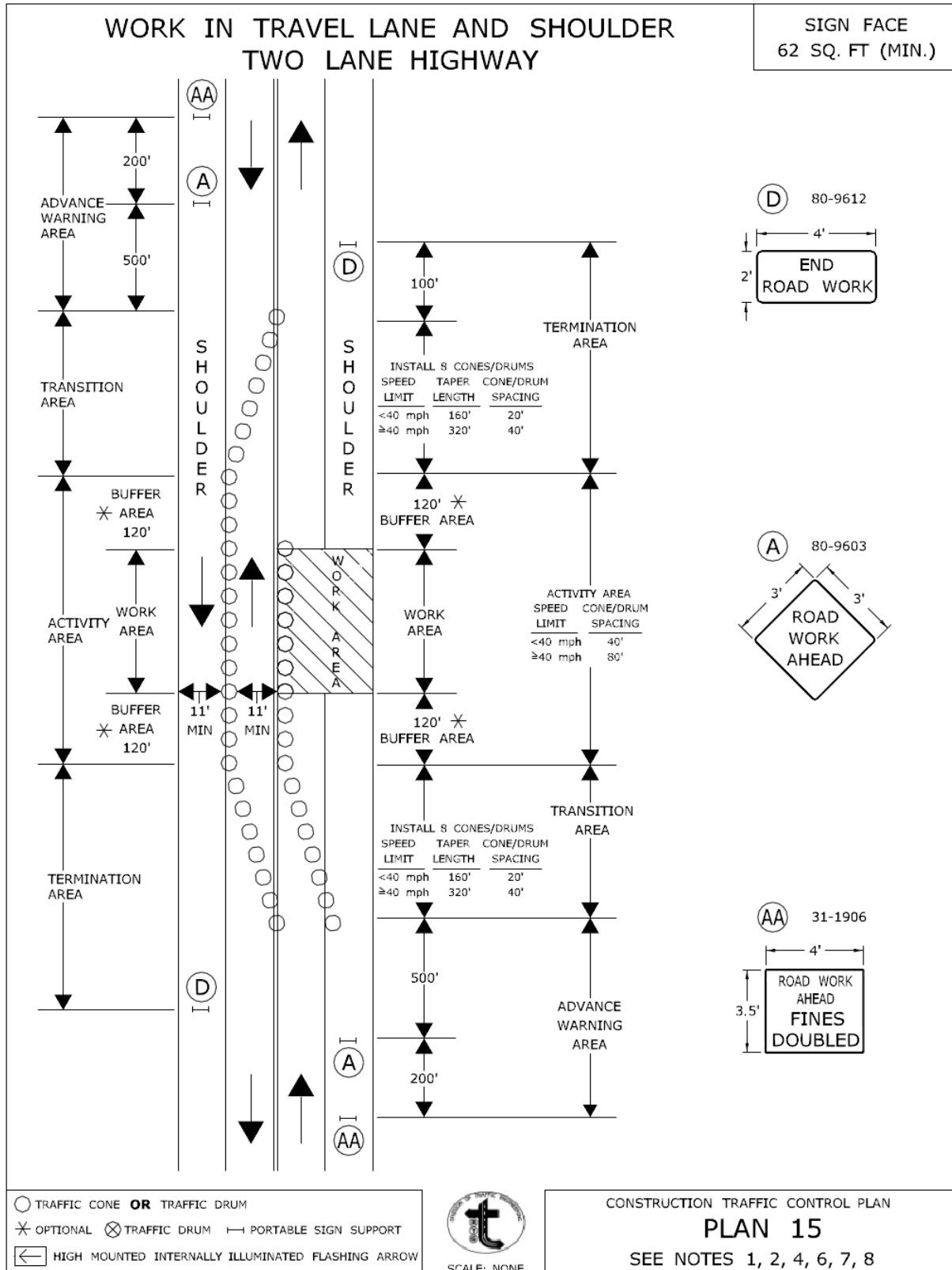
CONNECTICUT DEPARTMENT OF TRANSPORTATION  
BUREAU OF ENGINEERING & CONSTRUCTION

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PRINCIPAL ENGINEER



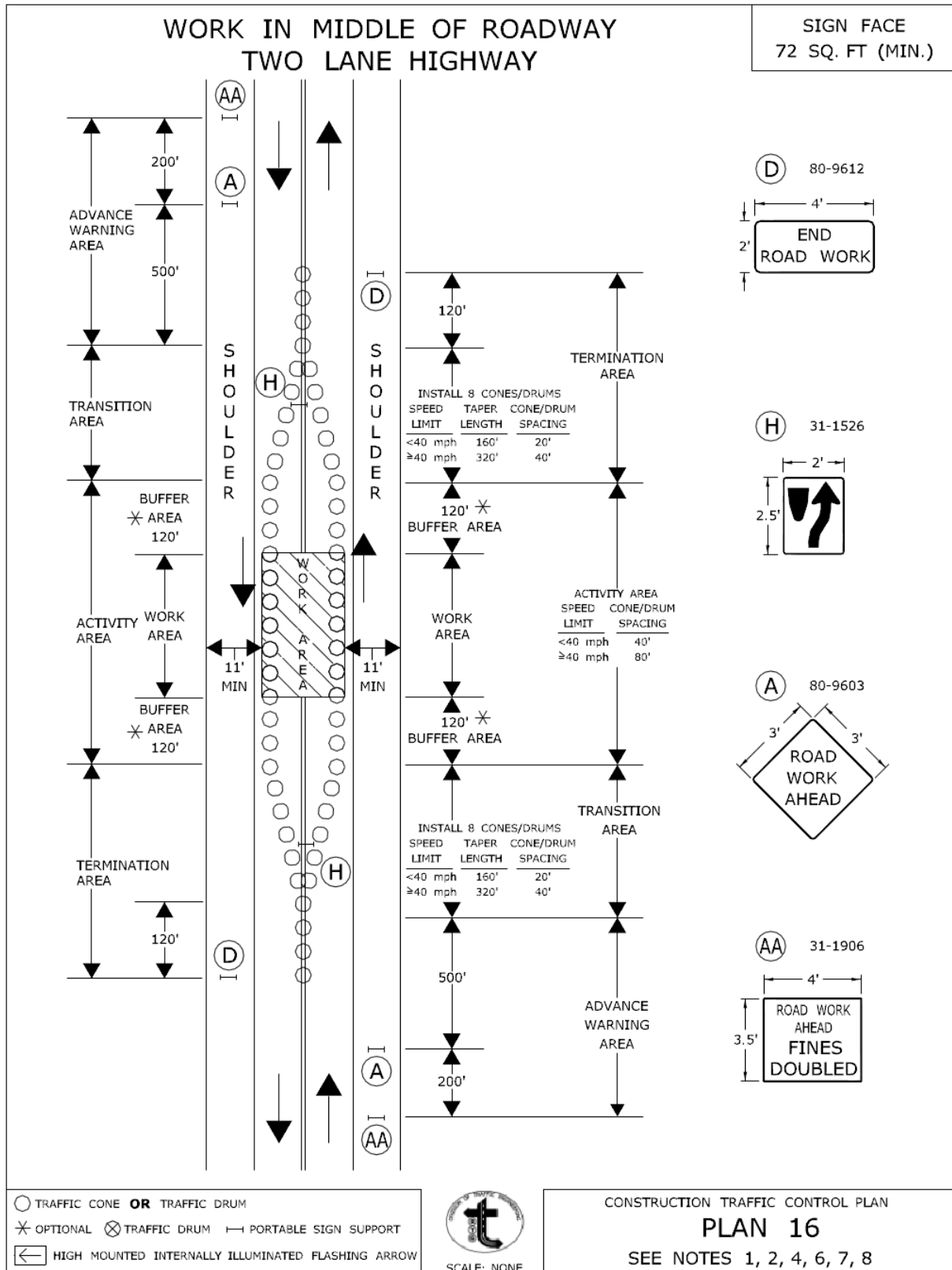
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PRINCIPAL ENGINEER

CONNECTICUT DEPARTMENT OF TRANSPORTATION  
BUREAU OF ENGINEERING & CONSTRUCTION



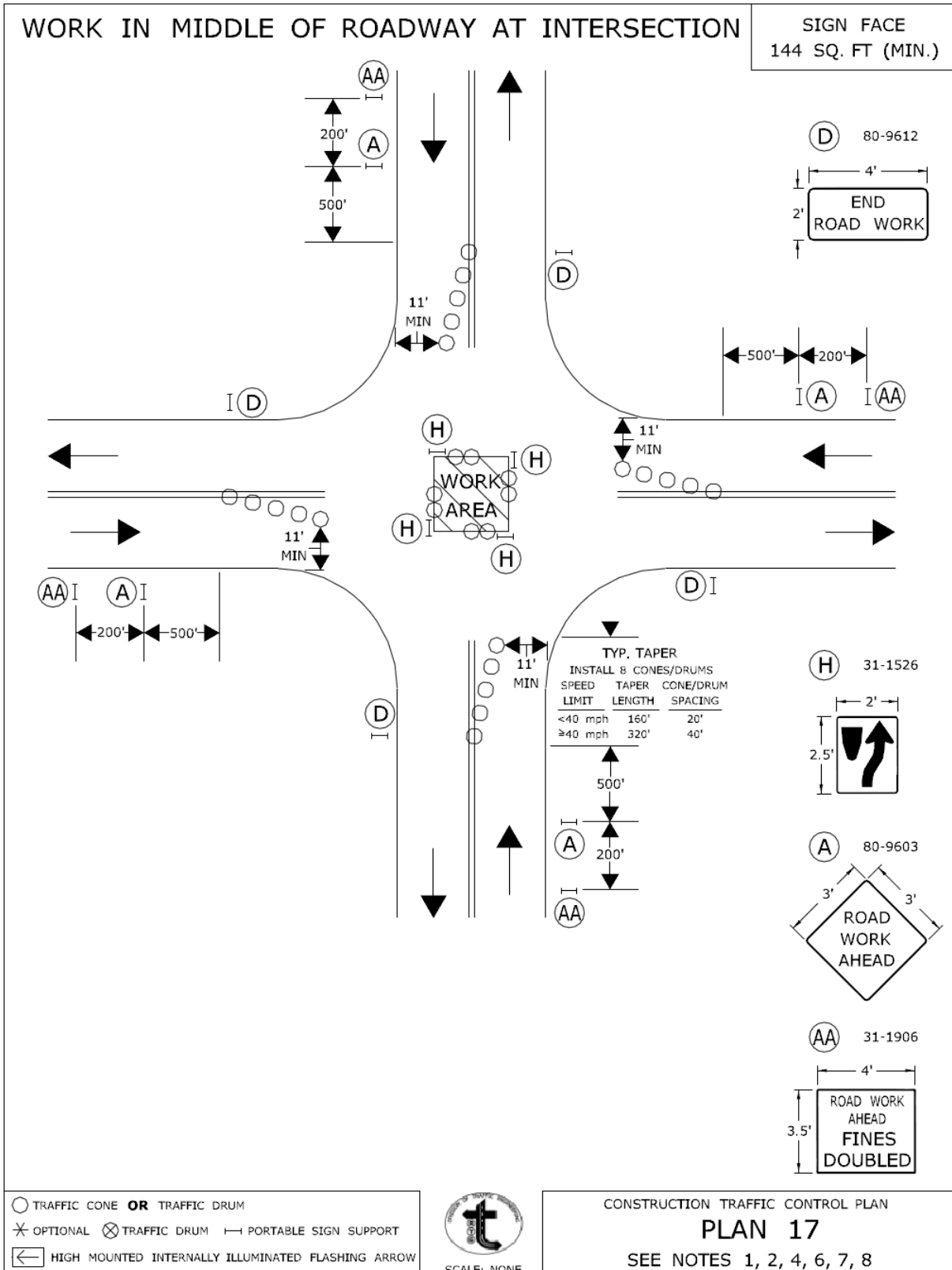
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BUREAU OF ENGINEERING & CONSTRUCTION

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PRINCIPAL ENGINEER



CONNECTICUT DEPARTMENT OF TRANSPORTATION  
BUREAU OF ENGINEERING & CONSTRUCTION

APPROVED *Charles S. Harlow*  
Charles S. Harlow  
2012.08.05 15:56:51-04:00  
PRINCIPAL ENGINEER



○ TRAFFIC CONE **OR** TRAFFIC DRUM  
 ✱ OPTIONAL ⊗ TRAFFIC DRUM — PORTABLE SIGN SUPPORT  
 HIGH MOUNTED INTERNALLY ILLUMINATED FLASHING ARROW



SCALE: NONE

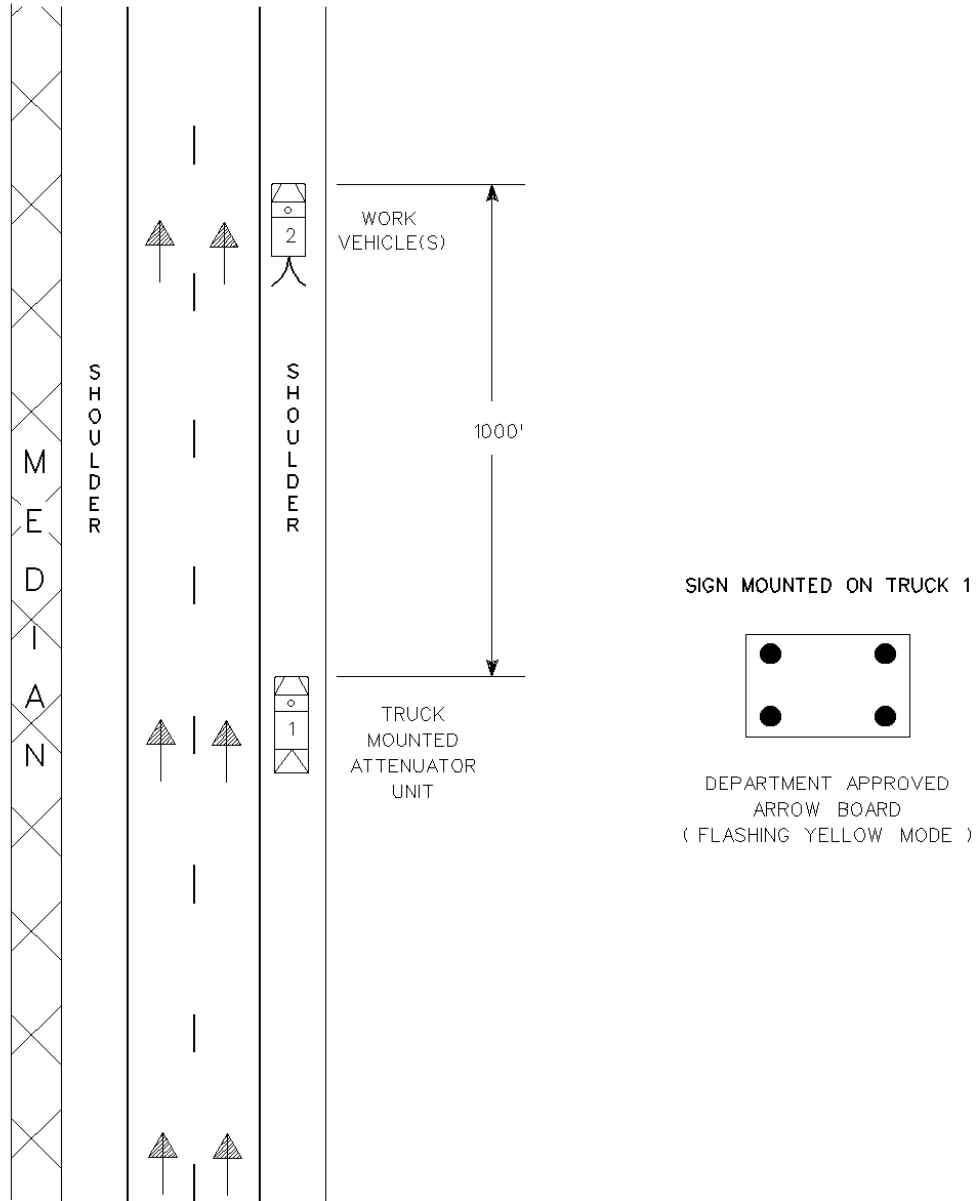
CONSTRUCTION TRAFFIC CONTROL PLAN  
**PLAN 17**  
 SEE NOTES 1, 2, 4, 6, 7, 8

CONNECTICUT DEPARTMENT OF TRANSPORTATION  
 BUREAU OF ENGINEERING & CONSTRUCTION

APPROVED *Charles S. Harlow*  
 PRINCIPAL ENGINEER  
 Charles S. Harlow  
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### MOVING OPERATION ON RIGHT SHOULDER MULTILANE HIGHWAY & SECONDARY ROADWAYS



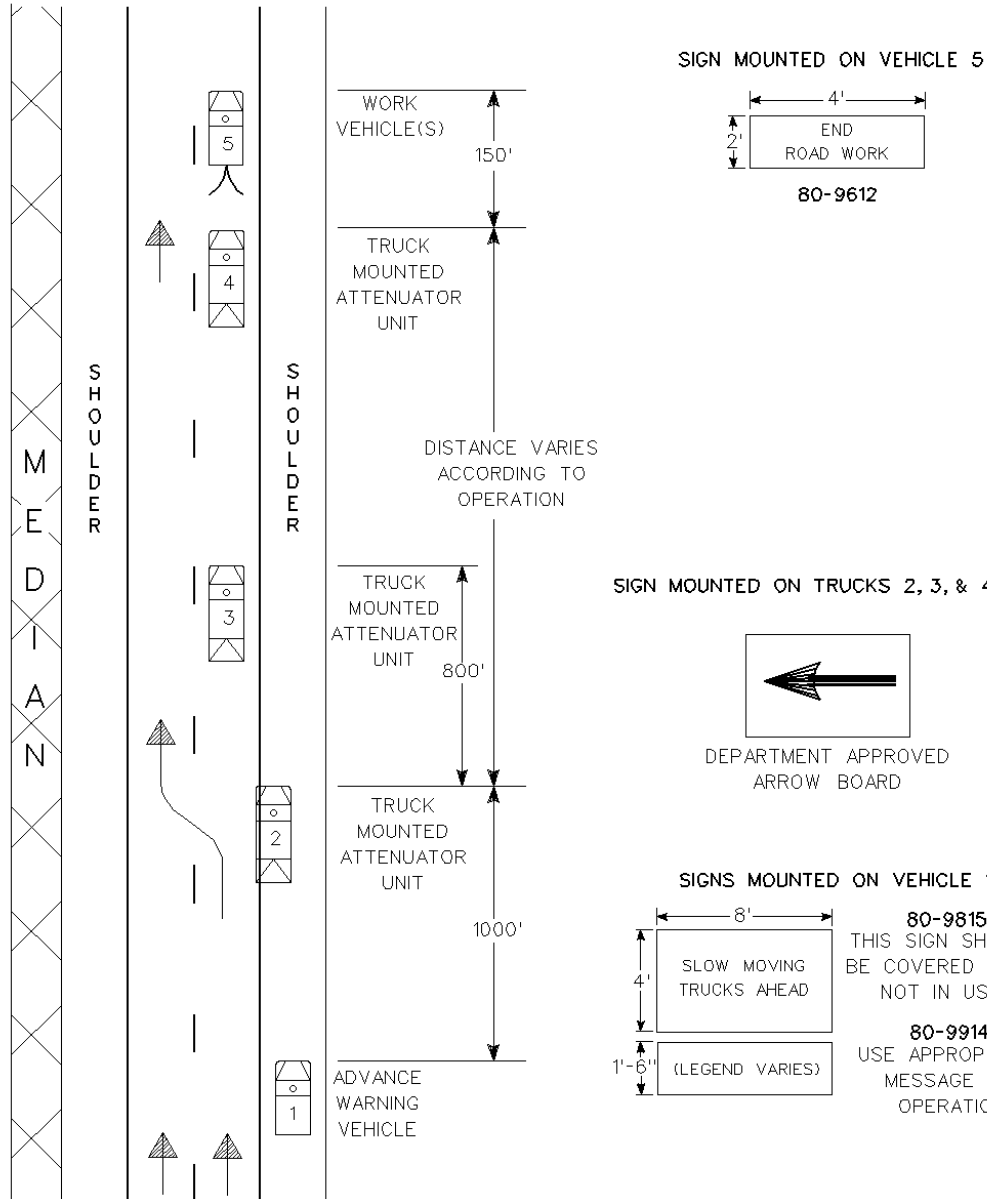
REV'D 1-02

CONNECTICUT  
DEPARTMENT OF TRANSPORTATION  
BUREAU OF ENGINEERING &  
HIGHWAY OPERATIONS  
DIVISION OF TRAFFIC ENGINEERING

CONSTRUCTION  
TRAFFIC CONTROL PLAN  
PLAN 19  
SCALE NONE

APPROVED J. McCall DATE 1-30-02  
PRINCIPAL ENGINEER

### MOVING OPERATION IN RIGHT LANE AND OUTSIDE SHOULDER AT THE SAME TIME MULTILANE HIGHWAY

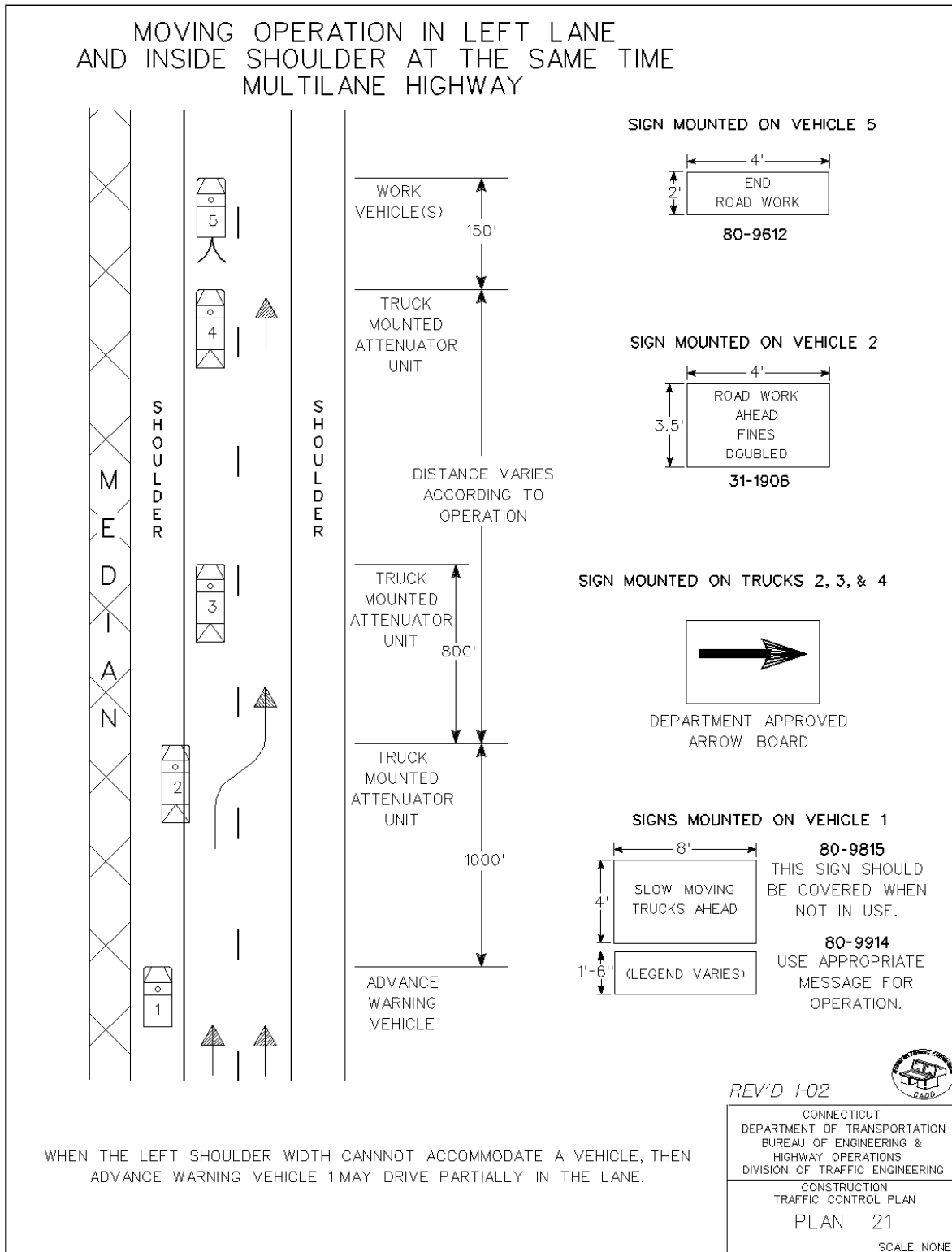


REV'D I-02

CONNECTICUT  
DEPARTMENT OF TRANSPORTATION  
BUREAU OF ENGINEERING &  
HIGHWAY OPERATIONS  
DIVISION OF TRAFFIC ENGINEERING

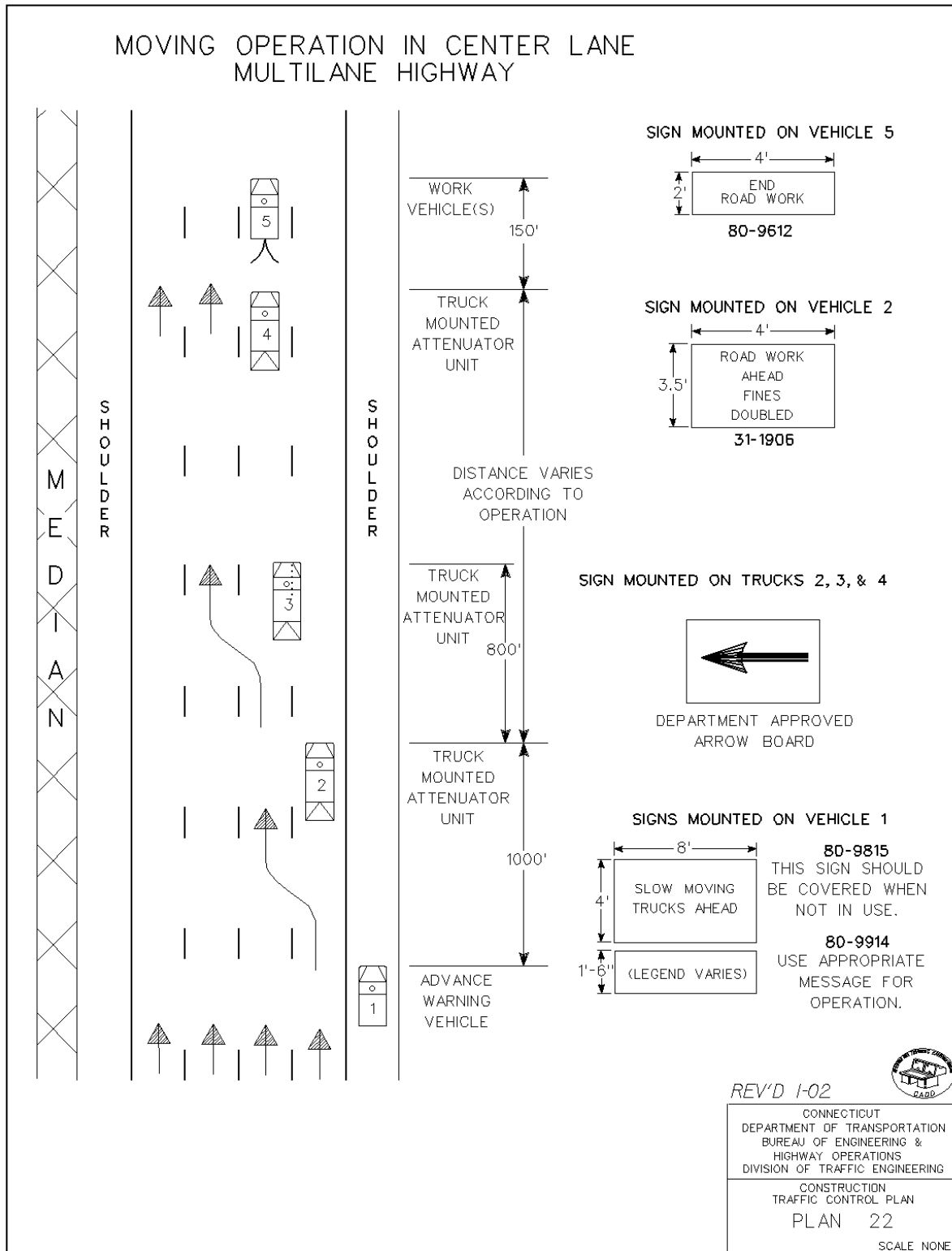
CONSTRUCTION  
TRAFFIC CONTROL PLAN  
PLAN 20  
SCALE NONE

APPROVED John D. McCall DATE I-30-02  
PRINCIPAL ENGINEER



APPROVED John D. McCall DATE 1-30-02  
PRINCIPAL ENGINEER

### MOVING OPERATION IN CENTER LANE MULTILANE HIGHWAY



REV'D 1-02



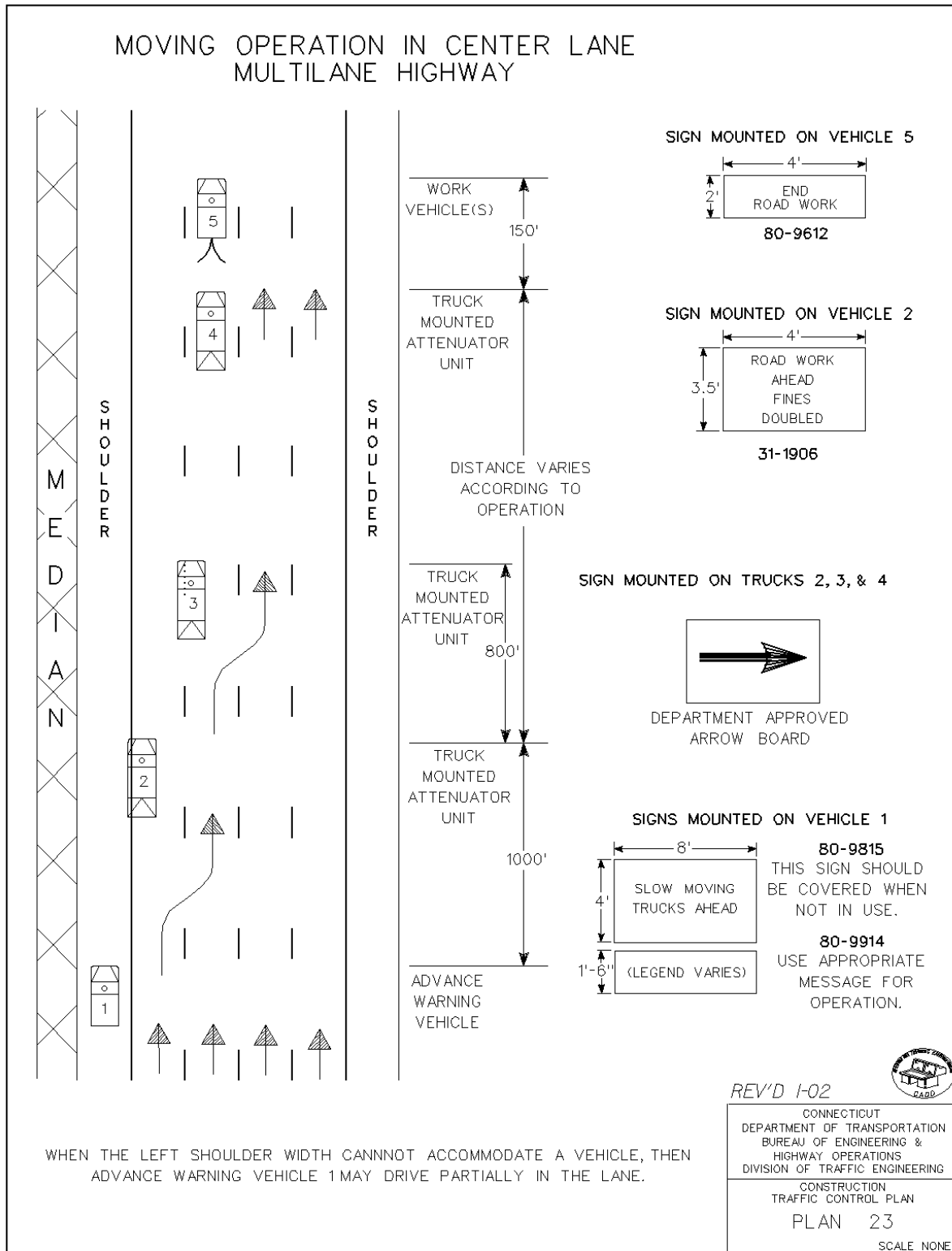
CONNECTICUT  
 DEPARTMENT OF TRANSPORTATION  
 BUREAU OF ENGINEERING &  
 HIGHWAY OPERATIONS  
 DIVISION OF TRAFFIC ENGINEERING

CONSTRUCTION  
 TRAFFIC CONTROL PLAN  
 PLAN 22

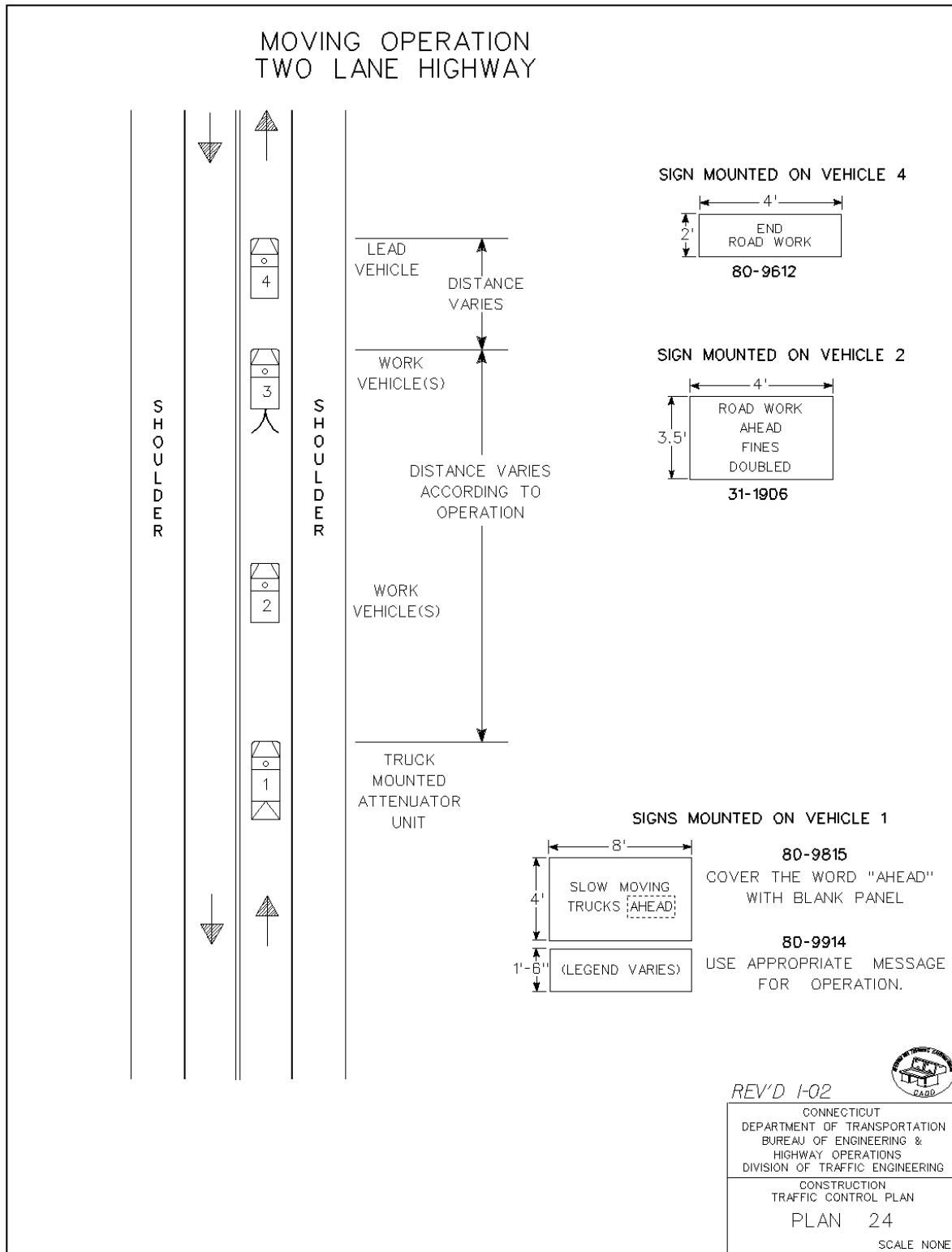
SCALE NONE

APPROVED John D. McCall DATE 1-30-02  
 PRINCIPAL ENGINEER

### MOVING OPERATION IN CENTER LANE MULTILANE HIGHWAY



APPROVED John D. Mical DATE 1-30-02  
PRINCIPAL ENGINEER



APPROVED John D. McCall DATE 1-30-02  
PRINCIPAL ENGINEER

**Article 9.71.05 – Basis of Payment is supplemented by the following:**

The temporary relocation of signs and supports, and the furnishing, installation and removal of any temporary supports shall be paid for under the item “Maintenance and Protection of Traffic”. Temporary overhead sign supports and foundations shall be paid for under the appropriate item(s).

The cost of furnishing, installing, and removing the material for the 4H:1V traversable slope shall be paid for under the item “Maintenance and Protection of Traffic.”

## **ITEM #1001001A – TRENCHING AND BACKFILLING**

The work under the item Trenching and Backfilling shall conform to Section 10.01 of the Standard Specifications amended as follows:

**Materials:** Article 10.01.02 – Materials, add the following:

Concrete fill for restoration of bituminous concrete overlaid concrete pavement shall conform to the requirements of Article M.03.01 and Article M.03.02 of the Standard Specifications and shall be capable of achieving 3,000 psi (21 MPa) within 12 hours. The Contractor shall submit a design mix to the Engineer for approval.

Processed Aggregate Base shall conform to the requirements of Article M.05.01 of the Standard Specifications.

Bituminous Concrete HMA S0.5 and HMA S1.0 shall conform to the requirements of Special Provision M.04 –Bituminous Concrete Materials.

Joint Seal shall conform to the requirements of Article M.04.01-8 – Joint Seal Material Requirements of the Standard Specifications.

Reinforcement shall conform to the requirements of ASTM A615, Grade 60.

Topsoil shall conform to the requirements of Article M.13.01 – Topsoil of the Standard Specifications. Turf Establishment materials shall conform to Article M.13 of the Standard Specifications.

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 utility marking tape shall not delaminate nor smear when wet and shall be resistant to insects. The utility marking tape shall not degrade when exposed to alkalis, acids or other corrosive elements found in soil.

**Construction Methods:** Article 10.01.03 – Construction Methods, add the following:

All cuts in roadways shall be done in a neat and workmanlike manner, so as to cause the least possible injury to all other improvements. The Contractor should provide protection to all slopes, roadways, guide rails, drainage structures, illumination conduit and appurtenances, utilities, etc. as may be necessary or as required by the Engineer. Any property damage caused by excavation shall be repaired as directed by, and to the satisfaction of, the Engineer at no additional compensation. Excavating shall not be performed until immediately before installation of conduit and other appurtenances. The material from the excavation shall be placed where directed by the Engineer and in a position where the least damage and obstruction to vehicular traffic and the least interference with the surface drainage will occur.



All excavations shall be closed at the end of each day.

All pavement cutting required for this item, regardless of the type, shall be included as work under this item.

Where possible, communication conduit and electrical conduit shall be installed in the same trench and shall be paid for under this item as one. Payment shall not be made for separate trenching and backfilling where electrical and communication conduit may be installed in the same trench, but have been installed separately by the Contractor.

When trenching occurs in roadways, neat lines shall be drawn on the surface and the roadway shall be saw cut and removed to neat lines as indicated on the plans or as directed by the Engineer. The Contractor shall repair the pavement immediately upon completion of the trench backfilling and compaction in accordance with these specifications and to the dimensions on the contract drawings, or as directed by the Engineer. Where trenching occurs across bituminous concrete overlaid concrete pavement, repairs shall include filling the trench with high-early concrete fill and upon curing, permanent surface pavement repairs.

Unpaved areas disturbed during construction shall be restored with a minimum of 2 inches (50 mm) of topsoil and established turf.

Topsoil shall be provided in conformance to Section 9.44.03 of the standard specifications. Turf Establishment shall conform to Section 9.50.03 of the Standard Specifications.

The Contractor shall install utility marking tape above installed conduit as identified on the conduit installation details in the plans.

**Method of Measurement:** Article 10.01.04 – Method of Measurement: Add the following:

There shall be no separate measurement for sawcutting, temporary pavement repair, concrete fill, joint sealing, permanent pavement repair, sidewalk repair, cutting reinforcement, reinforcement, utility marking tape, topsoil and turf establishment.

**Basis of Payment:**

Article 10.01.05 -- Basis of Payment: Replace the second paragraph with the following:

It shall also include all sand encasement, backfilling, utility marking tape, grading, seeding, fertilizing, mulching, disposal of surplus material, sawcutting sidewalks and paved areas, as well as furnishing and installing curbing, riprap, crushed stone, processed aggregate subbase, gravel borrow, concrete fill, topsoil, sidewalk, pavement or structure, as the case may be.

**ITEM #1002214A – TRAFFIC CONTROL FOUNDATION -  
CONTROLLER-TYPE IV MODIFIED**

All work shall conform to the requirements of Section 10.02 of the Standard Specifications with the following modifications:

**Article 10.02.01 - Description:**

Add the following:

This item will also include the installation of a traffic control foundation for a traffic management system cabinet.

**Article 10.02.03 - Construction Methods:**

Add the following paragraph:

Where a foundation is placed within or adjacent to a concrete sidewalk, unless otherwise directed by the Engineer, the entire section of sidewalk shall be replaced in accordance with Section 9.21.

The foundation dimensions will be as required to support the traffic management system cabinet and as shown on the approved foundation drawing.

The Contractor shall be responsible for the re-grading of the area surrounding the Traffic Control Foundation - Type IV Modified to allow for the adjacent concrete sidewalk pad installation to be installed level with a 2% ( $\frac{1}{4}$ " per foot) pitch. See the Miscellaneous Details provided in the contract plans.

**Article 10.02.05 - Basis of Payment:**

In the first sentence insert the words "installation of borrow" after the words "disposal of surplus material".

**ITEM #1002232A – TRAFFIC CONTROL FOUNDATION - SPAN POLE -TYPE C****ITEM #1002233A – TRAFFIC CONTROL FOUNDATION - SPAN POLE -TYPE D****Description:**

This item consists of furnishing and installing a foundation of the type specified in accordance with the plans, as directed by the Engineer and in conformance with this specification.

**Materials:**

Concrete for the formed top of foundation shall conform to the requirements for Class “F” Concrete in Section 6.01 of the Standard Specifications and shall attain a 28-day compressive strength of 4,000 psi (27.6 MPa).

Concrete for the drilled shaft below the construction joint shall also conform to the requirements for Class “F” Concrete, except for the following:

- Entrained air will not be allowed
- Accelerators will not be allowed
- Slump shall be at least 6” to 8” (150mm to 200mm) for placement in dry shafts and 8” (200mm) when wet or casing methods are used. Slump shall not exceed 8” (200mm).
- A trial mix study for drilled shaft concrete should include the construction of a graph of slump loss versus time after batching. A proper mix design will maintain a slump of at least 4” (100mm) for at least 4 hours (the 4-inch (100mm) slump value is the minimum at which adequate fluid pressures can be assumed to develop against the sides of the drilled shaft hole). Testing shall be performed at the approximate temperature at which the concrete will exist in the field. An increase in temperature of 18 degrees F. (10 degrees C.) will increase the rate of slump loss by a factor of approximately 2.

Type III cement is prohibited.

Reinforcing steel shall conform to the requirements of Section 6.02 and Article M.06.01.

Anchor rods shall conform to ASTM F1554, Grade 105 (Grade 725). The leveling nuts shall conform to ASTM A563, Heavy Hex Grade DH (A563M, Heavy Hex Class 12). The internal threads of nuts shall be re-tapped after galvanizing to accommodate the increased diameter of the rods. The washers shall conform to ASTM F436 (F436M), Type 1. The rods, nuts and washers shall be galvanized in accordance with ASTM A153 (A153M), Class C. Hooked anchor rods are not permitted. Welding to anchor rods is not permitted.

Anchor plates shall conform to the requirements of AASHTO M270, Grade 50 (Grade 345), galvanized. The Contractor shall not drill holes or perform other operations on plates that are harmful to the galvanizing.

Rigid metal conduit, ground rod sleeves and related hardware and end caps shall be galvanized steel conduit and shall conform to Section M.15.09.

Bare copper grounding conductor shall be #8 AWG stranded bare copper wire conforming to M.15.13. The grounding bolt shall be stainless steel with a hex head.

Ground rods shall be 5/8-inch (16mm) in diameter by 12-feet (3660mm) long copper clad steel. The copper cladding shall be a minimum thickness of 0.128 inches (4mm). The ground rod clamp shall be a square-head bolt type listed for direct soil burial.

Zinc-rich field primer for touch up of galvanized hardware shall conform to the requirements of ASTM A780. The use of aerosol spray cans will not be permitted.

Granular Fill for backfill around formed foundation shall conform to Article M.02.01.

Bituminous concrete shall be as directed by the Engineer.

Topsoil shall conform to Article M.13.01.

Fertilizer shall conform to Article M.13.03.

Seed Mixture shall conform to Article M.13.04.

Mulch Materials shall conform to Article M.13.05.

Any admixtures proposed for use in a bentonite slurry, if used to construct a drilled shaft, shall be approved by the Engineer. Bentonite slurry properties may be adjusted to suit field conditions with the approval of the Engineer. Polymer or other slurry materials may be submitted to the Engineer for review.

### **Construction Methods:**

#### **Submittals:**

The Contractor is required to submit the following:

1. Working Drawings

- The Contractor shall obtain survey elevations of the ground surface at the foundation. He shall submit to the Engineer for approval an elevation view of the foundation showing:
  - The proposed foundation with elevations at the top and bottom of the proposed foundation
  - The proposed elevation at the mandatory construction joint
  - The existing ground elevations at the high and low side of the proposed foundation

The Contractor shall furnish the approved foundation elevations to the reinforcing bar detailer. These elevations shall be included with the foundation reinforcing shop drawings when submitted to the Designer for review.

- The Contractor shall submit a foundation constructability plan which includes the following:

- Access to the area including the following, when applicable:
  - Temporary road
  - Removal of guide rails or concrete barriers
  - Utility locations and drainage installations that could obstruct construction
  - Clearing and grubbing (this shall be accomplished in accordance with Section 2.01)
- Traffic Protection including the following applicable considerations:
  - Temporary guide rails and/or concrete barriers
  - Maintenance and Protection of Traffic Control Plans for work that cannot be accomplished using the Typical Traffic Control Plans (All work to install the camera pole foundation shall be accomplished in accordance with Article 1.08.04 – Prosecution & Progress and item 0971001A- Maintenance & Protection of Traffic unless otherwise approved in writing by the Engineer)
- Drilling procedure including all calculations and specifications associated with the Contractor's proposed drilling procedure and tools and machinery used.
- Fabrication drawings
  - The use of hooked anchor rods is not permitted
  - Welding of anchor rods is not permitted

## 2. Shop Drawings

- The Contractor shall submit shop drawings for the reinforcement including the following:
  - A note indicating that no welding of reinforcement will be allowed.
  - Supplemental cages or ties that will be used to lift the reinforcing cage and prevent distortion. Reinforcing cages shall be tied adequately for handling, but may need internal ties or cages, which shall be detailed for approval. The support bars or cage, if intended to remain in the finished foundation, shall be arranged so as not to interfere with concrete placement. Supplemental cages, if composed of weldable bars, may be welded, but may only be secured to the designed cage by ties. If the Contractor determines that supplemental cages or ties will not be necessary, a note indicating this shall be included on the shop drawings.
- The Contractor shall submit shop drawings for the anchor rods and plates including the following:
  - Material designations
  - Length and diameter of anchor rods
  - Number of anchor rods
  - Thickness and dimensions of anchor plate
  - Anchor rod hole diameters and locations, including bolt circle diameter and edge distance
  - Angular orientation of the anchor rods around the bolt circle
  - Galvanizing requirements

### **Constructing the Drilled Shaft Portion of the Foundation**

The Contractor is responsible for properly locating the foundation. He shall notify the Engineer two weeks before beginning to drill the foundation. Should ledge, high ground water, or unsuitable materials be encountered, the Contractor shall notify the Engineer immediately so the Engineer may determine if relocation or alteration of the foundation is necessary. Bedrock is anticipated to be encountered within the depths of the drilled shafts at the following structures:

- CCTV-691W-05
- CCTV-691E-10
- CCTV-691E-13
- CCTV-91N-02
- CCTV-91S-03
- CCTV-91N-08
- CCTV-66W-14
- CCTV-372-W-01

The top of rock will be considered as the point where rock, defined as bedded deposits and conglomerate deposits exhibiting the physical characteristics and difficulty of rock removal as determined by the Engineer, is encountered which cannot be drilled with earth augers and/or underreaming tools configured to be effective in the soils indicated in the contract documents, and requires the use of special rock augers, core barrels, air tools, blasting, or other methods of hand excavation. Minimum required lengths of rock socket shall be determined from the table provided in the contract plans (refer to Camera Pole Foundation Details) based on the depth to the top of rock from the foundation grade level.

Boulders are anticipated to be encountered within the depths of the drilled shafts at the following structures:

- CCTV-15N-01
- CCTV-691-W-06
- CCTV-691E-07
- CCTV-91S-04

It is the Contractor's responsibility to utilize proper equipment and methodology to drill through the boulders. It should be noted that boulders may also be encountered at other structure locations.

Prior to drilled shaft construction, the grade in the vicinity of the shafts shall be constructed to the finished grade.

This work may require rock excavation, drilling rock or using slurry filled shafts through whatever materials are encountered to reach the depths indicated on the plans and specifications. The Contractor shall submit a sequence plan outlining drilling, casing, slurry, reinforcement and concrete placement procedures for the Engineer to review.

Temporary casing of the drilled shafts may be necessary to prevent sloughing of the granular soils. While the casing is being withdrawn, a sufficient head of concrete shall be maintained above the bottom of the casing, to prevent "necking" of the shaft due to sloughing soils. Concrete placed near

the surface shall be in full contact with the undisturbed soil to provide lateral stability for the full length of the shaft.

Provisions shall be made to minimize surface water infiltration into the shaft excavations.

Construction of drilled shaft shall be in accordance with AASHTO Standard Specifications for Highway Bridges 2002 Division II, Section 5 and with U.S.D.O.T. Publication FHWA-IF-99-025, "Drilled Shafts: Construction Procedures and Design Methods."

The maximum allowable horizontal variation of the center of the top of the drilled shaft from the required location shall be 0.5% of the shaft diameter. The ground surface at each shaft location shall be re-compacted if disturbed during construction in order to minimize lateral deflection of the shafts.

The concrete shaft shall not be out of plumb by more than 1% of the total length.

Should the depth of drilled shaft extend below the depth shown on the plans, a minimum of one half of the longitudinal bars required in the upper portion of the shaft shall be extended the additional length by adding longitudinal reinforcing bars at the bottom of the cage. Tie or spiral bars shall be continued for the extra depth and the stiffener bars shall be extended to the final depth. All longitudinal and transverse bars shall be lap spliced or spliced with mechanical splices. Welding to the reinforcing steel will not be permitted.

Approved cylindrical concrete feet (bottom supports) shall be provided to insure that the bottom of the reinforcing cage is maintained the proper distance above the base.

The drilled shaft concrete shall be placed as soon as possible after the placement of reinforcing steel. Concrete shall be placed to the level of the construction joint shown on the plans. Longitudinal reinforcing shall extend above the construction joint to within 3" (75mm) of the top of foundation.

Casings, if used in drilling operations, shall be removed from the hole. The casing may be removed as concrete is placed provided a 5 foot (1525mm) head of concrete is maintained, or the casing may be removed after the concrete has been poured, provided that the concrete has not been set. Separation of the concrete by hammering or otherwise vibrating the casing during withdrawal operations shall be avoided.

Concrete may be placed by free fall in dry holes if dropped vertically and concrete does not hit the reinforcing, supporting cage or the side walls of the shaft before it reaches the base. Smaller maximum-sized aggregate in the concrete mix will increase cohesion of the mix and discourage segregation. Concrete placement down the center of the shaft shall be directed by use of a hopper and drop chute.

Concrete may be placed in wet installations by tremie or concrete pump. Groundwater may be encountered during drilled shaft construction. So, concrete shall be placed using a concrete pump or tremie pipe in accordance with the specifications. Place concrete in the slurry filled shaft by the tremie method in such a manner that the concrete displaces the slurry from bottom and rises like

a liquid, and mixing of concrete with the slurry will not occur. The concrete shall be placed through a top metal hopper and into a rigid leak-proof elephant trunk tremie pipe sufficiently large enough to permit free flow of concrete. The tremie pipe shall be located so that it can be removed without disturbing the position of the reinforcing. Initially, there shall be a suitable plug at the bottom of the tremie pipe that will not discharge concrete until the concrete head has at least reached the top level of the slurry.

The intent is that bentonite slurry not be permitted to contaminate the concrete as the concrete is initially introduced to the tremie pipe. Thereafter, a positive concrete head shall be maintained throughout. The bottom of the tremie pipe shall be inside the concrete for at least a depth of 60 inches (1524mm), and this depth shall be maintained throughout. The concrete level shall be horizontal during the pouring operations. No horizontal movement of the tremie pipe will be permitted. The concreting of the shaft shall proceed continuously to 12 inches (305mm) above the final top of shaft elevation to produce a monolithic shaft foundation, with uncontaminated concrete for the design shaft length.

Concrete placement shall be continuous from the bottom of drilled shaft to the construction joint at the top. The elapsed time from the beginning of concrete placement in the shaft to the completion of the placement shall not exceed 2 hours. Admixtures such as water reducers, plasticizers, when approved for use, shall be adjusted for the conditions encountered on the job so the concrete remains in a workable plastic state throughout the 2-hour placement limit. Prior to concrete placement, the Contractor shall provide test results of both a trial mix and a slump loss test conducted by an approved testing laboratory using approved methods to demonstrate that the concrete will maintain a minimum slump of 4" (100mm) for 4 hours. Tests shall be conducted at temperatures comparable to those at which the concrete will be placed.

Cross-Hole Sonic Logging (CSL) tests are not required for the CCTV structures because the axial loads are light. Instead, careful records of concrete quantities placed shall be kept and compared with the theoretical quantities.

### **Constructing the Top of the Foundation**

The top portion of the concrete foundation shall be formed and reinforced as shown on the plans. The top surface shall be level within  $\pm 1/8"$  ( $\pm 3\text{mm}$ ). The shape may be round or square as shown to facilitate forming. If a square shape is chosen, additional reinforcing is required to reinforce the corners and flat sides.

The number of conduits in the foundation shall be as shown on the plans. Electrical conduits of the size specified on the plans shall extend 2 feet (610mm) out from the side of the formed portion of the foundation. All conduit ends terminating below grade shall be capped with a malleable iron cap. All above grade conduit ends shall be terminated with an insulated bonding bushing with tinned insert. Conduit caps shall be installed before the concrete is placed and shall remain in place until the cable is installed.

Rigid metal conduit, drain pipe, anchor rods and the anchor plate shall be placed and secured in proper position in the formed portion of the top of foundation. A template shall be used to hold the required anchor rod assembly, ground rod sleeve and conduits in their correct positions. The



orientation of the anchor rods on the bolt circle are important to the positioning of the handhole on the pole. The anchor rod locations shall be in accordance with approved shop drawings. Each anchor rod shall be fitted with two leveling nuts and double nuts above the base plate. Conduits shall extend up from the top of foundation to the height shown on the plans.

Concrete shall be placed in the forms in accordance with the applicable provisions of Subarticle 6.01.03-6.

Curing of the concrete shall be performed in accordance with Subarticle 6.01.03-9.

Forms shall not be removed until after the concrete has hardened properly and not less than 24 hours after the concrete has been placed.

The portions of the foundations that will remain exposed to view shall be finished to the satisfaction of the Engineer and in conformance with the pertinent requirements of Subarticle 6.01.03-10.

The Contractor may install the camera pole after a minimum of 7 days of proper curing of the concrete if he can show that the concrete has reached 3000 psi (21MPa) as confirmed by test cylinders. Concrete cylinders shall be cast, cured and tested in accordance with Subarticle 6.01.03-4. A sufficient number of cylinders shall be cast to enable further testing at a later date if the compressive strength is determined to be below the minimum strength specified.

Where a foundation is placed within or adjacent to a concrete sidewalk, the entire section of sidewalk between joints shall be replaced in accordance with Section 9.21, unless otherwise directed by the Engineer.

The disturbed ground along the access path to the shaft locations shall be restored and protected from erosion within 5 calendar days of the completion of the foundation construction.

**Method of Measurement:**

This work will be measured for payment by the number of foundations completely installed and accepted.

**Basis of Payment:**

The work will be paid for at the contract unit price each for “Traffic Control Foundation - Span Pole – Type C” and “Traffic Control Foundation - Span Pole – Type D” complete in place, which price shall include layout, cutting and removing existing pavement, excavation, drilling, temporary casing, slurry, granular fill, backfill, concrete, reinforcing, anchor rods and plates, nuts and washers, rigid metal conduit sweeps, pvc weepholes, ground rod, ground wire, clamps, bonding bushings and grounding bolts. It shall include construction access path, topsoil, grading, seeding, fertilizing, mulching, riprap, restoration of bituminous concrete sidewalk and pavement surfaces treatments to be restored, as directed by the Engineer, and all materials, equipment, labor, tools and work incidental thereto.

No additional payment will be made for the Contractor to test the slurry when it is used to construct a drilled shaft foundation.

All concrete sidewalk replaced due to foundation installation shall be paid for at the Contract unit price for “Concrete Sidewalk.”

When rock is encountered within the limits of excavation, its removal will be paid for at the Contract unit price per vertical foot (vertical meter) for “Rock-in-Foundation Excavation,” which price includes any additional excavation to remove the rock and any additional concrete required to fill the excavation beyond the designed foundation hole dimensions. Rock-in-foundation excavation is defined as rock in definite ledge formation, boulders, or portions of boulders, cement masonry structures, concrete structures or Portland cement concrete pavement with a cross-sectional area that exceeds 50% of the cross-sectional area of the designed foundation hole.

The protection and restoration (if necessary) of existing underground wiring, conduits, drainage structures, pipes and underdrain systems within the excavation limits will not be paid for separately, but will be included as part of the work.

The removal of existing roadside barrier systems, installation and removal of temporary roadside barrier systems and resetting existing roadside barrier systems will not be paid for separately, but will be included as part of the work.

The restoration of existing surface treatments (pavement, access roads, slope protection, topsoil & seed, etc.) in all areas disturbed by the work will not be paid for separately, but will be included as part of the work. The Engineer will determine the type, thickness and horizontal limits of the surface treatments to be restored.

No direct payment will be made for the work of testing the concrete from the drilled shaft or formed top of foundation in accordance with Subarticle 6.01.05. Concrete cylinder curing boxes will be included under Item #0969062A – Construction Field Office, Medium.

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

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

### **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.

For the 4” (100 mm) PVC conduit, the Contractor shall be required to install the conduit **simultaneously** with the pullboxes to insure that the conduit innerduct on each side of the pullbox is at exactly a 90-degree angle to the side of the pullbox. For Rigid Metal Conduit under Roadway, the Contractor shall be required to install the conduit **simultaneously** with the installation of the pullboxes. For Rigid Metal Conduit under Roadway, the Contractor shall be required to install a minimum of 10 feet (3.0 meters) of Flexible Conduit on each side of the pullbox to insure that the innerduct enters the pullbox at exactly a 90 degree angle to the side of the pullbox. **The cost of the Flexible Metal Conduit shall be included in the cost of the appropriate conduit item; it shall not be paid for separately. The required installation is shown on the IMS details. The required length of Flexible Metal Conduit on each side of a structure shall be as shown on the appropriate detail.**

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. PVC Outerduct:

The complete PVC Type 40 Multi-cell conduit system shall be UL Listed, designed and engineered for direct burial or encased underground applications. Protective outer-duct shall be 4" (100 mm) PVC Type 40 with extended 6" (150 mm) integral bell end and have a lay length of 20 feet (6.1 m). The outer-duct shall have a longitudinal running print line to assure proper innerduct orientation and alignment. This line shall consist of the following wording: "INSTALL THIS SIDE UP – Connecticut D.O.T. Cable – For Assistance Call 860-594-3447". The outer-duct shall be marked with data traceable to plant location, date, shift, and machine of manufacture.

The outer-duct shall have a circumferential ring on the spigot end of the ducts so as to provide a reference point for ensuring the proper insertion depth when connecting conduit ends. Both ends of the conduit shall be capped to protect inner-duct during shipment and job site storage.

The PVC conduit system to be utilized shall be a complete system and the Contractor shall provide the following fittings:

- Coupling Kits
- Terminator Kits
- Lubrication Fittings
- Repair Kits
- Installation Accessories

A complete line of fittings, adapters, and elbows shall be available and shall be manufactured from the same materials and manufacturing process as the conduit. The multi-cell conduit shall be joined by use of a coupling system that effectively seals the outerducts and innerducts but allows for expansion or contraction in the system. A silicone non-petroleum base lubricant may be used for assembly of the multi-cell conduit.

All conduit entering and exiting conduit termination 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 the innerduct.

#### C. Couplings:

The PVC coupling body shall allow for transitions from PVC conduit to RMC conduit to Flexible Sweeps and any combination thereof. The coupling body shall have a factory

assembled, multi-stage gasket that is anti-reversing for sealing both the outer and inner-duct. A secondary, mid-body gasket shall be seated at the shoulder of the bell to assure 100psi (690 kPa) air pressure (in accordance with Bellcore GR-2884 Issue 1) and watertight integrity with minimum joint infiltration of 6 psi (41 kPa ). This will allow for the use of Air-Jet technology to be used in the placing of cables. The PVC conduit system shall be designed so that both straight sections and fittings will assemble without the need for cement or glue.

The coupling body shall be designed so that when the conduit is joined, the outer walls of the innerducts and the inner walls of the outerduct shall be sealed, providing an airtight seal from within the innerduct system and a watertight seal from the outside of the outerduct. The coupling body shall be tested for water tightness and air-tightness in accordance with Bellcore GR-2884-CORE Issue 1, July 1995 (R3-41 for water-tightness and R3-43 for air-tightness). The coupling body shall conform to the following requirements:

Watertightness: 6 psi (41 kPa ) minimum

Air Tightness: no significant leakage at 100 psi (690 kPa )

The system shall be designed so that expansion and contraction of the inner-duct shall take place in the coupling body, and the fittings shall allow going from steel to PVC without compromising air/water tightness, or pulling capabilities. The coupling body shall be factory assembled in the bell end of the outer duct and shall be manufactured from high impact engineered thermoplastic. The coupling body face shall be supplied with lead-ins to facilitate assembly. The coupling body shall have each conduit entrance identified with a raised number and the white inner duct locator conduit entrance shall have raised ribs that can be felt through a glove.

The PVC system shall be designed so that the assembly of components can be accomplished by inserting the spigot end into the male bell end to the marked insertion depth. (The insertion depth is marked on the spigot end)

#### D. Sweeps:

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

<b>Radius</b>	<b>Bend</b>	<b>System</b>
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 PVC outer jacket and be acceptable for exposed and direct burial installation. The inner-duct shall extend 6” out of the spigot end of the flexible elbow. Once the elbow is

bent to the proper angle, the innerducts shall be trimmed to the proper length for insertion to the bell end. PVC inner ducts shall not be allowed in bend and sweeps.

<b>Length</b> Feet (Meters)	<b>Radius</b> Feet (Meters)	<b>Bend</b> degrees (°)	<b>System</b>
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 Bellcore GR-2884 Issue 1 Section R3-35 and R3-36.

#### E. 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.

#### F. 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.

#### G. 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:

<b>Radius</b>	<b>Bend</b>	<b>System</b>
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.



<b>Length</b> Feet (Meters)	<b>Radius</b> Feet (Meters )	<b>Bend</b> degrees (°)	<b>System</b>
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.

#### H. Structure Mounted Conduit Supports

For applications in which the multi-cell conduit system is specified on the plans and/or by the Engineer to be attached to a bridge or other structure, bridge hanger assemblies and conduit support devices shall be required as shown on the details for these attachments. These hanger assemblies and support devices shall be designed for application to the specific bridge or structure for which they will be used, and their materials and design shall be approved by the Department prior to their use.

Threaded rods, anchor bolts, nuts and washers shall conform to ASTM A449 and shall be galvanized in accordance with ASTM A153.

All hex nuts shall be “Prevailing Torque Reusable Type Lock Nuts.”

I. Conduit Testing/Marking Tape:

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.

J. Identification Posts:

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.

K. 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.

PVC conduits entering conduit terminal points shall terminate flush with the inside wall. The inner-duct shall extend 6" (150 mm) from the inside face.

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.

When PVC cannot be installed at the required depth, such as where ledge or rock is encountered, the Contractor shall install Rigid Metal conduit at the maximum depth possible. In areas where the conduit is installed in the shoulder and the required depth cannot be obtained, the conduit shall be installed at a minimum depth of 18" (450 mm) and capped in

concrete. If the Contractor is unable to obtain a minimum depth of 18" (450 mm), the Contractor shall install the conduit as directed by the Engineer.

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 Under Roadway:

For Rigid Metal Conduit under Roadway, the Contractor shall be required to install the conduit **simultaneously** with the installation of the pullboxes and shall be required to install a minimum of 10 feet (3.0 meters) of Flexible Conduit on each side of the pullbox to insure that the innerduct enters the pullbox at exactly a 90 degree angle to the side of the pullbox. The required installation is shown on the IMS details. The required length of Flexible Metal Conduit on each side of a structure shall be as shown on the appropriate detail.

The preferred method of installing steel casing under roadway shall be by veneering or cutting. In areas where the conduit is installed under live traffic, such as a ramp crossing, the conduit will be capped in concrete. In areas where the conduit is installed in the shoulder and the required depth cannot be obtained, the conduit shall be installed at a minimum depth of 18" (0.45 meters) and capped in concrete.

Where veneering or cutting is not possible, and under the direction of the Engineer, the conduit shall be installed by Horizontal Directional Drilling.

#### C. Structure Mounted Conduit Supports

The Contractor will be required to submit to the Engineer for approval a proposal detailing the proposed installation method of the surface mounted conduit including the spacing between the conduit supports. The Contractor shall support the conduit as recommended by the manufacturer and approved by the Engineer.

Surface mounted conduit shall be installed where indicated on the plans; using mounting brackets and/or clamps as detailed on the plans or as directed by the Engineer.

Anchor bolts for conduit supports shall be drilled and anchored into sound concrete only. The anchorage system shall be installed per the manufacturers' recommendations. If existing reinforcement is encountered during drilling, the hole shall be abandoned, filled with non-shrink grout and relocated as directed by the Engineer. After installation of the conduit support, tighten all chemical anchor bolts to the torque as recommended by the anchorage system manufacturer.

#### D. 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.

E. 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.

F. 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 (meters) 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 (meter) 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.

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

### **Description:**

The mainline fiberglass conduit shall be a 4” multi-duct conduit system designed and engineered for installation underneath or on the outside of the parapet of a structure. 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) inner-ducts 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 pull tape as required in the specification.

Work under this item 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:**

The multi-cell conduit system shall be a pre-assembled conduit manufactured from a 4” (100 mm) round outer-duct containing four (4) factory installed 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.

### **Outer-duct:**

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. Fiberglass conduit and fittings shall be supplied with an ultraviolet inhibitor. The color of the outer-duct shall be a gray that matches as close as possible the color of the parapets of the structures. The Contractor will be required to submit a color swatch for approval.

The complete conduit system shall be UL listed, designed and engineered for an outdoor plant application. Protective outer duct shall be filament wound fiberglass reinforced epoxy as manufactured to comply with the specifications outlined in NEMA TC-14 and UL 1684 as noted.

The extra heavy wall fiberglass conduit shall have a minimum wall thickness of ¼ in. (6.35 mm). The extra heavy wall conduit shall prevent the penetration of a .45 caliber slug fired from a distance of 20 feet (6.1 meters). The protective outer-duct shall have extended 6 inch (150 mm) integrally wound bell ends and shall be shipped in a minimum lay length of 20 feet (6.1 meters). The outer-duct shall have a longitudinal running print line to assure proper innerduct orientation and alignment. This line shall consist of the following wording: “Install This Side Up –

Connecticut D.O.T. Cable – For Assistance Call 860-594-3447”. The outer duct shall be marked with data traceable to plant location, date, shift, and machine of manufacture.

PHYSICAL AND MECHANICAL PROPERTIES

TEST METHODS

Ultimate Tensile Strength – 11,000 PSI Min.

ASTM D 2105

Dielectric Strength – 500 Volts/Mil.

ASTM D 149

Water Absorption – 1% Max.

ASTM D 570

Specific Gravity – 1.9-2.0

ASTM D 792

Glass Content – 68 ± 2 %

API SPEC 15 LR

Barcol Hardness – 58-52

ASTM D 2583

The outer duct shall have a circumferential ring on the spigot end of the ducts so as to provide a reference point for ensuring the proper insertion depth when connecting conduit ends. Both ends of the conduit shall be capped to protect innerduct during shipment and job site storage.

The fiberglass conduit system to be utilized shall be a complete system and the Contractor shall provide the following fittings:

- Coupling Kits
- Terminator Kits
- Lubrication Fittings
- Repair Kits
- Installation Accessories

A complete line of fittings, adapters, and elbows shall be available and shall be manufactured from the same materials and manufacturing process as the conduit. The multi-cell conduit shall be joined by use of a coupling system that effectively seals the outer-ducts and innerducts but allows for expansion or contraction in the system.

All multi-cell conduit entering and exiting conduit termination 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 the innerduct.

Couplings:

The couplings shall allow for transitions from fiberglass conduit to rigid metal conduit to flexible sweeps to PVC conduit and any combination thereof. The coupling body shall have a factory assembled, multi-stage gasket that is anti-reversing for sealing both the outer and innerduct. A secondary, mid-body gasket shall be seated at the shoulder of the bell to assure 100 psi (690 kPa) air pressure in accordance with Telcordia (formerly Bellcore) GR 2884 Issue 1 and watertight integrity with minimum joint infiltration of 6 psi (41 kPa). This will allow for the use of Air-Jet technology to be used in the placing of cables.

The coupling body shall be designed so that when the conduit is joined, the outer walls of the innerducts and the inner walls of the outerduct shall be sealed, providing an airtight seal from within the innerduct system and a watertight seal from the outside of the outerduct. The coupling body shall be tested for water tightness and air-tightness in accordance with Telcordia



GR-2884-CORE Issue 1, July 1995 (R3-41 for water-tightness and R3-43 for air-tightness). The coupling body shall conform to the following requirements:

- Water tightness: 6 psi (41 kPa) minimum
- Air Tightness: no significant leakage at 100 psi (690 kPa).

The system shall be designed so that expansion and contraction of the inner-duct shall take place in the coupling body, and the fittings shall allow going from steel to PVC without compromising air/water tightness, or pulling capabilities. The coupling body shall be factory assembled in the bell end of the outer duct and shall be manufactured from high impact engineered thermoplastic. The coupling body face shall be supplied with lead-ins to facilitate assembly. The coupling body shall have each conduit entrance identified with a raised number and the white inner duct locator conduit entrance shall have raised ribs that can be felt through a glove.

The conduit 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. Tighten set screws

Flexible Sweeps:

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

<b>Radius</b>	<b>Bend</b>	<b>System</b>
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.

<b>Length</b> Feet (Meters)	<b>Radius</b> Feet (Meters )	<b>Bend</b> degrees (°)	<b>System</b>
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 movable spacer every 4 feet (1.32 m). The bends shall not violate the minimum bend radius of the fiber optic cable to be installed.

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

Innerduct:

The innerducts 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 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.

Conduit Testing:

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

The pull tape shall consist of polyethylene or PVC jacket woven into the polyester tape. The pull tape shall be NEPTCO Part No. WP1250P, or approved equal, for cable sizes of less than 97 fibers. NEPTCO Part No. WP1800P, or approved equal, shall be used for cable size of 97-288 fibers.

The pull tape shall have the following properties:

- Proper tensile strength for the required fiber installation, or 1250 lbs. (5.55kN) minimum
- 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

### Structure Mounted Conduit Supports

For applications in which the multi-cell conduit system is specified on the plans and/or by the Engineer to be attached to a bridge or other structure, bridge hanger assemblies and conduit support devices shall be required as shown on the details for these attachments. These hanger assemblies and support devices shall be designed for application to the specific bridge or structure for which they will be used, and their materials and design shall be approved by the Department prior to their use.

Threaded rods, anchor bolts, nuts and washers shall conform to ASTM A449 and shall be galvanized in accordance with ASTM A153.

All hex nuts shall be “Prevailing Torque Reusable Type Lock Nuts.”

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

When the Contractor core drills through abutment back walls, wing walls and retaining walls, the conduit within the wall shall be Rigid Metal. Fiberglass conduit will only be installed underneath the structure, not within the walls. Rigid Metal conduit shall be galvanized steel conforming to Section M.15.09 of the standard specifications.

### Construction Methods

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.

Fiberglass conduit shall extend 2” (50 mm) into the manhole/vault/pullbox for installation of grounded end bushings.

Conduits and innerduct entering conduit terminal points or where terminated in trench, shall be capped or sealed to prevent ingress of water and debris into the conduit. At each conduit terminal point, a PVC coupling body with an anti-reversing gasket that seals between the innerduct and the conduit shall be used. Conduits containing innerduct shall be plugged using a quadplex expansion plug inside the conduit around the innerduct. Each innerduct shall be sealed with an expanding Neoprene Plug that withstands 22 psi (150 kPa) and seals the innerduct from

water and debris infiltration, and a provision for tying off a pull line. Innerduct containing one cable shall be plugged using an expandable cable seal off.

#### Structure Mounted Conduit Supports

The Contractor will be required to submit to the Engineer for approval a proposal detailing the proposed installation method of the surface mounted conduit including the spacing between the conduit supports. The Contractor shall support the conduit as recommended by the manufacturer and approved by the Engineer.

Surface mounted conduit shall be installed where indicated on the plans; using mounting brackets and/or clamps as detailed on the plans or as directed by the Engineer.

Anchor bolts for conduit supports shall be drilled and anchored into sound concrete only. The anchorage system shall be installed per the manufacturers' recommendations. If existing reinforcement is encountered during drilling, the hole shall be abandoned, filled with non-shrink grout and relocated as directed by the Engineer. After installation of the conduit support, tighten all chemical anchor bolts to the torque as recommended by the anchorage system manufacturer.

#### 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.

#### Pull Tape

The Contractor shall install pull tape, by hand pulling, blowing, or via vacuum method, into each empty conduit and empty cell within the multi-cell conduit. The intention of this installation 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. The Contractor shall neatly coil and secure 10 ft. (3 meters) of slacked pull tape in each vault location.

The pull tape shall be field installed within each innerduct for the purpose of attaching to, and pulling of, the fiber optic cable.

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' X 3' (55 cm by 91 cm) standard plan sheets. 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 (meters) of the type and size installed and accepted. Expansion fittings, fixed and flexible sweep-bends, 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.

Core drilling through abutment back walls, wing walls and retaining walls, including the placement of the joint seal around the conduit at the front and rear face of the walls shall be included in the cost of the Fiberglass conduit of the type and size specified. The Rigid Metal conduit within the walls shall be measured for payment by the actual number of feet (meters) of the type and size installed and accepted.

All work necessary to complete the attachment of the conduit, including but not limited to mounting brackets, clamps, hangers, anchors, bolts, etc. to the structures, will not be measured for payment but shall be included in the pay item for the conduit.

The pull tape and 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 (meter) 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, bedding material, boxes, caps, pull-rope, inserts, warning

tape, ground wire, identification posts with signs, structural supports, equipment, tools, labor and work incidental thereto.

Trenching and backfilling shall be paid separately as specified in Section 10.01 of the Standard Specifications.

## **ITEM #1008907A – CLEAN EXISTING CONDUIT**

### **Description:**

The work under this item shall consist of cleaning existing conduit, as required, as shown on the plans or as directed by the Engineer to facilitate installation of new cable.

### **Construction Methods:**

The Contractor shall remove all existing cable from conduit that will be reused. The contractor will be directed to clean the conduit which has obstructions or is found to be impassable. This cleaning process shall be by one of the following methods:

- 1) Rodding
- 2) A high pressure jet spray, or air pressure
- 3) By pulling a mandral or ball through the conduit.

The Contractor shall submit in writing his anticipated method of cleaning the conduit to the Engineer for approval prior to cleaning any conduit.

If the conduit is found to be damaged to any extent that the cleaning process will not clear the obstruction, it will be the judgment of the Engineer whether to replace the entire conduit run or excavate the damaged section for repair.

### **Method Of Measurement:**

This work shall be measured for payment on an hourly basis based on the actual number of hours for the Contractor's forces, regardless of the number of employees, rendering services in accordance with these specifications. Payment will be made only for those hours when the Contractor's employee(s) is performing work. No travel time will be paid.

### **Basis Of Payment:**

The work under the Item "Clean Existing Conduit" shall be paid for at the contract unit price per hourly basis, which price shall include all cleaning, material, tools, equipment, all labor, and work incidental thereto.

When it is determined by the Engineer to repair or replace damaged sections of existing conduit, the work involved in the replacement of the conduit will be paid separately under the appropriate contract item(s) for Repair Multiduct Conduit, Rigid Metal Conduit, RMC Multiduct Conduit, PVC Conduit, Trenching and Backfilling, and the applicable restoration items.

## **ITEM #1008910A – MULTIDUCT CONDUIT REPAIR**

### **Description:**

The work under this item shall consist of repairing damaged sections of existing multiduct conduit or innerduct as directed by the Engineer to facilitate installation of new fiber optic cable in the duct system.

### **Materials:**

Materials used for backfilling excavations around conduit repairs shall conform to the requirements of Section 10.01.02.

### **Construction Methods:**

Prior to the installation of new fiber optic cable in spare innerducts of existing multiduct conduit, the Contractor shall verify the condition of the spare innerduct in which the fiber optic cable is to be installed and identify any possible obstructions. This work shall be performed in accordance with the requirements of the respective items for Optical Fiber Cable, Single Mode, Loose Buffer Tube Cable.

If the conduit innerduct is found to be damaged or impassable to any extent that the cleaning process will not clear the obstruction, the Engineer will determine whether the conduit is to be repaired or replaced. Where the Engineer determines that the conduit should be replaced, work will be performed under separate items.

When directed by the Engineer to repair the damaged or impassable section of multiduct conduit or innerduct, the Contractor shall submit in writing to the Engineer a detailed procedure for the multiduct conduit repairs, identifying all procedures, equipment and materials that will be utilized for his work.

The Contractor shall excavate below the existing conduit and to a sufficient distance to either side of the damage so as to expose the obstructed portion and determine the length of the multiduct conduit that will need to be removed for the repair. The Contractor shall remove the damaged segment of multiduct conduit taking care not to damage the existing innerducts. As necessary, damaged segments of innerduct for the proposed fiber optic cable shall be cut-out and removed and repaired utilizing a split duct system, or other approved method as detailed in the Contractor's approved procedure.

Prior to making repairs to innerduct, the Contractor shall take steps to verify the integrity of remaining multiduct conduit to either side of the damaged section.



Following the repairs to the innerduct, the section of multiduct conduit that was removed shall be repaired utilizing a split duct system, or other approved method as outlined in the Contractor's approved procedure.

The excavation shall be backfilled in conformance with the requirements of Section 10.01.03 of the Standard Specifications. Topsoil shall be provided in conformance to Section 9.44.03 of the Standard Specifications. Turf Establishment shall conform to Section 9.50.03 of the Standard Specifications.

**Method of Measurement:**

This item shall be measured for payment as provided under Article 1.09.04 – Extra and Cost Plus Work.

The sum of money shown on the estimate and in the itemized proposal as "Estimated Cost" for Repair Multiduct Conduit will be considered the price bid even though payment will be made only for actual work performed. The estimated cost figure is not to be altered in any manner by the bidder. Should the bidder alter the amount shown, the altered figures will be disregarded and the original price will be used to determine the total amount bid for the contract.

**Basis of Payment:**

This work will be paid on a cost-plus basis according to Article 1.09.04 – Extra and Cost Plus Work. There will be no payment for maintenance and protection of traffic for work associated with this item unless, in the opinion of the Engineer, the sole purpose of the maintenance and protection of traffic is for repair of the multiduct conduit.

The cleaning of the existing innerduct and identification of any damaged or impassable sections will be paid under Item #1008907A - Cleaning Existing Conduit.

When it is determined by the Engineer to replace entire damaged sections of existing multiduct conduit, the work involved in the replacement of the conduit will be paid separately under the appropriate contract item(s) for RMC Multiduct Conduit, Trenching and Backfilling, and any applicable restoration items.

<u>Pay Item</u>	<u>Pay Unit</u>
Multiduct Conduit Repair	est. (est.)

## **ITEM #1009016A – 18” X 12” X 8” CAST IRON JUNCTION BOX**

### **Description:**

This item shall consist of furnishing and installing cast iron junction boxes at locations shown on the plans or as directed by the Engineer and in accordance with these specifications.

### **Materials:**

Cast Iron Junction Boxes shall conform to the material requirements of Article M.15.10. The junction boxes shall be 18” high X 12” wide X 8” deep and shall include a screened  $\frac{3}{4}$ ” drain hole located at the bottom of the box along the 12” wide dimension. The drain hole shall include woven insect screen to prevent insects and bees from entering the box. The screen shall be fastened inside the box.

The junction box cover shall be attached with approved stainless steel bolts, sealing washers and lock washers. The cover shall be equipped with a neoprene or rubber cover gasket and shall include a minimum of eight (8)  $\frac{1}{4}$ ” X 1” bolted connections securing the cover to the junction box. All stainless steel hardware shall conform to the requirements of ASTM 304.

### **Construction Methods:**

The junction boxes shall be mounted as shown on the plans or as directed by the Engineer. All hardware used in conjunction with mounting of these boxes shall be rust and corrosion resistant.

The junction box shall be installed at a higher elevation than its conduit connected handhole or pullbox to prevent the ingress of water into the junction box.

Conduit knockouts shall be made in the junction box by an approved method recommended by the manufacturer. Diameter of the knockouts shall be no larger than the minimum diameter required to accept the size conduit specified on the plans.

All conduits are to be secured to the junction box using the washers, locknuts, and bushings as detailed on the plans or as recommended by the manufacturer.

The junction box shall be installed where as the drain hole is at the bottom of the box facing the ground.

All excess concrete shall be removed from the junction box cover, recessed bolt holes, and bolt heads.

**Method of Measurement:**

The work for this item will be measured for payment by the number of cast iron junction boxes of the size specified, complete and accepted in place.

**Basis of Payment:**

This work will be paid for at the Contract unit price each for "Cast Iron Junction Box" of the size specified, complete in place, which price shall include all materials, box, cover, gasket, drain pipe, drain hole screen, cover bolts, necessary fittings and hardware, including that necessary for mounting, removal of excess concrete, all equipment, tools and labor incidental thereto.

**ITEM #1014503A – TRANSFORMER 5 KVA 240V - 120V****Description:**

The work under this item shall consist of furnishing and installing a transformer of the type specified herein, on the outside of the proposed Electrical Service Cabinets and/or Traffic Management System Cabinets (TMSC) as shown on the plans or as directed by the Engineer.

**Materials:**

Transformers shall be the type and size required to provide for the necessary functions listed herein. The Contractor shall submit for approval the specifications for the transformer to be used, prior to the start of work for the installation of the cabinets. The transformer shall be a one-piece, dry type, 5 KVA, single phase, with a 2:1 winding ratio, and rated for nominal 240V at both the primary and secondary windings. The transformer shall be designed for step-down application. A full-capacity rated center tap shall be made available at the low-voltage winding, so that it can be used for providing a 240V/120V split-phase output.

The transformer shall be UL listed for outdoor use and shall be suitable for salt-spray conditions prevalent along the expressway. The transformer shall be housed in a weatherproof, corrosion resistant enclosure capable of mounting on the TMSC and have an approved thermal installation system to minimize heat transmitted to the cabinet. Conduit knockouts shall be provided as required. The transformer shall be equipped with ANSI standard leads. The transformer ratings shall meet the applicable ANSI/NEMA Standards for specialty transformers.

**Other Requirements:**

- Typical impedance at 60hz: 3% to 7%;
- Transformer efficiencies meet levels defined in DOE 10 CFR part 431 effective on January 1st, 2016;
- Transformer in-rush currents shall not exceed 15 times full load Ampere (FLA) current rating. Excitation current shall be maximum 3% of FLA rating;
- Insulation class F: 180°C system with Average Temperature Rise of 115°C or lower;
- Provide transformer taps, 2 x +2.5%, per NEMA ST 20;
- Core construction: high grade non-aging, fully processed silicon steel laminations or better;
- Coil conductors shall be copper windings, with terminations brazed, welded or bolted;
- Impregnation: vacuum pressure impregnated core and coils;
- Core & coil assembly shall be grounded to enclosure with a flexible copper grounding strap or equivalent. Ventilation slots shall not be blocked;
- Neutral conductor for the split-phase 240V/120V winding must be rated for 125% FLA;

- Transformer enclosure shall be ventilated, steel, type NEMA 3R, with ANSI 61 grey enclosure finish suitable for outdoor applications;
- Transformer shall be suitable for environments with salt spray conditions.
- Primary and secondary terminations shall have terminals on the same side of the transformer, mounted on insulated supports;
- Anti-vibration pads/isolators shall be used between the transformer core and coil and the enclosure;
- Transformer shall be UL listed, built to NEMA ST-20 and in accordance with all applicable UL, and ANSI/IEEE standards;

**Construction Methods:**

The transformer shall be mounted on the TMSC or electrical service cabinet per the manufacturer's specifications and as directed by the Engineer. The Contractor is to verify the requirements of the system for the transformer to be utilized.

The transformer shall be mounted on the side of the TMSC or electrical service cabinet which is away from the traffic flow of the adjacent roadway to minimize vehicle spray during wet conditions. The transformer shall be mounted such that the mounting brackets, bolts or hardware do not conflict with the internal hardware of the cabinets.

The transformer shall have rigid metal conduit and all associated fittings, and couplings for the service cable.

**Method of Measurement:**

This work will be measured for payment by the number of transformers of the type specified, installed, completed, operating and accepted in place.

**Basis of Payment:**

This work will be paid for at the contract unit price for each "Transformer 5 KVA 240V - 120V" complete and accepted in place which price shall include the transformer, enclosure, all required conduit, fittings, couplings, internal wiring, mounting brackets, mounting hardware, drilling for mounting brackets, material, equipment, tools, labor and incidental thereto.

**ITEM #1015041A – PULLBOX**

**ITEM #1015044A – ELECTRIC VAULT (IMS)**

**Description:**

Vaults and Pullboxes for IMS are defined as structures implemented to facilitate cable installation, splicing and excess cable storage. Vaults and Pullboxes are generally located at intermediate locations to facilitate cable installation. This item shall consist of furnishing and installing concrete structures of the design and dimensions indicated in the details or as ordered by the Engineer, and in conformity with these specifications. Vaults and Pullboxes installed underground may be precast or cast-in-place.

**Materials:**

All vaults, pullboxes and associated components shall comply with industry standards for communications applications and be of suitable construction for installation in an off-highway environment. Work in this section shall meet or exceed the applicable provisions of the following documents:

1. AASHTO HS 20-44 rating
2. AASHTO M-199.
3. ASTM C857-83, Minimum Structural Design Loading for Underground Precast Concrete Utility Structures.
4. ASTM C858-83, Underground Precast Concrete Utility Structures.

All vaults shall include the following provisions:

1. A sump 12” (300 mm) in diameter.
2. Four ¾” (19mm) diameter pulling inserts in the floor.
3. 8 Unistruts of the length indicated on the plans.
4. Knockouts located on each wall, aligned to as close to the center of the vault as possible, to facilitate cable pull-through or change in direction.
5. The galvanized steel cover with frame shall conform to Article M.08.02 of the Standard Specifications. The assembled steel covers shall include a locking mechanism that will not allow the covers to open more than 120 deg. from the closed position.
6. The steel covers shall be installed flush with the top of the concrete structure.
7. The minimum thickness of the vault walls shall be 6” (150 mm).

All pullboxes shall include the following provisions:

1. "C" Channel of length indicated.
2. Four  $\frac{3}{4}$ " (19mm) diameter pulling inserts in the floor.
3. Knockouts, located on each wall, aligned as close to the center of the pullbox as possible, to facilitate cable pull through or direction change.
4. The galvanized steel cover with frame shall conform to Article M.08.02 of the Standard Specifications. The assembled steel covers shall include a locking mechanism that will not allow the covers to open more than 120 deg. from the closed position.
5. The steel covers shall be installed flush with the top of the concrete structure.
6. The minimum thickness of the pullbox walls shall be 4" (100mm).

Vaults, Pullboxes and covers shall have a vertical proof-load strength of 25,000 lbf (110,000 Newtons) in accordance with Federal Specification RR-F-621e. The vaults and pullboxes shall be reinforced with a galvanized Z-bar welded frame and cover. Frames shall be anchored to the boxes by means of  $\frac{1}{4}$ " x 2" (6.25 mm x 51-mm) long concrete anchors. Hold down screws shall be  $\frac{3}{8}$ " (9.5-mm) hex head screws of Type 316 stainless steel. The nut shall be zinc plated carbon steel and shall be made vibration resistant with a wedge ramp at the root of the thread. The nut shall be spot welded to the underside of, or fabricated with, the galvanized Z-bar pull box frame.

Steel covers shall be countersunk approximately  $\frac{1}{4}$ " (6.35 mm) to accommodate the bolt head. The bolt head shall not extend more than  $\frac{1}{8}$ " (3.2 mm) above the top of the cover when tightened down. A  $\frac{1}{4}$ " (6.35- mm) tapped hole and brass-bonding screw shall be provided.

After the installation of the precast units, the steel covers shall be installed and kept bolted down during periods when work is not actively in progress. When placing the steel cover for the final time, the cover and the Z-bar frame shall be cleaned of all debris and securely tightened down. Each pullbox supplied shall be secured with two bolt down locking hex bolts.

### **Construction Methods:**

The Contractor shall contact DOT Highway Operations to conduct a walk-through of the project limits and to stake out the proposed locations of vaults, or pullboxes prior to installation.

All dimensions and exact locations of existing underground substructures and utilities shall be field verified by the Contractor prior to committing any materials or any excavation. Following are the parameters required for the execution of work in this section:

1. Excavation shall be performed in accordance with Article 2.02 of the Standard Specifications.
2. All pre-cast units shall be installed on a level foundation of granular fill, compacted.

3. All pre-cast units shall be installed at grade in paved areas, and one (1) inch (25 mm) above grade in unpaved areas.
4. Backfill shall consist of good compactable material as prescribed in Section M.02 of the Standard Specifications. In no case shall the material be saturated soil, or contain large rocks, or chunks.
5. All pre-cast units shall be free of debris and ready for cable installation.

The Contractor shall provide the excavation into which the individual components shall be lowered. The excavation shall allow for overall assembled height plus added height of risers, manhole castings, etc., and bedding material consisting of a minimum of 6" (150 mm) of granular fill, compacted conforming to Article 2.13 of the Standard Specifications. A minimum clearance of 6" (150 mm) around the sidewalls of the manhole shall be provided. The excavation hole shall not contain water during the installation. Where found during excavation, unsuitable material shall be excavated as directed by the Engineer and replaced with granular fill, compacted.

All spare conduits and innerducts shall be sealed by means of reusable mechanical plugs. The Contractor shall use extreme care with the cables especially with regard to the minimum bending limitations.

When all cables at each pre-cast unit are securely racked, the void areas around the conduits or innerducts containing cables shall be sealed using reusable mechanical plugs.

**Method of Measurement:**

This work shall be measured for payment by the number of electric vaults (IMS) or pullboxes of the type specified, complete and accepted in-place.

**Basis of Payment:**

This work shall be paid for at the contract unit price each for "Electric Vault (IMS)" or "Pullbox", complete in-place, which price shall include all materials, concrete, steel cover, locks, pulling irons, conduit plugs, appurtenances, dewatering, any excavation, granular fill, backfilling, replacement of pavement, including grading and placing topsoil, seeding, fertilizing, mulching and all equipment, tools, labor and work incidental thereto.



## **ITEM #1017032A – SERVICE (METERED)**

### **Description:**

Furnish and install a metered electric service at the location shown on the plans or as directed by the Engineer.

### **Materials:**

- Meter Socket
  - UL listed
  - Manual lever bypass
  - Locking metal cover for the glass enclosure
  - Contact the serving utility company for a list of approved meter sockets
- Conduit Bond Clamp
  - UL listed
  - Rated for direct burial

### **Locations served by Eversource (formerly Connecticut Light and Power Co.)**

Meter socket rated at 200 amps.

Enclosure capable of accepting a 3 inch (75 mm) rigid metal conduit (RMC).

### **Construction Methods:**

Comply with the National Electric Code (NEC), the Department of Public Utilities Control (DPUC), and the serving power company requirements. Install a meter socket with associated equipment on the outside of the controller cabinet or service cabinet, as shown on the plans. Mount the enclosure approximately 54 inches (1.37 meters) above the ground. Install an expansion fitting in the RMC between the ground and the enclosure. Attach a direct-buried bond clamp to the service RMC below ground level, adjacent to the foundation. Bond the service conduit to the controller/service cabinet ground rod. Install a continuous nylon pull rope of at least 200 lbs (90 Kg) breaking strength in the conduit between the meter socket and the service source.

Meter will be furnished and installed by the utility company. Ensure all circuit breakers are off when service is connected by the utility company. The work must be inspected and approved by the Engineer or his designated representative prior to scheduling a service connection. Record the meter number and the date service is connected for billing purposes.

### **Service Request**

- Traffic Signal on State Road: Contact the CT DOT Traffic Electrical office to complete the necessary service request forms.
- Traffic Signal on Town Road: Complete all necessary request forms and forward to the appropriate power company office.

- Incident Management Site: Complete all necessary request forms and forward to the appropriate power company office.

For additional requirements, refer to Notice to Contractor – Service Connections (Utilities)

**Method of Measurement:**

The installation of the Service (Metered) will be measured for payment by the number of metered electric services of the type specified, completed, with service connected, and accepted in place.

**Basis of Payment:**

This work will be paid for at the contract unit price each for "Service (Metered)" complete and accepted in place. The price shall include all material above ground such as the meter socket enclosure, RMC between the ground and the enclosure, expansion fittings, coupling, and load side service conductors. The price shall also include direct-buried ground clamp, bonding wire, pull rope, all material, equipment, tools, labor, and incidentals necessary.

Work for coordinating and scheduling new electrical service to the meter will be included under Item #1017034A – Install Service.

## **ITEM #1017033A – SERVICE CABINET**

### **Description:**

The work under this item shall consist of furnishing and installing a complete service cabinet of the type specified at the locations shown on the plans or as directed by the Engineer and in accordance with these specifications.

### **Materials:**

The service cabinet shall be manufactured to NEMA type 3R requirements of an aluminum alloy wall thickness of 3 mm, with a hinged weatherproof gasketed door, stainless steel handle and tumbler-type Conn-1 lock. The pedestal mounted cabinet shall be approximately 36 inches high, 16 inches deep, and 20 inches wide in size or the equipment in volume.

The foundation shall conform to Section 10.02.

The pedestal shall conform to Section 11.02, 3' Aluminum Pedestal.

Ground rod shall conform to Article M.15.15-7.

Trenching and Backfilling shall conform to Section 10.01.

Rigid Metal Conduit shall conform to Section 10.08.

Cable shall conform to Section 11.13 and these specifications.

A meter socket shall be provided on the outside of the service cabinet and shall be paid for under its contract item.

A 3/4 inch marine-grade plywood backboard painted black shall be provided.

A neutral and ground bus bar shall be mounted in the rear of the cabinet.

The circuit breakers shall be thermal magnetic type. The number of poles, voltage rating and current ratings shall be as shown on the plans.

**Construction Methods:**

The Contractor shall completely install the conduit, foundation, pedestal, cabinet, wiring, circuit breakers, bus bars, backboard and required equipment as indicated on the plans or as directed by the Engineer. The Contractor shall install the service cabinet at locations shown on the plans or as directed by the Engineer. The Contractor shall install in the pedestal foundation one spare 2” RMC conduit sweep.

The service cabinet should be located behind metal beam rail, beyond fixed objects such as proposed wood poles or utility poles, abutments and beyond the travel way. The location of the service cabinet should not create an obstacle in the sight line of vehicles traveling on the adjacent roadways. The location of the service cabinet shall be adjusted with respect to roadway geometry as directed by the Engineer.

The service cabinet shall provide power to a VMS cabinet as indicated on the plans.

**Method of Measurement:**

This work will be measured for payment by the number of Service Cabinets installed, complete and accepted. Each service cabinet will be measured for payment regardless of single or multiple services.

**Basis of Payment:**

This work will be paid for at the contract unit price each for "Service Cabinet" complete and accepted in place which price shall include the cabinet, trenching and backfilling, foundation, pedestal, circuit breakers, bus bars, backboard, conduit, cable, and all equipment, tools, labor, and work incidental thereto.

Meter socket shall be paid separately under Item 1017032A – Service (Metered).

## **ITEM #1017034A – INSTALL SERVICE**

### **Description:**

The work under this item shall consist of the Contractor coordinating and scheduling the service installations/connections of the electrical service by the Utility Company from the utility service source to the meter socket on the service cabinet, Traffic Management System (TMS) cabinet, Traffic Management System Mini Hub (TMSMH) cabinet, Variable Message Sign (VMS) cabinet, or direct service connection from a cabinet or location with metered service to the TMS, TMSMH and VMS cabinets. This work will also entail installation of the meter by the Utility Company, installation of riser conduit, installation of utility poles, installation of primary and secondary conductors, installation of transformers and transformer pads, and installation of conductors underground between the utility service source and the meter socket on the service, TMS, TMSMH or VMS. The work shall also include energizing the metered or unmetered service connection.

The Utility Company may render a service charge to the Contractor for installation and connection of underground services. These charges are to be paid for under this item. This item will include all associated utility work to have power installed into the meter socket and energized. The IMS site plans detail in general the work that needs to be accomplished. The work detailed on the IMS site plans and specified herein will be paid for under this item.

### **Materials:**

The materials for this work shall conform to the special provisions herein, utility specifications and the National Electrical Code.

### **Construction Methods:**

The Contractor may install the service only after contacting and obtaining approval from the Utility Company. A representative of the Utility Company must be present for work involved with installing electric service from a manhole or pad mounted transformer/transclosure, unless otherwise directed by the Utility Company.

Under this item, the Contractor shall verify the load requirements of the system components for each TMS, TMSMH and VMS location and notify the Engineer of any potential changes in electric service that may result in inadequate service connections. The Contractor shall verify the type and size of electric service cable to be used for electric service from a cabinet or location with metered service to the TMS, TMSMH and VMS cabinets, as shown on the site plans.

The Contractor shall contact the Utility Company representatives listed on the site plans at least 30 days in advance to coordinate the service connection work to be performed by the Contractor and the Utility Company. The date the service is connected and energized shall be recorded for billing purposes and provided to the Engineer or his designated representative. All work

performed by the Contractor under this item shall be in accordance with serving power company requirements, the Department of Public Utilities Control (DPUC), and the National Electrical Code. The Contractor shall obtain the necessary utility specifications prior to any service work.

The Contractor shall make all arrangements with the utility company and complete the required service request forms for all service locations.

For additional Utility Service Company requirements, refer to Notice to Contractor – Service Connections (Utilities).

Billing for the monthly energy charges shall be to the following:

State of Connecticut Department of Transportation  
P.O. Box 317546  
Newington, CT 06131-7546

This item shall include all required service conductors on the load side of the meter socket.

All circuit breakers in the cabinet shall be off when service is connected by the utility company.

At all locations, the new cabinet electrical service installation shall be inspected and approved by the Engineer or his designated representative prior to the service being energized. The Contractor shall contact Luis Calderon, ConnDOT Property and Facility Services, to schedule this inspection.

**Method of Measurement:**

This work will be measured for payment by the number of electric services installed, energized, complete and accepted by the Engineer and Utility Company.

**Basis of Payment:**

This work will be paid for at the contract unit price for each "Install Service", complete, energized and accepted in place, which shall include meter, service conductors between utility service source and meter socket, riser conduit, utility poles, primary conductors, secondary conductors, transformers, transformer pads, all Utility Company charges, and all materials, equipment, tools, labor and incidentals thereto.

Meter socket enclosure, RMC between the ground and the TMS, TMSMH or VMS Cabinet (including expansion fittings and couplings), and load side service conductors will be paid separately under Item #1017032A – Service (Metered).

## **ITEM #1017051A – SERVICE REVISION**

### **Description:**

The work under this item shall consist of revisions to an existing service cabinet to install new circuit breakers of the type specified at the locations shown on the plans or as directed by the Engineer and in accordance with these specifications.

### **Materials:**

Conductors shall conform to Section 10.12 and Article M.15.11 shall be type XHHW-2 rated for 600 volts. Conductors shall be sized as indicated on the plans.

The circuit breakers shall be thermal magnetic type. The number of poles, voltage rating and current ratings shall be as shown on the plans. See Drawing Title Typical Electrical and ATC Details.

### **Construction Methods:**

At existing service cabinets where the existing metered service shall be retained, the Contractor shall install a new Single pole (120V) circuit breaker for CCTV Traffic Management System Cabinets (TMSC) rated for 50 Amps.

The circuit breakers and service cables shall be clearly marked in the cabinet for their use and future identification.

### **Method of Measurement:**

This work will be measured for payment by the number of existing service cabinets revised, complete and accepted. Each service cabinet will be measured for payment regardless of single or multiple services.

### **Basis of Payment:**

This work will be paid for at the contract unit price each for "Service Revision" complete, which price shall include all conductors, circuit breakers and all materials, tools, equipment, labor and work incidental thereto.

**ITEM #1050106A – MOTORIST AID VARIABLE MESSAGE SIGN - TYPE A**

**ITEM #1050107A – MOTORIST AID VARIABLE MESSAGE SIGN - TYPE B**

**DESCRIPTION:**

The work under this item shall consist of the following:

Furnishing and installing a Variable Message Sign (VMS), Field Controller and Field Controller Cabinet completely wired;

Furnishing and installing the associated communications and power between each sign and controller, inside conduit provided separately;

Furnishing of spare equipment;

Furnishing and installing the supplied VMS housing on sign supports (sign supports supplied as part of other items in this Contract);

Testing of each completed Motorist Aid Variable Message Sign

**MATERIALS:**

The following VMS components shall be supplied as part of this contract item:

**VARIABLE MESSAGE SIGNS**

Two (2) types of variable message signs shall be supplied in accordance with these specifications, and are hereby designated as Types A and B.

**Type A – Daktronics Vanguard® VMS Model No. VF-2120-27x65-12-46-A**

The Type A VMS shall contain a full LED pixel matrix comprised of 27 pixel rows by 65 pixel columns. Pixels are located on 1.75-inch (46mm) horizontal and vertical centers. The display is a continuous and unbroken matrix of pixels, both horizontally and vertically.

Type A VMS shall have 12” (305 mm) character height and text messages shall be legible to a viewing distance of 600 feet (183 m). This legibility distance shall apply:

For character font heights of 12 inches (305 mm) and higher

During all normally encountered weather and lighting conditions, all times of the day

During dawn and dusk hours when sunlight is shining directly on the display face or when the sun is shining from directly behind the VMS



The display matrix should nominally display three lines of 12-inch (305-mm) text based on a standard 7x5 font.

**Type B – Daktronics Vanguard VMS Model No. VF-2120-27x65-66-A**

The Type B VMS shall contain a full LED pixel matrix comprised of 27 pixel rows by 65 pixel columns. Pixels are located on 2.6-inch (66mm) horizontal and vertical centers. The display is a continuous and unbroken matrix of pixels, both horizontally and vertically.

Type B VMS shall have an 18” (450 mm) character height and text messages shall be legible to a distance of 1,000 feet (305 meters) from the sign face. This legibility distance shall apply:

For character font heights of 18 inches (450 mm) and higher  
During all normally encountered weather and lighting conditions, all times of the day  
During dawn and dusk hours when sunlight is shining directly on the display face or when the sun is shining from directly behind the VMS

The display matrix should nominally display three lines of 18-inch (450-mm) text based on a standard 7x5 font.

**GENERAL**

All VMS shall meet the following requirements:

The maximum dimensions of VMS housings shall not exceed:

72” H x 162” W x 16” D (1810 mm H x 4115 mm W x 404 mm D) for Type A VMS  
94” H x 217” W x 16” D (2393 mm H x 5519 mm W x 404 mm D) for Type B VMS

The maximum weight of each VMS, including all internal components and mounting hardware, shall not exceed:

1500 lb (680 kg) for Type A VMS  
1700 lb (773 kg) for Type B VMS

All VMS housing side walls shall be vertical. LED display modules shall be mounted parallel to the front VMS wall.

The total VMS AC power requirements shall not exceed:

2900 watts for Type A VMS  
3600 watts for Type B VMS

Power consumption shall include the following fully-loaded circuits:

LED display (all pixels on at maximum drive current)  
VMS environmental control (vent. fans, etc.), with fans at in rush current level  
Utility outlets fully loaded

The VMS housing shall be constructed to have a neat, professional appearance. The housing shall protect internal components from rain, ice, dust, and corrosion in accordance with NEMA enclosure Type 3R standards, as described in *NEMA Standards Publication 250, Enclosures for Electrical Equipment (1000 Volts Maximum)*.

All VMS and field controller components shall be 100% solid-state, except for the ventilation fans and external interconnects.

All VMS and field controller components shall properly operate throughout a minimum temperature range of -29 to +165° F (-34 to +74° C) and a relative humidity range of 0% to 95%, non-condensing. All VMS and field controller components shall not be damaged by temporary exposure to temperatures of -40 to +185° F (-40 to +85° C).

All high voltage electrical components (exceeding 24 volts DC) used in the VMS and the field controller shall be UL (Underwriter's Laboratory) listed and meet all local NEC codes applicable to VMS applications.

VMS component mounting hardware (nuts, bolts, screws, standoffs, rivets, fasteners, etc.) shall be fabricated from stainless steel, aluminum, nylon, or other durable corrosion-resistant materials suitable for the roadway signage application.

The presence of ambient radio signals, magnetic or electromagnetic interference (including that from nearby power lines), transformers and motors shall not impair performance of the VMS system. The VMS system shall not radiate electro-magnetic signals that adversely affect any other electronic device, including those located in vehicles passing underneath or otherwise near the VMS and its sign controller.

## **LED DISPLAY MODULE**

VMS pixels will be constructed with discrete LEDs manufactured by Avago Technologies (formerly Agilent Technologies), Toshiba Corporation, Nichia Corporation, or equivalent.. This LED shall conform to the following minimum requirements:

- A high-intensity, solid state lamp utilizing Aluminum Indium Gallium Phosphide (AlInGap) technology.
- LED lens shall be un-tinted and non-diffusing.

- The LED packages shall be fabricated from UV light resistant epoxy.
- LED lens diameter shall be 5 millimeters (or T 1-3/4).
- The LED manufacturer shall assure color uniformity and consistency on the LED display face within the 30 degree cone of vision. Inconsistent color shifts or intensity will be cause for rejection.
- The LED manufacturer shall perform intensity sorting of the bins. LEDs shall be obtained from no more than two (2) consecutive luminous intensity “bins” as defined by the LED manufacturer.
- The LED manufacturer shall perform color sorting of the bins. LEDs shall be obtained from no more than two (2) consecutive color “bins” as defined by the LED manufacturer.
- The various LED color and intensity bins shall be distributed evenly throughout the sign and shall be consistent from pixel to pixel. Random distribution of the LED bins shall not be accepted.
- Each pixel will contain the quantity of discrete amber LEDs needed to output a minimum luminous intensity of 9,200 candelas per square meter when measured using a photometric meter through the VMS front face panel assembly. Failure to conform to the requirements will be cause for rejection.
- Peak wavelength of emitted light shall be  $590 \pm 5$  nanometers.
- LED operating temperature range shall be  $-40$  to  $+120^{\circ}\text{C}$  ( $-40$  to  $+248^{\circ}\text{F}$ ), and storage temperature range shall be  $-40$  to  $+120^{\circ}\text{C}$  ( $-40$  to  $+248^{\circ}\text{F}$ ).
- LED's shall have a minimum half-power viewing angle of  $30^{\circ}$ . Half-power viewing angle is defined such that, at a given distance from the LED, luminous intensity measured at any point at an angle of  $15^{\circ}$  from the LED's center axis is no less than half the luminous intensity measured directly on the LED's center axis. Using optical lenses with 15 degree LED's will not conform to 30 degree half-power viewing cone specifications and will be cause for rejection.
- LED package style shall be through-hole flush-mount type, and all LED's shall be soldered with the base of their lens mounted within 0.254 mm (0.010 inches) of the printed circuit board. Through-hole LEDs with standoffs or surface-mount LEDs will not be accepted.
- The LEDs shall be rated by the LED manufacturer to have a minimum lifetime of 100,000 hours of continuous operation while maintaining a minimum of 70% of the original brightness.

Each VMS shall be constructed with multiple display circuit boards, each of which contains five (5) LED pixels horizontally and nine (9) pixels vertically. Each pixel, which is defined as the smallest programmable portion of a display matrix, shall consist of a minimum of eight (8) closely spaced discrete LED's for 18" signs and a minimum of four (4) closely spaced discrete LED's for the 12" signs and shall conform to the following requirements:

- Each pixel shall consist of two electrically parallel strings of six LED's for the 18" signs and two strings of three LED's for the 12" signs. LED string forward current shall be limited to 30 milliamps, whenever a forward voltage is applied.
- The failure of an LED string shall not cause a change in the performance of the other LED string in its pixel, nor shall it cause the failure of any other LED string in the VMS. Similarly, the failure of a given pixel shall not cause the failure of any other pixel in the VMS.
- Each LED pixel shall emit a minimum luminous intensity of 40 candelas for the 18" signs and 18 candelas for the 12" signs when driven with a forward current of 30 milliamps DC per LED string. This shall create an overall display matrix luminance of at least 9,200 candelas per square meter.
- Discrete LED's shall be mounted perpendicular to their PC boards. Any variations in discrete LED color and intensity shall be thoroughly dispersed throughout the entire display, thereby creating a uniform appearance of both color and intensity from pixel to pixel.
- The 9x5 pixel board's printed circuit laminate shall meet all IPC standards. The pixel boards shall be Woven FR-4 fiberglass and has a minimum thickness of 0.063 inches (1.5 mm) +/- .005 inches (0.127mm). Printed circuit board through-holes shall be plated with a minimum copper thickness of 314 ml per square meter (one ounce per square foot) of plated area.
- The printed circuit board through-hole for each LED cathode lead shall be connected to a large copper trace pad having an approximate surface area of 25.8 square mm (0.04 square inches) and shall meet IPC Standards. The trace pads shall dissipate heat from the LED's and shall be presented on both the front and backsides of the LED pixel board. The cathode lead shall be the heat dissipation path for LED's.
- All exposed metal on both sides of the LED pixel board, except the signal power connectors, shall be protected from water and humidity exposure by a thorough application of acrylic conformal coating. Bench level repairs to individual pixels, including discrete LED replacement and conformal coating repair, shall be possible.

- Individual addressing of the each LED display module shall be configured via the communication wiring harness and connector. No on-board addressing jumpers or switches shall be allowed.
- The LED driver circuitry shall be able to measure the forward current of each LED pixel and determine if the pixel is functioning normally. This information shall be reportable to both the VMS Central Control Software and the Laptop (Local) Control Software.
- All LED pixel boards shall be identical and interchangeable throughout the VMS

LED's shall be driven using Pulse Width Modulation (PWM) within the LED manufacture's specifications, where pulse width is used to achieve the proper LED intensity level for a given ambient lighting condition. Multiplexing of LED's, or other types of current pulses which exceed 30 milliamps in amplitude, shall not be used.

The current pulse shall be modulated from a 1.024-millisecond period; the pulse amplitude shall not exceed 30 milliamps per LED string. All pixels which are constructed with two electrically parallel strings shall not exceed 60 milliamps.

The LED display shall process a minimum data refresh rate of 10 frames per second.

Each LED display module shall be mounted to the rear of the display's front face panels using durable non-corrosive hardware. No tools shall be required for module removal and replacement. The modules shall be mounted such that the LEDs emit light through the face panel's pixel holes and such that the face panel does not block any part of the viewing cone of any of the LEDs in any pixels. The use of lenses to achieve defined viewing cone shall be cause for rejection.

An electronic driver circuitry shall be provided for each 9-high by 5-wide (9x5) LED pixel module and shall control all 45 pixels on that module. The LED driver electronics shall be integrated into the LED pixel module..

Each LED driver circuitry shall be microprocessor-controlled and shall communicate with the sign controller on a wire or fiber optic communication network using an addressable network protocol. The microprocessor shall process commands from the sign controller to display data, perform diagnostic tests, and report pixel and diagnostic status.

Constant current LED driver ICs shall be used to prevent LED forward current from exceeding the LED manufacturer's recommended forward current whenever a forward voltage is applied. To maximize LED service life, LED drive currents will not be allowed that exceed the manufacturer's recommendations for the 100,000-hour lifetime requirement

The LED driver circuit shall contain a seven segment numeric LED display that indicates the functional status of the LED pixel display module. At a minimum, it shall indicate error

states of the LED pixels and communication network. The indicator shall be positioned such that a maintenance technician can easily view the status code for diagnostic purposes. The LED display module shall report the status, including pixel errors, voltage levels, etc to the sign controller upon request.

Display modules and all associated components shall be easily replaceable through the VMS housing rear access doors. Display modules shall mount securely to a support frame located inside the sign housing. Module removal and replacement shall be accomplished without the use of any hand tools.

All display module electrical connections shall be the quick-disconnect locking connector type. Removal of a 9x5 display module from the VMS shall not require de-soldering.

Removal of a 9x5 LED module from the VMS shall neither affect the display functionality of any other portion of the VMS, nor shall it affect the structural integrity of the VMS in any way.

## **REGULATED DC POWER SUPPLIES**

The LED pixel display modules will be powered with auto-ranging regulated switching power supplies that convert the incoming AC to DC at a nominal voltage of 24 volts DC. Power supplies will be wired in a redundant parallel configuration that uses multiple supplies for the VMS display matrix.

Power supplies will be arranged in redundant pairs within the display such that each pair supplies power to a defined region of the sign. Each pair of power supplies will contain two (2) physically and electrically independent supplies. Each pair of power supplies shall be parallel, but will not be wired in a current sharing configuration.

Power supplies within each pair shall be redundant and rated such that if one supply fails, the remaining supply shall be able to operate 100% of the pixels in that display region at 100% brightness when the internal VMS air temperature is +140°F (60°C) or less.

The power supplies shall be sufficient to maintain the appropriate LED display intensity throughout the entire operating input voltage range.

The output of each power supply will be connected to multiple circuits that provide power to the LED modules. Each output circuit will not exceed 15 amperes and will be fused.

Each group of power supplies will be monitored by a microprocessor-controlled circuit. This circuit shall monitor the voltage of each power supply and the status of each output circuit's fuse. The power supply voltages and fuse states will be reported via a CAN (controller area network) communication network to the sign controller upon request.

The power supplies used to power the LED pixel modules will be identical and interchangeable throughout the VMS.

The power supplies used to power the LED pixel modules shall be have an application of acrylic conformal coating, to protect from the environmental elements, and must be UL listed.

The regulated DC power supplies shall conform to the following specifications:

- Nominal output voltage of 24 VDC +/- 10%
- Nominal maximum output power rating of 1000 watts
- Operating input voltage range shall be a minimum of 90 to 260 VAC
- Operating temperature range shall be a minimum of -30°F to +165°F (-34°C to +74°C)
- Maximum output power rating shall be maintained over a minimum temperature range of -30°F to +140°F (-34°C to +60°C)
- Power supply efficiency shall be a minimum of 80%
- Power factor rating shall be a minimum of 0.95
- Power supply input circuit shall be fused
- Automatic output shut down and restart if the power supply overheats or one of the following output faults occurs: over-voltage, short circuit, or over-current
- Power supplies shall be UL listed
- Printed circuit boards shall be protected by an acrylic conformal coating

## **VMS HOUSING**

The VMS housing shall provide rear service access for all LED display modules, electronics, power supplies, environmental control equipment, air filters, wiring, and other internal VMS components.

The VMS housing structural frame shall consist of aluminum extrusions made from 6061-T6 and/or 6063-T6 aluminum alloy. All sides of the VMS housing exterior, except the front, shall be covered with 0.125-inch (3.17 mm) thick aluminum sheets made from 5052-H32 aluminum alloy. This external aluminum skin shall be attached to the structural framework using a proven method of attachment.

VMS housing right, left, front, and rear walls shall be vertical. The bottom wall shall be horizontal. The top wall shall be tilted using a minimum six-degree slope from front to back to facilitate water runoff.

VMS structural assembly hardware (nuts, bolts, washers, and direct tension indicators) shall be galvanized A325 high-strength steel and shall be appropriately sized for the application.

## **WELDING**

The aluminum skin shall be welded to the VMS cabinet frame. All exterior sheet seams shall be continuously seam welded to the VMS frame to form a single structure. Stitch welding shall be used on the interior of the cabinet to attach the aluminum skin sheets to the aluminum extrusion frame. The VMS housing shall be welded and inspected in accordance with the requirements to the latest revision of *ANSI/AWS D1.2 Structural Welding Code-Aluminum*. Compliance with this standard shall include, but shall not be limited to, the following:

- Welding shall be performed according to documented in-house welding procedures
- Personnel who perform welding on the VMS housing shall be certified to *AWS D1.23* for all weld types required for housing fabrication
- A Certified Welding Inspector (CWI) shall inspect VMS welding on a daily basis and shall complete written reports that document welding progress, weld integrity, and any corrective action taken. The VMS manufacturer shall archive these reports and make them available for review, upon request of the Engineer.

### **CHEMICAL BONDING**

An alternate method of attaching the aluminum sheet to the cabinet extrusion shall be the use of a two-part chemically bonding structural adhesive. The adhesive shall be applied in a continuous bead on all cabinet extrusion surfaces that contact the aluminum sheet. The adhesive shall provide the necessary structural bond between the aluminum sheet and the cabinet extrusion as required by the contract specifications and other pertinent standards and codes. The adhesive shall ensure a watertight seal is obtained around the entire perimeter of the cabinet and where any aluminum sheets are spliced.

To ensure that appropriate procedures are followed to bond the aluminum sheet and cabinet extrusion, the structural adhesive manufacturer shall certify the VMS manufacturer. The VMS manufacturer is responsible for performing all necessary testing of the adhesive to meet all requirements of the contract specifications.

### **MOUNTING BRACKETS**

Multiple mounting brackets in the form of Z-bar extrusions shall be bolted to the VMS housing exterior rear wall to facilitate attachment of the VMS to the support structure. Mounting brackets shall be:

- Extruded from aluminum alloy number 6061-T6
- Attached to the VMS structural frame members, not just the exterior sheet metal
- Installed at the VMS manufacturer's factory
- Attached to the VMS using mechanically galvanized A325 high-strength steel bolts
- Attached to the VMS using direct tension indicators to verify that mounting hardware is tightened with the proper amount of force
- Installed such that all bracket-to-VMS attachment points are sealed and water-tight



- Designed and fabricated such that the installing contractor can drill into them without penetrating the VMS housing and compromising the housing's ability to shed water

## **LIFTING HARDWARE**

For moving and installation purposes, multiple galvanized steel lifting eyebolts shall be attached to the top of the VMS housing. Eyebolt hardware shall attach directly to the VMS housing structural frame and be installed at the VMS factory. All mounting points for eyebolts shall be sealed to prevent water from entering the VMS housing. Lifting hardware, as well as the housing frame, shall be designed such that the VMS can be shipped and handled without damage or excessive stress being applied to the housing prior to or during VMS installation on its support structure.

The lifting eyebolts shall be easily removed by one individual without opening or entering the display and without any risk of compromising water-tightness. Special tools shall not be required. Removal of the eyebolts shall not create holes and no replacement bolts or other hardware shall be necessary to seal the cabinet

## **FRONT FACE CONTRUCTION**

The VMS front face shall be constructed with multiple rigid panels, each of which supports and protects a full-height section of the LED display matrix. The panels shall be fabricated using aluminum sheeting on the exterior and polycarbonate sheeting on the interior of the panel.

Front face panels shall provide a high-contrast background for the VMS display matrix. The aluminum mask of each panel shall be painted black and shall contain an opening for each pixel. Openings shall be large enough to not block any portion of the viewing cones of the LEDs.

Face panels shall be attached to each other using stainless steel hardware. Seams that separate adjacent panels shall be sealed. Panels shall not be welded or otherwise permanently mounted to the VMS housing. Panels shall be mounted in such a way that they are removable from the interior of the VMS housing.

Each panel shall have a single polycarbonate sheet attached securely to the inside of the aluminum panel. The polycarbonate sheet shall cover all of the pixel openings. The polycarbonate shall be sealed to prevent water and other elements from entering the VMS. The polycarbonate shall contain UV inhibitors that protect the LED display matrix from the effects of ultraviolet light exposure and prevent premature aging of the polycarbonate itself. The use of a plastic lens system will not meet the requirements and will be cause for rejection. Polycarbonate sheets shall have the following characteristics:

- Tensile Strength, Ultimate: 10,000 PSI (69 MPa)
- Tensile Strength, Yield: 9,300 PSI (64 MPa)
- Tensile Strain at Break: 125%

- Tensile Modulus: 330,000 PSI (2275 MPa)
- Flexural Modulus: 330,000 PSI (2275 MPa)
- Impact Strength, Izod (1/8", notched): 17 ft-lbs/inch of notch (908 J/meter)
- Rockwell Hardness: M75, R118
- Heat Deflection Temperature Under Load: 264 PSI at 270F (1800 kPa at 132C) and 66 PSI at 288F (455 kPa at 142C)
- Coefficient of Thermal Expansion:  $3.9 \times 10^{-5}$  in/in/F ( $7.0 \times 10^{-5}$  cm/cm/C)
- Specific Heat: 0.30 BTU/lb/F (1.25 kJ/kg/C)
- Initial Light Transmittance: 85% minimum
- Change in Light Transmittance, 3 years exposure in a Southern latitude: 3%
- Change in Yellowness Index, 3 years exposure in a Southern latitude: less than 5%

LED display modules shall mount to the inside of the VMS front face panels. No tools shall be needed for removal and replacement of LED display modules.

VMS front face borders (top, bottom, left side, and right side), which surround the front face panels and LED display matrix, shall be painted black to maximize display contrast and legibility.

In the presence of wind, the VMS front face shall not distort in a manner that adversely affects LED message legibility.

VMS housings shall be constructed to present a clean, neat appearance, and the components located within are protected from rain, snow, dirt, and corrosion. Sign housing floors shall possess small weep holes for draining any water that accumulates due to internal condensation. Weep holes shall be screened to prevent the entrance of insects.

The VMS housing and all associated components shall be designed and constructed so that maintenance is performed from the rear side of the VMS housing.

## **SERVICE ACCESS**

The VMS housing shall provide safe and convenient access to all modular assemblies, components, wiring, and subsystems located within the VMS housing. All of those internal components shall be removable and replaceable by a single technician.

One (1) access door shall be provided for each 15 to 25 pixel wide section of the sign housing. One (1) door shall also be provided for accessing the load center and sign control electronics. These doors shall hang from an overhead track and slide horizontally on rollers to provide access to the sign interior. Each door shall have two sets of wheels that roll in the overhead track.

The doors shall be retained to prevent them from falling off or blowing around in the wind when in the open position. Hinged or removable doors shall not be acceptable. To prevent

interference with the sign mounting structure, the doors shall not extend beyond the Z-bar mounting extrusions when in the open or closed position.

Each door shall cover an opening that is a minimum of 27-inches (686 mm) wide and 54-inches (1,372 mm) high. When in the open position, the door shall not obstruct any portion of the opening. Ventilation hoods and closed doors shall not obstruct the opening of any door. The doors shall not interfere with the flow of air through the ventilation hoods.

Each door shall contain a minimum of six (6) quarter-turn latches. To prevent unauthorized access to the cabinet, the doors shall require the use of a non-standard key tool. Screwdriver or hex-head tools shall not be used for activating the latches. The latches shall pull the door tight and compress a gasket located around the perimeter of each door. The gasket shall prevent water from entering the cabinet around doors.

Type A VMS access and housing doors shall have an approximate opening dimension of 43.5 inches (1105 mm) high by 18.75 inches (476 mm) wide. Equipment access doors shall have an opening dimension of 43.5 inches (1105 mm) high by 24.75 inches (629 mm) wide.

Type B and C VMS housing doors shall have an approximate opening dimension of 64.5 inches (1700 mm) high by 33 inches (838 mm) wide. Equipment access doors shall have an opening dimension of 64.5 inches (1700 mm) high by 28 inches (711 mm) wide.

Wiring for LED display modules and other components shall be installed in the VMS housing in a neat and professional manner, and shall not impede the removal of LED modules, power supplies, environmental control equipment, or other VMS components. The insulation color and numerical labeling of all conductors shall correspond to VMS power and signal schematics.

Wiring diagrams shall be provided in the VMS maintenance manual.

## **EXTERIOR FINISH**

VMS front face panels and front face border pieces shall be coated with semi-gloss black Kynar 500 resin, which has an expected outdoor service life of 10 to 15 years.

All other VMS housing surfaces, including the access doors and VMS mounting brackets, shall be natural mill-finish aluminum.

The VMS housing shall not have the manufacturer's name, trademark or other identification information displayed on the outside surfaces.

## **VMS HOUSING ENVIRONMENTAL CONTROL**

The VMS shall contain a electronically controlled ventilation system and a failsafe thermostat designed to keep the internal VMS air temperature lower than +140°F (+60°C), when the outdoor ambient temperature is +115°F (+46°C) or less.

The ventilation system shall consist of two or more air intake ports. Intake ports shall be located near the bottom of the VMS rear wall. Each intake port shall be covered with a filter that removes airborne particles measuring 500 microns in diameter and larger. One or more ball bearing-type fans shall be mounted at each intake port. These fans shall positively pressure the VMS cabinet.

Fans and air filters shall be removable and replaceable from inside the VMS housing. To ease serviceability, the fans shall be mounted no more than four (4) feet from the floor of the VMS cabinet.

The ventilation system shall move air across the rear of the LED modules in a manner such that heat is dissipated from the LED's. The airflow shall move from the bottom of the cabinet towards the top to work with natural convection to move heat away from the modules.

Each exhaust port shall be located near the top of the rear VMS wall. One exhaust port shall be provided for each air intake port. All exhaust port openings shall be screened to prevent the entrance of insects and small animals.

An aluminum hood attached to the rear wall of the VMS shall cover each air intake and exhaust port. All intakes and exhaust hoods shall be thoroughly sealed to prevent water from entering the VMS.

## **ENVIROMENTAL MONITORING SYSTEM**

The VMS shall include sensors that monitor and report ambient (external) light level and temperature, as well as the internal temperature and humidity.

Sensors that measure the outdoor ambient light level and the outdoor ambient temperature at the VMS site shall be mounted in-line with the VMS housing walls. This ambient light and temperature measurement system shall consist of three (3) electronic light sensors.

Two of the light sensors shall be placed such that they measure the ambient light levels striking the front and rear of the VMS. The third light sensor shall be mounted to the floor of the VMS housing and shall face the ground. The VMS sign controller shall continuously monitor the light sensors and adjust the LED display matrix intensity to a level that creates a legible message on the VMS face.

A minimum of one (1) ambient temperature sensor shall be mounted to the rear wall of the VMS housing. The sensor shall be placed such that it is never in direct contact with sunlight. The external temperature sensor reading shall be continuously monitored by the VMS sign controller and shall be reported to the VMS control software upon request.

The VMS shall contain a minimum of one (1) temperature sensor. The sensor(s) shall measure the temperature of the air in the cabinet over a minimum range of -40°F to +176°F (-40°C to +80°C). The internal temperature sensor output shall be continuously monitored by the VMS sign controller and shall be reported to the VMS control software upon request.

## **FIELD CONTROLLER TO VMS COMMUNICATIONS**

Communications between the field controller and VMS shall utilize multi-mode Outdoor Fiber Optic Cable and patch panels supplied as part of this item.

The contractor installing fiber optic communications components must meet all requirements for “Approval of Fiber-Optic Cable Installation, Splicing and Testing”, as detailed in Notice To Contractor Installation Qualifications. Qualifications for fiber optic cable installation, splicing, and testing shall be submitted to the department for approval as detailed in the Notice To Contractor Installation Qualifications.

1. The Outdoor Fiber Optic Cable shall be stranded loose buffer tube cable with a minimum of six (6) strands of 50µm multimode fiber; two or four for active communications and two or four for spare use. Each end of the six strands shall be terminated using the appropriate outdoor rated spider kit with ST connectors and tested for proper installation.
2. The optical fiber cable shall be an accepted product of the United States Department of Agriculture Rural Utilities Service (RUS) 7 CFR 1755.900 and meet the requirements of the ANSI-ICEA Standard for Fiber Optic Outside Plant Communications Cable, ANSI/ICEA S-87-640-1992.
3. Outdoor Fiber Optic Cable shall meet the Material requirements of Item 1113604A – Optical Fiber Cable, Single Mode, Loose Buffer Tube Cable, 6 Fiber.

All fiber optic communications components, such as connectors, installation kits, patch panels, patch cords etc. shall also be included as part of this item and must be submitted for approval by the department. The fiber splice and optical budget loss shall meet all requirements to successfully communicate between the sign and field controller. Each of the six fibers shall be tested for proper operation after installation, and to ensure that the performance meets the VMS manufacturer’s requirements.

## **FIELD CONTROLLER**

Each VMS shall be supplied with an associated field (local) controller, which shall be installed in a base-mounted control equipment cabinet located near the sign and as shown on the plans.

The sign controller shall be a stand-alone microprocessor-based system, which does not require continuous communication with the VMS control software in order to perform most VMS control functions. The field controller shall meet the following requirements:

- Communicate using embedded NTCIP protocol
- Contain memory for storing changeable and permanent messages, schedules, and other necessary files for controller operation
- Include a front panel user interface with LCD and keypad for direct operation and diagnostics
- Environmentally-resistant enclosure
- EIA 19-inch (480 mm) equipment rack mount
- 120 VAC operation
- Contain a minimum of three (3) NTCIP-compliant RS232 communication ports
- Contain a minimum of one (1) NTCIP-compliant Ethernet port with RJ45 connector
- Contain a minimum of one (1) NTCIP-compliant RS422 communication port with RJ45 connector
- Have the ability to play volatile messages
- Contain a built-in Hayes-compatible modem with standard RJ11 connector
- Contain VMS-specific control firmware (embedded software) that shall monitor all external and internal sensors and communication inputs and control the display modules as directed by external control software and the front panel interface
- Operate over a temperature range of -30 to +165° F (-34 to +74° C)
- Integrated watchdog timer circuit
- Communication to the VMS via fiber-optic and hard-wire interface ports.
- All printed circuit boards shall be sealed with an acrylic conformal coating

## Memory

Field controllers shall have both permanent and changeable memory. Permanent memory shall be in the form of non-volatile memory and contain the executable field controller software and default communication and power failure messages. This memory shall be formed by a combination of Flash ROM and battery-backed static RAM integrated circuits that retain the data in memory for a minimum of 30 days following a power failure. Changeable memory shall contain the library of messages, the message display schedule and programmable operating parameters. Each message has the capability to be defined and stored as a six-frame message. The field controller shall store a minimum of 500 changeable messages.

## Front Panel User Interface

The field controller front panel shall include a menu driven architecture, 16-button keypad and a 64x240 graphical LCD. These devices shall be used to perform the following functions:

- Monitor the current status of the field controller, including the status of all sensors and a representation of the message visible on the display face including the use of graphical messages
- Perform all diagnostics testing of various system components, including pixels, power systems, sensors, and more
- Activate, create, preview, and delete messages stored in memory
- Blank the sign
- Start and stop the schedule
- Configure display parameters, including display size and color technology
- Configure date and time
- Configure communications port settings and NTCIP options
- Select automatic or manual brightness mode of operation

The front panel interface shall include:

- Power switch to turn the controller on and off and an LED “on” indicator
- A “local/remote” switch with an LED indicator that places the controller in local mode such that it can be controlled from the front panel interface, instead of via the primary communication channel
- Reset switch to quickly restart the controller
- LED “Active” indicator blinks when the controller is operating
- LED to indicate when any of the NTCIP communication channels are active
- A front-mounted RS-232 serial communication port (“Local”) for connecting a laptop directly to the controller.

### Serial Communication Ports

The VMS sign controller shall contain a minimum of three (3) NTCIP-compatible RS232 communication ports. These ports shall support multiple communication interfaces, including, but not limited to, direct null-modem (for local laptop control), dial-up and leased-line modems, radio systems, cellular modems, and fiber optic modems. The RS232 ports shall all have standard DB9M connectors.

The baud rate, connection type, and NTCIP communication protocol shall be configurable. Each port must support all typical serial baud rates ranging from 1200 to 115,200 baud. All three ports shall be capable of supporting either of the following sub network profiles: NTCIP 2101 (PMPP) or NTCIP 2103 (PPP). They shall also be capable of supporting either NTCIP 2201 (Null) or NTCIP 2202 (Internet) transport profiles. Only one each of the transport and sub network profiles shall be active at any time on each port.

Each port’s default settings shall be set as listed below:

<u>Baud Rate</u>	<u>Connection Type</u>	<u>NTCIP Sub network Profile</u>	<u>NTCIP Transport Profile</u>
9600	Direct	NTCIP 2101 – PMPP	NTCIP 2201 – Null

## **Ethernet Port**

The field controller shall contain one (1) 10/100 base-T Ethernet communication port. This port shall be available for optional use for communicating from the central control system to the VMS field controller when an Ethernet network is available.

Communications on this port shall be NTCIP-compatible using the NTCIP 2202 Internet transport profile and the NTCIP 2104 Ethernet sub network profile. This shall permit the controller to be operated on any typical Ethernet network using the TCP/IP and UDP/IP protocols.

## **Dial-Up Modem Communication Port**

The VMS sign controller shall include one (1) built-in Hayes-compatible dial-up modem or include one external modem. The external modem shall be a sixnet model VT-1. The modem port shall have a standard RJ11 and serial DB-9 connector. The sixnet model VT-1 shall include a 120V AC to 12V DC power supply that shall be hardened. The sixnet modem shall include rack mounting hardware.

This modem shall be configured to support either the NTCIP 2101 (PMPP). At least one of the following transport profiles shall also be available for configuration: NTCIP 2201 (Null) or NTCIP 2202 (Internet). Only one each of the transport and sub network profiles shall be active at any time on the port.

The modem shall be configurable to support both incoming and outgoing calls as supported by NTCIP. The modem shall support a minimum communication speed range from 1200 baud to 28,800 baud. The modem shall support the following protocols at a minimum: Hayes-compatible "AT" command set, MNP5, MNP10, and V.42bis.

## **Clock**

The field controller shall contain a computer-readable time-of-year clock that has a lithium battery backup. The battery shall keep the clock operating properly for 10 years without external power, and the clock shall automatically adjust for daylight savings time and leap year. The clock shall be set by the field controller's microprocessor, and it is accurate to within 1 minute per month.

## **Display Interface**

The field controller shall transmit and receive data packets to and from a distribution board. The distribution board shall communicate with all sensors, drivers, and other devices using multiple networks running throughout the VMS.



Data transferred shall include pixel states, sensor values, and I/O readings from various devices, such as door sensors and power supply monitors. Pixel data shall include the states to be displayed on the sign face as well as diagnostic data retrieved from the LED drivers.

Communication from the field controller to the distribution board shall be using fiber optic cables that connect at the rear of the field controller. The controller shall also have optional copper connections as an alternative to the fiber optic interface.

### **VMS field controller software – messages**

The field controller shall receive its instructions in the following ways:

Remotely - via non-switched or dial-up communications from the Central Control (In-Station) Software. A minimum of two RS-232 ports shall be provided on each field controller.

Locally - via direct laptop computer connection (RS-232) to the field controller (via an RS-232 diagnostic port).

The field controller shall not require continuous communication with the Central Control Software in order to perform certain VMS control functions. Each VMS shall be able to display the following types of messages:

Static Message - The selected message is displayed continuously on the sign face until the field controller blanks the sign or affects the display of another message.

Flashing Message - All or part of a message is displayed and blanked alternately at rates from as fast as 3 flashes per second to as slow as 1 flash per 10 seconds. The flash rate is programmable in increments of 0.1 seconds.

Multiple-Frame Messages - The displayed message can consist of up to six different frames, with each frame containing up to 3 lines of text. Each message frame can be displayed in user-programmable durations of 0.5 seconds or greater, adjustable in increments of 0.1 seconds.

VMS shall be capable of displaying messages composed of any combination of alphanumeric character fonts, punctuation symbols, and graphical pictures. This includes the following character fonts and shapes:

“A” through “Z” - as upper and lower case letters, having a vertical height of seven (7) pixels and higher

“0” through “9” - as decimal digits, having a vertical height of seven (7) pixels and higher

A blank or space

Eight (8) directional arrows

Punctuation marks as follows: . , ! ? - ‘ ’ ” ’ / ( )

Special characters as follows: # & \* + < >.

The VMS shall be able to display a minimum of the following alphanumeric character fonts:

7x5 single stroke - seven (7) pixel rows high by five (5) pixel columns wide, with a single-pixel stroke width and a minimum of one (1) pixel columns of inter-character spacing.

7x6 double stroke - seven (7) pixel rows high by six (6) pixel columns wide, with a two-pixel stroke width and a minimum of one (1) pixel columns of inter-character spacing.

7x4 single stroke variable width

11x7 double stroke - eleven (11) pixel rows high by eleven (7) pixel columns wide, with a two-pixel stroke width and a minimum of one (1) pixel columns of inter-character spacing.

Proportional fonts shall be provided as the default setting when displaying messages.

Inter-line spacing for different character fonts shall be variable and selectable.

The field controller shall handle such details as centering text on a display line, right justification, left justification, and legible spacing of letters and words. The software shall include a mechanism to allow the selection of a particular font style.

The field controller shall be capable of implementing a message selected from those stored in its memory, based upon date and time as specified by a message schedule feature.

Display of a scheduled message shall be overridden by instructions sent from a Central Control (In-Station) Software operator. A Central Computer or Laptop (Local) Computer shall be able to cause the field controller to implement a particular message that is selected from those stored in its memory, or a new message entered via the control software.

Software shall incorporate fail-safe procedures to check messages received and shall not change a message stored in memory, change the message currently displayed on the sign, change the schedule stored in memory, unless the new message is correctly received.

Normally, a displayed message shall remain on the sign until either a command to change the current message or a schedule stored in the field controller's memory indicates that it is time for a different message. However, it shall be possible to confer a "priority" status onto any message, and a command to display a priority message shall overwrite any non-priority message being displayed.

Each VMS and field controller shall contain an LED intensity control system. Field controller analysis of VMS photo-sensor ambient light measurements automatically shall determine which pre-programmed LED intensity level will provide the best VMS legibility for the measured ambient light condition. The LED intensity control system shall not cause any visual flickering of the LED display matrix. If desired, automatic intensity control can be overridden and manually controlled.

The LED intensity control system shall conform to the following:

The VMS shall contain three (3) photo-sensors, which are provided and installed as described elsewhere in this specification.

Manual and automatic intensity control modes shall be provided in a manner that enables the user to select the desired mode of operation, although the typical control mode is “automatic”.

Automatic intensity control shall select one of sixteen LED intensity levels based on the measured ambient light. The threshold points for each intensity level shall be user-programmable.

Manual intensity control shall be selectable using both the Central Computer and a local laptop computer connected to the RS-232 port furnished in the field controller.

### **VMS Field Controller Identification**

The field controller shall use multiple types of addressing when operating on NTCIP communication networks. The addressing shall be configurable through the front panel user interface.

When operating over PMPP serial networks (NTCIP 2101), the controller’s address shall be configured in the range 1 to 255. The default address shall be set to 1.

When operating on Ethernet networks (NTCIP 2104) a static IP address and subnet shall be used. If a dial-up or direct connect serial network is configured for PPP (NTCIP 2103), then no addressing shall be required.

### **VMS Field Controller response to errors**

In the event of a power failure, the default “power recovery message” shall be displayed. Both types of default messages shall be stored in the non-volatile memory of the controller. The Contractor shall confirm the contents of the default communications and power failure messages with ConnDOT prior to manufacturing of the controllers.

The field controller shall contain a hardware watchdog timer that automatically resets the controller processor in the event of a controller lock-up.

The field controller shall be capable of automatically informing a central control system of the occurrence of important event or subsystem failures. This shall be handled via NTCIP “traps.” When one of these events occurs, the field controller shall create a data packet for transmission to the central controller that shall contain details about the event.

Traps shall be generated for the following events:

- **Field controller restart** – Indicates that the field controller restarted due to a power interruption, intentional restart, or other event.
- **Power supply failure** – Indicates that a diagnostic sensor detected a power supply is not operating correctly.
- **Door open** – Indicates that one of the doors on the VMS housing or control equipment cabinet has been opened. Note: This feature requires that an optional sensor be installed in the sign.
- **Over Temperature Shutdown** – Indicates that the maximum safe operating temperature has been reached or exceeded, resulting in a blanking of the display.

### **VMS Field Controller Diagnostic Test**

Upon command from either the front panel control interface or via NTCIP from remote control software, the sign controller shall direct all of the LED modules to perform diagnostic tests of all their pixels and shall not disrupt the message being displayed on the VMS to assure motorist safety. The controller shall then collect and report the results of the pixel testing.

The controller shall also be capable of automatically detecting in real-time the status of each of the display’s pixels and reporting their on/off status. This monitoring shall take place without interfering with the display of data on the VMS face.

### **VMS Field Controller Diagnostic Features**

The functional status of field controller communications and major VMS components shall be reported to the VMS Central Control Software and the Laptop (Local) Control Software. This includes:

Field Controller Communications - as “normal or “failed”

VMS Site AC Power - “normal” or “failed”

VMS Display Status - as {name of message being displayed}, “off”, or “disabled due to overheating”

Maximum Pulse Width Modulation (PWM) Level - the maximum usable portion of the maximum possible LED forward current pulse width; this is a user programmable value and is presented as a percentage value of 50% to 100%, in minimum increments of 1%.

LED Intensity Level - the percentage of the “Maximum PWM Level” which is either automatically selected by the VMS field controller or is manually selected by a Central Control CONNDOT Software or Laptop Control Software operator

LED Intensity Control Method - as “automatic” or “manual”

LED Pixel Status - displayed upon operator request, in a bit-map graphic format - as “on”, “failed - stuck on”, or “failed - stuck off”, or “General Electrical Failure”

Regulated DC Power Supply Output - as “pass” or “failed”

Internal VMS Temperature - LED pixel board temperature as measured by two internal sensors - presentable in degrees F and C

Ambient VMS Site Temperature - outdoor air temperature as measured by an external temperature sensor - presentable in degrees F and C

### VMS Field Controller Power Interruption

Contents of the field controller’s memory shall be preserved by battery backup during AC power interruptions and the field controller will automatically resume operation once AC power is restored. The field controller shall have the ability to report power interruptions to both Central and Laptop Control Software.

### VMS Field Controller NTCIP Compliance

The field controller shall be NTCIP compliant as noted below. This specification references the NTCIP standards through their NTCIP designated document numbers. Each NTCIP Component covered by these project specifications shall implement NTCIP as defined by the specific versions of the standards documents listed below.

**Table 1: NTCIP Standards**

<b>Document Number and Version</b>	<b>Document Title</b>	<b>Document Status</b>
NTCIP 1101:1996 and Amendment 1	<i>Simple Transportation Management Framework (STMF)</i>	Approved Standard with Amendment
NTCIP 1102:2004	<i>Octet Encoding Rules (OER) Base Protocol</i>	Approved Standard
NTCIP 1103 v1.26a	<i>Transportation Management Protocols</i>	Recommended Standard
NTCIP 1201:1996 and Amendment 1	<i>Global Object (GO) Definitions</i>	Approved Standard
NTCIP 1203:1997 and Amendment 1	<i>Object Definitions for Dynamic Message Signs</i>	Approved Standard with Amendment
NTCIP 2001:1996 and Amendment 1	<i>Class B Profile</i>	Approved Standard
NTCIP 2101:2001	<i>Point to Multi Point Protocol (PMPP) Using RS-232 Subnetwork Profile</i>	Approved Standard
NTCIP 2103:2003	<i>Point-to-Point Protocol Over RS-232 Subnetwork</i>	Approved Standard

<b>Document Number and Version</b>	<b>Document Title</b>	<b>Document Status</b>
	<i>Profile</i>	
NTCIP 2104:2003	<i>Ethernet Subnetwork Profile</i>	Approved Standard
NTCIP 2201:2003	<i>Transportation Transport Profile</i>	Approved Standard
NTCIP 2202:2001	<i>Internet (TCP/IP and UDP/IP) Transport Profile</i>	Approved Standard
NTCIP 2301:2001	<i>Simple Transportation Management Framework (STMF) Application Profile</i>	Approved Standard

### **NTCIP General Requirements**

#### **1. Subnetwork Profiles**

Each serial or modem port on each NTCIP device shall be configurable to support either NTCIP 2101 or NTCIP 2103. Only one of these profiles shall be active at any given time. Serial ports shall support external dial-up modems.

Each Ethernet port on the NTCIP device shall comply with NTCIP 2104.

The NTCIP device(s) may support additional Subnet Profiles at the manufacturer's option. At any one time, only one subnet profile shall be active on a given port of the NTCIP device. Response datagrams shall use the same transport profile used in the request. The NTCIP device shall be configurable to allow a field technician to activate the desired subnet profile and shall provide a visual indication of the currently selected subnet profile.

#### **2. Transport Profiles**

Each serial or modem port on each NTCIP device shall be configurable to support both NTCIP 2201 and NTCIP 2202.

Each Ethernet port on the NTCIP device shall comply with NTCIP 2202.

The NTCIP device(s) may support additional transport profiles at the manufacturer's option. Response datagrams shall use the same transport profile used in the request. Each NTCIP device shall support the receipt of datagrams conforming to any of the supported transport profiles at any time.

#### **3. Application Profiles**

Each NTCIP device shall comply with NTCIP 2301 and shall meet the requirements for Conformance Level 1.

An NTCIP device may support additional application profiles at the manufacturer’s option. Responses shall use the same application profile used by the request. Each NTCIP device shall support the receipt of application data packets at any time allowed by the subject standards.

**4. Object Support**

Each NTCIP device shall support all mandatory objects of all mandatory conformance groups as defined in NTCIP 1201 and NTCIP 1203.

Each NTCIP device shall support all mandatory objects in all optional conformance groups required herein. All optional objects listed in these specifications shall be supported.

The NTCIP device(s) shall are required to support the following optional conformance groups.

**Table 2: Required Conformance Groups from NTCIP 1201 and NTCIP 1203**

<u>Conformance Group</u>	<u>Reference</u>
<u>Time Management</u>	<u>NTCIP 1201</u>
<u>Timebase Event Schedule</u>	<u>NTCIP 1201</u>
<u>Report</u>	<u>NTCIP 1201</u>
<u>PMPP</u>	<u>NTCIP 1201</u>
<u>Font Configuration</u>	<u>NTCIP 1203</u>
<u>VMS Configuration</u>	<u>NTCIP 1203</u>
<u>MULTI Configuration</u>	<u>NTCIP 1203</u>
<u>MULTI Error Configuration</u>	<u>NTCIP 1203</u>
<u>Illumination/Brightness Control</u>	<u>NTCIP 1203</u>
<u>Scheduling</u>	<u>NTCIP 1203</u>
<u>Sign Status</u>	<u>NTCIP 1203</u>
<u>Status Error</u>	<u>NTCIP 1203</u>
<u>Pixel Error Status</u>	<u>NTCIP 1203</u>

The following table indicates objects that are considered optional in the NTCIP standards, but are required by this specification. It also indicates modified object value ranges for certain objects. Each NTCIP device shall provide the full, standardized object range support (FSORS) of all objects required by these specifications unless otherwise indicated below.

**Table 3: Modified Object Ranges and Required Optional Objects**

<b>Object</b>	<b>Reference</b>	<b>Project Requirement</b>
moduleTable	NTCIP 1201 Clause 2.2.3	Shall contain at least one row with <i>moduleType</i> equal to 3 (software).
maxTimeBaseScheduleEntries	NTCIP 1201 Clause 2.4.3.1	Shall be at least 28
maxDayPlans	NTCIP 1201 Clause 2.4.4.1	Shall be at least 20
maxDayPlanEvents	NTCIP 1201 Clause 2.4.4.2	Shall be at least 10
maxEventLogConfig	NTCIP 1201 Clause 2.5.1	Shall be at least 50
eventConfigMode	NTCIP 1201 Clause 2.4.3.1	The NTCIP Component shall Support the following Event Configuration: onChange, greaterThanValue, smallerThanValue Hysteresis is Bound, Periodic
eventConfigLogOID	NTCIP 1201 Clause 2.5.2.7	FSORS
eventConfigAction	NTCIP 1201 Clause 2.5.2.8	FSORS
maxEventLogSize	NTCIP 1201 Clause 2.5.3	Shall be at least 200
maxEventClasses	NTCIP 1201 Clause 2.5.5	Shall be at least 16
eventClassDescription	NTCIP 1201 Clause 2.5.6.4	FSORS
maxGroupAddresses	NTCIP 1201 Clause 2.7.1	Shall be at least 1
communityNamesMax	NTCIP 1201 Clause 2.8.2	Shall be at least 3
NumFonts	NTCIP 1203 Clause 2.4.1.1.1.1	Shall be at least 12
MaxFontCharacters	NTCIP 1203 Clause 2.4.1.1.3	Shall be at least 255
defaultFlashOn	NTCIP 1203 Clause 2.5.1.1.1.3	The VMS shall support the full range of these objects with step sizes no larger than 0.5 seconds



<b>Object</b>	<b>Reference</b>	<b>Project Requirement</b>
defaultFlashOff	NTCIP 1203 Clause 2.5.1.1.1.4	The VMS shall support the full range of these objects with step sizes no larger than 0.5 seconds
defaultBackgroundColor	NTCIP 1203 Clause 2.5.1.1.1.1	The VMS shall support the black background color
defaultForegroundColor	NTCIP 1203 Clause 2.5.1.1.2	The VMS shall support the amber background color
defaultJustificationLine	NTCIP 1203 Clause 2.5.1.1.1.6	The VMS shall support the following forms of line justification: left, center, and right
defaultJustificationPage	NTCIP 1203 Clause 2.5.1.1.1.7	The VMS shall support the following forms of page justification: top, middle, and bottom
defaultPageOnTime	NTCIP 1203 Clause 2.5.1.1.1.8	The VMS shall support the full range of these objects with step sizes no larger than 0.5 seconds
defaultCharacterSet	NTCIP 1203 Clause 2.5.1.1.1.10	The VMS shall support the eight bit character set
VMSMaxChangeableMsg	NTCIP 1203 Clause 2.6.1.1.1.4	Shall be at least 100.
VMSMessageMultiString	NTCIP 1203 Clause 2.6.1.1.1.8.3	The VMS shall support any valid MULTI string containing any subset of those MULTI tags listed in Table 3 (below)
VMSControlMode	NTCIP 1203 Clause 2.7.1.1.1.1	Shall support at least the following modes: local, external, central, and centralOverride
VMSSWReset	NTCIP 1203 Clause 2.7.1.1.1.2	FSORS
VMSMessageTimeRemaining	NTCIP 1203 Clause 2.7.1.1.1.4	FSORS
VMSShortPowerRecoveryMessage	NTCIP 1203 Clause 2.7.1.1.1.8	FSORS
VMSLongPowerRecoveryMessage	NTCIP 1203 Clause 2.7.1.1.1.19	FSORS

<b>Object</b>	<b>Reference</b>	<b>Project Requirement</b>
VMSShortPowerLossTime	NTCIP 1203 Clause 2.7.1.1.1.10	FSORS
VMSResetMessage	NTCIP 1203 Clause 2.7.1.1.1.12	FSORS
VMSCommunicationsLossMessage	NTCIP 1203 Clause 2.7.1.1.1.12	FSORS
VMSTimeCommLoss	NTCIP 1203 Clause 2.7.1.1.1.12	FSORS
VMSEndDurationMessage	NTCIP 1203 Clause 2.7.1.1.1.15	FSORS
VMSMemoryMgmt	NTCIP 1203 Clause 2.7.1.1.1.16	The VMS shall support the following Memory management Modes: normal, clearChangeableMessages, clearVolatileMessages
VMSMultiOtherErrorDescription	NTCIP 1203 Clause 2.4.1.1.1.20	If the vendor implements any vendor-specific MULTI tags, the VMS shall provide meaningful error messages within this object whenever one of these tags generates an error
VMSIllumControl	NTCIP 1203 Clause 2.8.1.1.1.1	The VMS shall support the following illumination control modes: Photocell, and Manual
VMSIllumNumBrightLevels	NTCIP 1203 Clause 2.8.1.1.1.4	Shall be at least <u>248</u>
VMSIllumLightOutputStatus	NTCIP 1203 Clause 2.8.1.1.1.9	FSORS
numActionTableEntries	NTCIP 1203 Clause 2.9.1.1.1	Shall be at least 200
watcdogFailureCount	NTCIP 1203 Clause 2.11.1.1.1.5	FSORS
VMSStatDoorOpen	NTCIP 1203 Clause 2.11.1.1.1.6	FSORS
fanFailures	NTCIP 1203 Clause 2.11.2.1.1.8	FSORS
fanTestActivation	NTCIP 1203 Clause 2.11.2.1.1.9	FSORS

<u>Object</u>	<u>Reference</u>	<u>Project Requirement</u>
tempMinCtrlCabinet	NTCIP 1203 Clause 2.11.4.1.1.1	FSORS
tempMaxCtrlCabinet	NTCIP 1203 Clause 2.11.4.1.1.2	FSORS
tempMinSignHousing	NTCIP 1203 Clause 2.11.4.1.1.5	FSORS
tempMaxSignHousing	NTCIP 1203 Clause 2.11.4.1.1.6	FSORS

## 5. MULTI Tags

Each NTCIP device shall support the following message formatting MULTI tags. The manufacturer may choose to support additional standard or manufacturer-specific MULTI tags.

**Table 4: Required MULTI Tags**

<u>MULTI Tag</u>	<u>Description</u>
<u>fl and /fl</u>	<u>Flashing text with flash rates controllable in 0.1-second increments.</u>
<u>fo</u>	<u>Font</u>
<u>jl2</u>	<u>Justification- line-left</u>
<u>jl3</u>	<u>Justification- line-center</u>
<u>jl4</u>	<u>Justification- line- right</u>
<u>jp2</u>	<u>Justification- page- top</u>
<u>jp3</u>	<u>Justification- page- middle</u>
<u>jp4</u>	<u>Justification- page- bottom</u>
<u>mv</u>	<u>Moving text</u>
<u>nl</u>	<u>New line</u>
<u>np</u>	<u>New page</u>
<u>pt</u>	<u>Page times controllable in 0.1-second increments</u>

## FIELD CONTROLLER CABINET

The field controller and related equipment shall be housed within a ground mount weatherproof (NEMA 3R) CalTrans 334 type outdoor mounting cabinet, or equivalent, supplied as part of these items, constructed of fabricated aluminum. Fabricated aluminum cabinets are

permitted providing that they are rigidly constructed and have a minimum thickness of 3.175 mm (0.125 inches or #11 gauge).

Cabinets shall be supplied with the field controller equipment installed in the cabinet by the VMS manufacturer. The cabinets shall contain the necessary space to house the maximum dimensions of the control equipment intended to be housed within, also usable space equal to or greater than the volume of the equipment to house the equipment.

The cabinet shall be furnished with full front and rear doors equipped with a Conn.-2 lock (tumbler type). Two Conn.-2 keys shall be furnished for each cabinet. When closed, both doors shall fit tightly on a neoprene gasketing material. Door hinge-pins shall be made of stainless steel. Door hinges and securing brackets shall be bolted so doors may be changed without the need to cut welds.

For locations where the cabinet will be installed on a new, Precast Traffic Control Foundation – Type IV Modified, the proposed cabinet shall be 24” x 30” x 66” (600 mm x 750 mm x 1650mm).

Each cabinet shall be equipped with two shelves that extend the full width of the cabinet. Each shelf shall be adjustable in height, with a minimum of 6 inches (150 mm) of clearance between the upper and lower shelves.

Outside surfaces shall be cleaned and prepared in a manner consistent with industry standards for extruded and/or cast aluminum products. Outside cabinet surfaces shall be free of all manufacturers' markings and identification information.

The cabinet shall be fabricated with “S” flanges in the top ventilation to prevent forced snow, ice and road salt from entering the enclosure. The Contractor shall, at no cost to the Department, replace any or all equipment installed in the cabinet (including the cabinet and or parts) damaged due to the entry of water, snow, ice and road salt.

All exterior traffic cabinet surfaces shall be provided with a brushed natural-aluminum finish.

All permanent mounted fixtures and appurtenances shall be attached with a nut and bolt or screw. Quick fasteners such as rivets are not permitted.

Equipment and terminals shall be arranged within the cabinet such that they will not interfere with the entrance, tracing, and connection of conductors. All wiring panels (terminal blocks) shall be neatly finished and clearly and permanently marked with identifications. All conductors and communication cable shall be neatly arranged in the cabinet and bundled in groups with cable ties.

All AC circuit wiring shall be Number 14 AWG stranded copper rated at 600 volts, at a minimum. All DC circuit wiring shall be Number 20 AWG stranded copper rated at 600 volts, at a minimum. Ribbon cable will not be allowed for control equipment cabinet wiring.

The anchor bolts shall be ASTM – A-36 steel rods. Dimensions shall be 3/4” x 18” (19 mm X 457 mm). Each bolt shall have a 90-degree bend at one end and shall be threaded at the other end for a sufficient length to properly mount the cabinet. Threads, nuts, flat washers and lock washers provided with each bolt shall be galvanized per ASTM- A-153. Two bolts shall be supplied with the Type B cabinets.

As a minimum, each field controller cabinet shall be furnished with the following:

One (1) NEMA 20-R, 120 VAC duplex GFCI electrical outlet and one (1) lamp receptacle.

One (1) edco FAS-TEL-DOT surge suppressor for dial up communications.

Removable, clear acrylic shield for the incoming power panel equipment, which contains an opening to provide for manual operation of breakers.

A minimum of Four (4) circuit breakers. One main circuit breaker shall be rated for the power supply line. The secondary circuit breaker shall be provided for sign power, including the environmental control system. The third circuit breaker shall be for the duplex convenience outlet receptacle and lamp socket. The fourth circuit breaker shall be as required for the control equipment power. The circuit breakers shall be rated in accordance with the NEC and local electrical codes. Separate terminal strips shall be provided for each circuit breaker and an unfused terminal (with a minimum of ten spare terminals) for the neutral side of the power supply line.

A thermostatically controlled exhaust fan shall be mounted to the top section of the control cabinet with a screen guard. The thermostat shall turn on the exhaust fan between 90° F and 130° F (34° C and +54°C). The fan shall be mounted within a rain, snow and insect tight housing and be thermostatically controlled by a thermostat. The thermostat shall be mounted no higher than the door-opening frame for ease of adjustment. The fan and cabinet ventilation holes are to be located so as to direct the bulk of the airflow throughout the entire cabinet and in particular over the controller unit.

The cabinet shall contain a power panel board and circuit breakers that meet the following minimum requirements:

- Service entrance-rated
- Minimum of 12 circuit breaker mounting positions
- Short circuit ratings of 22,000 amps and 10,000 amps for the main and branch circuits, respectively
- UL listed

Surge protection of circuits shall be provided using one or more metal oxide varistors (MOV) as needed.

A heavy plastic envelope or pull out drawer – The envelope or drawer shall contain the appropriate site plans, cabinet wiring diagrams, schematics, etc. If proposing a heavy plastic envelope, the envelope shall be bolted to the inside of the cabinet door and shall be 12” x 18” (300 mm X 450 mm) or larger. If proposing a pull out drawer, it shall be placed in the 19” (182 mm) rack with minimal dimensions of 2” H X 16” W X 16” D (53mm H X 406mm W X 406 mm D).

A roof-mounted fluorescent lamp with door-mounted switch shall be included.

A heavy plastic envelope – this envelope shall contain the appropriate site plans, cabinet wiring diagrams, schematics, etc. The envelope shall be bolted to the inside of the cabinet door. The envelope shall be 12” X 18” (300 mm X 450 mm) or larger.

The following information shall be permanently affixed to the inside door of the cabinet:

TOWN AND LOCATION:

PROJECT NUMBER:

PURCHASE ORDER NUMBER:

CABINET MANUFACTURER:

MANUFACTURING DATE:

CABINET SCHEMATIC IDENTIFICATION DATE:

SOLD BY:

INTERSECTION NUMBER:

## **CENTRAL SOFTWARE**

The Contractor shall be responsible for all labor required to ensure that the existing ConnDOT Central Control and Laptop computer software programs required to support the use of all the variable message signs and field controllers installed as part of this items. The Central Control and Laptop software packages shall fully support the use of ConnDOT and NTCIP VMS protocols, and be compatible with all current Connecticut DOT Daktronics variable message signs and field controllers.

## **SPARE PARTS**

The following spare parts shall be included as part of these items. All spare parts shall be delivered in new and working condition prior to final acceptance of the VMS sites.

- LED Pixel Boards –18 inch (457 mm): 1 per 18” sign
- LED Pixel Boards –12 inch (305 mm): 2 per 12” sign
- Field Controller – 1
- (VCB) LED Driver Boards – 1
- VMS Regulated Power Supplies – 2
- VMS Display Cooling Fan – 1 per sign
- Multi-mode fiber-optic module for VMS – 1
- Sixnet VT-1 modem -1

### **CONSTRUCTION METHODS:**

Upon approval of the shop drawings, the Contractor shall order and take delivery of the sign from the manufacturer. The Contractor shall store the sign at a facility approved by the Engineer until the day of installation.

Upon completion of the sign support installation (including foundation and steel supports), the VMS shall be installed on the sign support in accordance with the drawings and special provisions.

The sign installation shall be performed in accordance with the manufacturer recommendations and as shown on the drawings. Where a horizontal and/or vertical angle is required, the sign shall be installed initially to this prescribed angle. The Contractor, together with the Engineer, shall verify the sign angle in the field is desirable and confirm the layout with the Engineer. The Contractor shall make the necessary adjustments to the sign angle as a result of the field check. These adjustments should be limited to adjustment of the supporting brackets to the sign.

Upon the installation of the sign and the field cabinet and controller, the Contractor shall advise the Engineer and VMS manufacturer.

### **VMS FIELD CONTROLLER CABINET**

The cabinet and field controller equipment shall be installed on the traffic control foundation in accordance with the plans. The Contractor shall be responsible for the installation of all power and communications cables between the VMS housing and the field controller cabinet.

At the locations identified on the plans where the Contractor shall replace the existing VMS Cabinet with a new VMS Cabinet (3’-8<sup>1</sup>/<sub>4</sub>” x 2’-1<sup>3</sup>/<sub>8</sub>” x 4’-10<sup>11</sup>/<sub>16</sub>” (1124 mm x 645 mm x 1490 mm), the Contractor shall contact Eversource to request a temporary disconnect and re-connect (outage) of the electric metered service to the cabinet to facilitate replacement. See the

special provision “Notice to Contractor – Incident Management System Equipment Installations”.

All cabling shall be connected as recommended by the VMS manufacturer. All communication lines, signal wires, and power cables entering/exiting the field controller cabinet and the electronics equipment to which the external cabling is connected shall be protected against lightning strikes and power surges.

The fiber-optic cable shall be installed and terminated by the Contractor between the VMS and field controller, terminated on both ends with ST connectors, and tested with an OTDR (factory calibrated and certificated) to ensure proper performance. Any splice or installation issues will be immediately corrected at no charge to the Department.

The field controller cabinet shall be earth grounded by an appropriately sized ground rod, which shall be located at the base of the control equipment cabinet footing and is electrically bonded to the cabinet. VMS and control equipment cabinet earth grounds shall be connected with a properly-sized ground cable located in the power conduit that runs between the control equipment cabinet and the VMS.

The field controller cabinet shall also be earth grounded to its AC power feed. Earth grounding shall be the responsibility of the Contractor.

All wiring and grounding shall conform to the requirements of the National Electrical Code and local electrical codes.

## **VMS TESTING**

All VMS equipment shall be certified by an independent source to UK Highways Agency standard TR2516.

## **Production Test**

Production of VMS, cabinets and controllers may proceed after the successful conclusion of factory demonstration/acceptance tests. All production variable message signs, field controllers, and control equipment cabinets to be provided for this Contract shall be inspected and tested by the manufacturer prior to shipment. Production Tests shall demonstrate that each type of equipment fully conforms to these Special Provisions. The Production Test procedure/report shall be submitted for review and approval by the Engineer and shall include:

- a list of all equipment required to perform the tests
- a list of all tests to be performed
- a list of all test steps to be performed with a detailed description of how the test will be conducted and the expected results for each test step
- a method for documenting each test step undertaken and a record of test results
- a method for documenting test failures, corrective action taken, and results of the retest



The Contractor shall provide a copy of all Production Test reports to the Engineer at the time of shipment.

### **Field Test**

All variable message signs, field controllers, and control equipment cabinets shall be inspected and tested upon installation in the field. A representative of the VMS manufacturer shall be present at each VMS site during all field tests. Field Tests shall demonstrate that each type of equipment fully conforms to these Special Provisions, including demonstration of all functional capabilities of the associated software. The Field Test procedure/report shall be submitted for review and approval by the Engineer and include:

- a list of all tests to be performed
- a list of all test steps to be performed with a detailed description of how the test will be conducted and the expected results for each test step
- a list of all equipment required to perform the tests
- a method for documenting each test step undertaken, a record of who performed the tests, and a record of test results
- a method for documenting test failures, corrective action taken, and results of the retest

The Contractor shall provide the Engineer with a written copy of the Field Test report for each VMS site installed, signed by the Contractor and the VMS manufacturer, within ten days of completion of the test.

### **Sign/Field Controller Communications**

The Contractor shall verify proper operation of each VMS and field controller using a laptop computer supplied by the Contractor.

### **Photosensor System and Dimming**

The Contractor shall verify that the operation of the photosensor system and dimming circuitry meet the requirements specified herein and is configured to the optimal settings required for each site.

### **Actuation**

The Contractor shall verify that the field controller turns all sign display elements on and off by calling up test patterns from a laptop computer.

Once these tests are completed, the Contractor shall contact the ConnDOT Highway Operations Center (860-594-3447) to test and verify proper operation of the dial-up modem communications and remote sign operation.

## **Field Inspection/System Acceptance Test**

Upon successful completion of the field test and submittal of the test reports to the Engineer, a field review of each site will be arranged between the Contractor and the Highway Operations Engineer to review and inspect the field installation. An inspection punch-list of any outstanding items will be prepared by ConnDOT and submitted to the Contractor for correction. Once all outstanding items for each sign site have been addressed, a 30-day System Operational Test shall commence. During the course of this test, the system must function continuously in accordance with the specifications for the duration of the test. If a malfunction occurs within the stated time frame, then the Contractor shall make all necessary repairs to the system and re-establish proper operational. Upon approval of the Engineer, the 30-day test will begin anew. The system must operate a full thirty (30) consecutive days without a malfunction before the site will be accepted by the Engineer.

Any performance requirement discrepancies shall be regarded as failures and shall be documented and diagnosed by the Contractor. If the problem is hardware-oriented, then the Contractor shall remove the failed unit and replace it with a new unit with no additional cost to the State. The Contractor shall be responsible for all work delays caused by failed equipment.

## **Documentation**

The Contractor shall provide a total of four (4) copies of the Operation and Maintenance Manuals for each sign provided as part of this contract. The manuals shall contain sufficient information to operate and maintain the equipment including:

- Schematics for all VMS and field controller cabinet components including, but not limited to, sign controller and power supply equipment. The schematics shall include circuit board-level diagrams, component part numbers and quantities.

- Wiring and interconnection diagrams

- Operating and troubleshooting instructions

- Repair and replacement procedures

- Safety procedures and warnings

- A complete parts list and a list of recommended spares

- A set of Management Information Bases (MIB's) as described in these Special Provisions.

The Contractor shall provide "as-built" construction details for each sign location (including site plan and schematic/wiring information) before final acceptance and payment for each VMS site. Electronic copies of the site plans will be provided for revision, upon request, by the Engineer.

## **WARRANTY**

Each VMS shall be provided with a one-year manufacturer's warranty for all manufacturer-provided parts, including shipping and handling expenses. The warranty shall

include replacement, repair and/or exchange of all VMS parts. Exchange parts shall be provided for shipment the same day that the manufacturer is notified of the failure. All parts repairs performed by the manufacturer must be returned to ConnDOT or its designated service provider within two weeks of receipt. The one-year warranty will commence from the end of the 30-day test for each site. A copy of the manufacturer's warranty shall be provided to the Connecticut DOT at the time of VMS delivery.

**METHOD OF MEASUREMENT:**

This item will be measured for payment by the actual number of complete units of each VMS, field controller and cabinet, and utility coordination, and wiring, and associated equipment and software, and paid for at the Contract unit price per each site complete. This price shall include furnishing, installing, and testing the variable message sign and associated enclosure, fiber-optic communications cable, connectors, wiring connections and hardware, fittings, earth grounding, field controller and cabinet, utility coordination, fiber-optic data modems, software, hardware and spare parts. This price shall also include the VMS warranty and provision of VMS system documentation sufficient for operations and maintenance.

**BASIS OF PAYMENT:**

This work shall be paid for at the contract unit price each for “Motorist Aid Variable Message Sign – Type A” or “Motorist Aid Variable Message Sign – Type B”, complete in-place, which price shall include all materials, communication cable, and all equipment, tools, labor, utility coordination and work incidental thereto.

Foundations for VMS Control Cabinet will be paid under Item 1002214A – Traffic Control Foundation – Controller – Type IV Modified

Conduit for wiring between the VMS and the field controller cabinet will be paid separately.

**ITEM #1050113A – MOTORIST AID VARIABLE MESSAGE SIGN  
SYSTEM OPERATIONS (ESTIMATED COST)**

**Description:**

The purpose of this item is to provide the necessary services required to maintain the Motorists Aid Variable Message Sign (VMS) equipment existing and newly installed, operating to the manufacturer's specifications, so as to provide a means to monitor, detect and manage incidents as they occur on the highway. The Contractor will be responsible for maintaining VMS sign and cabinet equipment at each field site(s). The work included in this item for the existing VMS will commence upon the Contract Notice to Proceed. The work included in this item for newly installed VMS will commence upon completion of the 30 Day Operational Test discussed elsewhere in the contract documents. The Contractor shall meet with the telephone company in the event a failure or error occurs with the telephone equipment or the equipment installed by this project.

**Materials:**

All materials utilized to maintain and repair of the VMS shall be in conformance with the specifications of this project or as recommended by the manufacturer.

The Contractor shall provide all the cables, connectors, tools, replacement equipment and labor necessary to successfully maintain the operation of the equipment.

The Contractor shall be able to use replacement parts available from the State of Connecticut inventory in order to expedite the repair process. As soon as possible and to the State's satisfaction, the Contractor shall provide replacement equipment to be re-entered into the State's inventory.

The Contractor shall provide documentation certifying the manufacturer's repair or replacement of the spare equipment upon return of the equipment to the Department.

**Construction Methods:**

The work to maintain the Motorists Aid Variable Message Sign (VMS) equipment shall include furnishing all necessary labor, materials, equipment, tools, transportation, supplies, maintenance and protection of traffic, and incidentals required to repair and maintain all sign system components. The work shall not include repairs or replacements made necessary by damage resulting from vandalism or traffic accidents.

Any VMS equipment that has been damaged through the Contractors own actions shall be repaired and/or replaced by the Contractor at no cost to the State.

It is the Contractor's responsibility to ensure that the selected maintenance personnel have been properly trained and certified by the sign manufacturer to maintain the VMS equipment. The Contractor is responsible for all costs involved in properly training maintenance personnel during the full period of sign system operations. These costs will not be paid as part of this item.

A copy of the sign manufacturer's certification for maintenance personnel training must be provided to the Engineer IN WRITING within 2 weeks of the Contract Notice to Proceed.

#### REPORTING MALFUNCTIONS:

##### Certification:

The Contractor shall provide the State with evidence satisfactory to the State that they fully understand the purpose for which the equipment is intended and they are qualified and capable of fulfilling all provisions of this item. The Contractor as well as individual personnel performing this work shall be certified by all manufacturers of the equipment to be maintained as being capable of maintaining the equipment and also capable of obtaining and installing the necessary spare parts to keep the system on-line. The Contractor, prior to the commencement of the start of the equipment operations, shall be required to submit training certificates for all of the pertinent equipment.

##### Response Time:

The Contractor shall service and maintain the existing VMS following the Contract Notice to Proceed and the newly installed VMS at the conclusion of the 30 Day Operational Test for each site, as allowed by the Engineer. All VMS equipment shall be serviced and maintained on a twenty-four (24) hour a day, seven days a week basis. The Contractor shall provide a suitable means of communication between them and the Newington Operations Center (NOC). This shall include a twenty-four (24) hour telephone number, a fax number for emergency purposes and a fax number for daily communications and log activities. Repairs shall commence not more than 8 hours after notification and shall be completed within 24 hours of notification.

The Contractor shall be responsible for coordination of work. The Contractor shall coordinate the service described herein with any equipment or work to determine the cause of the errors or failures to successfully restore the VMS operation. The Contractor shall meet with the telephone company if necessary in the event a failure or error occurs with the telephone equipment or the equipment installed by this project. The Contractor shall coordinate between the Contractor, Engineer, Telephone Company and NOC representative to discuss the requirements and time table of this service.

The Contractor shall keep a neat and accurate log book of all the malfunctions reported with the date and time that the information was received and the nature of the problem. The log book shall be submitted to the Engineer monthly or upon request by the Engineer. The Contractor shall include in the log book the time that each unit is checked for proper operation, the condition of each unit checked, and the date and time each unit was restored to proper operation or replaced.

Work performed under this item shall conform to the latest National Electrical Code standards, local electrical codes, and Department of Transportation installation requirements. The Contractor shall conform to these requirements as specified herein.

#### **MAINTENANCE AND PROTECTION OF TRAFFIC**

Lane closures, when required for maintenance of the Signs shall abide by the requirements for time of day and patterns as described under the special provisions of article 1.08.03 - Prosecution of Work.

#### **STORM DAMAGE, VANDALISM AND KNOCKDOWNS:**

During the maintenance period, work under this item shall not include repairs or replacements made necessary by damage resulting from vandalism or traffic accident or catastrophic storm damage to the completed and accepted system.

The Contractor, when directed by the Engineer, shall provide labor, material equipment to repair or replace any equipment comprising the completed and accepted system from damage resulting from vandalism or traffic accident or storm damage.

The funds for this work shall not be included in the contract, but obtained from normal maintenance detailed estimate of the required repair work which shall be submitted to the Engineer, and a price negotiated prior to authorizing the Contractor to proceed. This estimate shall include an estimate of man hours, parts, travel and equipment checks.

#### **METHOD OF MEASUREMENT**

This item shall be measured for payment as provided under Article 1.09.04 – Extra and Cost Plus Work.

The sum of money shown on the estimate and in the itemized proposal as “Estimated Costs” for this work will be considered the price bid even though payment will be made only for actual work performed. The estimated cost figure is not to be altered in any manner by the bidder. Should the bidder alter the amount shown, the altered figures will be disregarded and the original price will be used to determine the total amount bid for the contract

#### **BASIS OF PAYMENT**

This work will be paid on a cost-plus basis according to Article 1.09.04 – Extra and Cost Plus Work. Warranties in effect for equipment associated with VMS operation shall be honored by the suppliers of the equipment. Contractor or sub-contractor will be responsible for securing warranted equipment and installation. There will be no payment for materials included under a manufacturers warrantee. Labor costs only will be reimbursed on a cost plus basis.

If warranties have expired, any equipment and labor that must be repaired will be paid on a cost plus basis.

## **ITEM #1108164A – MODIFY EXISTING MAIN FIBER HUB**

### **Description:**

This item consists of modifications to the communications equipment installed at the Connecticut DOT Main Fiber Hub (MFH). The MFH is an existing communications shelter located in Hartford, CT at the I-84/I-91 interchange. The MFH houses equipment racks containing video and data communications equipment that links a number of field equipment sites to various agency operations centers including the DOT Newington Operations Center.

### **Scope:**

The Main Fiber Hub modifications include the work listed below and elsewhere in this specification. This item shall consist of connecting and configuring existing communication equipment to newly furnished equipment included within this project:

Install item 1112268A Single mode fiber optic directional coupler at this location as detailed in the item specification

Install item 1108627A terminal port server in the existing equipment racks as determined by the engineer and detailed in the item specification.

Install item 1108841A Multi-Channel demultiplexer in the existing equipment racks as determined by the engineer and detailed in the item specification.

Install all necessary cabling and make configuration changes to the existing American Dynamics Video Switcher.

Install all necessary cabling from newly installed devices to the existing Brocade Ethernet switch.

Update all existing Point to Point wiring diagrams and rack elevation diagrams to include all newly installed equipment from this project.

### **MATERIALS:**

1.0 Baseband Video Cable – RG-6U Type and connectors

1.1 The baseband cable shall be precision coaxial cable designed to transmit baseband NTSC video signals between communications equipment as described herein. All coax cabling shall be manufactured by Belden.

- 1.2 The cable shall have a polyethylene jacket
- 1.3 The outer conductor shall be tinned copper double braid 98% shield coverage.
- 1.4 The center conductor shall be 18 AWG solid bare copper
- 1.5 The nominal impedance shall be 75 ohms, plus or minus 2%.
- 1.6 The nominal DC loop resistance of the center conductor shall be 32.5 ohms/km.
- 1.7 The nominal DC loop resistance of the shield shall be 3.6 ohms/km.
- 1.8 The cable shall be 100% sweep tested.
- 1.9 Connectors for Baseband Video Cable
- 1.10 Connectors shall be BNC type, manufactured specifically for the baseband video coaxial cable to which they will be attached.
- 1.11 The BNC connectors shall meet or exceed the following specifications:
  - Characteristic Impedance 75 ohms (true)
  - Return Loss less than – 35dB to 1 GHz
  - Mechanical Durability 500 Cycles Minimum
  - Corrosion Resistance MIL-STD-202, Method 101
  - Solvent Resistance MIL-STD-202, Method 215
- 1.12 The center conductor of the BNC connector shall be 1.25 micrometers (50 millionths of an inch) gold plating over copper plate.

## 2.0 Data Cables

- 2.1 Data cables shall be TIA/EIA 568A Category 6, characterized up to 350 MHz, suitable for 1000Base-T local area network applications.
- 2.2 Category 6 cable shall be used for T-1, Ethernet, and serial data communications connections between communications equipment as shown on the Drawings.
- 2.3 Data cables installed in outdoor equipment racks shall be rated for outdoor installations. All cabling to be installed in outdoor equipment cabinets shall maintain specified electrical properties over the entire operating temperature range, specified below



2.4 Data cables shall be terminated with RJ-11, RJ-45, RJ48 or other approved connectors as required by the communications equipment.

2.5 Data cables used for horizontal wiring shall be 4 pair 24 AWG cable as required by the application and as directed by the Engineer and shall comply with the following requirements:

- Conductor: 24 AWG (solid bare copper)
- Nominal Capacitance: 14 pF/ft
- Characteristic Impedance:  $100\Omega \pm 15\%$
- Maximum DC Resistance: 9.4/100m
- Velocity of Propagation: 71% (minimum)

2.6 Data cables used for patching between equipment in equipment racks shall be 4 pair cable and shall comply with the following requirements:

- Conductor: 24 AWG (stranded tinned copper)
- Nominal Capacitance: 14 pF/ft
- Characteristic Impedance:  $100\Omega \pm 15\%$
- Maximum DC Resistance: 9.4/100m
- Velocity of Propagation: 71% (minimum)

2.7 Equipment located within environmentally controlled rooms shall be capable of meeting the following requirements:

- Storage Temperature:  $-40^{\circ}$  to  $+70^{\circ}$  Celsius
- Operating Temperature Range:  $0^{\circ}$  to  $+50^{\circ}$  Celsius
- Relative Humidity: 5 to 90%, non-condensing
- Fire Resistance: Complies with TR-NWT-000063, Issue 3.

### 3.0 Fiber Optic Patch Cords and Connectors:

3.1 Fiber Optic Patch Cords shall be furnished in sufficient length and quantity, and installed in the Newington Highway Operations Center to connect the existing field fiber-optic cables terminated at an existing patch panel to the optical equipment in the equipment racks.

3.2 The Fiber Optic Patch Cords shall be manufactured to industry standards

3.3 All optical fibers, coatings, tubes, metals and jackets shall be free of roughness, porosity, blisters, splits and voids in accordance with good manufacturing practice.

- 3.4 The color coding and position of fibers / buffer tubes within the cable shall be in accordance with TIA/EIA-598-A "Optical Fiber Cable Color Coding".
  - 3.5 The cable shall be suitable for operation over a temperature range of -20°C to +60°C.
  - 3.6 The cable shall provide mechanical support and protection for the specified number of fibers. The outer jacket of the cable shall be constructed of medium or high density polyethylene. The cable jacket shall be marked with the manufacturer's name, sequential meter or foot markings, month, year or quarter year of manufacture, and a telecommunications handset symbol, as required by Section 350G of the National Electrical Safety Code.
  - 3.7 The cable shall be suitable for installation in plenums and risers.
  - 3.8 At a minimum, the cable shall be UL-listed OFNR/OFNP.
  - 3.9 The cable shall be composed of materials that are fully compliant with the State of Connecticut, NEC, and all other applicable local codes that pertain to wiring and cabling within a plenum air space or riser shaft.
  - 3.10 Materials used in the cable shall not produce hydrogen in a concentration large enough to cause any degradation in the transmission performance of the optical fibers.
  - 3.11 Materials used in the cable shall not support galvanic action.
- 4.0 Fiber Optic Patch Cord Connectors:
- 4.1 ST connectors shall have a ceramic ferrule with a nickel plated nut and body. SC connectors shall have a ceramic insert.
  - 4.2 The connector shall be of the ST-type (for Optelecom Video Demultiplexer) and SC-type (for existing fiber optic patch panel) and fully compatible with the fiber optic cable utilized and the mating jacks to which they will be attached.
  - 4.3 The connector shall be compatible with a ultra physical contact (UPC) finish. All connectors shall be polished to a UPC finish such that the return loss per mated pair of connectors is at least 25 dB. The return loss when the connector is mated with previously installed connectors shall be at least 18 dB.
  - 4.4 The connector mean loss shall not be greater than 0.2 dB with a standard deviation of not greater than 0.1 dB.

- 4.5 The connector loss shall not vary more than 0.1 dB after 500 repeated matings.
  - 4.6 The connector shall withstand an axial load of 135 N.
  - 4.7 The connectors shall be attached in accordance with the manufacturer's recommended materials, equipment and practices.
  - 4.8 The connector shall be suitable for the intended environment and shall meet the following environmental conditions.
  - 4.9 Operating Temperature: -20 to +50° C
  - 4.10 Storage Temperature: -30 to +60° C
  - 4.11 The connector loss shall not vary more than 0.2 dB over the operating temperature range.
  - 4.12 When not in use, connectors shall be protected by a suitably installed waterproof protection cap.
- 5.0 Warranty:
- 5.1 All cables and connectors shall be warranted for parts and labor by the vendor against defects and failures, which may occur through normal use for a minimum of one (1) year from the date of installation. A copy of the warranty must be presented to the Engineer prior to the approval of use of the equipment.

**Construction Methods:**

- 6.0 Installation:
- 6.1 The Contractor will furnish and install video baseband (coaxial) cables and connectors from the video demultiplexer to the existing video matrix switcher.
  - 6.2 The Contractor shall reprogram the existing American dynamics video matrix switch to include the new CCTV's from this project. The Contractor shall request matrix switch assignments from the Engineer.
  - 6.3 The contractor shall furnish and install Data cables for pan, tilt, and zoom (PTZ) control from the new terminal port server and existing terminal port server to the existing American dynamics video matrix switcher. Camera PTZ control for each traffic management system mini-hub cabinet (TSMHC) shall be interleaved

between the newly installed terminal port server and existing port server. Each Traffic management system Mini Hub Cabinet shall have a minimum of two PTZ connections to the existing video switcher using one existing Port sharing device and one newly installed port sharing device.

- 6.4 The contractor shall ensure the new terminal port server connects to the newly installed terminal server located in the Traffic Management System Mini-Hub cabinet for local Pan Tilt Zoom control at the Main Fiber Hub.
  - 6.5 The contractor shall furnish and install CAT-6 Ethernet Data cables from the video demultiplexer network monitoring card and terminal port server to the existing Brocade Ethernet switch as directed by the engineer.
  - 6.6 The contractor shall install fiber optic jumper cables for each Traffic management system Mini-hub cabinet from the existing fiber optic patch panel to the input on the fiber optic directional coupler. The contractor shall install fiber optic jumper cables from the output of the fiber optic directional coupler to the video demultiplexer and to the patch panel connecting to the Newington Operations Center (NOC).
  - 6.7 The contractor shall install fiber optic jumper cables for each Traffic management system Mini-Hub cabinet (as detailed in the fiber splicing diagram) from the existing patch panel to the existing brocade Ethernet switch. The contractor shall connect the fiber optic cable to existing SFP optics as determined by the engineer. The existing SFP optic has LC fiber optic connectors.
- 7.0 Submittals:
- 7.1 As part of Section 1.06 (Control of Materials) for this project, the Contractor shall submit the following documentation:
  - 7.2 Detailed wiring diagrams, equipment cabinet front elevation drawings, point to point wiring diagrams, and equipment installation drawings indicating supports and appurtenances required for proper installation. Updated Wiring diagrams and rack elevation diagrams shall be submitted in Visio 2010 format.
  - 7.3 Schematic showing wiring panel assembly including panel dimensions, locations of terminal blocks, surge suppression, transformers, cables, etc.
  - 7.4 Product data and cut sheets, operating and maintenance manuals. Information regarding materials, finishes and accessories.

8.0 As-built Documentation:

8.1 As part of the project as-builts, the Contractor shall provide updated electronic files in Visio 2010 format for point to point wiring diagrams and rack elevation diagrams in order to complete the 30 day operational test. As-built documentation shall include cable labeling for all newly installed cables.

9.0 Testing:

9.1 All coaxial cable and BNC connectors shall be tested prior to installation for compliance with requirements specified in this section.

9.2 All Ethernet data cables shall be tested prior to installation for compliance with the CAT 6 standard.

9.3 The contractor shall verify and record fiber optic power levels for all incoming video and data fiber uplinks from each TMSMHC to ensure they are within equipment tolerances.

10.0 Delivery, Storage, and Handling

10.1 All material shall be new and delivered in unopened packaging.

10.2 The Contractor shall deliver, store, handle and install all materials and equipment in such a manner as not to degrade quality, serviceability or appearance.

10.3 The Contractor shall be responsible for storage of the materials and equipment prior to installation in a clean, dry location free from construction dust, precipitation and excess moisture.

10.4 The Contractor shall be required to replace any damaged materials and equipment, as determined by the Engineer, at no additional cost to the Department

11.0 Work Area Requirements

All debris from demolition and/or construction activities shall be cleaned daily, removed and disposed by the Contractor from the premises. Disposal of the debris is the sole responsibility of the Contractor. The Contractor shall comply with all prevailing local laws, rules, and ordinances with regard to disposal.

The Contractor shall protect walls, floor, doorframes, doors, ceilings and stairs from construction activities, including overloading.

**Method of Measurement:**

This item shall be measured for payment at the contract lump sum price for “Modify Existing Main Fiber Hub”, installed, tested and accepted in place.

**Basis of Payment:**

This work will be paid for at the contract lump sum price for “Modify Existing Main Fiber Hub”, which price shall include all materials, hardware, cables, connectors, as-builts, testing, test equipment, labor, tools, all equipment, and incidentals necessary to complete the work.

## **ITEM #1108539A – MODIFY EXISTING OPERATIONS CENTER CONTROL SYSTEM**

### **Description:**

The existing operations center control system is located in the Department of Transportation Administration building located at 2800 Berlin Turnpike Newington. The Newington Operations Center (NOC) control room is located on the ground floor in Room G316. The work in this specification will be conducted in room G322 (Computer Room). This item shall consist of connecting the video and data equipment within this project at the NOC.

### **Scope:**

The operations center modifications include the work listed below and elsewhere in this specification. This item shall consist of connecting and configuring existing communication equipment to newly furnished equipment included within this project:

Install item 1108627A terminal port server in the existing equipment racks as determined by the engineer and detailed in the item specification.

Install item 1108841A Multi-Channel demultiplexer in the existing equipment racks as determined by the engineer and detailed in the item specification.

Install all necessary cabling from newly installed devices and make configuration changes to the existing American dynamics Video Switcher.

Install all necessary cabling from newly installed devices to the existing Brocade Ethernet switch.

Update all existing Point to Point wiring diagrams and rack elevation diagrams to include all newly installed equipment from this project.

### **Materials:**

#### 1.0 Baseband Video Cable – RG-6U Type

- 1.1 Precision video coaxial cable shall be utilized to transmit baseband NTSC video signals between communications equipment as described herein and elsewhere in these specifications and as shown on the drawings. All cabling shall be manufactured by Belden and plenum where required.
- 1.2 The cable shall have a polyethylene jacket
- 1.3 The outer conductor shall be tinned copper double braid 98% shield coverage.
- 1.4 The center conductor shall be 18 AWG solid bare copper

- 1.5 The nominal impedance shall be 75 ohms, plus or minus 2%.
- 1.6 The nominal DC loop resistance of the center conductor shall be 32.5 ohms/km.
- 1.7 The nominal DC loop resistance of the shield shall be 3.6 ohms/km.
- 1.8 The cable shall be 100% sweep tested.

## 2.0 Connectors for Baseband Video Cable

- 2.1 Connectors shall be BNC type, manufactured specifically for the baseband video coaxial cable to which they will be attached.
- 2.2 The BNC connectors shall meet or exceed the following specifications:
  - Characteristic Impedance 75 ohms (true)
  - Return Loss less than – 35dB to 1 GHz
  - Mechanical Durability 500 Cycles Minimum
  - Corrosion Resistance MIL-STD-202, Method 101
  - Solvent Resistance MIL-STD-202, Method 215
- 2.3 The center conductor of the BNC connector shall be 1.25 micrometers (50 millionths of an inch) gold plating over copper plate.

## 3.0 Data Cables

- 3.1 Data cables shall be TIA/EIA 568A Category 6, characterized up to 350 MHz, suitable for 1000Base-T local area network applications.
- 3.2 Category 6 cable shall be used for T-1, Ethernet, and serial data communications connections between communications equipment as shown on the Drawings.
- 3.3 All data cables installed in indoor equipment racks or on cable tray shall be plenum where required.
- 3.4 Data cables installed in outdoor equipment racks shall be rated for outdoor installations. All cabling to be installed in outdoor equipment cabinets shall maintain specified electrical properties over the entire operating temperature range, specified below



3.5 Data cables shall be terminated with RJ-11, RJ-45, RJ48 or other approved connectors as required by the communications equipment.

3.6 Data cables used for horizontal wiring shall be either 4 pair or 24 pair cable as required by the application and as directed by the Engineer and shall comply with the following requirements:

- Conductor: 24 AWG (solid bare copper)
- Nominal Capacitance: 14 pF/ft
- Characteristic Impedance:  $100\Omega \pm 15\%$
- Maximum DC Resistance: 9.4/100m
- Velocity of Propagation: 71% (minimum)

3.7 Data cables used for patching between equipment in equipment racks shall be 4 pair cable and shall comply with the following requirements:

- Conductor: 24 AWG (stranded tinned copper)
- Nominal Capacitance: 14 pF/ft
- Characteristic Impedance:  $100\Omega \pm 15\%$
- Maximum DC Resistance: 9.4/100m
- Velocity of Propagation: 71% (minimum)

3.8 Equipment located within environmentally controlled rooms shall be capable of meeting the following requirements:

- Storage Temperature:  $-40^{\circ}$  to  $+70^{\circ}$  Celsius
- Operating Temperature Range:  $0^{\circ}$  to  $+50^{\circ}$  Celsius
- Relative Humidity: 5 to 90%, non-condensing
- Fire Resistance: Complies with TR-NWT-000063, Issue 3

#### 4.0 Fiber Optic Patch Cords and Connectors:

4.1 Fiber Optic Patch Cords shall be furnished in sufficient length and quantity, and installed in the Newington Highway Operations Center to connect the existing field fiber-optic cables terminated at an existing patch panel to the optical equipment in the equipment racks.

4.2 The Fiber Optic Patch Cords shall be manufactured to industry standards

4.3 All optical fibers, coatings, tubes, metals and jackets shall be free of roughness, porosity, blisters, splits and voids in accordance with good manufacturing practice.

4.4 The color coding and position of fibers / buffer tubes within the cable shall be in accordance with TIA/EIA-598-A "Optical Fiber Cable Color Coding".

- 4.5 The cable shall be suitable for operation over a temperature range of -20°C to +60°C.
  - 4.6 The cable shall provide mechanical support and protection for the specified number of fibers. The outer jacket of the cable shall be constructed of medium or high density polyethylene. The cable jacket shall be marked with the manufacturer's name, sequential meter or foot markings, month, year or quarter year of manufacture, and a telecommunications handset symbol, as required by Section 350G of the National Electrical Safety Code.
  - 4.7 The cable shall be suitable for installation in plenums and risers.
  - 4.8 At a minimum, the cable shall be UL-listed OFNR/OFNP.
  - 4.9 The cable shall be composed of materials that are fully compliant with the State of Connecticut, NEC, and all other applicable local codes that pertain to wiring and cabling within a plenum air space or riser shaft.
  - 4.10 Materials used in the cable shall not produce hydrogen in a concentration large enough to cause any degradation in the transmission performance of the optical fibers.
  - 4.11 Materials used in the cable shall not support galvanic action.
- 5.0 Fiber Optic Patch Cord Connectors:
- 5.1 ST connectors shall have a ceramic ferrule with a nickel plated nut and body. SC connectors shall have a ceramic insert.
  - 5.2 The connector shall be of the ST-type (for Optelecom Video Demultiplexer) and SC-type (for existing fiber optic patch panel) and fully compatible with the fiber optic cable utilized and the mating jacks to which they will be attached.
  - 5.3 The connector shall be compatible with a ultra physical contact (UPC) finish. All connectors shall be polished to a UPC finish such that the return loss per mated pair of connectors is at least 25 dB. The return loss when the connector is mated with previously installed connectors shall be at least 18 dB.
  - 5.4 The connector mean loss shall not be greater than 0.2 dB with a standard deviation of not greater than 0.1 dB.

- 5.5 The connector loss shall not vary more than 0.1 dB after 500 repeated matings.
- 5.6 The connector shall withstand an axial load of 135 N.
- 5.7 The connectors shall be attached in accordance with the manufacturer's recommended materials, equipment and practices.
- 5.8 The connector shall be suitable for the intended environment and shall meet the following environmental conditions.
- 5.9 Operating Temperature: -20 to +50° C
- 5.10 Storage Temperature: -30 to +60° C
- 5.11 The connector loss shall not vary more than 0.2 dB over the operating temperature range.
- 5.12 When not in use, connectors shall be protected by a suitably installed waterproof protection cap.

**Warranty:**

All equipment shall be warranted for parts and labor by the vendor against defects and failures, which may occur through normal use for a minimum of one (1) year from the date of installation. A copy of the warranty must be presented to the Engineer prior to the approval of use of the equipment.

**Construction Methods:**

**6.0 Installation:**

- 6.1 The Contractor will furnish and install video baseband (coaxial) cables and connectors from the video demultiplexer to the existing video matrix switcher.
- 6.2 The Contractor shall reprogram the existing American dynamics video matrix switch to include the new CCTV's from this project. The Contractor shall request matrix switch assignments from the Engineer.
- 6.3 The contractor shall furnish and install Data cables for pan, tilt, and zoom (PTZ) control from the new terminal port server and existing terminal port server to the existing American dynamics video matrix switcher. Camera PTZ control for each traffic management system mini-hub cabinet (TSMHC) shall be interleaved between the newly installed terminal port server and existing port server. Each Traffic management system Mini Hub Cabinet shall have a minimum of two PTZ

connections to the existing video switcher using one existing Port sharing device and one newly installed port sharing device.

- 6.4 The contractor shall ensure the new terminal port server connects to the newly installed terminal server located in the Traffic Management System Mini-Hub cabinet for local Pan Tilt Zoom control at the Newington Operations Center.
- 6.5 The contractor shall furnish and install CAT-6 Ethernet Data cables from the video demultiplexer network monitoring card and terminal port server to the existing Brocade Ethernet switch as directed by the engineer.
- 6.6 The contractor shall install fiber optic jumper cables for each Traffic management system Mini-hub cabinet from the existing fiber optic patch panel to the input on the video demultiplexer.
- 6.7 The contractor shall install fiber optic jumper cables for each Traffic management system Mini-Hub cabinet (as detailed in the fiber splicing diagram) from the existing patch panel to the existing brocade Ethernet switch. The contractor shall connect the fiber optic cable to existing SFP optics as determined by the engineer. The existing SFP optic has LC fiber optic connectors.

#### 7.0 Submittals:

- 7.1 As part of Section 1.06 (Control of Materials) for this project, the Contractor shall submit the following documentation:
- 7.2 Detailed wiring diagrams, equipment cabinet front elevation drawings, point to point wiring diagrams, and equipment installation drawings indicating supports and appurtenances required for proper installation. Updated Wiring diagrams and rack elevation diagrams shall be submitted in Visio 2010 format.
- 7.3 Schematic showing wiring panel assembly including panel dimensions, locations of terminal blocks, surge suppression, transformers, cables, etc.
- 7.4 Product data and cut sheets, operating and maintenance manuals. Information regarding materials, finishes and accessories.

#### 8.0 As-built Documentation:

- 8.1 As part of the project as-builts, the Contractor shall provide updated electronic files in Visio 2010 format for point to point wiring diagrams and rack elevation diagrams in order to complete the 30 day operational test. As-built documentation shall include cable labeling for all newly installed cables.

9.0 Testing:

- 9.1 All coaxial cable and BNC connectors shall be tested prior to installation for compliance with requirements specified in this section.
- 9.2 All Ethernet data cables shall be tested prior to installation for compliance with the CAT 6 standard.
- 9.3 The contractor shall verify and record fiber optic power levels for all incoming video and data fiber uplinks from each TMSMHC to ensure they are within equipment tolerances.

10.0 Delivery, Storage, and Handling

- 10.1 All material shall be new and delivered in unopened packaging.
- 10.2 The Contractor shall deliver, store, handle and install all materials and equipment in such a manner as not to degrade quality, serviceability or appearance.
- 10.3 The Contractor shall be responsible for storage of the materials and equipment prior to installation in a clean, dry location free from construction dust, precipitation and excess moisture.
- 10.4 The Contractor shall be required to replace any damaged materials and equipment, as determined by the Engineer, at no additional cost to the Department

11.0 Work Area Requirements

All debris from demolition and/or construction activities shall be cleaned daily, removed and disposed by the Contractor from the premises. Disposal of the debris is the sole responsibility of the Contractor. The Contractor shall comply with all prevailing local laws, rules, and ordinances with regard to disposal.

The Contractor shall protect walls, floor, doorframes, doors, ceilings and stairs from construction activities, including overloading.

**Method of Measurement:**

This item shall be measured for payment at the contract lump sum price for “Modify Existing Operations Center Control System” of the type specified, installed, tested and accepted in place.

**Basis of Payment:**

This work will be paid for at the contract lump sum price for “Modify Existing Operations Center Control System” of the type specified, which price shall include all materials, hardware,

cables, connectors, labor, tools, all equipment, as-builts, testing, test equipment, and incidentals necessary to complete the work.

## **ITEM #1108627A – TERMINAL (PORT) SERVER**

### **Description:**

These items involve the provision, installation and configuration of the Terminal Port Server. The Contractor shall install the Terminal Server in standard EIA-19-inch equipment racks located in Traffic management system Mini-Hub cabinet (TSMHC), Operations Center, and/or Main Fiber Hub as shown on the plans.

### **Materials:**

#### 1.0 Terminal (Port) Server:

1.1 Terminal port servers shall be used to encapsulate serial field device data to the TCP/IP protocol and provide connectivity to the Ethernet network. Serial field device data will travel to the Highway Operations Center as TCP/IP over an Ethernet network as shown on the plans. Terminal servers shall operate with CCTV camera control and shall support asynchronous terminals, modems, printers and other serial devices and shall be hardware independent.

1.2 Terminal (Port) Servers shall be manufactured by **Digi International model Connectport TS 16 MEI** and comply with the following specifications:

- At least 16 serial ports
- Ethernet: 10/100Mbps
- Serial Interfaces: RS-232/422/485
- Serial Speed: 50 bps to 230 Kbps
- Operating Temperature: -20° to 60°C
- Storage Temperature: -40°C -85°C
- Relative Humidity: 5-95% non-condensing
- SNMP ver 2
- Operating System: Supported for virtual comm. Driver  
Windows Server 2008, 2012, Windows 7/8/10
- Protocols supported: TCP, IP, UDP, TELNET, RTTELNET, DHCP, ICMP
- Power requirement: External 100-250 v 50/60 hz power supply
- Relative humidity: 0% to 90%
- Management: Management
- Circuit Board: Conformal Coating (Outdoor installation only)

2.0 Copper Cables and Connectors:

2.1 The Contractor shall provide all necessary interface cabling and connectors to include but not be limited to the following:

2.1.1 Category 6 cable to connect the equipment and patch panels.

2.1.2 RJ45 10pin connectors.

2.2 The cables and connectors shall meet the specifications provided elsewhere.

**Construction Methods:**

1.0 General:

1.1 Terminal (Port) Servers shall be installed by the Contractor in the TMSMHC and Main Fiber Hub as shown on the plans.

1.2 All equipment shall be from the same manufacturer, designed by the manufacturer to operate with each other.

1.3 The Contractor shall prepare the equipment for shipment to the sites as indicated on the plans.

1.4 Installation shall include all required interface cable types as specified in these special provisions.

2.0 Terminal (Port) Server:

2.1 Terminal Port Servers shall be used to convert serial communications to Ethernet communications at the TMSMHC, Main Fiber Hub, and Newington Operation Center locations as shown on the plans. All serial and category 6 cables shall be provided to facilitate a complete end-to-end solution. The Terminal Port Servers shall interface to the 10/100 Ethernet Switch in the TMSMHC and Existing brocade switches at the Newington Operations Center, and Main Fiber Hub via category 6 cable for Ethernet communication. The contractor shall furnish and install the category 6 cable to make a connection to the existing Brocade switches and to the existing American dynamic video switcher at the Newington Operations Center and Main Fiber Hub.

3.0 Cables and Connectors:

3.1 The Contractor is required to furnish and install CAT 6 patch cables and connectors from the proposed Terminal Server for all Ethernet, RS 422, and RS 232 connections. The Contractor shall provide the necessary patch cable lengths based on the distance and cable path between the patch panel and the



communications equipment in the communications rack. Patch cables shall be neatly routed through cable management with tie wraps as necessary.

4.0 Submittals:

4.1 The Contractor shall provide the following information as part of the shop drawing/catalog cut submittal:

4.1.1 Functional block diagrams, wiring diagrams, and point-to point wiring details shall be in Visio 2010

4.1.2 Detailed shop drawings, wiring diagrams, equipment cabinet front elevation drawings, and equipment installation drawings indicating supports and appurtenances required for proper installation.

4.1.3 Product data, Operations and Maintenance manuals. Information regarding materials, finishes and accessories.

5.0 Spare Parts:

5.1 The Contractor must supply 1 terminal server of the type specified in the above specifications.

6.0 Testing:

6.1 The Contractor shall deliver components of the full duplex data communications system, only after the individual performance of each component has been demonstrated in accordance with the Contract.

**Method of Measurement:**

The work to be measured for payment under these items shall be the number of Terminal (Port) Servers of the type specified, installed, completed, tested and accepted at the locations specified in the contract plans.

**Basis of Payment:**

The work to be done under these items shall be paid at the Contract Price for each Terminal (Port) Server, which price shall include all equipment, materials, spare terminal server, cables, connectors, splicing, tools, installation, labor, shipping and incidental items required to satisfy these Specifications.

## **ITEM #1108628A – PORT SHARING DEVICE**

### **DESCRIPTION:**

This work includes the furnishing and installing port sharing devices as shown on the Drawings and detailed in this specification. The Ethernet Port Sharing Devices are used in the Traffic Management System Cabinet (TMSC) since each of the devices Traffic Flow Monitor and Variable Message Sign are individually I/P addressable. This specification Section describes the requirements for furnishing, installing, configuring, and testing Ethernet Port Sharing Devices (PSD), which shall be installed at designated locations to permit three or more Ethernet devices to communicate over fiber. The Ethernet Port sharing device must be made by the same manufacturer of the Traffic Management System Minihub Cabinet (TSMHC) 10/100Base-TX 100Base-FX Ethernet Switch to ensure system compatibility.

### **MATERIALS:**

The Ethernet Port Sharing Device with 10/100Base-TX 100Base FX ports shall be located at each TMSC which will interface with the 10/100 Ethernet Switch located in the TSMHC. The Ethernet Port Sharing Device shall provide Ethernet data from each TMSC to the TSMHC as shown on the plans. The following functional specifications shall apply:

All equipment shall be from the same manufacturer **Garrettcom model no. 6KL** as what is installed in the (TSMHC) and designed by the manufacturer to operate with each other. The Ethernet equipment used for communication shall comply with IEEE and RFC standards.

The Ethernet Port Sharing Device shall comply with the following requirements:

1. At least one Craft port for switch configuration
2. Minimum of 6-10/100Base-TX Ethernet ports with speed auto negotiation and full/half duplex mode IEEE 802.3u
3. Packet forward and filtering rate of at least 14,880pps for 10Mbps; 148,800pps for 100Mbps
4. 256K Memory buffer (minimum)
5. Store and forward with IEEE802.3x full duplex, non-blocking flow control
6. Support 8192 MAC address and IEEE 802.1Q VLAN Tagging
7. Support IEEE 802.1p (Quality of Service) for 4-level transmission priorities
8. Support IP Multicast Filtering through IGMP Snooping (v2) (RFC1112) and support user configurable static multicast groups.

9. Support SNMP v2 and v3, Web-based (http) management, and Telnet
10. Support port-mirroring
11. Standard 19" rack-mountable size
12. Operating temp: -40°C - 85°C with no fans for a minimum of four hours, meeting the following standards IEC61850-3, Nema TS-2, and IEC 60068.
13. Operating Humidity: 10% - 95% RH non-condensing
14. Storage Temp: -40°C - 85°C
15. Support Rapid Spanning IEEE 802-1w and multiple spanning tree protocol IEEE 802.1s. The switch must support a minimum of six simultaneous instances of multiple spanning tree protocol.
16. Two 1310 100Base FX ports for single mode fiber (LC) type connectors with a minimum rated distance of 40 Kilometers. The optical budget for the 100Base FX ports must be greater than or equal to 20 dB at 1310nm wavelength. Optics shall be supplied in the small form factor pluggable (SFP)
17. Circuit Board Conformal Coating
18. Switching latency of 6 us or less
19. Switching bandwidth of 1.6Gbps or better
20. Port based network access control (802.1x)

Copper Cables and Connectors:

The Contractor shall furnish and install all necessary interface cabling and connectors including:

- Category 6 cable to connect the equipment and patch panels.
- RJ 45 connectors.
- Power supply.

## Network Cables:

Patch cables for interconnecting Ethernet network devices shall be UTP Category 6 (CAT 6), 250 MHz, and 4-Pair Data Cable. Cables shall have solid copper conductors, Polyolefin insulation material, PVC jacket with nylon ripcord and pairs shall be twisted with staggered left hand lays. They shall support LAN applications up to 1 gigabit, and shall comply with NEC Article 800, UL Subject 444, EIA/TIA 568A, Category 6, PCC FT4. The cable used for connecting to the craft port shall be manufacturer specified.

All Category 6 cables shall meet following Specifications:

Capacitance unbalanced	330 pf/100m max @ 1 KHz
Conductor D.C.R	28.6 Ohm/M'
DCR unbalanced	5% max
Minimum Bend Radius	2.25"
Propagation delay skew	45 ns/100m max
Temperature rating	-20 C to +60 C
AWG Size	23
Shield Coverage	Unshielded
Stranding	Solid
Insulation Type	Polyolefin
Working Voltage	300
Jacket Type	PVC
Rating	UL Subject 444
CSA Rating	PCC FT1
Nom. O.D.	0.19 in
Nom. Cap	14
UL Listing	NEC CM/MP

## Manufacturer's Qualifications:

The manufacturer of the Ethernet Port Sharing Device shall have a minimum of five (5) year's experience in the design, manufacture, and testing of 10/100Base-TX 100Base FX Ethernet switches.

**WARRANTY:**

All equipment supplied under these items shall be warranted for parts by the manufacturer against defects and failures, which may occur through normal use for a period of three (3)

years from the date of acceptance. A copy of the warranty shall be presented to the Engineer before installation of the equipment.

**SPARES:**

The following spare parts shall be included:

Two (2) spare Ethernet port sharing devices 10/100 Base-TX 100Base FX of the type and size specified in this document. All necessary power supplies, cables and connectors shall be provided for the spare units.

**CONSTRUCTION METHODS:**

The Ethernet Port Sharing Device 10/100 Base-TX 100Base FX shall interface to the TFM's and VMS Controller (100Base-T) to the Ethernet Switch located in the (TMSMHC) (100Base-FX port). The communication to the (TMSMHC) will be through two dedicated single mode fibers.

All materials shall be new and approved by the Engineer. All equipment shall be the latest revision or product version under production by the equipment supplier. Obsolete, no-longer-supported, or no-longer-produced equipment shall not be acceptable.

Serial numbers and model numbers, if available, shall be permanently engraved on all removable components and hardware.

The Contractor shall prepare the equipment for shipment to the sites as indicated on the plans.

The Contractor shall furnish and install rack mount hardware. Installation shall include all required interface cable types as specified in these special provisions.

The contractor shall label all copper data and fiber cables.

**Cables and Connectors:**

The Contractor shall furnish and install CAT 6 patch cables, fiber optic patch cords and connectors from the proposed Ethernet Port sharing device to the Ethernet media converter and/or patch panel in the TMSMHC. If a media converter is not used then the contractor will be responsible for terminating the CAT 6 cable from the field TFM's and VMS controller into a patch panel/Surge arrestor and then provide a CAT 6 patch cable from the patch panel/surge arrestor to the Ethernet port sharing device.

The contractor will ensure a complete and working end to end connection from the proposed Ethernet port sharing device to the existing 10/100 Ethernet switch error free with no packet loss.

**Submittals:**

As part of Section 1.06 “Control of Materials”, the Contractor shall provide the following information as part of the shop drawing/catalog cut submittal:

- Functional block diagrams, wiring diagrams, and point-to point wiring details in Visio 2010 format.
- Detailed shop drawings, wiring diagrams, equipment cabinet front elevation drawings, and equipment installation drawings indicating supports and appurtenances required for proper installation.
- Product data, Operations and Maintenance manuals. Information regarding materials, finishes and accessories.

Delivery, Storage, and Handling:

- All materials shall be delivered in the manufacturer’s original unopened protective packages.
- All materials shall be stored in their protective packaging and protected against soiling, physical damage, or wetting before installation.
- All equipment shall be protected during transportation and until installation against damage and stains.
- All equipment and materials shall be stored in a clean, dry location free from construction dust, precipitation and excess moisture.
- Replace damaged materials and equipment, as determined by the Engineer, at no cost to the Department.

Configuration and Testing:

The Contractor shall configure the Ethernet port sharing device according to manufacturer’s instructions and Prior to installation, the Contractor shall demonstrate all required functions of the equipment and shall demonstrate complete operability with connected equipment and system as a whole.

**METHOD OF MEASUREMENT:**

The work to be measured for payment under these items shall be the number Ethernet Port Sharing Device inclusive of the spare units of the type specified, installed, completed, tested, configured and accepted. No separate measurement will be made for spare units to be furnished as part of this item.

**BASIS OF PAYMENT:**

The work to be done under these items shall be paid at the Contract Price for each Ethernet Port Sharing Device inclusive of the spare units. This price shall include all equipment, materials, cables, fiber patch cords, connectors, installation, configuration, labor, shipping and incidental items required to satisfy these Specifications.

**ITEM #1108629A – TRAFFIC MANAGEMENT SYSTEM MINI-HUB CABINET****DESCRIPTION:**

These items involve the provision, installation and configuration of equipment at the Traffic Management System Mini-Hub Cabinet (TSMHC) at the site(s) shown on the plans. The TSMHC is field equipment cabinets equipped with video and data communications equipment and serve as field hubs for transporting video and data from the traffic management system cabinets (TFSC) to the Main Fiber Hub (MFH) and/or the Highway Operations Center (HOC) as shown on the plans.

**Scope:**

Traffic Management System Mini-Hub Cabinets (TSMHC) shall be furnished with following equipment as described herein or as shown on the plans. The Contractor is responsible for including the necessary equipment to successfully complete the project.

- Item 1108629A TSMHC with power rack/panel, surge suppression, input panel, 19” rack rails, heater, ventilation, light bulb, locks and other material as required herein this specification.
- Item 1108707A Rack Mount Optical Video Data Receivers (RMOVDR), specified elsewhere, to receive video and PTZ data from the Traffic Management System Cabinets (TMSC).
- Item 1108628A Ethernet Port Sharing Devices (PSD), specified elsewhere, to allow locally connected Ethernet devices such as Traffic Flow Monitors (TFM) and Variable Message Sign (VMS) data to share a single data channel.
- Item 1108627A Terminal Server to receive the RS-422 pan tilt zoom (PTZ) communication from the RMOVDR and covert it to Ethernet communication. The Terminal server located at the Main Fiber Hub will convert the Ethernet communication back to RS-422 before going to the video switchers.
- Item 1108661A 10/100 Base-TX 100 Base-FX Ethernet Switch, specified elsewhere, to aggregate the data from the Ethernet Port Sharing Devices and Terminal Server and uplink the data to the Main Fiber Hub.
- Item 1108662A Ethernet Media Converter, specified elsewhere, used to connect Variable Message Signs and Traffic Flow Monitors locally connected to the (TSMHC) to the Data Transport System equipment i.e. Ethernet Port Sharing Device.
- Item 1108826A Optical Fiber Termination Patch Panel (OFTPP) to connect the fiber cable to the video and data equipment from the TSMHC to the MFH, leased telephone lines or HOC.



**MATERIALS:****1.0 Traffic Management System Mini-Hub Cabinet:**

- 1.1. The FEC shall have the following approximate dimensions: 24" (610 mm) W x 30" (762 mm) D x 96" 2438 mm H. The Contractor shall verify the height of the cabinet will sufficiently house all of the necessary equipment. The Contractor shall provide a rack elevation with the shop drawings to the Engineer to verify all equipment will be capable of being installed in the cabinet. See requirements for submittals elsewhere in this specification.
- 1.2. The TMSMHC (TMSMHC) shall be an enclosure suitable for outdoor mounting on a concrete foundation.
- 1.3. The TMSMHC shall meet the requirements as specified in Chapter 12 of the Type 170 Traffic Signal Control Hardware Specification FHWA-1 P:-78-6 as modified by this Specification.
- 1.4. The TMSMHC shall be sized to accommodate all required equipment, and provide adequate additional space for maintenance activities in the cabinet.
- 1.5. The TMSMHC shall be furnished with front and rear doors possessing securing brackets, each door equipped with a special Conn-2 lock (tumbler-type). One key shall be furnished for each cabinet provided. When closed, both doors shall fit tightly to a neoprene gasketing material. The door hinge pins shall be made of stainless steel. The door hinges and securing brackets shall be made of stainless steel and bolted so doors may be changed without the need to cut welds.
- 1.6. The TMSMHC shall be supplied with internal EIA standard 483 mm (19") racks as shown in the Drawings.
- 1.7. The TMSMHC shall have one (1) pull out drawer that extends the complete width and depth of the rack rails. The shelf shall be adjustable in height in the rack rails. The shelf must be able to support a laptop computer when fully extended outward.
- 1.8. The TMSMHC shall be equipped with adequate heating as required for cabinet components and ventilating system to maintain inside temperature between +5 to +60 degrees C at any time. The heating and ventilating system shall include an electric heater, fan and replaceable filter mounted on the intake vent. The ventilation fan assembly shall be of adequate size to circulate air in the cabinet and controlled by an adjustable thermostat. The fan and cabinet are to be located so as to direct the bulk of the airflow throughout the entire cabinet. The fan motor shall have a suppresser across it equal to or better than 0.1  $\mu$ f/47 ohm protection @ 600v. All points on the thermostat and fan at which 110 VAC are present shall be insulated to prevent electric shock.
- 1.9. The TMSMHC shall be equipped with an enclosed, 19" rack mounted electric strip heater and blower with a rating of approximately 800 watts at 120 VAC. The enclosure

shall house the strip heater and blower in which air shall be drawn in across the strip heater and exhausted out from the blower. The enclosure shall feature an internal thermal cut-off that will shut off the heater should the exhaust area become obstructed. The ventilation fan and strip heater with blower shall be controlled by a high-low adjustable thermostat which can be set to ensure the Cabinet interior temperature remains between +5° C and +60° C under average weather conditions. The strip heater with blower thermostat shall have an adjustable low temperature range down to at least 0°C. The heater shall be wired directly to the AC circuit breaker reserved for the heaters.

- 1.10. An external temperature-sensing device shall be provided to measure the internal cabinet temperature.
- 1.11. The MHC shall be equipped with an incandescent lamp of 100 watt rating mounted and wired such that the lamp comes on when either front or rear door is opened. The lamp shall be directly wired to AC.
- 1.12. The following electrical devices shall be provided on a hinged 19" EIA power distribution rack-mounted assembly in the TMSMHC. The hinged power distribution assembly shall be rack mounted on the opposite side of the ITS equipment. The hinged rack assembly chassis shall be constructed of aluminum and have a clear anodized finish. The hinged power assembly shall be able to swing out to provide clear access to rack mounted equipment for serviceability. A catalog cut of the power distribution assembly must be submitted for review and approval of the Engineer as part of the shop drawing review process.
  - One (3) 20 Amp duplex 120 VAC power receptacles. The electronic equipment in the cabinet shall not be connected to the GFCI receptacles unless directed by the Engineer.
  - Main circuit breaker, minimum 120 VAC, 40 Amp. Note: The Contractor is required to provide the necessary main circuit breaker to sufficiently power all of the equipment to be installed in the TMSMHC.
  - Minimum - Eight (8) load circuit breakers, 120 VAC, 15 Amp. Note: The Contractor is required to provide the necessary circuits and 120 VAC, 15 Amp duplex power receptacles to power all of the equipment to be installed in the TMSMHC.
  - Neutral bus.
  - Ground bus.
  - Two (2) types of power line surge protectors shall be provided between both line conductors (AC+ and AC-) and equipment ground.
  - The protectors shall be installed at the service terminal block.
  - An EDCO SHA-1230 surge suppression device shall be provided on the load side of the main circuit breaker. The protector shall be installed on the rack-mounted power assembly.
  - A heavy plastic envelope shall be provided which will contain cabinet wiring diagrams, schematics, etc. The envelope shall be securely fastened to the inside

of the front cabinet door. The envelope shall be 12” (300 mm) x 18” (455 mm) or larger.

1.13. The following information shall be permanently affixed to the inside door of the cabinet:

- TOWN AND LOCATION
- PROJECT NUMBER
- PURCHASE ORDER NUMBER
- CABINET MANUFACTURER
- MANUFACTURING DATE
- CABINET SCHEMATIC IDENTIFICATION DATE
- SOLD BY
- INTERSECTION NUMBER (If applicable)

1.14. The TMSMHC shall be fabricated from sheet aluminum providing it is rigid and has a minimum thickness of 3.17 mm.

1.15. All outside surfaces shall be cleaned and prepared in a manner consistent with industry standards for extruded and/or cast aluminum products. All outside surfaces shall be brushed aluminum. Outside surfaces shall be free of all manufacturers’ marking and identification information.

1.16. The TMSMHC shall be suitable for an outdoor installation on a concrete foundation and provide adequate environmental protection for the devices housed in the cabinets for year-round operation.

1.17. The TMSMHC shall comply with NEMA 3R standards.

1.18. All field cabinets shall operate from an 115VAC +/- 10%, 60 Hz power source.

1.19. The TMSMHC shall include one ITS commander by southern manufacturing for powering devices in the cabinet with remote temperature and voltage monitoring.

## 2.0 Input Wiring Assembly:

2.1. A rack mounted input wiring assembly shall be provided for each TMSMHC. A copy of the wiring assembly layout is included as part of the project plans. The assembly shall serve as the termination point for all communication and low-voltage power wiring to the CCTV cameras, traffic flow monitors (if required), variable message signs (if required) and other field equipment specified in the contract and shown on the plans that connect to the TMSMHC. In addition, the panel shall serve as a mounting location for surge suppression devices, low-voltage AC and DC transformers, and equipment cables that connect to devices in the TMSMHC such as OVDR’s port-sharing devices, fiber-optic modems, encoders, video multiplexers etc.

- 2.2. The input wiring assembly shall be rack mounted on the backside of the TMSC above the power distribution panel. The assembly shall be hinged to provide access to rack mounted equipment. All cables shall be securely trained and fastened to allow free swinging of the wiring assembly and prevent fraying or damage. The panel shall swing out to provide access to rack mounted equipment for serviceability.
- 2.3. All terminal positions and devices on the input wiring assembly shall be clearly marked and identified.

### 3.0 Surge Suppression:

- 3.1. The following types of voltage transient/surge suppression shall be provided and installed on the input wiring assembly. Each surge suppression device shall be supplied and installed in an appropriate socket that is fastened to the wiring assembly.
  - Coaxial CCTV cable input – EDCO CX-06-BNCY-I
  - Traffic Flow Monitor data communications – EDCO LCDP-030 (one unit for every TFM). This is only needed for TFM's that are locally connected to the cabinet using category 6 cable.(Ethernet circuit)
  - Traffic Flow Monitor power – EDCO PHC060 (one unit for every two (2) TFMs)
  - CCTV camera data communications – EDCO PC642C-008 LC Two (2) EDCO devices may be required if Manchester data communications is used for local camera control. (RS-422 circuits)
  - CCTV camera power – EDCO PHC060.
  - Variable Message Sign with direct connect communications – EDCO LCDP-030 (one unit for every VMS) This is only needed for VMS's that are locally connected to the cabinet using category 6 cable (Ethernet circuit)
  - CCTV Ethernet connection – EDCO CAT6-POE-I
- 3.2. All field terminations, interconnections and wiring cable connections shall be made using terminal block strips. Crimp-on spade lugs shall be installed on all cabling for easy connection and removal. All wiring connections shall be as short as possible to minimize signal loss and reduce transients.
- 3.3. Cables installed between surge suppression devices and cabinet equipment (such as OVDR's, port sharing devices, etc.) may be made directly from the output terminals of the EDCO surge suppression units.
- 3.4. Transformers that supply low-voltage power shall be securely fastened to the wiring panel assembly.

### 4.0 Warranty:

- 4.1. All equipment supplied under these items shall be warranted for parts by the vendor against defects and failures, which may occur through normal use for a period of one

(1) year from the date of Final Acceptance. A copy of the warranty shall be presented to the Engineer before installation of the equipment.

## **CONSTRUCTION METHODS:**

### 1.0 TSMHC:

- 1.1. The field equipment cabinets shall be configured with all equipment and interconnect cabling required for each of the TSMHC. The Contractor shall install and connect all required equipment.
- 1.2. Equipment to be installed by the Contractor in the TSMHC cabinets in addition to those mentioned under the scope of this item includes:
  - Power supplies
  - Power distribution panels
  - Input wiring assemblies
  - Cabling as required to provide a complete assembly

### 2.0 Submittals:

- 2.1. The Contractor shall submit the following documentation:
  - Detailed shop drawings, power assemblies, input wiring diagrams, equipment cabinet front rack elevation drawings, and equipment installation drawings indicating supports and appurtenances required for proper installation in Visio 2010 format.
  - Schematic showing wiring panel assembly including panel dimensions, locations of terminal blocks, surge suppression, transformers, cables, including wiring labels in Visio 2007 format.
  - Product data and cut sheets, operating and maintenance manuals. Information regarding materials, finishes and accessories.
  - The Contractor shall submit four (4) copies of the “as-built” equipment manuals with the documentation for the TSMHC. The equipment manuals shall include technical information, wiring diagrams and schematics, hookup prints, parts list and a troubleshooting guide.

### 3.0 Test procedures and test results:

- 3.1. Using a Tektronix VM-700 Video Measurement test set at each of the TSMHC and at the MFH (If required), the Contractor shall measure the video signal transmitted from each of the TSMHC. The received video signal shall meet or exceed EIA-RS-250-C Short Haul standards.
- 3.2. Using a Tektronix VM-700 Video Measurement test set at the MFH and at the Newington Highway Operations center, the Contractor shall measure the de-

multiplexed video signals transmitted from each of the TMSMHC. The received video signal shall meet or exceed EIA-RS-250-C Medium Haul standards.

#### 4.0 Delivery, Storage, and Handling:

- 4.1. The Contractor shall deliver, store, handle and install all materials and equipment in such a manner as not to degrade quality, serviceability or appearance.
- 4.2. The Contractor shall be responsible for storage of the materials and equipment prior to installation in a clean, dry location free from construction dust, precipitation and excess moisture.
- 4.3. The Contractor shall be required to replace any damaged materials and equipment, as determined by the Engineer, at no additional cost to the Department.
- 4.4. All materials shall be delivered in the manufacturer's original unopened protective packages.
- 4.5. All materials shall be stored in their original protective packaging and protected against soiling, physical damage, or wetting, before installation. All equipment shall be protected during transportation and until installation against damage and stains.

#### 5.0 Installation:

- 5.1. Install the TMSMHC on the cabinet foundation, and apply bead of silicon sealant between outside base edge of cabinet and foundation. The Contractor is responsible for ensuring the bolt patten matches between the TMSMHC and the cabinet foundation.
- 5.2. Install all power and service connections.
- 5.3. Install and connect field fiber optic cables and all other equipment cabling required to fully interconnect the equipment as shown on the Drawings. Apply conduit duct sealant to all ducts, and cap all unused ducts.
- 5.4. Install the rack mounted equipment in the mini-hub cabinet in accordance with the equipment manufacturer's recommendations.
- 5.5. The Contractor shall connect all equipment power supply to one of the ITS commander 120 VAC receptacles reserved for equipment in the cabinet.
- 5.6. Install and connect field fiber optic cable and all other equipment cabling required to fully interconnect the equipment as shown on the Drawings.
- 5.7. The optical fiber path for each video link shall have been tested and verified in accordance with the plans prior to the OVDR installation.

- 5.8. Power distribution panel components shall be mounted in or on the rack/panel such that they are readily accessible. All hazardous voltage points shall be covered to prevent inadvertent contact. The circuit breakers shall be labeled.
- 5.9. All wiring shall be neat and firm and in conformance with the current National Electrical Code. Any work performed by the Contractor for the utility installation shall be in accordance with P.U.C.A and State of Connecticut Department of Transportation Form 817. The Contractor shall obtain the necessary utility specifications prior to any service work.
- 5.10. All wiring to the hinged power distribution panel shall be harnessed so that the panel may be moved to facilitate field repairs on the panel. AC+ signal power shall be brought to an accessible terminal. Logic Ground, AC-, and Chassis Ground must be tied to a common point in the cabinet and grounded. The cabinet shall be wired such that the removal of two jumper wires will completely isolate all said grounds from one another. The AC+ service wire shall be wired direct to the line side of the main circuit breaker.
- 5.11. All power cables and communication cables connected within the TMSMHC shall be neatly trained along the rail racks.
- 5.12. The Contractor shall neatly train all optical patch cords and pigtailed together when routing them along the same path and shall neatly train them along the support rails in the camera control equipment cabinet. The contractor will provide rack mounted cable management when needed or as directed by the engineer.
- 5.13. The fibers shall be carefully managed and connected to a 19" rack mounted patch panel with six SC fiber connectors. The fiber cable sheath shall be sealed to provide a moisture barrier at the termination point.
- 5.14. No cables shall be installed with a sweep-bend radius less than the manufacturer's minimum recommended bending radius.
- 5.15. All communication cables must be terminated by the approved ITS integrator.

#### 6.0 Testing:

- 6.1. The Contractor shall be responsible for all testing and documentation required establishing approval and acceptance of this Item.
- 6.2. Pre-Installation Testing:
  - 6.2.1. The Contractor shall be required to perform quality control testing on one (1) of the cabinets and all of the thermostats and heating/cooling assemblies prior to delivery.

- 6.2.2. The Contractor shall submit test procedures and documented test results to the Engineer. The test procedures shall document the nature of test activities to be performed.
- 6.2.3. The test procedures shall be submitted to the Engineer prior to initiation of the testing. The procedures will be returned to the contractor within two (2) weeks indicating either “accepted” or “make corrections noted”.
- 6.2.4. In the case that corrections are required, the Contractor shall submit revisions within one (1) week.
- 6.2.5. Four (4) copies of the final test procedures shall be submitted to the Engineer prior to commencement of testing. The testing and test procedures shall include, but not be limited, to the following:
- 6.2.6. Visual Inspection: The Contractor shall perform detailed visual inspection to confirm that the following aspects of the cabinet are in compliance with the requirements of this specification:
  - General appearance: Cabinet dimensions, finish, locks and door handles, door frames, latching mechanism, door hinges, bolts, louvered vents and filters, gaskets, and lifting eyes.
  - Interior insulation, side panels, equipment rack.
  - Electrical components: power distribution assembly, conductors, color coding, terminal blocks, heater operation and mounting, fan ventilation area, trouble lamp.
- 6.2.7. The Contractor shall perform visual test of the following components: service light, power distribution assembly, fan, heater, main power disconnect and thermostat.
- 6.2.8. The Contractor shall refer to the testing and documentation of the materials and equipment listed under these items to the testing and documentation for other pertinent items contained in this contract.

6.3. Proof-of-Performance Testing:

- 6.3.1. The contractor shall energize each cabinet and confirm proper operation of heaters, fans, thermostats and service lights.

6.4. Installation Testing:

- 6.4.1. Upon complete installation of all field equipment (including camera assemblies, MHC, OVDR's, etc.), an operational test shall be performed by the Contractor and demonstrated to the Engineer to verify proper installation and operation. The test shall verify the proper operation of the field equipment installation.



6.5. Ground Test

6.5.1. All cabinet grounding systems when completed in place shall have a resistance to ground of not more than that shown in the table below as determined in the following manner:

1. Temporarily connect a 10 ampere load between the AC+ side of the equipment cabinet fuse and the ground system. It should be assured that the applied power voltage is 120 volts AC at the time of the test.
2. Disconnect the power company AC neutral from the ground system.
3. Connect a voltmeter between the power company AC neutral and the ground system.

Cabinet Insulated Model 170 Type	Voltmeter Reading (Volts) 20	Equivalent Resistance (Ohms) 2.0
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4. If the voltmeter reading is higher than the appropriate voltage shown in the above table under the 10 ampere load, the grounding system has an unacceptable resistance to ground. Additional grounding including electrical bonding of underground metallic conduit, may be necessary in order to meet the requirements of this test.
5. The results of this test shall be recorded and provided to the Engineer for each cabinet installed prior to acceptance and 30-test operational testing.

6.5.2. Insulation Resistance Testing – An insulation resistance test at 500 volts DC shall be made on each circuit between the circuit and ground. The insulation resistance shall not be less than 10 mega ohms on each circuit.

6.6. 30-Day Operational Testing:

6.6.1. Upon successful completion of the installation test and approval by the Engineer, a 30-day System Operational Test for each TMSMHC site shall commence. During the course of this test, the system must function continuously in accordance with the specifications for the duration of the test. If a malfunction occurs within the stated time frame, the Contractor shall make all necessary repairs to the system and re-establish proper operation. Upon approval of the Engineer, the 30-day test will begin anew. The system must operate for a full thirty (30) consecutive days without malfunction before the system will be accepted by the Engineer. The Contractor shall refer to "Notice To Contractor – 30 Day System Operational Test" for additional testing requirements. The Contractor shall coordinate the 30-day System Operational Test with other pertinent items in this contract.

**METHOD OF MEASUREMENT:**

These items shall be measured for payment by the number of Traffic Management System MiniHub cabinets with all required cabling, power supplies and other required appurtenances installed, completed, tested and accepted.

**BASIS OF PAYMENT:**

The work to be done under this Item shall be paid at the Contract Unit Price Each for the Traffic Management System Mini-Hub Cabinet which price shall include all equipment, materials, connectors, splicing, tools, installation, labor, shipping and incidental items required to satisfy these Specifications.

## **ITEM #1108644A – TRAFFIC MANAGEMENT SYSTEM CABINET**

### **Description:**

This work includes the furnishing and installing of outdoor equipment cabinets as shown on the Drawings and detailed in this specification.

### **Materials:**

#### 1. General:

- 1.1. The Traffic Management System Cabinet (TMSC) shall serve as an environmental enclosure for the field equipment. The TMSC shall be installed at camera sites as shown on the plans.
  - Rack mounted input wiring panel with all appropriate surge suppression devices, terminal blocks and power supplies.
  - Rack mounted power distribution panel.
  - Heating and ventilation system
- 1.2. Publications listed below form a part of these Specifications to the extent referenced. The publications are referred to in the text by the basic designation only.
  - National Electrical Manufacturers Association (NEMA Standard 250)
  - Underwriters Laboratories UL50 and UL508
  - National Electrical Code – Most recent edition
  - 170 Traffic Signal Control Hardware Specification FHWA-1 P:-78-6

#### 2. Traffic Management System Cabinet (TMSC):

- 2.1. The TMSC shall meet the NEMA 3R standard. The TMSC shall be 24”W x 30”D x 67”H with 19” rack rails mounted inside the cabinet. The TMSC shall be fabricated with “S” flanges in the top ventilation to prevent forced snow, ice and road salt from entering the enclosure.
- 2.2. The TMSC shall operate from an 115VAC +/- 10%, 60 Hz power source.
- 2.3. The TMSC shall be an enclosure suitable for outdoor mounting on a concrete foundation.
- 2.4. The TMSC shall meet the requirements as specified in Chapter 12 of the Type 170

Traffic Signal Control Hardware Specification FHWA-1 P-78-6 as modified by this Specification.

- 2.5. The TMSC shall be furnished with front and rear doors possessing securing brackets, each door equipped with a Conn-2 lock (tumbler-type). One (1) key shall be furnished for each cabinet installed. When closed, both doors shall fit tightly to a neoprene gasketing material. The door hinge pins shall be made of stainless steel. The hinge pins shall be the length of the door. The door hinges and securing brackets shall be made of stainless steel and bolted so doors may be changed without the need to cut welds.
- 2.6. The TMSC shall be supplied with internal EIA standard 19" racks as specified in the Drawings. The 19" racks shall be installed on both the front and rear door access points.
- 2.7. The TMSC shall have one rack mounted shelf that extends the complete width and depth of the cabinet. The shelf shall be adjustable in height and shall have rails to extend outwards. The shelf must be able to support a laptop computer when fully extended outward.
- 2.8. The TMSC shall be equipped with adequate heating as required for cabinet components and ventilating system to maintain inside temperature between +5 to +60 degrees C at any time. The heating and ventilating system shall include an electric heater, fan and replaceable filter mounted on the intake vent. The ventilation fan assembly shall be of adequate size to circulate air in the cabinet and controlled by an adjustable thermostat. The fan and cabinet are to be located so as to direct the bulk of the airflow throughout the entire cabinet. The fan motor shall have a suppresser across it equal to or better than 0.1  $\mu$ f/47 ohm protection @ 600v. All points on the thermostat and fan at which 110 VAC are present shall be insulated to prevent electric shock.
- 2.9. The TMSC shall be equipped with an enclosed, 19" rack mounted electric strip heater and blower with a rating of approximately 800 watts at 120 VAC. The enclosure shall house the strip heater and blower in which air shall be drawn in across the strip heater and exhausted out from the blower. The enclosure shall feature an internal thermal cut-off that will shut off the heater should the exhaust area become obstructed. The ventilation fan and strip heater with blower shall be controlled by a high-low adjustable thermostat which can be set to ensure the cabinet interior temperature remains between +5° C and +60° C under average weather conditions. The strip heater with blower thermostat shall have an adjustable low temperature range down to at least 0°C. The heater shall be wired directly to the AC circuit breaker reserved for the heaters.
- 2.10. The TMSC shall be equipped with an outdoor rated LED lamp with 100 watt equivalent output rating. The LED lamp shall be wired such that the lamp comes on when either front or rear door is opened. The lamp shall be directly wired to an AC breaker.

2.11. The following electrical devices shall be provided on a hinged 19" EIA power distribution rack-mounted assembly in the TMSC. The hinged power distribution assembly shall be rack mounted on the opposite side of the ITS equipment. The hinged rack assembly chassis shall be constructed of aluminum and have a clear anodized finish. The hinged power assembly shall be able to swing out to provide clear access to rack mounted equipment for servicability. A catalog cut of the power distribution assembly must be submitted for review and approval of the Engineer as part of the shop drawing review process.

2.11.1. One (1) 40 Amp main service input circuit breaker

2.11.2. Eight (8) 15 Amp load circuit breakers

2.11.3. Power bus

2.11.4. Ground bus

2.11.5. Neutral bus

2.11.6. Three (2) 20 Amp duplex 120 VAC power receptacles. In addition, one (1) GFCI duplex receptacle shall be included for tools and test equipment purposes. The electronic equipment to remain in the cabinet shall not be connected to the GFCI receptacles unless directed by the Engineer.

2.11.7. An EDCO ACP-340 surge suppression device shall be provided on the load side of the main circuit breaker. The protector shall be installed on the rack/panel mounted power assembly.

2.12. The TMSC shall have a heavy plastic envelope which will contain cabinet wiring diagrams, schematics, etc. The envelope shall be securely fastened to the inside of the front cabinet door. The envelope shall be 12" (300 mm) x 18" (455 mm) or larger.

2.13. The TMSC shall be fabricated from sheet aluminum providing it is rigid and has a minimum thickness of 3.17 mm. All outside surfaces shall be cleaned and finished. The outside surface appearance shall be brushed aluminum.

2.14. The TMSC shall be suitable for an outdoor installation on a concrete foundation and provide adequate environmental protection for the devices housed in the cabinets for year-round operation.

### 3.0 Input Wiring Assembly and Surge Suppression:

- 3.1 An rack mounted input wiring assembly measuring approximately 16"x19" shall be provided for each traffic management system cabinet. The assembly shall serve as the termination point for all communication and low-voltage power wiring to the CCTV cameras, traffic flow monitors (if required), variable message signs (if required) and other field equipment specified in the contract and shown on the plans. In addition, the assembly shall serve as a mounting location for surge suppression devices, low-voltage AC and DC transformers, and equipment cables that connect to devices in the traffic management system cabinet such as OVDT's, Ethernet port-sharing devices, fiber-optic media converters, etc.
- 3.2 The input wiring assembly shall be rack mounted on the backside of the TMSC above the power distribution panel. The assembly shall be hinged to provide access to rack mounted equipment.. All cables shall be securely trained and fastened to allow free swinging of the wiring assembly and prevent fraying or damage. The panel shall swing out to provide access to rack mounted equipment for servicabilty.
- 3.3 All terminal positions and devices on the wiring panel assembly shall be clearly marked and identified
- 3.4 The following types of voltage transient/surge suppression shall be provided and installed on the wiring panel assembly. Each surge suppression device shall be supplied and installed in an appropriate socket that is fastened to the wiring panel assembly.
- Coaxial CCTV cable input – EDCO CX-06-BNCY-I
  - Traffic Flow Monitor power – EDCO PHC060 (one unit for every two (2) TFM's)
  - Traffic Flow Monitor data communications – EDCO LCDP-030 (one unit for every TFM). This is only needed for TFM's that are connected to the cabinet using category 6 cable.(Ethernet circuit)
  - Variable Message Sign with direct connect communications – EDCO LCDP-030 (one unit for every VMS) This is only needed for VMS's that are connected to the cabinet using category 6 cable (Ethernet circuit)
  - CCTV camera data communications – EDCO PC642C-008 LC Two (2) EDCO devices may be required if Manchester data communications is used for local camera control. (RS-422 circuits)
  - CCTV camera power – EDCO PHC060.
  - Digital CCTV communications (For future use) – EDCO CAT6-POE
- 3.5 All field terminations, interconnections and wiring cable connections shall be made using terminal block strips except for Ethernet communications. Crimp-on spade lugs shall be installed on all cabling for easy connection and removal. All wiring connections shall be

as short as possible to minimize signal loss and reduce transients.

3.6 Cables installed between surge suppression devices and cabinet equipment (such as OVDT's, CICU, etc.) may be made directly from the output terminals of the EDCO surge suppression units.

3.7 Transformers that supply low-voltage power shall be rack mounted on the wiring assembly panel.

#### 4.0 Manufacturer's Qualifications:

4.1 The Manufacturer shall have a minimum of five (5) year's experience in the design, manufacture, and testing of TMSC of the type and size specified here in. The cabinets shall be manufactured according to world class quality standards. The manufacturer shall be ISO 9001 certified.

#### 5.0 Warranty:

5.1. All equipment supplied under these items shall be warranted for parts by the vendor against defects and failures, which may occur through normal use for a period of one (1) year from the date of installation. A copy of the warranty shall be presented to the Engineer before installation of the equipment.

#### **Construction Methods:**

##### 1. Submittals:

As part of Section 1.06 (Control of Materials) for this project, the Contractor shall submit the following documentation:

- 1.1. Detailed shop drawings, wiring diagrams, equipment cabinet front elevation drawings, and equipment installation drawings indicating supports and appurtenances required for proper installation in Visio 2010 format
- 1.2. Schematic showing wiring panel assembly including panel dimensions, locations of terminal blocks, surge suppression, transformers, cables, including wiring labels, etc in Visio 2010 format.
- 1.3. Product data and cut sheets, operating and maintenance manuals. Information regarding materials, finishes and accessories.

2. As-built Documentation:

2.1. As part of the project as-builts, the Contractor shall provide the following information:

2.1.1. Test procedures and test results.

2.1.2. The Contractor shall submit with the documentation for the TMSC item four (4) copies of the “as-built” equipment manuals. The equipment manuals shall include technical information, wiring diagrams and schematics, hookup prints, parts list and a troubleshooting guide.

3. Delivery, Storage, and Handling:

3.1. The Contractor shall deliver, store, handle and install all materials and equipment in such a manner as not to degrade quality, serviceability or appearance.

3.2. The Contractor shall be responsible for storage of the materials and equipment prior to installation in a clean, dry location free from construction dust, precipitation and excess moisture.

3.3. The Contractor shall be required to replace any damaged materials and equipment, as determined by the Engineer, at no additional cost to the Department.

3.4. All materials shall be delivered in the manufacturer’s original unopened protective packages. All materials shall be stored in their original protective packaging and protected against soiling, physical damage, or wetting, before installation. All equipment shall be protected during transportation and until installation against damage and stains.

4. Installation:

4.1. The Contractor shall install the TMSC on the foundation per the manufacturer’s requirements. Connect all cables for power and fiber. Install all equipment listed in this specification and other equipment as required to power and communications cables/connectors. All communication cables must be terminated by the approved ITS integrator.

4.2. Install the rack mounted optical video/data transmitters, Ethernet port sharing devices and fiber-optic media converters in the field equipment cabinets in accordance with the equipment manufacturer’s recommendations.

4.3. Install and connect field fiber optic cable and all other inter-equipment cabling required



to fully interconnect the equipment as shown on the Drawings.

- 4.4. Install and connect the video/data transmitter, Ethernet port sharing device, fiber optic data media converter power supplies to the existing 120 VAC receptacles reserved for the equipment in the cabinet.
- 4.5. The optical fiber path for each video link shall have been tested and verified in accordance with the plans prior to the equipment installation.
- 4.6. Power distribution assembly components shall be mounted such that they are readily accessible. All hazardous voltage points shall be covered to prevent inadvertent contact. The circuit breakers shall be labeled.
- 4.7. Install and connect equipment on wiring panel assembly such as equipment transformers, surge suppression, cabling with spade lugs and/or connectors, surge suppression, etc.
- 4.8. Install and connect the hinged wiring panel assembly inside traffic management system cabinet. All wiring shall be neat and firm and in conformance with the current National Electrical Code. Any work performed by the Contractor for the utility installation shall be in accordance with P.U.C.A and State of Connecticut Department of Transportation Form 817. The Contractor shall obtain the necessary utility specifications prior to any service work.
- 4.9. All wiring to the hinged power distribution assembly shall be harnessed so that the panel may be moved to facilitate field repairs on the panel. AC+ signal power shall be brought to an accessible terminal. Logic Ground, AC-, and Chassis Ground must be tied to a common point in the cabinet and grounded. The cabinet shall be wired such that the removal of two jumper wires will completely isolate all said grounds from one another. The AC+ service wire shall be wired direct to the line side of the main circuit breaker.
- 4.10. All power cables and communication cables connected within the TMSC shall be neatly trained along the rail racks.
- 4.11. The Contractor shall neatly train all optical patch cords and pigtails together when routing them along the same path and shall neatly train them along the support rails in the camera control equipment cabinet. The contractor will provide rack mounted cable management when needed or as directed by the engineer.
- 4.12. The fibers shall be carefully managed and connected to a 19" rack mounted patch panel with six SC fiber connectors. The fiber cable sheath shall be sealed to provide a moisture barrier at the termination point.
- 4.13. No cables shall be installed with a sweep-bend radius less than the manufacturer's

minimum recommended bending radius.

5. Testing:

5.1. The Contractor shall be responsible for all testing and documentation required to establish approval and acceptance of this Item.

5.2. Pre-Installation Testing:

5.2.1. The Contractor shall be required to perform quality control testing on one (1) of the cabinets and all of the thermostats and heating/cooling assemblies prior to delivery.

5.2.2. The Contractor shall submit test procedures and documented test results to the Engineer. The test procedures shall document the nature of test activities to be performed.

5.2.3. The test procedures shall be submitted to the Engineer prior to initiation of the testing. The procedures will be returned to the Contractor within two (2) weeks indicating either “accepted” or “make corrections noted”.

5.2.4. In the case that corrections are required, the Contractor shall submit revisions within one (1) week.

5.2.5. Four (4) copies of the final test procedures shall be submitted to the Engineer prior to commencement of testing. The testing and test procedures shall include, but not be limited, to the following:

- Visual Inspection: The Contractor shall perform detailed visual inspection to confirm that the following aspects of the cabinet are in compliance with the requirements of this specification:
- General appearance: cabinet dimensions, finish, locks and door handles, door frames, latching mechanism, door hinges, bolts, louvered vents and filters, gaskets, and lifting eyes.
- Interior insulation, side panels, equipment rack.
- Electrical components: power distribution assembly, conductors, color coding, terminal blocks, heater operation and mounting, fan ventilation area, trouble lamp.

- 5.2.6. The Contractor shall perform visual test of the following components: service light, power distribution assembly, fan, heater, main power disconnect and thermostat.
- 5.2.7. The Contractor shall refer to the testing and documentation of the materials and equipment listed under these items to the testing and documentation for other pertinent items contained in this contract.
- 5.3. Proof-of-Performance Testing – The contractor shall energize each cabinet and confirm proper operation of heaters, fans, thermostats and service lights.
- 5.4. Installation Testing - Upon complete installation of all field equipment (including camera assemblies, TMSC, OVDT's, PSD's, media converter - VMS) an operational test shall be performed by the Contractor and demonstrated to the Engineer to verify proper installation and operation. The test shall verify the proper operation of the field equipment installation.
- 5.5. 30-day Operational Testing - Upon successful completion of the installation test and approval by the Engineer, a 30-day System Operational Test for each TMSC site shall commence. During the course of this test, the system must function continuously in accordance with the specifications for the duration of the test. If a malfunction occurs within the stated time frame, the Contractor shall make all necessary repairs to the system and re-establish proper operation. Upon approval of the Engineer, the 30-day test will begin anew. The system must operate for a full thirty (30) consecutive days without malfunction before the system will be accepted by the Engineer. The Contractor shall refer to "Notice To Contractor – 30 Day System Operational Test" for additional testing requirements. The Contractor shall coordinate the 30-day System Operational Test with other pertinent items in this contract.

#### 5.6 Ground Test

5.6.1 All cabinet grounding systems when completed in place shall have a resistance to ground of not more than that shown in the table below as determined in the following manner:

1. Temporarily connect a 10 ampere load between the AC+ side of the equipment cabinet fuse and the ground system. It should be assured that the applied power voltage is 120 volts AC at the time of the test.
2. Disconnect the power company AC neutral from the ground system.
3. Connect a voltmeter between the power company AC neutral and the ground system.

Cabinet Insulated	Voltmeter Reading (Volts)	Equivalent Resistance (Ohms)
Model 170 Type	20	2.0

4. If the voltmeter reading is higher than the appropriate voltage shown in the above table under the 10 ampere load, the grounding system has an unacceptable resistance to ground. Additional grounding including electrical bonding of underground metallic conduit, may be necessary in order to meet the requirements of this test.
5. The results of this test shall be recorded and provided to the Engineer for each cabinet installed prior to acceptance and 30-test operational testing.

5.6.2 Insulation Resistance Testing – An insulation resistance test at 500 volts DC shall be made on each circuit between the circuit and ground. The insulation resistance shall not be less than 10 megohms on each circuit.

**Method of Measurement:**

This item shall be measured for payment by the actual number of equipped Traffic Management System Cabinets supplied and installed.

**Basis of Payment:**

The work to be done under this item shall be paid for at the Contract unit price each for Traffic Management System Cabinet of the type specified, which price shall include all materials, devices, hardware, termination panels, rack-mounted power assembly, rack-mounted wiring panels, surge suppression/transient protection, terminal strips, cable management, cables, connectors, tools, equipment, labor and incidentals necessary to complete this work.

## **ITEM #1108645A – AUXILIARY TERMINATION CABINET**

### **Description:**

This item will consist of furnishing and installing an Auxiliary Termination Cabinet (ATC) and liquidtight flexible metal conduit on all proposed field controller cabinets for Variable Message Signs, to provide for telephone service in accordance with the conditions set forth.

### **Materials:**

Each ATC shall be made of type 5052-H32, 0.125" (3.175mm) sheet aluminum with a brushed aluminum finish. The ATC shall be of clean-cut design and appearance. All seams shall be continuously welded and ground smooth. The ATC shall have dimensions of 16"H x 12"W x 10"D and shall conform to the NEMA 4X enclosure specifications. There shall be a 1/8" (3.175 mm) metal plate mounted on the back wall, spaced approximately 3/4" (19mm) from the back wall, for equipment provided and installed by the leased line provider. The door shall have two quarter-turn latches with a hasp and staple for padlocking. An oil resistant gasket shall seal the door. Door hinge pins shall be stainless steel material. All hardware used in the mounting of these cabinets shall be rust and corrosion resistant.

### **Construction Methods:**

The ATC shall be mounted on the side of the cabinet as close to the top of the cabinet as practical. Liquidtight flexible metal conduit shall be installed above ground from the underground conduit stub up to the ATC. An opening shall be made in the ATC corresponding to the size of the conduit entering from the bottom as shown on the plan. An insulated bushing shall be installed on the conduit. A 1 1/4" (31.75 mm) hole shall be made in the back of the ATC and through the side of the cabinet. A close nipple with insulated bushings shall be installed through the hole. The Contractor shall confirm the inside of the cabinet wall is clear, so that installation of the ATC will not damage any equipment inside the cabinet. A continuous nylon pull rope of at least 200 lbs. (90.72 kg) breaking strength, shall be installed in the conduit from the inside of the ATC to the leased line provider facilities. Four feet of slack shall be coiled and tied at each end to prevent removal until the installation of the leased line cable.

The ATC shall be bonded to the Variable Message Sign cabinet.

The contractor shall be responsible for verifying demarcation equipment can properly fit inside the Auxiliary Termination Cabinet. The contractor will be responsible for verifying demarcation equipment size with the leased line provider.

### **Method of Measurement:**

This item shall be measured for payment by the actual number of Auxiliary Termination Cabinets installed and accepted on the cabinets.

### **Basis of Payment:**

This item shall be paid for at the contract unit price each for "Auxiliary Termination Cabinet" which price shall include mounting hardware, liquidtight flexible metal conduit, close nipple, insulated bushings, pull rope, bonding wire, tools, and incidentals.

## **ITEM #1108661A – 10/100 BASE - TX ETHERNET SWITCH**

### **DESCRIPTION:**

This section involves the provision, installation and configuration of the 10/100 Base-TX Ethernet Switch. The Contractor shall install the proposed equipment in standard EIA-19-inch equipment racks located in the traffic management system mini hub cabinet (TSMHC) as shown in the drawings.

### **MATERIALS:**

The Ethernet switch shall provide Ethernet data aggregation at the TSMHC location to the existing Brocade switches located at the Newington Operations Center (NOC) and Main Fiber Hub (MFH) as shown on the plans. The following functional specifications shall apply:

All equipment shall be from the same manufacturer, **Garrettcom model 10KT** designed by the manufacturer to operate with each other. The Ethernet equipment used for communication shall comply with the following IEEE and RFC standards.

The 10/100Base-TX Ethernet Switch shall comply with the following requirements:

1. Minimum of eight (8) 10/100 Base-TX Ethernet ports with RJ-45 jacks IEEE 802.3u
2. At least one Craft port for switch configuration
3. 10/100 Base-TX with speed auto negotiation and full/half duplex mode
4. Packet forward and filtering rate of at least 14,880pps for 10Mbps; 148,800pps for 100Mbps; 11,900,000pps for 1000Mbps
5. 2M bits Frame buffer memory (minimum)
6. Store and forward with IEEE802.3x full duplex, non-blocking flow control
7. Support 8192 MAC address minimum and IEEE 802.1Q VLAN Tagging
8. Support IEEE 802.1p (Quality of Service) for 4-level transmission priorities
9. Support IP Multicast Filtering through IGMP Snooping (v2) (RFC1112) and support user configurable static multicast groups
10. Support SNMP, v2 and v3 Web-based (http) management, Telnet, and secure SSH
11. Support port-mirroring
12. Standard 19" rack-mountable size

13. Operating temp: -40°C - 85°C with no fans for a minimum of four hours, meeting the following standards IEC61850-3, Nema TS-2, and IEC 60068.

14. Operating Humidity: 10% - 95% RH non-condensing

15. Storage Temp: -40°C - 85°C

16. Support Rapid Spanning IEEE 802-1w and multiple spanning tree protocol IEEE 802.1s. The switch must support a minimum of six simultaneous instances of multiple spanning tree protocol.

17. Minimum of two 10/100/1000 TX ports and two 1000Base FX SFP ports – utilizing 1550nm wavelength with single Mode fiber (LC) type connectors with a minimum rated distance of 70 Kilometers. The optical budget for the 1000Base FX ports must be greater than or equal to 21dB at 1550nm wavelength. Optics shall be supplied in the small form factor pluggable (SFP)

18. Circuit Board Conformal Coating

19. All ports shall be modular and allow for port reconfiguration

20. Switching Latency of 10.5 us or better

21. Port based network access control (802.1X)

22. Two redundant power supplies with no fans

23. Backplane Switching bandwidth of 9.2 Gbps or greater when all ports are populated.

24. Minimum of sixteen 100Base FX ports utilizing 1310nm wavelength with single Mode fiber (LC) type connectors with a minimum rated distance of 40 kilometers. The optical budget for the 100Base FX ports must be greater than or equal to 20dB at 1310nm wavelength. Optics shall be supplied in the small form factor pluggable (SFP).

#### Copper Cables and Connectors:

The Contractor shall furnish and install all necessary interface cabling and connectors including:

- Category 6 cable to connect the equipment and patch panels.
- RJ 45 connectors.
- Power supply.

## Network Cables:

Patch cables for interconnecting Ethernet network devices shall be UTP Category 6 (CAT 6), 100-Ohm, and 4-Pair Data Cable. Cables shall have solid copper conductors, Polyolefin insulation material, PVC jacket with nylon ripcord and pairs shall be twisted with staggered left hand lays. They shall support LAN applications up to 100 MHz, and shall comply with NEC Article 800, UL Subject 444, EIA/TIA 568A, Category 6, PCC FT4. The cable used for connecting to the craft port shall be manufacturer specified.

All Category 6 cables shall meet following Specifications:

Capacitance unbalanced	330 pf/100m max @ 1 KHz
Conductor D.C.R	28.6 Ohm/M'
DCR unbalanced	5% max
Minimum Bend Radius	2.25"
Propagation delay skew	45 ns/100m max
Temperature rating	-20 C to +60 C
AWG Size	23
Shield Coverage	Unshielded
Stranding	Solid
Nom. Imp	100 ohms
Insulation Type	Polyolefin
Working Voltage	300
Jacket Type	PVC
Rating	UL Subject 444
CSA Rating	PCC FT1
Nom. O.D.	0.19 in
Nom. Cap	14
UL Listing	NEC CM/MP

## Manufacturer's Qualifications:

The manufacturer of the 10/100Base-TX Ethernet switch shall have a minimum of five (5) year's experience in the design, manufacture, and testing of 10/100Base-TX Ethernet switches.



Warranty:

All equipment supplied under these items shall be warranted for parts by the manufacturer against defects and failures, which may occur through normal use for a period of three (3) years from the date of acceptance. A copy of the warranty shall be presented to the Engineer before acceptance of the 30 day test.

Spares:

The following spare parts shall be included:

One (1) spare 10/100 Base-TX Ethernet Switch of the type and size specified in this document with all optics and options as stated above.

All necessary power supplies, cables and connectors shall be provided for the spare units.

**CONSTRUCTION METHODS:**

The newly installed 10/100Base-TX Ethernet Switch in the TMSMHC shall interface to all the newly installed port sharing devices in the Traffic management system cabinets (TMSC) utilizing 40 Kilometer 100 Base-FX SFP optics. The Ethernet switch will also interface all newly installed Terminal servers located at the TMSMHC utilizing the 10/100 TX Ethernet ports. The newly installed 10/100 Base TX Ethernet Switch located in the TMSMHC shall be interfaced to the existing Brocade SX-1600/SX-800 Ethernet equipment located in the Main Fiber Hub (MFH) and existing Garrettcom equipment located in an adjacent TMSMHC utilizing the 1000 FX fiber ports. The contractor will furnish and install all patch cables to make a complete end to end connection.

The contractor shall configure the 10/100-TX Ethernet switch for RSTP. The contractor shall ensure that VLAN's and RSTP is configured properly end to end to create a redundant ring to the Main Fiber Hub. Configuration of the existing Brocade switches will be handled by highway operations. Highway operations will provide VLAN and ip switch assignments to the contractor.

All materials shall be new and approved by the Engineer. All equipment shall be the latest revision or product version under production by the equipment supplier. Obsolete, no-longer-supported, or no-longer-produced equipment shall not be acceptable.

Serial numbers and model numbers, if available, shall be permanently engraved on all removable components and hardware.

The Contractor shall prepare the equipment for shipment to the sites as indicated on the plans.

The Contractor shall furnish and install rack mount hardware. Installation shall include all required interface cable types as specified in these special provisions.

The contractor shall label all data and fiber cables which shall correspond to the As-built wiring diagrams. The contractor will be provided existing Visio wiring diagrams which will need to be updated to include the newly installed equipment, wiring, and rack elevation diagrams.

#### Cables and Connectors:

The Contractor shall furnish and install CAT 6 patch cables and connectors from the proposed Ethernet equipment in the Mini-Hub cabinet and NOC. The Contractor shall provide the necessary patch cable lengths based on the distance and cable path between the patch panel and the communications equipment in the communications rack. Patch cables shall be neatly routed through cable management with tie wraps as necessary.

The Contractor shall provide all termination required to connect equipment to the optical fiber termination patch panel. The Contractor shall provide and install all interconnection fiber optic patch cords between the Ethernet Switch and fiber optic patch panel located in the TMSMHC. The Contractor shall match the fibers according to the fiber optic splicing plans to connect the Ethernet port sharing device in the (TMSC) to the matching Ethernet switch located in the TMSMHC. The contractor is required to make a completed end to end connection between Ethernet switches located in TMSMHC's, NOC, and MFH as detailed on the project plans.

The complete end to end optical fiber path for each data link shall have been tested and verified in accordance with this Contract prior to the connection to the Ethernet Switch.

The contractor once all connections are made between the TMSMHC's, NOC, and Main Fiber Hub will verify that light loss levels are within the proper optical budget range. If it is found that optical loss levels are too low or too high in relation to the OTDR fiber testing then the contractor will clean or replace dirty or damaged fiber patch cables for a low optical power condition and add optical attenuators for a high optical power condition.

#### Submittals:

As part of Section 1.06 "Control of Materials", the Contractor shall provide the following information as part of the shop drawing/catalog cut submittal:

- Functional block diagrams, wiring diagrams, and point-to point wiring details. Wiring diagrams shall be supplied in Visio 2010 format.
- Detailed shop drawings, wiring diagrams, equipment cabinet front elevation drawings, and equipment installation drawings indicating supports and appurtenances required for proper installation.
- Product data, Operations and Maintenance manuals. Information regarding materials, finishes and accessories.

#### Delivery, Storage, and Handling:

- All materials shall be delivered in the manufacturer's original unopened protective packages.
- All materials shall be stored in their protective packaging and protected against soiling, physical damage, or wetting before installation.
- All equipment shall be protected during transportation and until installation against damage and stains.
- All equipment and materials shall be stored in a clean, dry location free from construction dust, precipitation and excess moisture.
- Replace damaged materials and equipment, as determined by the Engineer, at no cost to the Department.

Configuration and Testing:

The Contractor shall configure the switch according to manufacturer's instructions and Prior to installation, the Contractor shall demonstrate all required functions of the equipment and shall demonstrate complete with operability with connected equipment and system.

**METHOD OF MEASUREMENT:**

The work to be measured for payment under this item shall be the number of 10/100 Base-TX Ethernet switches inclusive of all optics and spare units of the type specified, installed, completed, tested and accepted at the TMSMHC. No separate measurement will be made for spare units to be furnished as part of this item.

**BASIS OF PAYMENT:**

The work to be done under these items shall be paid at the Contract Price for each 10/100 Base-TX Ethernet switch inclusive of all optics and spare units. This price shall include all equipment, materials, power supplies, cables, Cat 6 patch cords, fiber optic patch cords, spare parts, connectors, installation, warranties, labor, shipping and incidental items required to satisfy these Specifications.

## **ITEM #1108662A – ETHERNET MEDIA CONVERTER**

### **DESCRIPTION:**

This item involves the provision, installation and configuration of **two (2)** Fiber Optic Ethernet Media Converters at either the Traffic Management system cabinet (TMSC) and/or Traffic Management system mini hub Cabinet (TMSMHC) where Ethernet communications to each Variable Message Sign (VMS) controller is over fiber optic cable.

#### Scope:

Ethernet media converters shall be installed at following locations:

- TMSMHC to the VMS Controller Cabinet
- TMSC to the VMS Controller Cabinet

#### General Requirements:

Ethernet media converters shall be used to convert Ethernet (electrical, over twisted-pair copper) to optical Ethernet on fiber. Ethernet media converters will interface to an Ethernet switch on one side and termination panel for the device on the other, as shown on the plans. Ethernet media converters shall transmit and receive 10/100 Mbps data over single mode fiber. It shall function as a 10/100 Mbps Ethernet link without degradation or adjustments.

### **MATERIALS:**

#### General Requirements:

The Ethernet media converters shall be rack mount units for those located in the VMS Controller Cabinet, TMSC, and TMSMHC. The circuit boards must be conformal coated to resist moisture.

All indicators shall be on the unit's front panel.

All equipment shall be from the same manufacturer, designed by the manufacturer to operate with each other. The contractor will be responsible for ordering a pair of media converters that work together.

Ethernet media converters shall meet the following specifications:

Interface	ISO/IEC 802.3 100BASE-TX; IEEE 802.3 100BASE-FX
Connectors	Fiber: FC on SFP connector or ST UTP: ISO/IEC 8877: 1992 - Jack (RJ-45)
Fibers	2 Fiber Utilizing One fiber for transmit and one fiber for receive Type A 2 Fiber Utilizing One fiber for transmit and one fiber for receive Type B
Distances	minimum 10 km on SM fiber
Center Wavelength	1310nm
Receive Sensitivity	-31dBm minimum
Transmit Power	0 dBm minimum
MTBF	> 100,000 hours
Data	Data Interface: 10/100 Base-T Ethernet full/half Data Rate: 10/100 Mbps IEEE 802.3 Compliant User selectable speed and duplex
Loss Budget	19 dB, 10/125 um Single Mode fiber
System	Bit Error Rate 1 in $10^{10}$ or better
Power	Standard 12VDC (with AC adapter)

#### Power Requirement:

Equipment located in VMS Controller Cabinet, TMSC, and TMSMHC shall operate from 115 VAC  $\pm 10\%$ , 60 Hz power. The equipment operations shall not be adversely affected by transient voltages, voltage harmonic distortion, voltage unbalance, surges and sags normally experienced on commercial power lines.

#### Transient suppression:

All equipment designs must include transient suppression for both common and transverse mode noise to minimize the effects of lightning surges or transients.

#### Environmental requirements:

Equipment shall meet the following requirements:

Storage Temperature	- 40° to + 85° Celsius
Operating Temperature Range	-40° to + 74° Celsius
Relative Humidity	5 to 95 %, non-condensing
Fire Resistance	Complies with TR-NWT-000063, Issue 3

**Manufacturer's Requirements:**

The manufacturer shall have a minimum of five (5) year's experience in the design, manufacture, and testing of Ethernet media converters. The manufacturer shall be ISO 9001 certified.

**Warranty:**

All equipment supplied under this item shall be warranted for parts by the manufacturer against defects and failures, which may occur through normal use for a minimum period of one (1) year from the date of installation. A copy of the warranty shall be presented to the Engineer before installation of the equipment.

**Spares:**

The following spare parts shall be included:

1 – Pair of Media Converters of the type specified in this document.

All necessary power supplies, cables and connectors shall be provided for the spare units.

**CONSTRUCTION METHODS:**

**Equipment Installation and Interconnection:**

1. All Ethernet media converters shall be installed in TSMHC, TMS, and VMS Controller Cabinets, in the quantities as shown on the Drawings.
2. The contractor shall configure (if required) and install all Ethernet Media Converters in the TSMHC, TMS, and VMS Controller Cabinets.
3. The Contractor shall coordinate the installation of the Ethernet Media Converter in the TSMHC, TMS, and VMS Controller Cabinets, with the Engineer and VMS manufacturer.

4. Installation shall include all required interface cable types as specified or as recommended by the manufacturer, in order to provide a fully functional system.

**Submittals:**

The Contractor shall provide the following information as part of the shop drawing/catalog cut submittal:

- Functional block diagrams, wiring diagrams, and point-to point wiring details in Visio 2010 format.
- Detailed shop drawings, wiring diagrams, equipment cabinet front elevation drawings, and equipment installation drawings indicating supports and appurtenances required for proper installation.
- Product data, Operations and Maintenance manuals. Information regarding materials, finishes and accessories.

**Delivery, Storage, and Handling:**

- All materials shall be delivered in the manufacturer's original and undamaged protective packages.
- All materials shall be stored in their original protective packaging and protected against soiling, physical damage, or wetting, before and during installation.
- All equipment shall be protected during transportation and installation against damage and stains.
- Store materials and equipment in a clean, dry location free from construction dust, precipitation and excess moisture.
- Replace damaged materials and equipment, as determined by the Engineer, at no additional cost to the Department.

**Protection and Cleaning:**

Protect finished surfaces from damage during fabrication, shipping, storage, testing and transfer to the site.

**Configuration and Testing:**

The Contractor shall configure the Ethernet Media Converters according to manufacturer's instructions and prior to installation; the Contractor shall demonstrate all required functions of the equipment and shall demonstrate complete operability with connected equipment and system.

**METHOD OF MEASUREMENT:**

The work performed under this item shall be measured and paid for each pair of Ethernet Media Converters inclusive of the spare units of the type specified, installed, completed, tested and accepted. No separate measurement will be made for spare units to be furnished as part of this

item. The Ethernet Media converter pair must work together to complete the communications circuit

**BASIS OF PAYMENT:**

The work to be done under these items shall be paid at the Contract Price Each for each pair of Ethernet Media Converters inclusive of the spare units. The price of which shall include all equipment, materials, power supplies, power converters, warranties, cables, connectors, splicing, tools, installation, labor, shipping and incidental items required to satisfy these Specifications.



## **ITEM #1108670A – WIRELESS ROUTER**

### **DESCRIPTION:**

This section involves the provision, installation and configuration of a Wireless Cellular Router. The Contractor shall install the proposed equipment in standard EIA-19-inch equipment racks located in the Variable message sign control cabinet. The wireless cellular router shall include externally mounted cellular antennas.

### **MATERIALS:**

The Wireless Cellular Router shall be located in each Variable message sign control cabinet. The Wireless Router shall provide Ethernet and/or Serial data aggregation from the variable message sign controller to the Newington Highway Operations Center (NHOC). The following functional specifications shall apply:

All wireless routers shall be manufactured by Digi international and shall be model Transport WR21-L52A-DE1-TH and or approved equal. The cellular wireless router must be certified by Verizon wireless for operation on Verizon's Private Network Gateway. The following accessories shall be supplied with the cellular wireless router:

1. Minimum of two (2) screw type Penta band antennas for setup purposes. The antennas shall have a gain of 3.2dBi and be compatible with frequencies of 850, 900, 1800, 1900, and 2100 MHz
2. One extended temperature range AC to DC power supply rated for -40C to +74C.
3. Surface mount kit attached to a rack mounted shelf.
4. One surface mount external Omni directional panorama antenna model LPMM-7-27 and or approved equal
5. Belden 8259 RG58A/U braided coax with the appropriate SMA connectors or manufactured panorama RG58 cables sized to the appropriate length.
6. 2 compatible SIM Cards for Verizon wireless service.

The wireless cellular router shall comply with the following requirements:

1. LTE Multi-Carrier (Verizon, AT&T, and Sprint) 700/850/1700(AWS)/1900 MHz; 2G/3G GSM fall back to 850/900/1700AWS/1800/1900/2100MHz; 2G/3G CDMA fall back to 800/1900MHz
2. The max transfer rate shall be 50 Mbps upload and 100 Mbps Download on LTE

- signal.
3. Antenna connectors: Ux, Lx variants 2x50 Ohm SMA (Center pin: female); E1, Dx, Bx variants 1x50 Ohm SMA (Center pin: female)
  4. Dual (2) Mini-Sim card slots with the capability of connecting to multiple cellular carriers for redundant connectivity
  5. Built in Surelink software to monitor connectivity to NHOC and switch to a secondary cellular carrier during network failure and remotely reboot the modem to reestablish cellular network connectivity.
  6. One (1) RS-232/422/485 port that is fully compatible with Digi realport COM Port Redirector software.
  7. Built in GPS receiver that is capable of sending coordinates via UDP/IP and TCP/IP using Python or GPS status query.
  8. One (1) USB 2.0 High-Speed Type A connector
  9. Support SNMP v1, v2, and v3, Web-based (https) management, and secure SSH management
  10. Support IP Multicast Filtering through IGMP Snooping (v2) (RFC1112).
  11. Support network address translation (NAT) with IP port forwarding for a minimum of 30 IP addressable devices
  12. Support IP pass-through to Ethernet connected device
  13. Support routing protocols RIP (v1, v2), OSPF, SRI, BGP, iGMP routing
  14. Stateful inspection firewall with scripting
  15. Support VPN IPsec with IKEv1, IKEv2 and Open VPN client and server PPTP, L2TP
  16. Encryption types supported DES, 3DES, and AES up to 256-bit
  17. Authentication types supported RADIUS and TACACS+
  18. Support IEEE 802.1p (Quality of Service)
  19. Standard 19" (480 mm) rack-mountable or din rail mounted.
  20. Operating temp: -35°C - 70°C with no fans for a minimum of four hours.
  21. Operating Humidity: 0% - 95% non-condensing.

22. Storage Temp: -40°C - 85°C

23. Support Rapid Spanning (RSTP) IEEE 802-1w

Cables and Connectors:

The Contractor shall furnish and install all necessary interface cabling and connectors including:

- Category 6 cable to connect the equipment and patch panels.
- RJ 45 connectors.
- DB 9 serial cable
- Coaxial cable for two LTE antennas.

Network Cables:

Patch cables for interconnecting Ethernet network devices shall be UTP Category 6 (CAT 6), 100-Ohm, and 4-Pair Data Cable. Cables shall have solid copper conductors, PVC jacket with nylon ripcord and pairs shall be twisted with staggered left hand lays. They shall support LAN applications up to 250 MHz, and shall comply with NEC Article 800, UL Subject 444, EIA/TIA 568A, Category 6, PCC FT4.

All Category 6 cables shall meet following minimum Specifications:

Capacitance unbalanced	330 pf/100m max @ 1 KHz
Conductor D.C.R	28.6 Ohm/M'
DCR unbalanced	5% max
Minimum Bend Radius	2.25" (57 mm)
Propagation delay skew	45 ns/100m max
Temperature rating	-20 C to +75 C
AWG Size	23
Shield Coverage	Unshielded
Stranding	Solid
Nom. Imp	100 ohms
Insulation Type	Polyvinylchloride
Working Voltage	300
Jacket Type	PVC
Rating	UL Subject 444
CSA Rating	PCC FT1

Nom. O.D.	0.19 in
Nom. Cap	14
UL Listing	NEC CM/MP

Manufacturer's Qualifications:

The manufacturer of the Wireless router shall have a minimum of five (5) year's experience in the design, manufacture, and testing of Cellular Wireless routers.

Warranty:

All equipment supplied under these items shall be warranted for parts by the manufacturer against defects and failures, which may occur through normal use for a period of five (5) years from the date of purchase. A copy of the warranty shall be presented to the Engineer before acceptance of the 30 day test.

Spare Equipment:

The following spare parts shall be included:

One (1) spare Wireless Routers of the type and size specified in this document with all accessories, cables, antennas, power supplies, mounting hardware/bracket, and options as stated above.

**CONSTRUCTION METHODS:**

The wireless router shall be installed in each VMS traffic management system cabinet (TMSC). The wireless router shall interface to the newly installed VMS controller via the wired Ethernet port on the LAN side of the wireless router. The contractor shall install the rack mounted shelf and surface mount the wireless router to the shelf. The contractor shall furnish and mount the external antenna on top of the auxiliary termination cabinet. The contractor shall furnish and install two RG58/U cables into the cabinet and connect to the wireless cellular router. The contractor will also furnish the required Verizon wireless Sim Cards for Verizon wireless private gateway service. The contractor shall set the IP address information in the VMS controller and verify connectivity from the VMS controller. IP address assignments for the VMS controller and Wireless router will be provided by the engineer.

All materials shall be new and approved by the Engineer. All equipment shall be the latest revision or product version under production by the equipment supplier. Obsolete, no-longer-supported, or no-longer-produced equipment shall not be acceptable.

Serial numbers and model numbers, if available, shall be permanently engraved on all removable components and hardware.

The Contractor shall revise the existing Daktronics cabinet wiring diagram to include wiring for the cellular wireless router and all associated cabling. The contractor shall provide this both paper and electronic copies in Visio 2010 format. A revised wiring diagram shall be supplied in the VMS TMSC.

#### Cables and Connectors:

The Contractor shall furnish and install CAT 6 patch cables and connectors from the proposed wireless router equipment to the VMS controller. The Contractor shall provide the necessary patch cable lengths based on the distance between the wireless router and the VMS controller in the rack. Patch cables shall be neatly routed through cable management with tie wraps as necessary.

#### Submittals:

As part of Section 1.06 "Control of Materials", the Contractor shall provide the following information as part of the shop drawing/catalog cut submittal:

- Functional block diagrams, wiring diagrams, and point-to point wiring details. Wiring diagrams shall be supplied in Visio 2010 format.
- Detailed shop drawings, wiring diagrams, equipment cabinet front elevation drawings, and equipment installation drawings indicating supports and appurtenances required for proper installation.
- Product data, Operations and Maintenance manuals. Information regarding materials, finishes and accessories.

#### Delivery, Storage, and Handling:

- All materials shall be delivered in the manufacturer's original unopened protective packages.
- All materials shall be stored in their protective packaging and protected against soiling, physical damage, or wetting before installation.
- All equipment shall be protected during transportation and until installation against damage and stains.
- All equipment and materials shall be stored in a clean, dry location free from construction dust, precipitation and excess moisture.
- Replace damaged materials and equipment, as determined by the Engineer, at no cost to the Department.

#### Configuration and Testing:

The Contractor shall configure and provision the wireless router according to manufacturer's instructions and Prior to installation, the Contractor shall demonstrate all required functions of the equipment and shall demonstrate complete with operability with connected equipment and system.

**METHOD OF MEASUREMENT:**

The work to be measured for payment under these items shall be the number of wireless routers inclusive of all accessories listed herein and spare units of the type specified, installed, completed, tested and accepted at the VMS locations. No separate measurement will be made for spare units to be furnished as part of this item.

**BASIS OF PAYMENT:**

The work to be done under these items shall be paid at the Contract Price Each for each wireless router furnished and installed, inclusive of all spare units. This price shall include all equipment, materials, power supplies, cables, Cat 6 patch cords, antennas, mounting brackets, RG58/U cable, spare parts, connectors, installation, warranties, labor, shipping and incidental items required to satisfy these Specifications.

## **ITEM #1108704A – OPTICAL VIDEO/DATA TRANSMITTER**

### **Description:**

This work includes the furnishing and installing optical video/data transmitters (OVDT's) as shown on the Drawings and detailed in this specification. This Item specifies the requirements for the video and data fiber-optic communications system to be furnished and installed at the Traffic Management System Cabinet (TMSC) and the Traffic Management System Mini-Hub Cabinet (TMSMHC) as shown on the Drawings and detailed in this Specification.

Optical Video/Data Transmitters (OVDT) are used in the TMSC for transmission of combined video, pan-tilt-zoom (PTZ) control, and two RS232, RS422, or RS485 data channels. A matching Optical Video/Data Transceiver is installed in the TMSMHC.

### **Materials:**

#### 1.0 Optical Video/Data Transmitter (OVDT):

- 1.1. The OVDT shall transmit one (1) video signal and three (3) full duplex asynchronous data signals from the Traffic Management System Cabinet (TMSC) to the Traffic Management System Mini-Hub Cabinet (TMSMHC) using one (1) single mode optical fiber. The OVDT shall be the 9245DT (BB)/SM-ST manufactured by Optelecom.
- 1.2. The OVDT shall be from the same manufacturer as item 1108707A (Rack Mount Optical Video/Data Receiver), designed by the manufacturer to operate with each other.
- 1.3. The video signal transmission shall employ digital transmission technology.
- 1.4. The OVDT shall employ automatic gain control (AGC) circuits, cable equalization and other features to minimize or eliminate any required field electrical or optical adjustments.
- 1.5. OVDT optical fiber connections shall be compatible with the single mode fiber-optic cable connectors and the fiber-optic interconnect panel connectors. Adapters will not be allowed by the Department. The OVDT shall interface to the single mode fiber cable using an ST connector.
- 1.7. All circuit boards shall be conformally coated.
- 1.8. Video Transmission Specifications:

- Video Input: 1 Volt peak-to-peak, 75 ohm
- Video Bandwidth: 5 Hz to 6.5 MHz minimum, -3 dB
- Video Signal-to-Noise Ratio: Equal to or greater than 63 dB at maximum optical attenuation
- Differential Gain: 1% maximum
- Differential Phase: 0.7 ° typical
- Wavelength: 1310/1550 nm
- Optical Loss Budget: 23 dB
- Operating Temperature: -40 to +74 degrees C
- Operating Humidity (Relative): 0 to 95% non-condensing
- Encoding: 9 bit

1.9. The data transmission channels shall be fully compliant with the data format and transmission speed requirements of the field devices to which they are to be connected. This includes the data signals required for existing CCTV camera pan-tilt-zoom (PTZ) control, RS232 for existing traffic flow monitors, and RS232 for existing Variable message signs direct connect.

1.10. Data Transmission Specifications:

- Data Circuits Available 3 full duplex
- Aggregate Data Rate 115 Kbps
- Data Format RS-232, RS-422, or RS-485 (NRZ, RZI, Manchester, bi-phase); fully compliant with the terminal equipment and intended application

1.11. Data port 1 shall be designated for Pan-Tilt-Zoom (PTZ) control signals (RS-422), data port 2 shall be designated for future use, and data port 3 shall be designated for future use.

1.12. OVDT's shall be hot-swappable, with LED status monitoring, BNC video connector, and power indicator.

1.13. Transient suppression equipment shall have no adverse effect upon the video or data transmission performance.



## 2. Installation and Environmental Requirements:

### 2.1. Optical Video/Data Transmitter:

- 2.1.1. The OVDT shall be configured for rack-mounting in traffic management system cabinets.
- 2.1.2. All modules and assemblies shall be clearly identified with name, model number, serial number and any other pertinent information required to facilitate equipment maintenance.
- 2.1.3. All external connections shall be made by means of connectors attached to a wiring harness or cable. The connectors shall be keyed to preclude improper hookups.
- 2.1.4. Connectors for copper data cable shall be screw type connectors compatible with the video and data fiber-optic transmission equipment.
- 2.1.5. All wires and cables to and from the connectors shall be color-coded and/or appropriately marked.
- 2.1.6. Equipment shall operate from 115 VAC plus/minus 10 percent, 60 Hz power. The equipment operations shall not be adversely affected by transient voltages, voltage harmonic distortion, voltage unbalance, surges and sags normally experienced on commercial power lines.
- 2.1.7. All equipment including the stand alone power supply shall be certified to operate over a temperature range of -10° Celsius to +60° Celsius with a relative humidity of 10% to 95%, without the need for additional cooling or heating equipment.

## 3. Manufacturer's Qualifications:

### 3.1. Optical Video/Data Transmitter:

- 3.1.1. The Manufacturer shall have a minimum of five (5) year's experience in the design, manufacture, and testing of Video and Data Fiber Optic Transmission Equipment is required. The system shall be designed and manufactured according to world class quality standards. The manufacturer shall be ISO 9001 certified.

## 4. Warranty:

- 4.1. All equipment supplied under these items shall be warranted for parts by the manufacturer against defects and failures, which may occur through normal use for a period of five (5) years from the date of installation. A copy of the warranty shall be presented to the Engineer before installation of the equipment.

5. Spare parts:

- 5.1. As part of this item the Contractor shall supply two (2) standalone OVDT's with power supplies, model 9245DT (BB)/SM-ST

**Construction Methods:**

1. Submittals:

As part of Section 1.06 (Control of Materials) for this project, the Contractor shall submit the following documentation:

- 1.1. Detailed shop drawings, wiring diagrams, equipment cabinet front elevation drawings, and equipment installation drawings indicating supports and appurtenances required for proper installation.
- 1.2. Schematic showing wiring panel assembly including panel dimensions, locations of terminal blocks, surge suppression, transformers, cables, etc. in Visio 2010 format
- 1.3. Product data and cut sheets, operating and maintenance manuals. Information regarding materials, finishes and accessories.

2. As-built Documentation:

- 2.1. As part of the project as-builts, the Contractor shall provide the following information:

- 2.1.1. Test procedures and test results.
- 2.1.2. The Contractor shall submit with the documentation for the TMSC item four (4) copies of the "as-built" equipment manuals. The equipment manuals shall include technical information, wiring diagrams and schematics, hookup prints, parts list and a troubleshooting guide.

3. Delivery, Storage, and Handling:

- 3.1. The Contractor shall deliver, store, handle and install all materials and equipment in such a manner as not to degrade quality, serviceability or appearance.
- 3.2. The Contractor shall be responsible for storage of the materials and equipment prior to installation in a clean, dry location free from construction dust, precipitation and excess moisture.
- 3.3. The Contractor shall be required to replace any damaged materials and equipment, as

determined by the Engineer, at no additional cost to the Department.

- 3.4. All materials shall be delivered in the manufacturer's original unopened protective packages. All materials shall be stored in their original protective packaging and protected against soiling, physical damage, or wetting, before installation. All equipment shall be protected during transportation and until installation against damage and stains.

#### 4. Installation:

- 4.1. Install the rack mounted optical video/data transmitters in the TMSC in accordance with the equipment manufacturer's recommendations.
- 4.2. Install any needed fiber optic patch cable, coax cable, or data cable required to fully interconnect the equipment as shown on the Drawings.
- 4.3. Install and connect the video/data transmitter power supply to one of the existing filtered 120 VAC receptacles reserved for communications in the cabinet.
- 4.4. The optical fiber path for each video link shall have been tested and verified in accordance with the plans prior to the OVDT installation.
- 4.5. All power cables and communication cables connected shall be neatly trained along the rail racks.
- 4.6. The Contractor shall neatly train all optical patch cords and pigtailed together when routing them along the same path and shall neatly train them along the support rails in the camera control equipment cabinet.
- 4.7. No cables shall be installed with a sweep-bend radius less than the manufacturer's minimum recommended bending radius.

#### 5. Testing:

- 5.1. The Contractor shall be responsible for all testing and documentation required for establishing approval and acceptance of this Item.
- 5.3. Proof-of-Performance Testing – The contractor shall connect each OVDT to the corresponding OVDR back at the TMSMHC. The OVDT link light must illuminate and video must transmit successfully without drops to the OVDR.
- 5.4. Installation Testing - Upon complete installation of the OVDT an operational test shall be performed by the Contractor and demonstrated to the Engineer to verify proper installation and operation. The test shall verify the proper operation of the

communications between the OVDT and rack mount OVDR.

**Method of Measurement:**

This item shall be measured for payment by the actual number of equipped Optical Video/Data Transmitter units installed in the TMSC's. No separate measurement will be made for spare units to be furnished as part of this item.

**Basis of Payment:**

The work to be done under this item shall be paid for at the Contract unit price each for Optical Video/Data Transmitter of the type specified, which price shall include all materials, OVDT, hardware, termination panels, Power supply, wiring panels, surge suppression/transient protection, terminal strips, cables, connectors, tools, warranties, spare equipment, labor and incidentals necessary to complete this work.

## **ITEM #1108707A – RACK MOUNT OPTICAL VIDEO/DATA RECEIVER**

### **Description:**

This item shall consist of furnishing, installing, connecting and configuring the Rack Mount Optical Video Data Receiver (RMOVDR) at the mini-hub cabinets at the locations shown on the plans. The work shall include cabling and connecting the RMOVDR

### **Materials:**

#### **1.0 Rack Mount Optical Video/Data Receiver**

- 1.1. The RMOVDR shall consist of a 483mm (19”) rack assembly that accepts a minimum of fourteen (14) 1-slot receiver cards the rack shall be four (4) R.U. (Rack Units) high. **The RMOVDR shall be the 9241DR (BB)-SM-ST.** The receiver cards will include a new optelecom 9002 chassis with dual 9050BF redundant power supplies and a 9942A network management card.
- 1.2. The RMOVDR rack assembly shall include fourteen (14) optical video/data receiver cards installed and configured for use. Some cards may not be used but all cards shall be configured for use.
- 1.3. Each RMOVDR card shall receive one (1) video signal and a minimum of three (3) full duplex asynchronous data signals transmitted from the traffic management system cabinet to the to the Mini Hub Cabinet, using one (1) single mode optical fiber.
- 1.4. The video signal transmission shall employ digital transmission technology.
- 1.5. The RMOVDR shall employ automatic gain control (AGC) circuits, cable equalization and other features to minimize or eliminate any required field electrical or optical adjustments.
- 1.6. Optical fiber connections to the receiver cards shall be compatible with the single mode fiber-optic cable connectors and the fiber-optic interconnect panel connectors. Adapters will not be allowed by the Department.
- 1.7. All video and data communications circuits shall include transient suppression equipment for both common and transverse mode noise.
- 1.8. The video signal performance specification for the transmission and reception is measured from the transmission input to the transmission output as per the testing criteria defined in EIA/TIA-250-C.

## 1.9. Video Transmission Specifications:

- Video Input: 1 Volt peak-to-peak, 75 ohm
- Video Bandwidth: 5 Hz to 6.5 MHz minimum, -3dB
- Video Signal-to-Noise Ratio: Equal to or greater than 63 dB at maximum optical attenuation
- Differential Gain: 1% maximum
- Differential Phase: 0.7 ° typical
- Wavelength: 1310/1550 nm
- Optical Loss Budget: 23 dB
- Operating Temperature: -40 to +74 degrees C
- Operating Humidity (Relative): 0 to 95% non-condensing
- Encoding: 9 bit

1.10. The data transmission channels shall be fully compliant with the data format and transmission speed requirements of the field devices to which they are to be connected. This includes the data signals required for existing CCTV camera pan-tilt-zoom (PTZ) control, RS232 for future use, and RS232 for future use.

## 1.11. Data Transmission Specifications

- Data Circuits Available 3 full duplex
- Aggregate Data Rate 115 Kbps
- Data Format RS-232, RS-422, or RS-485 (NRZ, RZI, Manchester, bi-phase); fully compliant with the terminal equipment and intended application

1.12. Data port 1 shall be designated for Pan-Tilt-Zoom (PTZ) control signals, data port 2 shall be designated for future use, and data port 3 shall be designated for future use.

1.13. The RMOVDR shall interface to the single mode fiber cable using an ST connector.

1.14. The RMOVDR shall be hot-swappable, with LED status monitoring, BNC video connector, and power indicator.

1.15. All modules and assemblies shall be clearly identified with name, model number, serial number and any other pertinent information required to facilitate equipment maintenance.

1.16. All external connections shall be made by means of connectors attached to a wiring harness or cable. The connectors shall be keyed to preclude improper hookups.

1.17. Connectors for copper data cable shall be screw type connectors compatible with the video and data fiber-optic transmission equipment.

1.18. All wires and cables to and from the connectors shall be color-coded and/or appropriately marked.

- 1.19. Equipment shall operate from 115 VAC plus/minus 10 percent, 60 Hz power. The equipment operation shall not be adversely affected by transient voltages, voltage harmonic distortion, voltage unbalance, surges and sags normally experienced on commercial power lines.
- 1.20. All video and data communications circuits shall include transient suppression for both common and transverse mode noise to minimize the effects of power surges or transients. Transient suppression equipment shall have no adverse effect upon the video or data transmission performance.
- 1.21. All equipment shall be certified to operate over a temperature range of -10° Celsius to +60° Celsius with a relative humidity of 10% to 95%, without the need for additional cooling or heating equipment.
- 1.22. All circuit boards shall be conformally coated.
- 1.23. All materials shall be delivered in the manufacturer's original unopened protective packages. All materials shall be stored in their original protective packaging and protected against soiling, physical damage, or wetting, before installation. All equipment shall be protected during transportation and until installation against damage and stains.
- 1.24. Store materials and equipment in a clean, dry location free from construction dust, precipitation and excess moisture. Replace damaged materials and equipment, as determined by the Engineer, at no additional cost to the Department.

## **2.0 Fiber Optic Patch Cords**

- 2.1 Fiber Optic Patch Cords shall be furnished in sufficient length and quantity, and installed in the mini hub cabinet to connect the optical fiber termination patch panel to the optical equipment in the equipment racks.
- 2.2 All optical fibers, coatings, tubes, metals and jackets shall be free of roughness, porosity, blisters, splits and voids in accordance with good manufacturing practice.
- 2.3 The cable shall be suitable for operation over a temperature range of -20°C to +60°C.
- 2.4 The cable shall provide mechanical support and protection for the specified number of fibers. The outer jacket of the cable shall be constructed of medium or high density polyethylene. The cable jacket shall be marked with the manufacturer's name, sequential meter or foot markings, month, year or quarter year of manufacture, and a telecommunications handset symbol, as required by Section 350G of the National Electrical Safety Code.
- 2.5 At a minimum, the cable shall be UL-listed OFNR/OFNP.

- 2.6 Materials used in the cable shall not produce hydrogen in a concentration large enough to cause any degradation in the transmission performance of the optical fibers.
- 2.7 Materials used in the cable shall not support galvanic action.

### **3.0 ST Connectors**

- 3.1 The connector shall have a ceramic ferrule with a nickel plated nut and body.
- 3.2 The connector shall be of the ST-type and fully compatible with the fiber optic cable utilized and the mating jacks to which they will be attached.
- 3.3 The connector shall be compatible with a physical contact (PC) finish. All connectors shall be polished to a PC finish such that the return loss per mated pair of connectors is at least 25 dB. The return loss when the connector is mated with previously installed connectors shall be at least 18 dB.
- 3.4 The connector mean loss shall not be greater than 0.2 dB with a standard deviation of not greater than 0.1 dB.
- 3.5 The connector loss shall not vary more than 0.1 dB after 500 repeated matings.
- 3.6 The connector shall withstand an axial load of 135 N.
- 3.7 The connectors shall be attached in accordance with the manufacturer's recommended materials, equipment and practices.
- 3.8 The connector shall be suitable for the intended environment and shall meet the following environmental conditions.
- 3.9 Operating Temperature: -20 to +50° C, Storage Temperature: -30 to +60° C
- 3.10 The connector loss shall not vary more than 0.2 dB over the operating temperature range.
- 3.11 Connectors shall be protected before installation by a suitably installed waterproof protection cap.



#### **4.0 Data Cables**

- 4.1 Data cables shall be TIA/EIA 568A Category 6, characterized up to 350 MHz, suitable for 1000Base-T local area network applications.
- 4.2 Category 6 cable shall be used for T-1, Ethernet, and serial data communications connections between communications equipment as shown on the Drawings.
- 4.3 Data cables installed in outdoor equipment racks shall be rated for outdoor installations. All cabling to be installed in outdoor equipment cabinets shall maintain specified electrical properties over the entire operating temperature range, specified below
- 4.4 Data cables shall be terminated with RJ-11, RJ-45, RJ48, DB-25F, 44 Pin D-Type connector or other approved connectors as required by the communications equipment.
- 4.5 Data cables used for horizontal wiring shall be either 4 pair or 24 pair cable as required by the application and as directed by the Engineer and shall comply with the following requirements:
- Conductor: 24 AWG (solid bare copper)
  - Nominal Capacitance: 14 pF/ft
  - Characteristic Impedance:  $100\Omega \pm 15\%$
  - Maximum DC Resistance: 9.4/100m
  - Velocity of Propagation: 71% (minimum)
- 4.6 Data cables used for patching between equipment in equipment racks shall be 4 pair cable and shall comply with the following requirements:
- Conductor: 24 AWG (stranded tinned copper)
  - Nominal Capacitance: 14 pF/ft
  - Characteristic Impedance:  $100\Omega \pm 15\%$
  - Maximum DC Resistance: 9.4/100m
  - Velocity of Propagation: 71% (minimum)
- 4.7 Equipment located within environmentally controlled rooms shall be capable of meeting the following requirements:
- Storage Temperature:  $-40^{\circ}$  to  $+70^{\circ}$  Celsius
  - Operating Temperature Range:  $0^{\circ}$  to  $+50^{\circ}$  Celsius
  - Relative Humidity: 5 to 90%, non-condensing
  - Fire Resistance: Complies with TR-NWT-000063, Issue 3.

## **5.0 Copper Coax Cables and Connectors:**

- 5.1 The coax cable shall be Belden Part Number 7915A or approved equal. The conductor shall be a Series 6 conductor with a solid stranding. The cable shall be 18 AWG with the conductor material being made of BC – Bare Copper. The conductor diameter shall be 0.040 in. The insulation shall be a gas injected Foam Polyethylene with an insulator diameter of 0.180 in. The outer shield shall be Duobond Plus™). The outer shield type shall be Tape/Braid/Tape. The tape shall be bonded aluminum foil-polyester tape – aluminum foil. The braid shall be aluminum. The tape shall cover 100% of the cable. The braid shall cover 77% of the cable. The outer jacket material shall be PVC – polyvinyl chloride. The overall nominal diameter shall be 0.275 in. The cable shall meet operating temperature of –40 C to + 80 C with a maximum pulling tension of 91lbs. with a min. bending radius of 5.75 in. The cable shall meet NEC/UL CM, with UL flame test UL 1685 UL Loading.
- 5.2 Precision video coaxial cable shall be utilized to transmit baseband NTSC video signals between communications equipment as described herein and elsewhere in these specifications and as shown on the drawings.
- 5.3 BNC-type connectors shall be utilized to terminate segments of the baseband video cable installed between communications equipment as shown on the Drawings.
- 5.4 The outer conductor shall be tinned copper double braid 98% shield coverage.
- 5.5 The cable shall be 100% sweep tested.
- 5.6 Connectors shall be BNC type, manufactured specifically for the baseband video coaxial cable to which they will be attached.
- 5.7 The BNC connectors shall meet or exceed the following specifications:
- Characteristic Impedance      75 ohms (true)
  - Return Loss                              less than – 35dB to 1 GHz
  - Mechanical Durability              500 Cycles Minimum
  - Corrosion Resistance              MIL-STD-202, Method 101
  - Solvent Resistance                  MIL-STD-202, Method 215

- 5.8 The center conductor of the BNC connector shall be 1.25 micrometers (50 millionths of an inch) gold plating over copper plate.

## **6.0 Manufacturer's Qualifications**

- 6.1 The Manufacturer shall have a minimum of five (5) year's experience in the design, manufacture, and testing of Video and Data Fiber Optic Transmission Equipment is required. The system shall be designed and manufactured according to world class quality standards. The manufacturer shall be ISO 9001 certified.

## **7.0 Warranty**

- 7.1 All equipment supplied under these items shall be warranted for parts by the manufacturer against defects and failures, which may occur through normal use for a period of five (5) years from the date of installation. A copy of the warranty shall be presented to the Engineer before installation of the equipment.

## **8.0 Spare Parts**

- 8.1 As part of this item the Contractor shall supply (1) 9942A network management Card, and (1) 9050BF Power supply

## **Construction Methods:**

### **1.0 Connections to existing Optical Fiber Termination Patch Panel (OFTPP):**

- 1.1. The Contractor shall provide all termination required to connect field fiber cable and the existing optical fiber termination patch panel (OFTPP) to the equipment described herein this specification.
- 1.2. The Contractor shall provide and install all interconnection fiber optic patch cords between the RMOVDR and the OFTPP in the Mini-Hub cabinet. The Contractor shall match the fibers from each TMSC as indicated on the fiber splicing plans.
- 1.3. The optical fiber path for each video link shall have been tested and verified in accordance with this Contract prior to the connection to the OVDR.
- 1.4. The Contractor shall provide to the Engineer a copy of all the planned port assignment for both video and data to and from the RMOVDR two weeks prior to installation. The planned assignments shall include assignments for the OFTPP, Optelecom OVDR, Optelecom multiplexer, and terminal servers.

### **2.0 Rack Mount Optical Video/Data Receiver:**

- 2.1 The RMOVDR assembly and components shall be assembled, configured and installed in the Traffic Management System Mini-Hub Cabinet. The configuration shall meet the requirements to successfully connect the video and PTZ data from each camera site into the TSMHC.
- 2.2 The Contractor shall connect the connect coax cables from video out ports on the RMOVDR fiber optic card units to the Video multiplexer. The Contractor shall connect the correct PTZ data connectors from the RMOVDR data ports to the terminal port server.
- 2.3 The Contractor shall neatly train all optical patch cords together when routing them along the same path and shall neatly train them along the support rails in the camera control equipment cabinet. The Contractor shall neatly train all coax and data cables along the support rails in the camera control equipment cabinet.
- 2.4 No cables shall be installed with a sweep-bend radius less than the manufacturer's minimum recommended bending radius.
- 2.5 The contractor shall configure and connect the 9942A network management card to the 10/100 Ethernet switch located in the TSMHC.
- 2.6 The contractor shall label all coax, data, and fiber cables which shall correspond to the As-built wiring diagrams. The contractor will be provided existing Visio wiring diagrams which will need to be updated to include the newly installed equipment, wiring, and rack elevation diagrams.

### **3.0 Testing:**

- 3.1 The Contractor shall be responsible for all testing and documentation required in establishing approval and acceptance of this Item.
- 3.2 Installation Testing - Upon complete installation of all field equipment (including OVDT, multiplexer/demultiplexer, terminal server, etc.), an operational test shall be performed by the Contractor and demonstrated to the Engineer to verify proper installation and operation. The test shall verify the proper operation of the field equipment installation.
- 3.3 30-day Operational Testing - The Contractor shall refer to "Notice To Contractor – 30 Day System Operational Test" for additional testing requirements. The Contractor shall coordinate the 30-day System Operational Test with other pertinent items in this contract.

### **4.0 Delivery, Storage, and Handling**

- 4.1 The Contractor shall deliver, store, handle and install all materials and equipment in such a manner as not to degrade quality, serviceability or appearance.

- 4.2 All material shall be new and delivered in unopened packaging.
- 4.3 The Contractor shall be responsible for storage of the materials and equipment prior to installation in a clean, dry location free from construction dust, precipitation and excess moisture.
- 4.4 The Contractor shall be required to replace any damaged materials and equipment, as determined by the Engineer, at no additional cost to the Department.

**5.0 Submittals:**

As part of Section 1.06 “Control of Materials”, the Contractor shall provide the following information as part of the shop drawing/catalog cut submittal:

- 5.1 Functional block diagrams, wiring diagrams, and point-to point wiring details. Wiring diagrams shall be supplied in Visio 2010 format.
- 5.2 Detailed shop drawings, wiring diagrams, equipment cabinet front elevation drawings, and equipment installation drawings indicating supports and appurtenances required for proper installation.
- 5.3 Product data, Operations and Maintenance manuals. Information regarding materials, finishes and accessories.

**Method of Measurement:**

These items shall be measured for payment by the number of Rack Mount Optical Video/Data Receivers of the type specified, installed, completed, tested and accepted.

**Basis of Payment:**

The work to be done under this Item shall be paid at the Contract Price each for the Rack Mount Optical Video/Data Receiver which price shall include all equipment, materials, cables, connectors, spare equipment, fiber patch cords, splicing, tools, installation, labor, warranties, shipping and incidental items required to satisfy these Specifications.

## **ITEM #1108826A – OPTICAL FIBER TERMINATION PATCH PANELS**

### **DESCRIPTION:**

This Section specifies the requirements for furnishing and installing Optical Fiber Termination Patch Panels for termination and connection of fiber optic cables at the locations shown on the plans. Fiber optic patch cables shall be installed between the patch panel and the optical equipment.

### **MATERIALS:**

#### 1. Optical Fiber Termination Patch Panel (OFTPP):

- 1.1 The OFTPP shall be manufactured by Corning Cable Systems, FDC Series or an equivalent Corning model approved by the Engineer. The OFTPP shall include a splice enclosure to protect the fused fibers as described herein this specification. Each interconnect panel shall be equipped with SC-type connector style jacks for attachment to fiber optic drop cables, distribution cables and patch cables.
- 1.2 The Optical Fiber Termination Patch Panel (OFTPP) shall be rack mountable and have the capacity to terminate seventy-two (72) optical fibers into SC panel connectors and shall be capable of simultaneously accommodating the fusion splicing of a minimum of seventy-two (72) optical fibers. SC connectors shall be used for the termination of the trunkline optical fibers at the Mini-Hub cabinets at the approximate location as shown on the Drawings.
- 1.3 All patch panel connector positions used for connection of fiber optic transmission equipment shall be identified on a label permanently affixed to the cabinet door. The label shall show the connector position and the designated fiber optic transmission equipment.
- 1.4 The OFTPP shall include all cable strain-relief, splice trays, fan-out kits, splices, tools, equipment and labor necessary to complete this Item as described in this specification and as shown on the Drawings.
- 1.5 The OFTPP shall have a splice tray organizer capable of holding a minimum of twelve (12) splice trays. The organizer shall provide access to and removal of individual splice trays and permit selective splicing to allow one or more fibers to be cut and splice to branch cable without disrupting other fibers.
- 1.6 All splice trays shall have a contrasting background for splicing colored fibers or as approved by the Engineer. The splice trays shall include clear snap-on covers, and tie-

wraps to secure the buffer or transport tubes to the tray. The splice trays shall be of adequate size to prevent induced attenuation due to fiber bending.

- 1.7 The OFTPP splice closure shall protect the fiber optic cable splices from mechanical damage, shall provide strain relief for the cable, and shall be manufactured of non-corroding materials.
- 1.8 Each splice tray shall be capable of accommodating a minimum of twelve (12) fusion splices for the single mode fiber cable of the type selected. The splice trays shall be compatible with the splice closure and shall be constructed of rigid plastic.
- 1.9 The splice tray shall have features that retain the fiber loops and control the bend radius. The splice tray cover shall be clear plastic to allow for inspection of the fibers without opening the tray.
- 1.10 Vinyl markers shall be supplied to identify each fiber to be spliced within the closure. Each splice (as required for testing) shall be individually mounted and mechanically protected on the splice tray.
- 1.11 Polyethylene tubes shall be supplied to protect exposed individual fibers within the closure.

## 2.0 Environmental Requirements:

- 2.1 All equipment shall be certified to operate over a temperature range of -20° Celsius to +60° Celsius with a relative humidity of 10% to 95%, non-condensing.
- 2.2 Termination panels shall be equipped with suitable means for routing and securing of cables and pigtails to prevent damage to fibers during all regular operation and maintenance.

## 3.0 Fiber Optic Patch Cords:

- 3.1 Fiber Optic Patch Cords shall be furnished in sufficient length and quantity, and installed in the mini hub or field cabinets to connect the optical fiber termination patch panel to the optical equipment in the equipment racks.
- 3.2 All optical fibers, coatings, tubes, metals and jackets shall be free of roughness, porosity, blisters, splits and voids in accordance with good manufacturing practice.
- 3.3 The cable shall be suitable for operation over a temperature range of -20°C to +60°C.
- 3.4 The patch cords shall be rated for indoor/outdoor use. The patch cord connector type must match to the equipment it is intended. Patch cords can be three different types LC to SC, ST to SC, or SC to SC.

3.4 Materials used in the cable shall not produce hydrogen in a concentration large enough to cause any degradation in the transmission performance of the optical fibers.

#### 4.0 ST and SC Connectors:

4.1 The ST connector shall have a ceramic ferrule with a nickel plated nut and body. SC connectors shall have a ceramic insert.

4.2 The connector shall be of the ST-type or SC-type and fully compatible with the fiber optic cable utilized and the mating jacks to which they will be attached.

4.3 The connector shall be compatible with a physical contact (PC) finish. All connectors shall be polished to a PC finish such that the return loss per mated pair of connectors is at least 25 dB. The return loss when the connector is mated with previously installed connectors shall be at least 18 dB.

4.4 The connector mean loss shall not be greater than 0.2 dB with a standard deviation of not greater than 0.1 dB.

4.5 The connector loss shall not vary more than 0.1 dB after 500 repeated matings.

4.6 The connector shall withstand an axial load of 135 N.

4.7 The connectors shall be attached in accordance with the manufacturer's recommended materials, equipment and practices.

4.8 The connector shall be suitable for the intended environment and shall meet the following environmental conditions:

4.8.1 Operating Temperature: -20 to +50° C

4.8.2 Storage Temperature: -30 to +60° C

4.9 The connector loss shall not vary more than 0.2 dB over the operating temperature range.

4.10 Connectors shall be protected before installation by a suitably installed waterproof protection cap.

#### 5.0 Warranty:

5.1 All equipment supplied under these items shall be warranted for parts by the vendor against defects and failures, which may occur through normal use for a period of one (1) year from the date of Final Acceptance. A copy of the warranty shall be presented to the Engineer before installation of the equipment.



## **CONSTRUCTION METHODS:**

### 1.0 Optical Fiber Termination Patch Panel (OFTPP):

- 1.1 The Contractor shall install and provide all splicing and termination required to connect field fiber cable (See plans) to the equipment shown on the plans and specified elsewhere in this project. The Contractor shall refer to Item 1112241A – Fiber Optic Cable Splice Enclosure for splicing requirements.
- 1.2 The Contractor shall install the OFTPP at the locations shown on the plans and shall provide and install all fiber optic patch cords between the optical equipment and the OFTPP as shown on the Drawings.
- 1.3 The OFTPP shall be mounted in the Mini-Hub cabinets at the approximate location as shown on the Drawings or the fiber distribution cabinets as directed by the Engineer. Sufficient lengths of cable between the patch panel and the optical equipment installed in the rack shall be coiled in the equipment cabinet to allow the OFTPP to be removed from the cabinet for splicing.
- 1.4 Splices to the fiber optic cable used in this project shall be fabricated using modern, high quality fusion type splicing equipment.
- 1.5 The maximum loss introduced by any splice shall not exceed 0.2 dB.
- 1.6 The average splice loss shall not exceed 0.1 dB for any given span, with a standard deviation not greater than 0.07 dB.
- 1.7 Each splice shall be tested for tensile strength by applying a force of not less than 200 grams.
- 1.8 All splices shall be arranged neatly in splice trays, supported and protected with a suitable splice protector.
- 1.9 The optical fiber path shall be tested and verified in accordance with this Contract prior to the connection to the equipment.
- 1.10 The Contractor shall neatly train all optical patch cords and pigtailed together when routing them along the same path and shall neatly train them along the support rails equipment cabinet.
- 1.11 No cables shall be installed with a bend radius less than the manufacturer's minimum recommended bending radius.

- 1.12 At the Newington Operations Center (NOC), dedicate each OFTPP to the incoming fiber optic trunk cables. Each OFTPP shall accommodate all or part of the fibers belonging from the same trunk cable.

## 2.0 Submittals:

The Contractor shall submit the following documentation:

- 2.1 Detailed shop drawings, wiring diagrams, equipment cabinet front elevation drawings, and equipment installation drawings indicating supports and appurtenances required for proper installation.
- 2.2 Product data and cut sheets, operating and maintenance manuals. Information regarding materials, finishes and accessories.
- 2.3 The Contractor shall submit four (4) copies of the “as-built” equipment manuals with the documentation for OFTPP installed. The equipment manuals shall include technical information, wiring diagrams and schematics, hookup prints, parts list and a troubleshooting guide.

## 3.0 Test procedures and test results:

- 3.1 The Contractor shall test the CCTV streams by connecting into the switch and using a software decoder to view the streams. The Contractor shall prepare a test matrix and present it to the Engineer for his approval.
- 3.2 Using a Tektronix VM-700 Video Measurement test set at each location the OFTPP installed, the Contractor shall measure the video signal transmitted from each of the Traffic Management System Cabinets. The received video signal shall meet or exceed EIA-RS-250-C Short Haul standards.
- 3.3 Using a Tektronix VM-700 Video Measurement test set at the Main Fiber Hub and at NOC, the Contractor shall measure the demultiplexed video signals transmitted from each of the Mini-Hubs (or field cabinet as applicable). The received video signal shall meet or exceed EIA-RS-250-C Medium Haul standards.

## 4.0 Delivery, Storage, and Handling:

- 4.1 The Contractor shall deliver, store, handle and install all materials and equipment in such a manner as not to degrade quality, serviceability or appearance.
- 4.2 The Contractor shall be responsible for storage of the materials and equipment prior to installation in a clean, dry location free from construction dust, precipitation and excess moisture.

4.3 The Contractor shall be required to replace any damaged materials and equipment, as determined by the Engineer, at no additional cost to the Department.

4.4 All materials shall be delivered in the manufacturer's original unopened protective packages.

4.5 All materials shall be stored in their original protective packaging and protected against soiling, physical damage, or wetting, before installation. All equipment shall be protected during transportation and until installation against damage and stains.

## 5.0 Testing:

The Contractor shall be responsible for all testing and documentation required establishing approval and acceptance of this Item.

### 5.1 30- Day Operational Test:

30-Upon successful completion of the installation test and approval by the Engineer, a 30-day System Operational Test for each TMSMHC site or other location(s) shown on the plans shall commence. During the course of this test, the system must function continuously in accordance with the specifications for the duration of the test. If a malfunction occurs within the stated time frame, the Contractor shall make all necessary repairs to the system and re-establish proper operation. Upon approval of the Engineer, the 30-day test will begin anew. The system must operate for a full thirty (30) consecutive days without malfunction before the system will be accepted by the Engineer. The Contractor shall refer to "Notice To Contractor – 30 Day System Operational Test" for additional testing requirements. The Contractor shall coordinate the 30-day System Operational Test with other pertinent items in this contract.

### 5.2 Pre-Installation Testing:

5.2.1 The Contractor shall submit test procedures and documented test results to the Engineer. The test procedures shall document the nature of test activities to be performed.

5.2.2 The test procedures shall be submitted to the Engineer prior to initiation of the testing. The procedures will be returned to the contractor within two (2) weeks indicating either "accepted" or "make corrections noted".

5.2.3 In the case that corrections are required, the Contractor shall submit revisions within one (1) week.

5.2.4 Four (4) copies of the final test procedures shall be submitted to the Engineer prior to commencement of testing. The testing and test procedures shall include, but not be limited, to the following:

5.2.5 Visual Inspection: The Contractor shall perform detailed visual inspection to confirm that the following aspects of the cabinet are in compliance with the requirements of this specification:

- General appearance: Cabinet dimensions, finish, door frames, latching mechanism, door hinges.
- Interior panels and racks.

5.2.6 The Contractor shall refer to the testing and documentation of the materials and equipment listed under these items to the testing and documentation for other pertinent items contained in this contract.

**METHOD OF MEASUREMENT:**

These items shall be measured for payment by the number of Optical Fiber Termination Patch Panels, with all required cabling, patch cords, connectors and other required appurtenances installed, completed, tested and accepted.

**BASIS OF PAYMENT:**

The work to be done under this Item shall be paid at the Contract Price for the Optical Fiber Termination Patch Panels, which price shall include all equipment, materials, connectors, patch cords, splicing, tools, installation, labor, shipping and incidental items required to satisfy these Specifications.

## **ITEM #1108841A – MULTI-CHANNEL FIBER OPTIC VIDEO MULTIPLEXER/DEMULTIPLEXER**

### **Description:**

These items involve the provision, installation and configuration of the Multi-Channel Fiber Optic Video Multiplexer/Demultiplexer in the mini-hub, main fiber hub and Newington Operations Center (NOC). The item will include but not limited to the following:

1. 3-Optelecom Model 9152DT-LD3P-ST multiplexers installed in mini-hub cabinets
2. 3-Optelecom Model 9152DT-LD3E-ST multiplexers installed in the mini-hub cabinets
3. 6-Optelecom Model 9152DR-LHS-ST demultiplexers installed in the main fiber hub
4. 6-Optelecom Model 9152DR-LHS-ST demultiplexers installed in NOC
5. 9-Optelecom Wavelength Division Mux/Demux Model 9980-1315L-ST-09
6. 7-Optelecom Network Management 9942A
7. 7-Rack Mount Card Chassis Model 9002
8. 14-Chassis Power supplies Model 9050BF, cables, fiber jumpers, and connectors.
9. Spare equipment

### **Materials:**

#### **Multi-Channel Fiber Optic Video Multiplexer/Demultiplexer**

The Multi-Channel Fiber Optic Video Multiplexer/Demultiplexer equipment shall be manufactured by Optelecom, Model 9152DT/9152DR. The Video Multiplexer and Demultiplexer are separate units that shall be designed by the manufacturer to operate with each other. The Multi-Channel Fiber Optic Video Multiplexer/Demultiplexer equipment shall be capable of transmitting or receiving a minimum of sixteen (16) one-way NTSC video signals over one (1) single-mode optical fiber. The Video Multiplexer/Demultiplexer shall utilize digital transmission technology.

The Video Multiplexer and Demultiplexer system shall include a comprehensive Network Management System to monitor system performance, configuration and fault conditions. The Video Multiplexer/Demultiplexer shall employ automatic gain control (AGC) circuits and other features to minimize or eliminate any required field adjustment Multi-Channel Fiber Optic Video Multiplexer/Demultiplexer Communications Link Performance Requirements.

The signal performance specification for the transmission/multiplexing and reception/demultiplexing is defined as the video signal characteristics measured from transmission input to

transmission output as per the testing criteria defined in EIA/TIA-250-C. The performance of each video channel shall meet or exceed the following specifications when all available video channels of the Video Multiplexer/Demultiplexer are active and the optical attenuation between Video Multiplexer and Video Demultiplexer is 32dB @ 1310nm. The Video Multiplexer and Video Demultiplexer shall be capable of transmitting a range of at least 75km.

### Specifications

Video Input	1 Volt peak-to-peak, 75 ohm
Video Bandwidth	2 MHz to 6.5 MHz per channel
Video Signal-to-Noise Ratio	>=67 dB at maximum optical attenuation
Differential Gain	3% maximum
Differential Phase	1° maximum
Dimensions (mm)	176 H x 425 W x 356 D (4 RU max)
Encoding	10 bit linear PCM
Sampling Rate	15 Msamples/sec (per video channel)
Bit Rate over Fiber	1.44 Gbps, minimum
Fiber Connector Type	ST type

### Network Management System

The Video Multiplexer/Demultiplexer system shall feature remote diagnostics, performance monitoring and system control. The Network Management System shall be compatible to the existing system.

At a minimum the following parameters shall be measured and their status reported to a central control terminal in the Newington Highway Operations Center:

- DC power supply failure
- received optical power level too high or low
- laser temperature out of acceptable range
- laser deterioration alarm
- Failure of system remote control/diagnostic circuitry.

**Mechanical Configuration:** The Multi-Channel Fiber Optic Video Multiplexers/Demultiplexers shall be mechanically configured for mounting in field deployed Mini-Hub equipment cabinets and at the Main Fiber Hub and Newington HOC, within EIA-310-C 19-inch equipment cabinets.

**Modular Design:** The equipment shall be modular in design such that major portions can be readily replaced in the field. Covers shall be provided for unused card slots. Modules of unlike functions shall be mechanically keyed to prevent insertion into sockets or connectors, if such connection would damage any components. All modules and assemblies shall be clearly

identified with name, model number, serial number and any other pertinent information required to facilitate equipment maintenance.

The network management card shall be connected to the 10/100 Ethernet switch located in the TMSMHC. The contractor will be responsible for assigning an IP address to the Network management card. The contractor will need to contact the engineer for the IP address assignments.

### Connectors and Wiring Harness

Optical fiber connections to the Multi-Channel Fiber Optic Video Multiplexers/Demultiplexers shall employ connectors compatible with the single mode fiber optic cable connectors and the fiber optic interconnect panel connectors. No adapters will be allowed by the Department.

Video coaxial cable connections to the Multi-Channel Fiber Optic Video Multiplexers/Demultiplexers shall employ BNC connectors meeting the requirements of the Video Multiplexers/Demultiplexers manufacturer. All external connections shall be made by means of connectors attached to a wiring harness or cable. The connectors shall be keyed to preclude improper hookups. All wires and cables to and from the connectors shall be appropriately marked using plastic identification tags and cable ties. All circuit boards shall be conformally coated.

Power Requirement: Equipment shall operate from 115 VAC plus/minus 10 percent, 60 Hz power. The equipment operations shall not be adversely affected by transient voltages, voltage harmonic distortion, voltage unbalance, surges and sags normally experienced on commercial power lines.

Transient Suppression: All equipment designs must include transient suppression for both common and transverse mode noise to minimize the effects of lightning surges or transients.

Environmental Requirements: Equipment located within environmentally controlled rooms shall be capable of meeting the following requirements:

Storage Temperature:	-55° to + 85° Celsius.
Operating Temperature Range:	-40° to + 74° Celsius.
Relative Humidity:	5 to 95 %, condensing.
Fire Resistance:	Complies with TR-NWT-000063, Issue 3.

Manufacturer's Qualifications:

The manufacturer of the Multi-channel Fiber-Optic Video Multiplexers/Demultiplexers shall have a minimum of five- (5) year's experience in the design, manufacture, and testing of Multi-channel Fiber Optic Video Multiplexers/Demultiplexers.

Warranty:

All equipment supplied under these items shall be warranted for parts by the vendor against defects and failures, which may occur through normal use for a period of one (1) year from the date of installation. A copy of the warranty shall be presented to the Engineer before installation of the equipment.

Spare Parts

The following spare parts shall be included

- 1- Optelecom Model 9152DT-LD3P-ST multiplexer
- 1- Optelecom Model 9152DT-LD3E-ST multiplexer
- 1- Optelecom Model 9152DR-LHS-ST demultiplexer
- 1- Optelecom Wavelength Division Mux/Demux Model 9980-1315L-ST-09
- 1- Optelecom Network Management Card Model 9942A
- 1- Rack Mount Card Chassis Model 9002
- 2- Chassis Power supplies Model 9050BF

**Construction Methods:**

No cables shall have a radius less than the manufacturer's minimum recommended bending radius.

All Multi-Channel Fiber Optic Video Multiplexer/Demultiplexers shall be installed in Mini-Hub cabinet, Main Fiber Hub, and Newington Highway Operations Center cabinets in the quantities as detailed in this specification.

The contractor shall configure and install all Video Multiplexer/Demultiplexers in the Mini-Hub (field equipment) cabinets, the Main Fiber Hub equipment cabinets, and the Newington Highway Operations Center cabinets.

Multi-Channel Fiber Optic Video Multiplexers shall be installed by the Contractor in the Mini-Hubs to transmit multiple video signals, optically, to matching (Video Demultiplexers).

The Multi-Channel Fiber Optic Video Demultiplexers shall be installed by the Contractor in the Main Fiber Hub and the Newington Highway Operations Center to receive multiple video signals and demodulate then into individual NTSC baseband video signals. The Video



Multiplexer and Demultiplexer shall be from the same manufacturer, designed by the manufacturer to operate with each other.

The Contractor shall prepare the equipment for shipment to the sites as indicated on the plans.

The Contractor shall install the Multi-Channel Fiber Optic Video Multiplexers/Demultiplexers in the video matrix switch cabinets or as directed by the Engineer. The Contractor shall coordinate the installation of the Multi-Channel Fiber Optic Video Multiplexers/Demultiplexers in the video matrix switch cabinets with the Engineer.

Installation shall include all required interface cable types as specified in these special provisions.

All blank module slots in rack frame and power supply assemblies shall be filled with a blank plate of construction and finish consistent with those of the modules. The plate shall be field removable without a requirement for special tooling or any disassembly of the system.

The system shall provide the ability to remove and replace any module in the system without requiring that the power supply be turned off and without disturbing the operation of any other modules in the same rack frame and power supply assembly.

All modules shall be labeled on the front panel to identify the video/data signal or fiber passing through the module. The labeling technique shall be such that all labels are neat and legible and shall be removable and replaceable to allow for substitution of modules in the event of failure.

All unused video inputs and outputs of each Multiplexer/Demultiplexer shall be terminated with a 75-ohm resistive load.

All Multi-Channel Fiber Optic Video Multiplexer/Demultiplexers shall be interconnected to other communications equipment as shown on the plans.

#### Submittals:

As part of Section 1.06 "Control of Materials", the Contractor shall provide the following information as part of the shop drawing/catalog cut submittal:

- Functional block diagrams, wiring diagrams, and point-to point wiring details in Visio 2010 format.
- Detailed shop drawings, wiring diagrams, equipment cabinet front elevation drawings, and equipment installation drawings indicating supports and appurtenances required for proper installation.
- Product data, Operations and Maintenance manuals. Information regarding materials, finishes and accessories.

Testing: The Contractor shall deliver components only after the individual performance of each component has been demonstrated in accordance with the Contract. The Contractor shall show proof that the equipment is installed and operating to manufacturer's requirements. The Contractor shall provide a testing plan to the Engineer for review and approval prior to the test. The Contractor shall contact the Engineer to witness the test. The test shall test all of the features of the equipment and meet the manufacturer's test requirements. Additional tests may be required as directed by the Engineer.

Method of Measurement:

The work to be measured for payment under this item shall be the total number of Multi-Channel Fiber Optic Video Multiplexers/De-multiplexers of the type specified, furnished, installed, completed, tested and accepted. No separate measurement will be made for spare units to be furnished as part of this item.

Basis of Payment:

The work to be done under these items shall be paid at the Contract Price Each for the Multi-Channel Fiber Optic Video Multiplexer/Demultiplexer, which price shall include all equipment, materials, video cable equalizers, cables, spare equipment, connectors, splicing, tools, installation, labor, shipping and incidental items required to satisfy these Specifications.

## **ITEM #1112210A – CAMERA ASSEMBLY**

### **DESCRIPTION:**

The “camera assembly” item shall consist of furnishing and installing an outdoor dome assembly with integral CCTV color camera and motorized lens, receiver/driver (if required), local camera control at the TMSC/TMSMHC appropriate interconnect wiring, at the locations shown on the plans. The equipment to be provided shall include any ancillary or incidental items including any code-translators, code-distributors, data converter units, camera controller units, cables, connectors and power supplies required at each video switcher site or camera location to make a complete and fully operating video surveillance system with the approved camera manufacturer.

### **MATERIALS:**

#### Manufacturer Requirements:

The Contractor shall ensure that all specified camera features, functions and performance requirements are supported by the American Dynamics 1024 video switcher and American Dynamics 2089 keyboard without loss of camera features, functions, performance and response time (except alarm returns). The camera assembly shall be a unit that has been tested and working with the American Dynamics 1024 video switcher at the Department’s Operation Center at 2800 Berlin Turnpike Newington CT. The Contractor will not be allowed to submit a camera manufacturer other than the manufacturers listed herein. **All camera assemblies shall be manufactured by Sensormatic - SpeedDome Ultra 8E day/night or latest equivalent model.** The catalog cut submittal shall clearly document any camera functions that do not meet the item specifications.

#### **1.0 Materials**

- High-speed, programmable dome with a high-resolution DSP7 camera incorporating programmable Day and Night camera modes
- Day and Night mode control by removal of an infrared (IR) cut filter
- Wide Dynamic Range (WDR) for viewing of detailed images when observing scenes with widely varying degrees of light
- Digital Slow Shutter (DSS) allowing more light accumulation within the CCD imager
- Electronic Image Stabilization (EIS) to compensate for physical movement and vibration of the dome with a user-selectable bandwidth of 5 or 10Hz
- Dome to conform to RoHS initiative standards.
- Outdoor enclosure
- Local camera controller
- Camera power, video and data cables.
- Code Distributors, Code Translators and Date Converters
- Spare equipment

- Power supply transformer

## 2.0 Performance Specifications

- The dome assembly must be comprised of a high-speed, pan/tilt assembly and a high-resolution Day or Night mode camera with 35X optical zoom, 12X digital zoom permitting up to 420X total zoom, and a horizontal resolution of 540TVL. The camera/lens assembly must provide continuous, full-time, auto focus capabilities.
- The pan/tilt mechanism must incorporate a sealed, precision slip-ring to provide 360° of continuous rotation.
- The tilt mechanism must provide for 110° of travel.
- Precise manual panning and tilting must be achievable through a combination of variable-speed operator control (speed ranges) and automatic adjustment of these speed ranges dependent upon zoom factor. Manual pan and tilt speeds must range from 0.25° to 100° per second. Preset pan speeds must range from 1° to 360° per second, and preset tilt operating speeds must be from 1° to 220° per second. Pan and tilt speeds will be automatically adjusted by the zoom factor to allow the user the same ease of control, regardless of the field of view.
- High-speed, DC direct-drive motors must be used to maintain high torque through the entire operating range. These motors must use pulse-width modulation and encoder feedback to control the acceleration, speed, and deceleration of the motors to ensure smooth, precise, accurate, and fluid movement. The design shall use DC direct-drive motors and no belt to ensure long-term, reliable operation.
- The dome assembly shall contain a built-in, multi-protocol receiver/driver for use with matrix switching systems using one or more of the following protocols:
- AD Manchester control code and a single 18AWG shielded twisted pair (STP) to support up to three daisy-chained domes a maximum of 1500m (5000ft)
- SensorNet control code and a single 22AWG unshielded twisted pair (UTP) to support up to 32 daisy-chained domes a maximum of 1000m (3000ft)
- RS-422/RS-485 control code and two pairs of 22AWG STP cabling to support up to 10 daisy-chained domes a maximum of 1000m (3000ft)
- AD-UTC and a 20AWG RG-59U video cable to control a dome a maximum of 700m (2,300ft)
- The receiver/driver will provide all voltages for camera controls, pan and tilt functions, and all motorized lens functions. In addition, the dome shall support selected third-party protocols for integration to other systems without the need for optional translator boards.
- The dome must natively support the National Transportation Communications for ITS Protocol (NTCIP) version 1205:2001 v01.08, implemented via the RS-422 communication interface.
- The dome must include standard support for UTP dome connections, which allow the use of separate cabling for transmission of video and dome control signals up to 300m (1000ft).
- The dome shall support 96 Presets, 16 Patterns, and 16 Preset Sequences depending upon protocol and controller used. The dome shall also support a Home Position that automatically returns the dome to a Preset, Pattern or Preset Sequence after a specified

period of inactivity: 1-60 minutes. A freeze frame function must be available that maintains a static image on-screen during dome movement and lens adjustment when presets and patterns are called. This freeze frame function helps to preserve hard-drive space when a digital video recorder is used.

- The dome must support a minimum of eight privacy zones to prevent users from viewing sensitive or secured areas. So as not to interfere with normal surveillance operations, these on-screen “shields” must block out only the area that has been defined as sensitive. The privacy zones should not cause the screen to blank out when the sensitive area is within the camera’s field of view. On the monitor, the privacy zones should appear larger or smaller depending on the camera’s zoom factor.
- The dome must support on-screen programming of dome parameters, including proportional flip, direction indicators and azimuth, maximum zoom stop, line-lock or internal crystal synchronization, AGC, white balance, Wide Dynamic Range selection, alarm actions and default states, infrared filter removal threshold, and home position. On-screen programming of dome name, 16 Area names, 96 Preset names, 16 Pattern names and four alarm names must also be provided. All of this on-screen programming, as well as the rest of the on-screen displays, must be available in the following languages: English, French, Italian, German, Spanish, and Portuguese.
- A DirectSet menu must be used to provide easy access to common dome settings when installed with compatible controllers. This DirectSet menu must provide access to the following features:
  - a. dome configuration menu
  - b. auto iris/autofocus resume
  - c. flip
  - d. default apple peel pattern
  - e. set North position
  - f. line lock off
  - g. line lock on
  - h. night mode, day mode
  - i. auto day/night mode
  - j. WDR on
  - k. WDR off
  - l. enable/disable wide dynamic range
  - m. activate smooth scan
  - n. activate stepped scan
  - o. activate random scan
  - p. activate a preset sequence
  - q. display the dome information screen
  - r. Password protection must be provided to prevent unauthorized access.
- Dome direction indicators and azimuth reading; Dome, Area, Preset, Pattern, Preset Sequence and alarm names; and zoom, focus, and iris status must be displayable on the monitor. All on-screen text character attributes must be user-selectable solid or translucent white, with or without black outline.

- On-screen display of dome usage statistics must be available. This usage information must provide a record of the number of pan, tilt, and zoom commands issued by the dome; operating time, time from last reset in seconds, and total reset count.
- The dome assembly design shall contain four alarm inputs and be field programmable to receive “normally open” or “normally closed” contacts. If operating on a SensorNet or RS-422 network, the dome shall be capable of receiving the alarm and transmitting the alarm back to the switching system and/or reacting to the alarm event independent of the switching system. If operating on a Manchester network, the dome must be able to process the alarm internally and automatically activate a Preset, Pattern or Preset Sequence.
- The dome assembly shall contain a single auxiliary output (outdoor dome) or three independent auxiliary outputs (indoor dome). The outdoor dome single auxiliary output shall be a form C relay contact. Each open collector auxiliary output must respond as momentary or latching (depending on system capability).
- The open collector of each auxiliary shall be required to handle +12Vdc at a maximum of 40mA.
- The complete dome assembly must be capable of operating to full specification with an applied voltage of 18 to 30Vac at a frequency of 50 or 60Hz and meet Class 2 standards. The power consumption cannot exceed 11W with all functions operating. The dome assembly shall have surge protection for the video, communications, power, and alarm connections.
- The camera shall have a 35X optical zoom and be a ¼-inch CCD interline transfer device. Day mode shall provide a minimum horizontal resolution of 540 lines with a usable video signal with a scene illumination of better than 0.24 Lux (20 IRE with AGC on) and 0.028 Lux (with an open shutter selection of 1/4sec).
- Night mode shall provide a minimum horizontal resolution of 540 lines with a usable video signal with a scene illumination of 0.021 Lux (20 IRE with AGC on) and 0.00041 Lux (IR mode with an open shutter selection of 1/2sec).
- The video output synchronization shall be 2:1 interlace and will observe the NTSC or PAL standards. Line-lock with an adjustable vertical phase must also be provided.
- The lens must be color-corrected, 3.4-119mm, f1.4, and must have continuous autofocus with manual override. The lens must also have auto-iris with manual iris override. The autofocus and auto-iris resume settings shall be configurable via on-screen menu settings.
- The dome shall incorporate a twist-lock release base for ease of installation and service. This base enables the installer to wire the appropriate cables onto an I/O board contained within the twist-lock base. The I/O base enables wiring to be completed once and for the housing/eyeball assembly to be connected and disconnected to the twist-lock base without disturbing the wires or connections. This I/O base option shall support four alarm inputs and three auxiliary outputs. In the event that the camera assembly must be replaced, the I/O base shall store presets, patterns, and other selected programming information. Each base will include diagnostic LEDs to indicate power and proper communications to and from the matrix.
- An installation tool that enables service personnel to connect and disconnect the housing/eyeball assembly without the use of a ladder or lift must be available. The dome

and base must be available separately so installation of the base can be accomplished by qualified personnel prior to the purchase of the dome or housing/eyeball assembly. An outdoor housing must also be available and shall provide for the same ease of installation and service.

- Upon initial power up and after dome resets, diagnostic tests must be run, including communication loopback, camera loopback, and motor circuit tests. The results of these tests must be displayable on the monitor. After initialization, the dome shall automatically pan, tilt, and zoom to its previous position.

### 3.0 Camera Assembly

3.1 Each camera assembly shall include, but not be limited to, the following equipment:

- Pendant mounted dome camera housing, mountings, pan and tilt unit, and other camera accessories as specified.
- ¼" CCD Integral color television camera with motorized lens.
- Integral receiver/driver installed in the dome housing.
- Local camera controller capabilities located in the traffic management system cabinet or portable variable message sign cabinet.
- Data Transmission RS-422. Data transmission shall use a dedicated data cable. The selected data transmission protocol shall require prior approval by the Engineer.
- All required wiring and connections to related equipment.

3.2 The dome camera, zoom lens, domed pressurized enclosure and control receiver shall be assembled and tested in accordance with these Technical Special Provisions prior to delivery to the job site. All equipment shall be UL listed. These assemblies shall be delivered to the job site as complete units, and installed on poles and camera lowering devices as shown on the plans and specified herein.

3.3 The operation of CCTV equipment dome type shall not be affected by transient voltages, surges, and sags normally experienced on commercial power lines. CCTV field hardware and related electronic components shall not be adversely affected by wind driven rain, salt in the air or ice buildup. The camera assembly shall have the capability to turn on or off the heater and blower systems by manual override from the operations center as specified and elsewhere in these provisions.

### 4.0 Camera Assembly Items

4.1 The camera shall be capable of automatically reestablishing video and data communications upon the restoration of communications or power to the cameras. The maximum lux level requirements shall be considered using a resulting image

on the video monitors at the Department’s Newington Operations Center. The cameras shall meet or exceed the following requirements:

**Note: Due to the market changes in the CCTV industry, the Contractor should contact the Department to verify camera features and performance.**

Operational

Manual Pan/Tilt Speed: .....	0.25° to 100° per second (based on zoom position)
Preset Pan/Tilt Speed: .....	360° per second maximum (Pan) 220° per second maximum (Tilt)
Pan Travel: .....	360° continuous
Tilt Travel:.....	110°
Pan/Tilt Accuracy:.....	± 0.5°
Zoom/Focus Accuracy: .....	± 0.5%
Programmable Patterns/Sequences/Areas/	
Privacy Zones: .....	16/16/16/8
Direction Indicators:.....	Yes
Presets: .....	96 max, system-capability dependent
Auto Synchronization:	
Line-Locked:.....	Remote V-phase adjustment
Internal:.....	Built-in sync generator
Address Range:	
RS-422/RS-485:.....	1 to 99
Manchester:.....	1 to 64
SensorNet:.....	1 to 255
AD-UTC: .....	Based on number of inputs
Alarm Inputs with I/O board (indoor only): .....	4 dry contacts with optical isolation/3.5mA sink
Alarm Outputs with I/O board (indoor only): .....	3 open collector drivers at 12Vdc, 40mA

Integral Receiver / Driver

Control Code: .....	AD Manchester, SensorNet, RS-422, or UTC
Maximum Daisy-Chain Devices:	
RS-422/RS-485:.....	10 Domes up to 1000m (3000ft)
SensorNet:.....	32 Devices up to 1000m (3000ft)
AD Manchester: .....	3 Domes, up to 1500m (5000ft)
Controllable Functions: .....	Pan, Tilt, Zoom, Focus (Manual/Auto), Iris (Manual/Auto)



Camera

Imager: .....	Interline transfer ¼-inch CCD array
Scanning System: .....	.2:1 interlace
Optical Zoom:.....	35X
Digital Zoom: .....	12X
Maximum Zoom:.....	420X
Video Output:.....	1.0V <sub>p-p</sub> , 75Ω composite
S/N Ratio:.....	-50dB (typical)
Horizontal Resolution: .....	540 lines at center
Minimum Illumination (20 IRE, AGC on):.....	0.24 Lux (color) 0.028 Lux (color with 1/4sec open shutter) 0.021 Lux (B/W IR mode) 0.00041 Lux (B/W IR mode with 1/2sec open shutter)
Gain Control:.....	Automatic (AGC)
White Balance: .....	Through-the-Lens (TTL) Automatic Tracing White Balance (ATW)
Day/Night .....	Auto (Med., Low, High) On, or Off
Wide Dynamic Range (WDR) .....	On or Off
Electronic Image Stabilization (EIS).....	On (5 or 10Hz) or Off
NTSC:	
Effective Pixels:.....	768 (H) x 494 (V)
Scanning: .....	525 lines, 60 fields, 30 frames
Horizontal: .....	15.734kHz
Vertical: .....	59.94Hz
Shutter Speed (Auto/Manual):.....	1/2 to 1/30,000

Lens

Design: .....	Aspherical
Aperture:.....	f1.4
Focal Length:.....	3.4 to 119mm
3.4mm field of view:.....	55.8° (H) x 41.8° (V)
119mm field of view:.....	1.7° (H) x 1.3° (V)

Features

Automatic Gain Control: .....	Off, On with adjustable max. dB, Open Shutter
White Balance: .....	Auto, Manual
Line Lock: .....	Off, On with adjustable vertical phase
Freeze Frame: .....	Maintains static image on-screen during call up of Preset or Pattern

Home Position: .....	Dome assumes a specified Preset or Pattern after a time-out period (1 to 60 minutes)
Alarm Processing: .....	External (by controller)
Alarm Input States: .....	Normally Open or Normally Closed
Alarm Input: .....	4 Normally Open (NO) or Normally Closed (NC)
Auxiliary Output: .....	3 Normally Open (NO) or Normally Closed (NC)
Diagnostic LEDs: .....	Power, communication, network type, and failure mode
On-Screen Text:	
Appearance: .....	Choice of outline or no outline for text overlay; solid, or translucent white characters
Language: .....	English, French, German, Italian, Portuguese, and Spanish
Password Protection: .....	3 to 8 character, user-programmable, to prevent unauthorized access to programmable features
DirectSet Menu: .....	provides access to commonly used dome features when used with compatible controllers
Overexposure Protection	The camera shall have built-in circuitry to signal the lens to appropriately adjust the iris opening to prevent any damage to the camera when pointed directly at strong light sources, including the sun.

## Electrical

Input Voltage: .....	18 to 30Vac, Class 2 LPS
Design Tolerance: .....	16 to 36Vac
Line Frequency: .....	50/60Hz
Power Consumption: .....	11W maximum
Power-on In-rush current: .....	1.5A
Allowable Drop-out: .....	100 $\mu$ s
Surge Protection:	
Video: .....	Low-capacitance Zener suppressor of 6.5V, 1500W
SensorNet/Manchester: .....	Isolation transformer coupled, 2000Vrms; PTC resettable fuse protects transformer; 9.8V, 1A, 500W; 8/20 $\mu$ s impulse
RS-422/RS-485: .....	10kA impulse rated gas tube

Alarm Input/ Auxiliary Output:..... TVS rated at 9.8V, 1A, 500W, 8/20µs  
impulse  
Power Line: ..... TVS rated at 60V, 250A, 1.5 joules; 8/20µs  
impulse

Data and video shall utilize separate cables

Mechanical

Dimensions (includes base) (H x D): ..... 205mm x 120mm (8in x 4.7in)  
Mounting : ..... pendant mounts for outdoor housing  
Bubble (for Top Hat Mount): ..... Clear (f0)  
  
Weight (Housing and Eyeball): ..... 1.09kg (2.40 lbs)  
Weight (Base with I/O board): ..... 0.16kg (0.35 lbs)

Pan – Tilt Drive

Pan-Tilt Drive.....Internal, powered by DC servo motors  
Or AC micro stepping motors

Environmental

Operating Temperature..... -10° to 50°C (14° to 122°F)  
Humidity..... 0 to 95% RH (non-condensing)  
Storage Temperature ..... -20° to 65°C (-4° to 149°F)

Regulatory

Emissions ..... FCC: 47 CFR Part 15, Subpart B  
Class A  
CE: EN55022 Class B  
CE: EN61000-3-2  
CE: EN61000-3-3  
AS/NZS 3548, Class A  
CISPR22  
ICES-003  
Immunity ..... CE: EN50130-4  
Safety..... UL: UL1950  
CUL: CSA 22.2.950  
CE: EN60950-1  
IEC 60950-1

**5.0 Camera Assembly Dome Enclosure**

A dome enclosure supplied and produced by the same manufacturer of the camera assemblies shall be supplied as part of each item. The enclosure shall be an American Dynamics SpeedDome Ultra Outdoor Dome Housing Model ADSDUHOC. The enclosure shall be rated for outdoor environment use and meet or exceed NEMA 4

rating. The dome enclosure shall meet or exceed IP66 rating. Each camera assembly shall be installed within the dome enclosure. The enclosure shall be pendant mounted and provided with a 1 ½” (38mm) diameter pipe fitting with NPT threads and all hardware required for attachment to the camera lower device and as shown on the plans. The dome housing shall be suitable for use in outdoor locations subject to extreme temperatures and wet conditions. The housing will incorporate a “twist-lock” mounting base to facilitate quick connection and disconnection of the dome housing/eyeball assembly.

### 5.1 Performance Specifications

- The outdoor dome housing will protect against water and dust intrusion and meet a minimum of NEMA-4 and IP66 ratings.
- The housing must include an outer sunshade and an inner aluminum housing with thermostat, heater, and fans to ensure protection and safe operation of the dome in temperatures of -40 °C to 50 °C (-40 °F to 122 °F) with a humidity range of 0–95% (non-condensing). The housing shall be constructed of reinforced fiberglass high impact polycarbonate material along with a UV stabilized sun shade trim ring and top cover.
- The housing must prevent the buildup of ice on the exterior bubble and be able to melt ice that has formed on the bubble during a power outage or other event within one hour of power being restored. The heater must be controllable via auxiliary outputs to aid in the clearing of moisture accumulation. The heater must be of a modular design, easily removable for servicing.
- The housing shall operate in sustained winds of up to 240 kph (150 mph) when properly mounted and installed on the pole.
- The housing and bubble shall have an Effective Projected Area (EPA) of approximately 125 square inches.
- The entire dome and housing will operate from a Class 2 power source requiring no more than 80 VA of power. The dome and housing shall be tolerant of 24 VAC supply voltages from 20 VAC to 36 VAC at 50/60Hz and be installed in accordance with Class 2 requirements.
- The housing must include an integral twist-lock I/O board to facilitate quick connect/disconnect of the dome from the housing. The housing shall incorporate “Euro-style” terminal screw connectors for ease of connection, and internal LEDs to verify proper power and communication status. The housing must provide four alarm inputs for use as alarm contacts and a Form C output rated at 30 volts AC or DC, 1 amp. The housing must provide for lightning and surge protection of the video, power, and communication lines.
- The housing shall include a clear bubble with no light loss. The bubble must be sealed with a gasket and secured with tamperproof screws. The appropriate security screwdriver bit must be provided with the housing.

### Mechanical

Construction:

Enclosure ..... Aluminum  
 Sun Shade/  
 Trim Ring/Top Cover ..... UV stabilized, polycarbonate  
 Color ..... Light gray  
 Height: ..... 321 mm (12.64 in)  
 Diameter: ..... 244 mm (9.61 in)  
 Bubble: ..... Acrylic  
 Bubble Diameter: ..... 75.3 mm (6.93 in)  
 Weight:  
     Without Dome ..... 2.6 kg (5.72 lbs)  
     With Dome ..... 3.8 kg (8.36 lbs)  
 Shipping Weight: ..... 3.3 kg (7.26 lbs)  
 Mechanical Connection ..... 1.5 in NPT  
 Mounting : ..... Outdoor Pole Mount

Electrical

Voltage ..... 20–36 VAC, 50/60 Hz  
 Power ..... 80 watts, maximum  
 Power-on In-rush Current ..... 3 A  
 Surge Protection:  
     Video..... Series resistor of 3.9  $\Omega$ ; low-capacitance Zener suppressor of 6.5 V, 1500 watts, 500 watts, 8/20  $\mu$ sec impulse, 500 watts, 10 kA impulse rated gas tube  
     Manchester/SensorNet ..... Isolation transformer coupled, 2000 Vrms; PTC resettable fuse protects transformer; TVS rated at 5.6 V, 40 A, 0.1 joules, 8/20  $\mu$ sec impulse, 500 watts, 10 kA impulse rated gas tube  
     RS-422 ..... Series resistors of 33  $\Omega$ ; TVS rated at 5.6 V, 40 A, 0.1 joules, 8/20  $\mu$ sec impulse, 500 watts, 10 kA impulse rated gas tube  
     Alarm Inputs (4)..... series resistors of 33  $\Omega$ ; TVS rated at 5.6 V, 40 A, 0.1 joules, 8/20  $\mu$ sec impulse, 500 watts, 10 kA impulse rated gas tube  
     Power Line ..... TVS rated at 60 V, 250 A, 1.5 joules, 8/20  $\mu$ sec impulse, 500 watts, 10 kA impulse rated gas tube  
     Auxiliary Output ..... 1000 V isolation Form 1-C relay

Allowable drop out:..... 150 ms

Environmental

Weatherproof Standard.....NEMA 4/IP66  
 Operating Temperature.....-40 °C to 50 °C (-40 °F to 122 °F)  
 Humidity.....0–95% RH (non-condensing)  
 Storage Temperature .....-10 °C to 50 °C (14 °F to 122 °F)  
 Wind Loading.....Sustained winds of 240 km/hour (150 miles/hour) when properly installed and mounted (wall, pole, ceiling, and over-the-roof mount with proper support)  
 Effective Projected Area (EPA) .....~125 square in (~317.5 square cm)

Regulatory

Emissions .....FCC: 47 CFR Part 15, Subpart B Class A  
 CE: EN55022 Class B  
 CE: EN61000-3-2  
 CE: EN61000-3-3  
 AS/NZS 3548, Class A  
 CISPR22  
 ICES-003  
 Immunity .....CE: EN50130-4  
 Safety.....UL: UL1950  
 cUL: CSA 22.2 No. 950  
 CE: EN60950  
 IEC950

5.2 The dome environmental enclosure shall be manufactured from high-quality acrylic substrate, aluminum, cell-cast or an approved equal. The enclosure shall be coated with an off-white, beige or gray finish, and outfitted with a sunshield to reflect direct rays from the sun from the control equipment within the housing without adversely effecting the optical qualities of the camera and lens. The sunshield shall have a means for dissipating heat to protect the camera from failing due to excessive sun exposure. The enclosure shall not allow external moisture to intrude the bubble of camera.

5.3 The bubble shall be constructed from high quality, clear, optically graded, thermoformed acrylic or approved equal. The bubbles shall be free of imperfections, scratches and blemishes. Tamper-proof hardware and a safety strap or lanyard shall be provided to attach the bubble assembly to the dome

enclosure. A gasket seal shall be provided between the bubble and dome enclosure to prevent water and dust entry. All external connections shall be environmentally sealed. The dome and bubble enclosure shall not exceed 380 mm. in height. Sufficient protective packing material shall be provided by the manufacturer to prevent damage to any enclosure surfaces during shipping and handling.

- 5.4 A thermostatically controlled heater/defroster and blower circulation system shall be provided to maintain the temperature in the specified range and ensure clear viewing during cold weather operation. The heater shall turn on at a minimum 4°C and off at a maximum of 15°C (+ or -2.8°C) to maintain the specified range defined in Section 2.0. The blower shall operate continuously. The blower shall be rated for continuous operation. All heater and blowers shall be mounted to the non-rotating housing of the dome. The enclosure shall prevent ice formation on the exterior of the enclosure. The camera assembly shall have capabilities to turn on or off the heater and blower systems by manual override from the operations center.
- 5.5 The enclosure shall provide easy access to the camera and pan-tilt unit and a quick release option to allow removal of the assembly.
- 5.6 The dome enclosure shall automatically restart camera operation upon restoration of power, video and data communications.
- 5.7 The camera and enclosure shall not experience any adverse operation during power fluctuations within the specified range.

## **6.0 Local Camera Controller**

- 6.1 Means shall be provided to perform all camera control functions locally within the field equipment cabinet for each dome camera. Activation of local camera control shall disable remote camera control. The following shall be included to provide local camera control:
  - A special purpose, RJ45 jack located in the input wiring panel within the traffic controller cabinet. The jack shall be wired for a minimum of three 3 pairs to provide for local control within the cabinet.

## 7.0 Camera Cable Assemblies

- 7.1 The Contractor shall furnish and install all cable and connectors, and make all connections between equipment as required to provide the specified operation. A camera cable assembly shall consist of a camera control cable carrying power for the camera and control lines for the lens and pan-tilt operations, and a video cable that carries the video signal generated by the camera. Specifications of all cable assemblies, including connectors, shall be submitted to the Engineer as part of the shop drawings for review and approval.
- 7.2 The Contractor shall supply and install interconnection wiring between the camera assembly/Lowering Device and the equipment installed at the termination point in the traffic management system cabinet and Mini-hub.
- 7.3 The Contractor shall supply and install interconnection wiring between the camera assembly and the wiring panel assembly installed in the traffic management system cabinet. The twisted pair cable shall be Belden Part Number 9734. The twisted pair cable shall be an eleven- (11) pair 7x32 stranded conductor. The conductor shall be a 24 AWG with the wires made of TC – Tinned Copper. The insulation shall be Foam Polyethylene with an insulator diameter of 0.061 in. The cable shall meet operating temperature of –20 C to + 80 C with a maximum pulling tension of 180lbs. and a min. bending radius of 5.75 in. The cable shall meet NEC/UL CM, with UL flame test UL 1685 UL Loading.
- 7.3 The coax cable shall be Belden Part Number 7915A. The conductor shall be a Series 6 conductor with a solid stranding. The cable shall be 18 AWG with the conductor material being made of BC – Bare Copper. The conductor diameter shall be 0.040 in. The insulation shall be a gas injected Foam Polyethylene with an insulator diameter of 0.180 in. The outer shield shall be Duobond Plus™). The outer shield type shall be Tape/Braid/Tape. The tape shall be bonded aluminum foil-polyester tape – aluminum foil. The braid shall be aluminum. The tape shall cover 100% of the cable. The braid shall cover 77% of the cable. The outer jacket material shall be PVC – polyvinyl chloride. The overall nominal diameter shall be 0.275 in. The cable shall meet operating temperature of –40 C to + 80 C with a maximum pulling tension of 91lbs. with a min. bending radius of 5.75 in. The cable shall meet NEC/UL CM, with UL flame test UL 1685 UL Loading.
- 7.4 The Category 6 cable shall be an OSP Broadband branded cable part number BBDN6. The cable shall be 23 AWG with a Aluminum tape shield. The cable shall be suitable for direct buried applications. The Category 6 cable shall be run between the traffic management System cabinet to the camera lowering device.



- 7.5 The Camera assembly power cable shall be Belden Part Number 8628 7 conductor 14 AWG. The power cable shall be run between the Traffic management system cabinet to the camera lowering device.
- 7.5 All wiring shall conform to the camera assembly manufacturer's requirements. All DC logic control conductors shall be shielded from conductors carrying AC power to prevent electrical noise from interfering with control. The interconnect wiring shall be protected with surge suppression.

## **8.0 Spare Equipment**

- 9.1 A minimum of one spare camera assembly shall be included for every three (3) camera assemblies provided. For example: If 3 cameras are installed, one (1) spare is provided. If 6 cameras are installed, two (2) spares are provided, etc.
- 9.2 The spare camera assembly shall be the same manufacturer and model provided for the camera assemblies installed on the poles.
- 9.3 The spare camera assembly shall include all necessary materials including but not limited to camera, enclosure, code converters, cables, power supply transformer etc. to replace any camera assembly requiring service.
- 9.4 The Contractor is allowed to use the spare camera assembly to replace defective camera assemblies during the equipment operations period. The Contractor shall replace the defective camera assembly at no additional cost to the Department.
- 9.5 The Contractor shall provide to the Department a properly operating spare camera assembly(ies) at the end of the equipment operations item.

## **10. Power Supply**

- 10.1 The Contractor shall furnish and install power supply transformer for each camera assembly in the traffic management system cabinet and or traffic management system mini-hub cabinet rated for outdoor use and environmental.
- 10.2 Each power supply transformer shall be from the same manufacturer for each camera assembly item and certified by the manufacturer for compatibility with the camera assembly.
- 10.3 The power supply transformer shall be a variable voltage power supply providing a range between 18 VAC and 36 VAC to provide the correct operating voltage for each camera assembly installed to meet the camera manufacturer's specifications, camera assembly cabling and voltage drop from the camera assembly and the input wiring panel. The Contractor shall be responsible for adjusting the voltage output of

the power supply transformer to each camera assembly to meet the camera manufacturer's operating voltage specifications.

- 10.4 The power supply transformer shall be UL rated and capable of being install in the wiring panel assembly in the traffic management system cabinet or traffic management system mini-hub cabinet as shown on the plans.
- 10.5 The power supply transformer shall be manufactured to prevent incidental shock in the event contact is made while installed and fully powered in the traffic management system cabinet or traffic management system mini-hub cabinet.

### **CONSTRUCTION METHODS:**

#### **1.0 Camera Assembly**

- 1.1 All assemblies, including camera, lens, pan-tilt unit, enclosures and receiver/drivers, shall be assembled and factory tested prior to delivery to the job site.
- 1.2 The assemblies shall be delivered to the job site as complete units, and installed on the lowering device mount as shown on the plans or as directed by the Engineer. The camera assembly shall be mounted in such a way that all designated areas are available for viewing by operating the pan, tilt and zoom functions. The Contractor shall contact the Engineer to confirm mount for maximum or preferred view.
- 1.3 The Contractor shall provide the required mounting adapters and hardware required to attach the camera assembly to the lowering device. Pole-mounted adapters shall be electrically bonded to the support bracket and pole. Camera assemblies shall be electrically bonded to the mounting adapter.
- 1.4 The Contractor shall pay particular attention to protection of the camera assembly dome enclosure glass face during installation. It is important that any clear surfaces not be scratched or marred. If any damage is observed by the Engineer, the Contractor will be required to replace the affected equipment at no cost to the State.
- 1.5 The qualified integrator shall furnish and install the camera cables between the camera lowering device through the camera pole to the traffic management system cabinet.
- 1.6 The Contractor shall connect cables for each camera assembly to the appropriate power and data connections as shown on the plans and as required by the camera manufacturer.

- 1.7 The Contractor shall clean all equipment during installation as required by the manufacturer. This is especially important for clear surfaces which must be free of any static electricity that can attract dust. The Contractor shall coat the exterior side of any clear surfaces with a water-resistant chemical, if use of such chemical is approved by the manufacturer.
- 1.8 All programming for all camera assemblies shall be conducted by an Integrator that is certified by the camera manufacturer. The Contractor shall submit certified integrator qualifications, including contact names and previous experience, to the Engineer as part of the catalog cut submittal.
- 1.9 The Integrator shall program each camera to fully utilize the capabilities of all programmable features to the satisfaction of the Engineer, including night time and other varying light conditions. The Integrator shall be responsible for coordinating the integration dates and times with the Engineer. The Integrator shall demonstrate to the Engineer that all programming features are included as specified.
- 1.10 The Contractor shall complete all camera programming at least two working days after the successful establishment of video and data communications between the camera site and the DOT Newington Highway Operations Center. The Contractor/Integrator shall contact the Engineer to coordinate the completion of all programmable features. Upon completion of the program features, the Contractor/Integrator shall record the program settings for each camera assembly and submit two copies to the Engineer for review and approval.

## **2.0 Local Camera Controller Installation**

- 3.1 If a shelf-mounted local camera controller is used, the Contractor shall install the controller in the traffic cabinet and furnish and install all necessary cables to interface the camera controller with the junction box, video camera output signal and power source.
- 3.2 If a manufacturer's keyboard is used for local camera control, the Contractor shall be responsible for purchasing a keyboard that is utilized for programming and configuring camera operation. Use of the keyboards provided as part of this contract item will not be allowed.
- 3.3 The Contractor is responsible for the purchase and supply of a video monitor and any other equipment required for on-site programming, configuration and testing at no additional cost to the Department.

### **3.0 Camera Cable Assembly Installation**

- 3.1 The Contractor shall supply and install all required interface cables between the camera assembly, lowering device, local camera controller, input panel and the power source. All cables shall be routed between the camera assembly via the inside of the camera pole or in a conduit as described in the lowering device and pole specifications. A ground wire shall be provided between the camera assembly and the traffic controller cabinet.
- 3.2 Wiring shall run continuous from source to destination. No splices will be allowed. Coaxial cables shall be installed without damaging the connectors, insulation or jacket. The coaxial cables shall not be kinked or bent tighter than the manufacturer's recommended bending radius. Sufficient slack cable shall be provided for equipment movement. All cabling shall be secured with tie-wraps and protected from physical damage. All interconnecting wiring and connectors shall meet all necessary standards with regard to voltage, current and environmental ratings. All electrical cable shall meet the requirements of the National Electrical Code. All communication terminations shall be terminated by the approved ITS integrator. A coax pigtail with copper conductors on one end and a BNC connector on the opposite end shall be supplied for connection to the camera lowering device.

### **4.0 Camera Assembly Tests**

- 4.1 The Contractor shall be responsible for the provision of all testing and documentation required to obtain approval and acceptance of the production, installation and operation of these materials, equipment and the overall system. The Contractor shall test each camera assembly as shown on the plans as described herein or as directed by the Engineer.
- 4.2 The Contractor shall test all cables for continuity, short circuits or grounds. Tests on cables with connectors attached (connectorized) shall be performed after installation. The Contractor shall perform system integration testing to ensure that the video interface and camera interconnect wiring functions properly and complies with all relevant standards when used in operation with all other devices installed under this contract or the procurement contract.
  - Verification of installation of specified cables and connections between camera assembly and the traffic controller cabinet.
  - Local operation of all CCTV equipment, exercising the pan, tilt, zoom, focus, iris opening, shutter control, power on/off and all other functions described herein this specification while observing the video picture on a portable monitor.

- Demonstration of camera sensitivity at low light levels to meet the specified requirements.
  - Demonstration of pan/tilt speed and extent of movement to meet the specified requirements.
  - Measurement of video signal level at the field equipment cabinet with VM700 video testing equipment.
  - Verify that video output from the camera is a 1-volt peak-to-peak, composite NTSC signal.
  - Random test of at least two installed camera to verify camera enclosure environmental resistance.
  - Preset test to ensure camera consistently goes to the proper preset position.
- 4.3 The integrator shall provide test reports for the category 6 cable and RG-6 coax cable installed to the top of the camera pole. The tests shall be done through the lowering device connections down to the TMSM or TMSMHC. Category 6 cable tests shall include length, Attenuation, Crosstalk (NEXT), Delay Skew, and Return Loss. RG-6 coax tests shall include HDTDR, Resistance, Length, Impedance, and insertion Loss. Any tests found to be outside RG-6 and CAT 6 standards will need to be remediated. Test results shall be submitted to the department before the start of the 30 day operational test.
- 4.4 Whenever any unit of equipment fails to pass the assembly tests, the Contractor shall correct the deficiencies, either by repair or replacement, at his expense (including freight costs) as required to comply with the testing requirements. Upon notification by the Contractor that the deficiencies have been corrected, the equipment shall be re-tested. All camera assembly testing and any re-testing shall be performed in the presence of the Engineer or his designated representative. The Contractor shall provide all test results to the Engineer in writing seven working days after the completion of each individual camera assembly test.

## 5.0 Factory Tests

- 5.1 All camera equipment furnished by the Contractor shall be tested and subjected to a nominal 72-hour burn-in period at the factory. The factory tests shall be in accordance with the manufacturer's standard procedures and quality assurance program.
- 5.2 The Contractor shall provide the Engineer with a copy of the manufacturer's test procedures and quality assurance procedures for information. If the Engineer determines that these procedures are not adequate, the Engineer may require that the Contractor conduct additional tests prior to installation. The Contractor shall provide documentation certifying and showing that each item supplied has passed factory inspection, burn-in and testing.

## **6.0 Central Control Tests**

- 6.1 The central control tests shall demonstrate that all equipment furnished by the Contractor has been installed properly and operates as a fully functional CCTV surveillance system using the existing ConnDOT video camera control system. Prior to initiating the central control tests, all camera assembly tests specified in (a) herein shall have been successfully conducted by the Contractor in the presence of the Engineer or his designated representative.
- 6.2 In the event that any Contractor-provided component of the CCTV surveillance system malfunctions or operates below the level specified, the Contractor shall be required to determine and correct the problems, including repair or replacement of equipment, at no cost to the Department. The Contractor shall respond with a qualified technical representative on site to determine and correct any problems within 24 hours following notification by the Engineer. The central control tests shall resume upon correction of the problem. In the event a malfunction is the result of equipment not installed by the Contractor (e.g., power service, etc.), the central control tests will be suspended until these problems are corrected by others.

## **7.0 Daytime Tests**

- 7.1 All central control and monitoring equipment shall be tested from the ConnDOT Newington Highway Operations Center facility during daytime hours. The Contractor shall contact the Engineer to arrange and coordinate the testing procedure. The tests shall include, but not be limited to the following:
- Operation of all newly installed camera assemblies from the central controller, exercising the pan, tilt, zoom, focus, presets, iris opening and all other functions and features described herein this specification while observing the video picture on the local monitor.
  - Display of each camera on a designated video monitor to verify proper operation and picture quality from each camera.
- 7.2 The Contractor shall correct any operational problems encountered with the video camera system during this test.

## **8.0 Nighttime Tests**

- 8.1 A second central control test shall be performed during the hours of darkness to verify proper operation of the auto iris lenses, shutter control and the absence of video signal noise. This test shall be conducted in the presence of the Engineer or

his designated representative at the Highway Operations Center. The test shall include the following as a minimum:

- Operation of all newly installed camera assemblies from the central controller, exercising the pan, tilt, zoom, focus, presets, iris opening and shutter control functions while observing the video picture on the local monitor.
- Display of each camera on a designated video monitor to observe both the brightest and darkest scenes available from each camera location.

8.2 The Contractor shall correct any operational problems encountered with the video camera system during this test.

## **9.0 Additional Tests**

9.1 Upon successful completion of the installation test and approval by the Engineer, a 30-day System Operational Test for each TMSC site shall commence. During the course of this test, the system must function continuously in accordance with the specifications for the duration of the test. If a malfunction occurs within the stated time frame, the Contractor shall make all necessary repairs to the system and re-establish proper operation. Upon approval of the Engineer, the 30-day test will begin anew. The system must operate for a full thirty (30) consecutive days without malfunction before the system will be accepted by the Engineer. The Contractor shall refer to "Notice To Contractor – 30 Day System Operational Test" for additional testing requirements. The Contractor shall coordinate the 30-day System Operational Test with other pertinent items in this contract.

## **10.0 Warranty**

10.1 All equipment supplied under these items shall be warranted for parts by the manufacturer against defects and failures, which may occur through normal use for a period of one (1) year from the date of installation. A copy of the warranty shall be presented to the Engineer before installation of the equipment.

### **METHOD OF MEASUREMENT:**

The work to be measured for payment under this item shall be the number of Camera Assemblies of the type specified, installed, completed, tested and accepted. No separate measurement will be made for spare units to be furnished as part of this item.

**BASIS OF PAYMENT:**

This work shall be paid for at the contract unit price for each "Camera Assembly" of the type specified, which price shall include all equipment including camera, lens, dome pan-tilt mechanism, enclosures, receiver/drivers, local camera controller, power supply, spare camera equipment, interconnect wiring, mountings, cabling and connectors, testing, testing equipment and all labor, materials, tools, equipment, transportation, storage and other incidentals necessary to complete the work. The cost of the spare cameras shall be included in this unit cost.



**ITEM #1112216A – CAMERA LOWERING DEVICE ASSEMBLY – TYPE A****ITEM #1112217A – CAMERA LOWERING DEVICE ASSEMBLY – TYPE B****Description:**

Work under this item shall consist of furnishing and installing a camera lowering system on a steel pole of the height specified on the plans. The camera lowering device and camera pole shall be fabricated in accordance with the details shown on the plans, in accordance with these specifications and as ordered by the Engineer and shall be mounted on a prepared foundation.

**Materials:**

The camera lowering system shall be designed to support and lower a simultaneous Dual analog and IP closed circuit television camera, lens, housing, PTZ mechanism, cabling, connectors and other supporting field components without damage or causing degradation of camera operations. The lowering system shall consist of a camera pole, suspension contact unit, divided support arm, and a pole adapter for attachment to a pole top tenon, conduit mount adapter, pole top junction box, and camera connection box. Camera pole height shall be either 70 feet (Type B), 85 feet (Type A) or 100 feet (Type A), as noted on the contract plans. **The construction of the camera lowering device shall be the [MG]<sup>2</sup> Model CLDMG2-HYPIP6+7-XXX(ST)**

**CAMERA POLE**

The pole may be round or may have 16 or more sides. It shall be of the diameter specified on the plans. If a multi-sided pole is chosen, the distance between outside faces of parallel sides shall be the same dimension as the specified outside diameter of the round pole. Both shall be tapered from top to bottom as shown on the plans.

The pole, base plate, top plate, tenon, tenon plate and handhole frames and covers shall be made of steel with minimum yield strength of 36,000 psi. All steel pole sections shall be of the same grade. The yield strengths of the plates welded to the pole at the top and bottom may be different than the yield strength of the pole.

Charpy V-notch sampling is required for the pole and base plate regardless of material thickness. The testing shall conform to AASHTO T 266 (ASTM E23). The minimum energy absorbed shall be as follows:

- 15 ft-lb at +40 degrees F for steel with a specified yield strength of 50 ksi and lower
- 15 ft-lb at -20 degrees F for steel with a specified yield strength greater than 50 ksi and equal to or less than 70 ksi

High strength bolts shall conform to ASTM A325, Type 1. Nuts shall conform to ASTM A563-DH, zinc coated or ASTM A194, Grade 2H, zinc coated as specified in ASTM A325. Washers

shall conform to ASTM F436, zinc coated. Compressible washer-type direct tension indicators may be used and shall conform to ASTM F959 Type 325.

Stainless steel bolts shall conform to ASTM A193, series 300.

Chain for connecting the handhole cover to the handhole shall be stainless steel of sufficient strength to support the weight of the cover.

Where “Silicone Joint Sealant” is specified on the plans, a primer will also be required for proper adhesion of the joint sealant to the steel. The following Primer and Silicone Joint Sealant or approved equals shall be used:

Dow Corning 1200 Prime Coat and Dow Corning 790 Silicone Building Sealant, manufactured by the Dow Corning Corporation, Midland, Michigan 48686-0994.

All steel components shall be completely hot-dip galvanized, after fabrication, in accordance with AASHTO M111 (ASTM A123) and AASHTO M232 (ASTM A153) as applicable.

Mechanical galvanizing of bolts shall conform to ASTM B695, Class 50.

Zinc-rich field primer for touch up shall conform to the requirements of ASTM A780. The use of aerosol spray cans will not be permitted. The color of the primer shall match the color of the galvanized surface as nearly as possible. Areas that do not match shall be recoated with the correct color primer at no additional expense to the State. Aluminum paint will not be allowed.

Closed cell elastomer for sealing handhole covers and for sealing the space between the foundation and base plate shall conform to ASTM D1056, Grade 2A2 or 2A3 and shall have a pressure-sensitive adhesive backing on one side for adhesion to steel. Closed cell elastomer contained within the anchor bolt pattern shall not interfere with the anchor rod leveling nuts and shall not block the opening in the base plate.

Certified test reports and Material Certificates will be required in accordance with Article 1.03.07 for hot-dip galvanizing to specify galvanizing has been tested and performed in accordance with AASHTO M111 (ASTM A123). Certified test reports and Material Certificates will be required for all structural steel components.

Tenon Design Requirements:

The Contractor is responsible for the design and details of the tenon and tenon plate at the top of the camera pole, the connection of the tenon plate to the pole top plate and all connections and openings required to attach and operate the lowering device. He shall coordinate the design of the tenon and tenon plate with Section - 2 Camera Lowering Device Assembly, of this specification. Dimensions and details shown on the plans are for the purpose of establishing a detailing concept for the connection of the tenon plate to the pole.

The design and fabrication of the tenon and tenon plate, shall conform to the requirements of AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals – 2001 (Fourth Edition), including the latest interim specifications. The Contractor shall incorporate the following information into the design:

- The design wind speed shall be 120 mph. The computation of wind pressures in accordance with Appendix C is not permitted.
- The minimum design life shall be 50 years.
- The structure shall be designed for fatigue category I and for the wind load effects due to natural wind gusts. Vibration mitigation devices are not permitted.
- The minimum thickness of the pole tenon shall be ¼”.
- The minimum thickness of the tenon plate shall be 3/8”.

#### Shop Drawings:

Prior to fabrication, the Contractor shall submit shop drawings to the Engineer for review in accordance with Article 1.05.02. Drawings shall be submitted for each camera pole to be installed. **Data for multiple sites may not be presented in a table and submitted along with “typical” details.** An identifier for each pole is noted on Site Plans or Location Plans and shall be used to identify each set of drawings and computations.

Shop drawings shall be submitted on 11" x 17" (Ledger/Tabloid) sheets with an appropriate border and title block. Procedures and other supporting data shall be submitted on 8 ½" x 11" (Letter) sheets. Electronic submissions of portable document files (.pdf) are acceptable.

The shop drawings shall be sealed by a Professional Structural Engineer, licensed in the State of Connecticut.

Deviations from any criteria noted on the plans or in this specification will not be considered for approval unless a request for change is submitted in writing to the District Engineer. Requests for change should be submitted and approved before preparing shop drawings. The request should include a reason for the proposed change. Shop drawings that do not conform to the contract plans and special provisions and prepared without written permission for the change may be rejected. Such a rejection gives no cause for a delay claim.

The shop drawings for each site shall contain the following information:

- The project number, town and camera pole identification number or Site Number
- Overall pole height and height of each pole section
- Cross sectional shape of pole (round or specify number of sides)
- Outside distance between parallel faces and width of flats at the top and bottom of each pole section (if member is multi-sided)
- Inside bend radius at angle points, if multi-sided member
- Wall thickness of each pole section

- Connection of pole to base plate (fillet welded socket connection or full penetration groove weld with a continuously welded backer bar). The following criteria shall be addressed:
  - The fabricator shall cut inside the specified opening in the base plate and grind to match the outside dimension of the pole.
  - The separation between the base plate and the pole within the socket shall not exceed 1/16” in order to assure sufficient fillet weld as specified in AWS D1.1, Section 5.22, “Tolerance of Joint Dimensions.”
- Groove welds at the base of poles less than 5/16” thick shall be ultrasonically tested in accordance with AWS D1.1, Annex K, as specified in Article 6.20.1. A 5/16” thick wall thickness may be substituted at no extra charge to avoid the need to use Annex K for full penetration weld inspection procedures
- Details and location(s) of the longitudinal seam welds in the pole, including designation of the penetration depth of the welds at the pole ends and within the length of the pole
- Welding process, electrodes, weld designations and non-destructive testing requirements
- Length of slip type field splice
- Diameter or distance across flats at the top and bottom of each pole section. Adequate tolerance should be allowed for the thickness of galvanizing, so the slip type field splice is adequate.
- Details of reinforced handholes and covers and their location on the pole (both vertical and angular orientation)
- Locations and diameters of holes in the pole wall for traffic flow monitor cables
- Tie-offs, grounding lug hole and other attachments
- Base plate details, including length, width and thickness, as well as anchor rod holes and other openings.
- A plan view of the pole and base plate showing the orientation of the anchor rod holes in relation to the hand hole at the base of the pole
- Pole top plate details, including length, width and thickness, as well as bolt holes and other openings
- Tenon and tenon plate, including length, width and thickness of tenon plate, as well as tie-offs, bolt holes and other openings. Coordinate dimensions with the manufacturer of the lowering device
- A copy of camera lowering device assembly support arm and pole connection details (to show compatibility with tenon)
- Material specifications for all components
- Minimum Charpy impact values for the steel pole and base plate
- Fabrication details of all components, including method of fabrication, when applicable
- Galvanizing requirements

Working Drawings:

Prior to fabrication, the Contractor shall submit erection drawings to the Engineer for review in accordance with Article 1.05.02. An individual set of drawings shall be prepared for each height camera pole.

Working drawings shall be submitted on 11" x 17" (Ledger/Tabloid) sheets with an appropriate border and title block. Design computations, procedures and other supporting data shall be submitted on 8 ½" x 11" (Letter) sheets.

The working drawings and design computations shall be sealed by a Professional Engineer, licensed 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 the work. Please note that each working drawing must be sealed.

Erection drawings shall include the following:

- The project number, town and camera pole identification number
- Overall pole height and location of slip type field splice
- Pole installation and erection procedure, including
  - lifting weight
  - crane size and placement
  - location where pole will be assembled
  - method of pulling pole sections together
  - proposed sequence of conduit and cable installation in pole, cable tie-off, etc.
  - method of lifting pole (including strongbacks, if required)
  - method of securing the base during tilt-up
  - proposed orientation of arm and handhole relative to traffic
  - method of turning pole to the proposed orientation
  - placement of elastomeric seal inside anchor rod circle
  - method of positioning leveling nuts in preparation for setting the pole (include minimum and maximum clear space between leveling nuts and foundation)
  - anchor rod and nut lubrication requirements
  - anchor rod nut tightening sequence, including degree of tightening

Bolting pole sections together to secure them during erection and lifting holes in the steel pole will not be permitted and may be cause for rejection of the pole. A suggested pole erection sequence is included in the camera pole plans.

#### CAMERA LOWERING DEVICE ASSEMBLY

The lowering system shall consist of a suspension contact unit, divided support arm, and a pole adapter for attachment to a pole top tenon, conduit mount adapter, pole top junction box, and camera connection box. **The construction of the camera lowering device shall be the [MG]<sup>2</sup> Model CLDMG2-HYPIP6+7-XXX(ST)**

The divided support arm and receiver brackets shall be designed to self-align the contact unit with the pole centerline during installation and ensure that the contact unit cannot twist under design wind conditions.

Round support arms are not acceptable.

The camera lowering device shall be designed in accordance with AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals – 2009 (Fifth Edition), including the latest interim specifications.

The lowering device manufacturer shall furnish independent laboratory testing documents certifying adherence to the stated wind force criteria identified in the CAMERA POLE section below utilizing, as a minimum, the effective projected area (EPA), the actual EPA or an EPA greater than that of the camera system to be attached.

The camera lowering device to be furnished shall be the product of the manufacturers with a minimum of two (2) years of experience in the successful manufacturing of such systems. The lowering device provider shall be able to identify a minimum of three (3) previous projects where the proposed system has been installed successfully for over a one-year period of time each.

#### Suspension Contact Unit

The suspension contact unit shall have a load capacity 600 lbs. with a 4 to 1 safety factor.

There shall be a locking mechanism between the fixed and moveable components of the lowering device. The movable assembly shall have a minimum of 2 latches. This latching mechanism shall securely hold the device and its mounted equipment. The latching mechanism shall operate by alternately raising and lowering the assembly using a winch and lowering cable. When latched, all weight shall be removed from the lowering cable. The fixed unit shall have a heavy duty cast tracking guide and means to allow latching in the same position each time. The contact unit housing shall be weatherproof with a gasket provided to seal the interior from dust and moisture.

The prefabricated components of the lift unit support system shall be designed to preclude the lifting cable from contacting the power or video cabling. The lowering device manufacturer shall provide a conduit mount adapter for housing the lowering cable. This adapter shall have an interface to allow the connection of a contractor-provided 1.25 inch PVC conduit and be located just below the cable stop block at the back of the lowering device. The Contractor shall supply and install the internal conduit in the pole as required by the Engineer and/or lowering device provider. **The only cable permitted to move within the pole or lowering device during lowering or raising shall be the stainless steel lowering cable. All other cables must remain stable and secure during lowering and raising operations.**

The female and male socket contact halves of the connector block shall be made of a UL94, V-0 rated thermosetting synthetic rubber. The female barrel contacts and the male pin contacts shall

be permanently and integrally encased in this rubber material to ensure optimum protection from moisture and the environment.

All current carrying male pin and female socket/barrel contacts shall be Gold-plated per ASTM B-488 over Nickel plated CA 360 per QQ-N-290m.

The DUAL Analog/Ethernet configuration contact connector shall include:

(7) specifically designed Male contacts sized a minimum of 0.125 inches while the female contacts shall be at least 0.125 inches I.D. at the contact area. All (7) contacts shall be soldered to #18/1 UL lead wire and affixed with numbered tags. Two of these wires shall be equipped with a factory installed BNC connector for video transmission/connection from the CCTV.

(13) specifically designed Male contacts sized a minimum of 0.09 inches while the female contacts shall be at least 0.09 inches I.D. at the contact area. Eight of the thirteen contacts shall be soldered to CAT5e Wire end terminated with an RJ45-Male connector. Five of the thirteen contacts shall be soldered to #18/1 UL lead wire and affixed with numbered tags, which may be used for additional camera requirements including but not limited to power, control, alarms or grounds.

All current carrying male pin and female socket/barrel contacts shall be Gold-plated per ASTM B-488 over Nickel plated CA 360 per QQ-N-290m. Each individual female barrel contact shall have a Nickel plated CA 360 sleeve which prevents foreign matter from entering the contact area as well as preclude the possibility of the leaves of the female contact from opening beyond allowable limits and ensure a snug fit around the respective male pins. There shall be at least one contact that is positioned in a manner which will allow it to make first and break last providing optimum grounding performance.

All soldering shall be per IPC J STD-001E. Each individual contact shall be rated for up to 600v and 7A but de-rated according to the wire used in the application. For optimum weatherproofing, each male shall be self-wiping with a shoulder at the base of each male contact so that it will recess into the female block, thereby giving a rain-tight seal to each individual contact when mated. Further, the wire leads from both the male and female rubber contact blocks shall be permanently and integrally molded in the synthetic rubber body. The facility manufacturing the electrical contact connector must comply with Mil Spec Q-9858 and Mil Spec I-45208.

### **Spare Equipment**

A minimum of one spare camera lowering device assembly with camera pole shall be supplied.

The spare camera lowering device assembly and pole shall be the same manufacturer and model provided for the camera lowering device assembly installed within the project limits.

The spare camera lowering device assembly shall include all necessary materials including but not limited to camera lowering device, pole top, camera junction box, cables, pole, etc. to provide a complete working lowering device assembly.

The spare camera lowering device assembly and pole shall be delivered to State Stores 660 Brook St. Rocky Hill, CT. Hours for the DOT Stores is between 8:00 AM and 3:00 PM, Monday through Friday. The Contractor shall contact Mr. Fred Connors, Assist. Fiscal Administrative Officer, at 860-258-1980 at least 48 hours prior to delivery.

### Camera Junction Box

The camera junction box shall be of two piece clamshell design with one hinge side and one latch side to facilitate easy opening. The general shape of the box shall be cylindrical to minimize the EPA. The Camera Junction Box shall be cast aluminum with stabilizing weights on the outside of the box to increase room on the interior. The box shall be capable of having up to 40 pounds of stabilizing weights. The bottom of the Camera Junction Box shall be drilled and tapped with a 1-1/2" NPT thread to accept industry standard dome housings and be able to be modified to accept a wide variety of other camera mountings. The junction box shall be gasketed to prevent water intrusion. The bottom of the box shall incorporate a screened and vented hole to allow airflow and reduce internal condensation. If utilizing a CCTV dome housing, it must be furnished from the camera factory with an epoxy sealed connection flange at the point of connection of the dome to the CLD junction box to ensure that there is no moisture migration from the CLD junction box into the dome.

### Pulleys

All pulleys for the camera lowering device and portable lowering tool shall have sealed, self-lubricated bearings, oil tight bronze bearings, or sintered bronze bushings.

### Cables and Connectors

The lowering cable shall be a minimum 1/8" diameter stainless steel aircraft cable with a minimum breaking strength of 1740 pounds with (7) strands of #19 wire each.

All electrical and video coaxial connections between the fixed and lowerable portion of the contact block shall be protected from exposure to the weather by a waterproof seal to prevent degradation of the electrical contacts. The electrical connections between the fixed and movable lowering device components shall be designed to conduct high frequency data bits and one (1) volt peak-to-peak video signals as well as the power requirements for operation of dome environmental controls.

The Power/Signal cable provided by the contractor/camera provider per the requirements of the camera shall be in the lengths as noted on the plans for each camera site. See Item No. 1112210A Camera Assembly for requirements pertaining to the camera power/signal cables. Further, the power signal cable shall be delivered to the lowering device manufacturer and prewired to the lowering device at the lowering device manufacturer prior to arrival at the jobsite. The coaxial video connection for the CCTV Camera shall be made from twisted pair to BNC with a manufactured off-the-shelf connector.



### Other Materials

The interface and locking components shall be made of stainless steel and or aluminum. All external components of the lowering device shall be made of corrosion resistant materials, powder coated, galvanized, or otherwise protected from the environment by industry-accepted coatings to withstand exposure to a corrosive environment.

The Camera Manufacturer shall provide weights and /or counterweights as necessary to assure that the alignment of pins and connectors are proper for the camera support to be raised into position without binding. The lowering unit will have sufficient weight to disengage the camera and its control components in order that it can be lowered properly.

The Camera Manufacturer shall provide the power and signal connectors for attachment to the bare leads in the camera junction box.

The Camera Manufacturer shall provide a mounting flange sufficient for mounting their respective camera assembly to a standard 1.5 inch NPT female, or other suitable method approved by the Engineer, at the bottom of the Camera connection box.

### Lowering Tool

The camera-lowering device shall be operated by use of a portable lowering tool. The tool shall consist of a lightweight metal frame and winch assembly with cable as described herein, a quick release cable connector, an adjustable safety clutch and a variable speed industrial duty electric drill motor.

This tool shall be compatible with accessing the support cable through the hand hole of the camera pole. The lowering tool shall attach to the pole with one single bolt. The tool will support itself and the load assuring lowering operations and provide a means to prevent freewheeling when loaded.

The lowering tool shall have a reduction gear to reduce the manual effort required to operate the lifting handle to raise and lower a capacity load. The lowering tool shall be equipped with a positive locking mechanism to secure the cable reel during raising and lowering operations. The lowering tool shall be provided with an adapter for operating the lowering device by a portable drill using a clutch mechanism.

The lowering tool should be capable of lowering and raising the camera assembly for the height of the pole within a five-minute time period.

### **Construction Methods:**

#### CAMERA POLE

The Contractor is responsible for reviewing the site conditions at each pole location as soon as possible. He shall immediately notify the Engineer of concerns such as conflicts with overhead

utilities, trees, the presence of drainage swales, buried facilities, etc. that could make installation undesirable, extremely difficult or even impossible.

#### Pole Fabrication

A maximum of one telescopic, slip-type field splice is permitted in the pole. The minimum length of this splice shall be 1.5 times the inside diameter of the exposed end of the female section.

Poles shall be fabricated in accordance with the dimensions and tolerances listed in ASTM A595. Each pole will be inspected for straightness at the fabrication shop and again upon delivery to the site where it will be installed. Deviations from the allowable tolerance are cause for rejection.

The pole top plate shall have slotted holes that allow field adjustment of the arm/camera orientation up to 360 degrees. A tenon shall be welded to a separate tenon plate - NOT to the pole top plate. The tenon plate shall be bolted to the pole top plate. The tenon shall have standard size mounting holes as shown on the plans for the mounting of the camera-lowering device assembly. The tenon shall be of dimensions necessary to facilitate camera lowering device component installation. A slot in the tenon shall be parallel to the pole centerline as shown on the plans for mounting the lowering device.

Traffic appurtenances shall be located and mounted on the pole as shown on the Traffic Flow Monitor (TFM) plans. A ½" diameter hole shall be located on the traffic side of the pole 12" above the detector, whose height is noted on the TFM plans. A rubber grommet shall be installed in the hole to protect the wire from chafing and to prevent moisture from entering.

A handhole of the size detailed on the plans shall be placed at the level of the ½" diameter TFM monitor cable hole facing away from oncoming traffic.

#### Handhole Requirements:

- The camera pole shall have handholes that are detailed and located as shown on the plans.
- The handhole shall be provided with a cover connected to the frame with stainless steel bolts.
- A neoprene gasket shall be adhered to the inside of the handhole cover such that the gasket makes contact with the frame and seals the opening against intrusion of water.
- The cover shall be attached to the frame with stainless steel bolts as shown on the plans. Coupling nuts shall be welded to the inside face of the handhole frame to receive the handhole cover bolts. The cover shall be trial-fitted in the shop before being galvanized. All bolts shall be threaded into the coupling nuts simultaneously and the cover shall fit tightly to the handhole frame with the elastomeric seal in place.
- A stainless steel chain shall connect the handhole cover and the handhole frame.
- The handhole frame shall accommodate a winch-anchoring bolt to secure the lowering device attachment. A drilled and tapped hole is specified on the plans. The female threads shall be re-tapped after galvanizing, if necessary, for compatibility with the bolt.
- The exposed edges of the handhole shall be ground smooth and rounded by grinding.

### Welding Requirements:

All welding shall conform to the following requirements:

- Department Welding Inspector shall be present during welding. At no time will welding of the pole and base plate and welding of the handhold frame to the pole be permitted without oversight by the Department Welding Inspector.
- AWS D1.1 Structural Welding Code - Steel as supplemented by Section 12 of AASHTO/ANSI/AWS D1.5 Bridge Welding Code.
- The pole members may be fabricated with no more than 2 longitudinal seam welds.
- The longitudinal seam welds for the pole members shall have 60% minimum penetration, except longitudinal seam welds within 6" of the member ends shall be complete joint penetration groove welds. At the slip-type splice, the longitudinal seam welds on the female section of telescopic splices shall be complete penetration groove welds for a length equal to 1.5 times the inside diameter of the exposed end of the female section plus 6".
- A minimum of 25% of the partial joint penetration seam welds and 100% of the complete joint penetration seam welds shall be non-destructively tested.
- Partial joint penetration seam welds shall be non-destructively tested in accordance with the magnetic particle method.
- Complete joint penetration seam welds shall be non-destructively tested in accordance with the ultrasonic method.
- Poles: the pole-to-transverse base plate connection may be made with a fillet welded socket connection with two fillet welds or a complete joint penetration groove weld with a backing ring attached to the plate with a continuous fillet weld.
- If a complete joint penetration groove weld is chosen for tube walls less than 5/16" thick, ultrasonic testing of the weld shall be performed in accordance with Annex K of AWS D1.1, as specified in Article 6.20.1.
- 100% of complete joint penetration groove welds shall be non-destructively tested by the ultrasonic method.
- 100% of fillet welds shall be non-destructively tested by the magnetic particle method.
- The joint between the backing ring and tubular member shall be sealed with silicone sealant at the top of the backing ring.

All welding, drilling of holes and any other fabrication practices that would damage the galvanized coating shall be completed prior to galvanizing the post.

After the post has been completely fabricated, welds ground smooth, flux and spatter removed, they shall be hot-dip galvanized in accordance with AASHTO M111 (ASTM A123). All pieces shall be galvanized in a single dip. Double-dipping will not be accepted.

All damaged areas of the galvanizing shall be properly prepared and touched-up. "Damaged" does not include mishandling or deliberate welding or drilling. Such deliberate destruction of the galvanized finish may be cause for rejection of the member. Damaged zinc shall be touched-up in accordance with ASTM A780. Spray aerosol cans of zinc rich primer will not be permitted. Zinc paint shall match the color of the galvanizing as nearly as possible. The Engineer may order additional touch-up if he deems it appropriate. Aluminum paint will not be permitted.

Fabricated materials shall be packed with sufficient dunnage and padding to protect finished surfaces. Poles shall be stored in a manner that does not dent or permanently bend the wall of the pole or permanently bend the pole along its axis.

### Pole Installation

See the camera pole drawings for a suggested erection procedure. The Contractor is fully responsible for developing a workable erection procedure.

The Contractor is responsible for the proper orientation of the camera pole and arm. The station and offset of the pole shall be as shown on the CCTV plans or as directed by the Engineer.

The camera pole shall be electrically grounded by attaching one end of a bare copper grounding conductor to the ½" ground tap using an exothermic weld. The rigid metal conduit shall be electrically grounded by passing the ground conductor through an insulated bonding bushing attached to the conduit. The conductor shall terminate at the ground lug connection at the handhole.

Ensure that the handhole covers are securely installed before leaving the pole unattended.

In the void between the top of the concrete foundation and underside of the base plate a ring of closed cell elastomer shall be placed to seal the opening in the base plate completely. Closed cell elastomer shall fit inside the anchor bolts, but allow clearance for tightening. The elastomer shall be compressed approximately 10% to 20% when the base plate is in its final position.

The following installation procedure is critical to preventing fatigue failure of the anchor rods with UNC threads:

1. The anchor rod double leveling nuts shall be pre-set to expose as few threads as possible below the nuts, while forming a level line in all directions across the top of the top leveling nuts. A sufficient number of threads should be exposed below the leveling nuts to allow the nuts to be adjusted when plumbing the installed pole. The installation will be considered unacceptable if 1 ½" or more of threads are exposed below the bottom nut.
2. The anchor rod leveling nuts and washers shall be in full contact with the bottom surface of the base plate when the centerline of the pole is plumb.
3. Once the leveling nuts have all been brought into full contact with the bottom of the base plate, the nuts above the base plate may be tightened to snug-tight. Snug tight is equivalent to the full effort of a workman on a 12" wrench.
4. The nuts shall then be turned an additional one-third turn beyond snug-tight.
5. The leveling nuts shall be retightened to ensure that full contact has been made.

6. Bring all double nuts in contact with the tightened nuts and turn until snug-tight.

Note: Nut rotation is relative to the anchor rod. The tolerance is plus 20 degrees.

The camera lowering device assembly shall be installed according to the manufacturer's specifications. The camera will be installed after the pole has been erected. To facilitate the camera installation, lower the control cable to the ground, attach the camera and raise it into position.

### CAMERA LOWERING DEVICE ASSEMBLY

The Contractor shall install the lowering device and pole on the span pole foundation in the location(s) as shown on the plans.

The Contractor shall utilize an authorized representative from the lowering device manufacturer to assist with the assembly and testing of the first lowering system onto the pole assembly. The manufacturer shall furnish the Engineer documentation certifying that the electrical contractor has been instructed on the installation, operation and safety features of the lowering device. The contractor shall be responsible for providing applicable maintenance personnel "on site" operational instructions.

The Contractor shall install two (2) - 1.25 inch PVC conduits inside the camera pole between the tenon assembly and camera pole handhole. One conduit will be installed to contain the stainless steel aircraft lowering device control cable. The second conduit will be used to contain the twisted pair camera control, category 6 cable, and coax video cable. The camera control cable shall be contained inside of the 1.25 inch PVC conduit and the camera coax video cable shall be secured with plastic cable ties to the outside the PVC conduit. The TFM communication cable shall not be contained inside a PVC conduit.

The Contractor shall be responsible for installing and coordinating the CCTV and TFM cables between the lowering device and the pole installation per the manufacturer's recommendations.

All Contractor personnel involved in terminating communication cables for the above listed items shall meet or exceed the above referenced installation qualifications and shall be approved by the Office of Highway Operations. See the special provision "Notice to Contractor – Installation Qualifications".

The Contractor shall contact the Engineer prior to installation of each lowering device assembly to determine the appropriate pole top tenon angle to use for optimum camera visibility. The Contractor shall then adjust the angle of the lowering device and pole top tenon as required.

The Contractor shall connect all power, video and data cables as required to fully operate the lowering device and camera assembly.

The camera lowering device assembly shall be mounted on the Camera Pole as dictated by the camera lowering device installation manual and the onsite representative. The lowering device assembly components, wiring and cabling shall be tested for proper signal continuity prior to installation of the pole on the foundation supports and anchor bolts.

Upon completion of the pole installation on the foundation, the unit shall be tested with a replica of the actual CCTV unit for the lowering device system functionality. The system shall be tested in the presence of the manufacturer's representative and Engineer.

**Method of Measurement:**

This work will be measured for payment by the number of camera lowering device and steel camera pole assemblies of the height specified, furnished, installed, tested, completed and accepted in place. No separate measurement will be made for spare units to be furnished as part of this item.

**Basis of Payment:**

This work will be paid for at the contract unit price each for "Camera Lowering Device Assembly – Type A" and "Camera Lowering Device Assembly – Type B", complete in place, which price includes the steel camera pole, tenon, base plate and all attachments, camera lowering device assembly, PVC conduit, suspension contact unit, pulleys, cables, connectors, lowering tool, spare equipment, and all equipment, materials, coordination, design, fabrication, tools, labor testing, manufacturer representation and incidentals thereto. The cost of the spare camera lowering device assembly with camera pole shall be included in this unit cost.

Anchor rods, nuts, and washers and anchor plates will be included for payment in the item "Traffic Control Foundation Span Pole – (Type C)" or "Traffic Control Foundation Span Pole – (Type D)"; the foundation type for each location shall be as indicated on the plans.

## **ITEM #1112241A – FIBER OPTIC CABLE SPLICE ENCLOSURE**

### **Description:**

This Item shall consist of furnishing and installing splice enclosures to interconnect optical fibers between two or more fiber optic cable segments.

### **Materials:**

#### A. Applicable Publications

1. Publications listed below form a part of these specifications to the extent referenced. The publications are referred to in the text by basic designation. All Fiber Optic Communication System hardware shall be compliant with the following specifications: Electronics Industries Association (EIA):
  - a. TIA-526-3-89 Fiber Optic Terminal Equipment Receiver Sensitivity and Maximum Receiver Input.
  - b. TIA-455-32A-90/Fiber Optic Circuit Discontinuity.
  - c. EIA-310-C Racks, Panels, and Associated Equipment.
  - d. EIA-359-A Colors for Color Identification and Coding.
  - e. EIA-TIA-455-A Standard Test Procedures for Fiber Optic Fibers, Cable Transducer Sensors, Connecting and Terminating Devices and Other Fiber Optic Components.
  - f. EIA-455-6B Cable Retention Test Procedure for Fiber Optic Cable Interconnecting Devices.
  - g. TIA/EIA-598-A Optical Fiber Cable Color Coding.

#### B. Fiber Optic Splice Enclosure

1. The Splice Enclosures shall accommodate from a minimum of 72 to 168 fiber splices. Each splice enclosure shall have a splice tray organizer capable of holding a minimum of 12 to 18 splice trays. The organizer shall provide access to and removal of individual splice trays and permit selective splicing to allow one or more fibers to be cut and spliced to branch cable(s) without disrupting other fibers.
2. The Contractor shall install Splice Enclosures of a capacity that they are capable of handling of 36 fibers more than the current fiber count at any given splice location as shown on the Drawings.
3. The Splice Enclosure shall fit within the space allocated for it as shown on the plans and to operate within the environment in which it is to be installed.

4. The Splice Enclosure shall protect the fiber optic cable splices from mechanical damage, shall provide strain relief for the cable, and shall be resistant to salt corrosion. The enclosure shall be waterproof and airtight, and shall be manufactured of non-corroding materials.
5. The Splice Enclosure shall be designed for a temperature range of  $-30^{\circ}\text{C}$  ( $-22^{\circ}\text{F}$ ) to  $+70^{\circ}\text{C}$  ( $158^{\circ}\text{F}$ ). The splice enclosure shall be capable of performing in a cable vault or pull box, environment where total and continuous submersion in water is to be expected.
6. All materials in the enclosures shall be non-reactive and shall not support galvanic cell action. The outer enclosure shall be compatible with the other enclosure components, splice trays, and cables. The end plate shall consist of two sections and shall have the capacity for a minimum of two cable entries on each end.
7. All Splice Enclosures shall employ re-usable sealing materials allowing multiple re-entrances without replacing any component. Access to the splice enclosures shall be accomplished without the use of special tools or devices. The splice enclosure shall employ a latching mechanism for entrance to the internal components of the enclosure.
8. All environmentally exposed components of the Splice Enclosures shall be UV light resistant.
9. All splice trays shall be lined to provide a contrasting background for splicing colored fibers or as approved by the Engineer. The splice trays shall include clear snap-on covers and tie wraps to secure the buffer or transport tubes to the tray. The splice trays shall be of adequate size to prevent induced attenuation due to fiber bending.
10. Each splice tray shall be capable of accommodating a minimum of 12 fusion splices for the single mode fiber cable of the type selected.
11. The splice tray shall have features that retain the fiber loops and control the bend radius. The splice tray cover shall be clear plastic to allow for inspection of the fibers without opening the tray.
12. Vinyl markers shall be supplied to identify each fiber to be spliced within the enclosure. Each splice shall be individually mounted and mechanically protected on the splice tray.



### C. Cable Racking Hardware

1. Cable racking hardware shall be made of a high performance polymer: Each splice enclosure shall be supported in the pullbox by a medium duty rack capable of supporting a minimum load of 100 lbs (445 N). Racks shall not be less than 6 inches (150mm) in length. Medium duty racks shall have 4 inch (100mm) arms minimum. At splice points, the pullbox shall have a horizontal rack capable of supporting, and holding securely in place, a splice closure.

### D. Warranty

1. All equipment supplied for this shall be warranted for parts by the vendor against defects and failures, which may occur through normal use for a period of one (1) year from the date of installation. A copy of the warranty must be presented to the Engineer before installation of the equipment.

## **Construction Methods:**

### A. Installation

1. Splice Enclosures shall be installed as shown in the Drawings or as directed by the Engineer. Unless otherwise specified, outdoor type Splice Enclosures shall be installed within vaults or pull boxes located adjacent to CCTV cameras and at fiber optic cable reel-end splice locations as shown on the Drawings.
2. The installations shall include all required components including sealing kits, cable racking hardware and mounting hardware to achieve an environmentally secure permanent installation.
3. The Contractor shall supply all materials, tools, equipment and labor including but not limited to fan out kits, connectors, trays, splice enclosures, and any other incidentals necessary to complete the installation of the fiber optic cable splice enclosure.
4. The Splice Enclosure shall be secured to the interior of the cavity of the vault or pullbox on cable racking hardware using tie-wraps.
5. The Outdoor Splice Enclosure shall be mounted in such position to allow the cable to enter and exit the enclosure without exceeding the cables minimum bending radius. Sufficient cable shall be coiled in the vault or pull box to allow the Splice Enclosure to be removed from the vault for current and future splicing and cable repairs. The Contractor shall install mounting hardware within the pullbox or splice location to support the splice enclosure and the splice enclosure

shall be securely fastened in place. In no cases shall the splice Enclosure be allowed to rest on the bottom of the pullbox or vault.

6. After the splice trays are placed inside the enclosure, the enclosure shall be sealed using a procedure recommended by the manufacturer that will provide a waterproof environment for the splices. Encapsulant shall be used to ensure water resistance. The individual fibers shall be looped one full turn within the Splice Enclosure to avoid micro bending.
7. Care shall be taken at the cable entry points to ensure a tight salt resistant and waterproof seal is made which will not leak upon aging. It is acceptable to have multiple cables enter the fiber optic cable Splice Enclosure through one port as long as all spaces between the cables are adequately sealed.
8. All splices shall be protected with a thermal shrink sleeve and shall be labeled in the splice tray with permanent vinyl markers. Butt ends shall also be labeled to identify the destination of the fiber.
9. The splices shall be fabricated using modern, high quality fusion type splicing equipment. All splicing equipment shall be in good working order, properly calibrated, and meeting all industry standards and safety regulations. Cable preparation, Enclosure installation, and splicing shall be accomplished in accordance with accepted and approved industry standards.
10. Optical fibers shall be spliced as noted on the plans using the fusion type and the maximum splice loss shall not exceed 0.10 dB per splice in each direction. The Contractor shall test all splices for signal loss.
11. Each splice shall be tested for tensile strength by applying a force of not less than 7 oz. (200 grams).
12. All splices shall be arranged neatly in splice trays, supported and protected with a suitable splice protector.
13. Only the fibers required to be spliced to Drop Cables at the CCTV Camera and Mini-Hub locations shall be severed and spliced. Where required, the buffer tube splitting tool recommended by the manufacturer shall be used to open the correct buffer tube. Unsevered fibers in an open buffer tube shall be coiled in the splice tray. When buffer tubes do not need to be opened, at least 4.0 m of unopened buffer tubes shall be coiled in the fiber optic Splice Enclosure.
14. Drop cable entrances to the splice enclosures shall adhere to the manufacturer's recommendations for the type of cable.

15. In order to reduce the overall number of splices required, the cable shall be installed in the maximum continuous reel length provided by the manufacturer, or as shown on the plans, or as approved by the Engineer. Factory splices will not be permitted. Prior to ordering the fiber optic cable, the Contractor shall be required to submit a detailed cable layout plan showing the proposed reel lengths and splice points.
16. Fiber identification shall be in accordance with the tables and schedules provided in the Contract Drawings.
17. Upon completion of the splicing operation, all waste material shall be deposited in suitable containers, removed from the job site, and disposed of in an environmentally acceptable manner.

#### B. Submittals

1. Submit:
  - a. Functional block diagrams, cable diagrams, and point to point cabling details.
  - b. Product data, installation manuals, materials, system configuration options and features, and accessories.
  - c. Shop Drawings shall be completely dimensioned and shall indicate the intended installation method and details.
  - d. Specifications for all assemblies and subassemblies (eg. High Density Frames, Splice Housings, Connector Panels, Underground Splice Enclosures and associated Splice Trays).
  - e. Installation and maintenance manuals for all equipment.

#### C. Testing

1. Testing shall be performed to demonstrate that all furnished and installed equipment complies with the requirements of each item, and shall be conducted using Manufacturer recommended procedures, materials and test equipment.

#### D. Delivery, Storage, and Handling

1. The Contractor shall deliver, store, handle and install all materials and equipment in such a manner as not to degrade quality, serviceability or appearance.
2. The Contractor shall be responsible for storage of the materials and equipment prior to installation in a clean, dry location free from construction dust, precipitation and excess moisture.
3. Contractor shall be required to replace any damaged materials and equipment, as determined by the Engineer, at no additional cost to the owner.

**Method of Measurement:**

Work under these items shall be measured for payment by the actual number of “Fiber Optic Cable Splice Enclosures” of the type specified, installed, tested, operating and accepted in place.

**Basis of Payment:**

The work to be done under this item shall be paid at the Contract Price each for “Fiber Optic Cable Splice Enclosure” which price shall include all materials, hardware, termination panels, labor, cables, connectors, tools, equipment and incidentals necessary to complete this work.

The Contractor shall note that the required racking in the pullboxes and the vaults is included in the Fiber Optic Cable Splice Enclosure item.

## **ITEM #1112252A – EQUIPMENT OPERATIONS (ESTIMATED COST)**

### **Description:**

The purpose of this item is to provide the necessary services required to maintain the Incident Management System (IMS) equipment existing and newly installed, operating to the manufacturer's specifications, so as to provide a means to monitor, detect and manage incidents as they occur on the highway. The work included in this item for the existing IMS equipment will commence upon receiving the Notice to Proceed for this contract. The work included in this item for newly installed IMS equipment will commence upon completion of the 30 Day Operational Test

### **Materials:**

All materials utilized to maintain and repair the Incident Management System (IMS) shall be in conformance with the specifications of this project or shall be in conformance with the specifications of the Procurement Contract, or as recommended by the manufacturer. The existing or newly installed IMS equipment shall include but not be limited to the operation of the CCTV Cameras, Traffic Management System Cabinets (TMSC), Traffic Management System Mini-Hub Cabinets (TFSMHC), Traffic Flow Monitors (TFM) and Variable Message Signs (VMS).

The Contractor shall provide all the cables, connectors, tools, replacement equipment and labor necessary to successfully maintain the equipment.

The Contractor shall be able to use replacement parts available from the State of Connecticut inventory in order to expedite the repair process. As soon as possible and to the State's satisfaction, the Contractor shall provide replacement equipment to be re-entered into the State's inventory.

The Contractor shall provide documentation certifying the manufacturer's repair or replacement of the spare equipment upon return of the equipment to the Department.

### **Construction Methods:**

#### **Certification:**

The Contractor shall provide the State with evidence satisfactory to the State that they fully understand the purpose for which the equipment is intended and they are qualified and capable of fulfilling all provisions of this item. The Contractor as well as individual personnel performing this work shall be certified by all manufacturers of the equipment to be maintained as being capable of maintaining the equipment and also capable of obtaining and installing the necessary spare parts to keep the system on-line. The Contractor, prior to the commencement of the start of the equipment operations, shall be required to submit training certificates for all of the pertinent equipment.

Response Time:

The Contractor shall service and maintain the newly installed IMS equipment at the conclusion of the 30 Day Operational Test for each installation and the existing IMS equipment from the contract Notice to Proceed as allowed by the Engineer. All IMS equipment shall be serviced and maintained on a twenty-four (24) hour a day, seven days a week basis. The Contractor shall provide a suitable means of communication between them and the Highway Operations Center (HOC). This shall include a twenty-four (24) hour telephone number, a fax number for emergency purposes and a fax number for daily communications and log activities. Repairs shall commence not more than 8 hours after notification and shall be completed within 24 hours of notification.

The Contractor shall keep a neat and accurate log book of all the malfunctions reported with the date and time that the information was received and the nature of the problem. The log book shall be submitted to the Engineer monthly or upon request by the Engineer. The Contractor shall include in the log book the time that each unit is checked for proper operation, the condition of each unit checked, and the date and time each unit was restored to proper operation or replaced.

Work performed under this item shall conform to the latest National Electrical Code standards, local electrical codes, and Department of Transportation installation requirements. The Contractor shall conform to these requirements as specified herein.

Any IMS equipment that has been damaged through the Contractors own actions shall be repaired and/or replaced by the Contractor at no cost to the State.

**Method of Measurement:**

This item shall be measured for payment as provided under Article 1.09.04 – Extra and Cost Plus Work.

The sum of money shown on the estimate and in the itemized proposal as “Estimated Costs” for this work will be considered the price bid even though payment will be made only for actual work performed. The estimated cost figure is not to be altered in any manner by the bidder. Should the bidder alter the amount shown, the altered figures will be disregarded and the original price will be used to determine the total amount bid for the contract.

**Basis of Payment:**

This work will be paid on a cost-plus basis according to Article 1.09.04 – Extra and Cost Plus Work. Warranties in effect for newly installed equipment associated with CCTV Cameras, Traffic Management System Cabinets (TMSC), Traffic Management System Mini-Hub Cabinets (TFSMHC), Traffic Flow Monitors (TFM) and Variable Message Signs (VMS) operation shall be honored by the suppliers of the equipment. Contractor or sub-contractor will be responsible for securing warranted equipment and installation. There will be no payment for materials included under a manufacturers warrantee. Labor costs only will be reimbursed on a cost plus basis.

If warranties have expired, any equipment and labor that must be repaired will be paid on a cost plus basis.

## **ITEM #1112268A – FIBER OPTIC DIRECTIONAL COUPLERS**

### **Description:**

This item shall consist of furnishing and installing single-mode fiber-optic cable optical directional couplers required for the transmission of video in the DOT Main Fiber Hub located in Hartford, CT.

Fiber Optic Directional Couplers are used to passively split the multiplexed analog video signals from the Mini-Hub camera sites, with most of the signal energy passed through to the Newington Highway Operations Center, and the remainder transmitted to the video demultiplexers in the Main Fiber Hub.

### **Materials:**

- A. Single Mode Optical Fiber Directional Couplers shall be manufactured by IPITEK model IP-C
  1. The Single Mode Optical Fiber Directional Couplers shall be capable of dividing a modulated optical signal into two duplicate optical signals with relative power ratios (in %) ranging from 50/50 to 95/05 in a minimum of 5% increments.
  2. The Single Mode Optical Fiber Directional Couplers shall be designed to provide equal optical signal power at the Newington Highway Operations Center and the Main Fiber Hub from optical transmitters located in each of the Mini-Hub sites. The Contractor shall verify the required relative power ratio for each Directional Coupler by measuring the optical attenuation between each Mini-Hub and the Main Fiber Hub and between the Main Fiber Hub and the Newington Highway Operations Center along each optical path designated for the transmission of multiplexed video.
  3. The Contractor shall furnish the required number of Single Mode Optical Fiber Directional Couplers as shown on the Drawings.
  4. The fiber optic directional coupler shall have a passband frequency up to 1550 nm (+/- 40 nm)
  5. The coupling ratios shall be set to 60/40.
  6. The couplers shall be suitable for installation in harsh environments.



7. The couplers shall be 100% factory-tested and certified for insertion loss, directivity and uniformity.
8. Only 'T', top, or 'P', premium, grade couplers are specified.
9. Couplers shall be packaged in a 6 inch standard cassette.
10. The Single Mode Fiber Optic Directional Couplers shall meet or exceed the following optical and mechanical specifications:

Uniformity	$\leq 0.6$ dB
Directivity	$\geq 55$ dB
Excess Loss	$\leq 0.09$ dB
Polarization Stability	$\pm 0.1$ dB
Thermal Stability	$\pm 0.1$ dB over stated range
Operational Temperature	- 40° C to +85° C

**B. Environmental Requirements**

1. The equipment shall operate at a temperature range of -40° Celsius to +85° Celsius.

**C. Warranty**

1. All equipment supplied for this shall be warranted for parts and labor by the vendor against defects and failures, which may occur through normal use for a period of one (1) year from the date of installation. A copy of the warranty must be presented to the Engineer before installation of the equipment
2. The Warranty period begins at the time of installation.

**Construction Methods:**

**A. Single Mode Optical Fiber Directional Couplers**

1. Installation
  - a. Splicing
    - i. All external connections shall be made by means of patching to specific fibers at the Main Fiber Hub.

- ii. The directional couplers shall be placed within the existing fiber optic directional coupler frame (high density patching frame) located in the equipment racks at the Main Fiber Hub. The contractor shall then furnish and install all necessary fiber optic patch cords from the existing patch panel to the Fiber optic directional coupler.

#### B. Protection and Cleaning

1. The Contractor shall protect finished surfaces from damage during fabrication, shipping, storage, testing and transfer to the installation Contractor.

#### C. Submittals

1. The Contractor shall submit:
  - a. Functional block diagrams, cable diagrams, and point to point cabling details in Visio 2010 format.
  - b. Product data and cut sheets, installation manuals, materials, system configuration options and features, and accessories.
  - c. Detailed Shop Drawings and Equipment Installation Drawings indicating supports and appurtenances required for proper installation.
  - d. Shop Drawings and Equipment Installation Drawings shall be completely dimensioned and shall indicate the intended installation method and details.
  - e. Installation, operating and maintenance manuals for all equipment.

#### D. Testing

1. Testing shall be performed to demonstrate that all furnished and installed equipment complies with the requirements of each item, and shall be conducted using Manufacturer recommended procedures, materials and test equipment.
2. The Contractor shall be responsible for all testing and documentation required to establish approval and acceptance in the production, installation and operation of these materials and equipment.
3. The Contractor shall test each fiber to demonstrate that equal optical power is received at the fiber optic cable termination point in the Fiber Optic Interconnect Cabinet in the Newington Highway Operations Center and at the termination point of all fibers in the Fiber Optic Interconnect Cabinet designated for multiplexed video at the Main Fiber Hub. The Contractor shall connect an optical transmitter of known optical power to fibers designated for transmission of multiplexed video at each Mini-Hub site.

4. The Contractor shall provide complete test documentation, including test procedures, test equipment identification, descriptions and calibration records, and test reports documenting the received optical power for every fiber tested.

E. Delivery, Storage, and Handling

1. The Contractor shall deliver, store, handle and install all materials and equipment in such a manner as not to degrade quality, serviceability or appearance.
2. All materials shall be delivered in manufacturer's original unopened protective packages.
3. All materials shall be stored in their original protective packaging and protected against soiling, physical damage, or wetting, before installation.
4. All equipment shall be protected during transportation against damage and stains.
5. The Contractor shall be responsible for storage of the materials and equipment prior to installation in a clean, dry location free from construction dust, precipitation and excess moisture.
6. Contractor shall replace any damaged materials and equipment, as determined by the Engineer, at no additional cost to the Department.

F. Quality Assurance

1. A minimum of five (5) years experience in the design, manufacture and testing of Single Mode Optical Fiber Directional Couplers is required. The equipment shall be designed and manufactured according to world class quality standards. The manufacturer shall be ISO 9001 certified.

**Method of Measurement:**

Work under these items shall be measured for payment by the actual number of Fiber Optic Directional Couplers specified, installed, tested, operating and accepted in place and as shown on the Drawings.

**Basis of Payment:**

The work to be done under this item shall be paid at the Contract Price each for Fiber Optic Directional Couplers which price shall include all materials, hardware, labor, cables, connectors, tools, equipment and incidentals necessary to complete this work.

## **ITEM #1113059A – TRAFFIC FLOW MONITOR**

### **Description:**

This special provision covers the requirements for the installation, calibration, and testing of the Traffic Flow Monitors (TFM) at the locations shown on the plans. The components shall include:

1. Detector unit and Enclosure
2. Traffic Flow monitor manufacturer approved fully regulated Power Supply to be installed in the Traffic Management System Cabinet or Traffic Management System Mini-hub Cabinet to supply power to a minimum of two Traffic Flow Monitors.
3. Traffic Flow monitor manufacturer approved external Serial to Ethernet converter
4. Cable between the detector unit and the adjacent traffic management system cabinet (TMSC) or traffic management system mini-hub cabinet (TSMHC), including the cables and connectors necessary at the locations where an auxiliary connection cabinet is specified.
5. Supporting bracket and banding for the TFM unit.
6. Pole-mounted Auxiliary Detector connection cabinet provided and installed when a traffic flow monitor is installed on opposite side of highway from the camera or (TMSC) or when a dedicated TFM pole is installed.
7. All other miscellaneous hardware required for the installation of the TFM
8. Menu Driven Windows 7 compatible or greater Set-up Software

The TFM will be used for traffic flow monitoring within the project limits. The TFM will be mounted on steel poles/sign structures as shown on the plans.

The Traffic Flow Monitor shall be a true presence microwave radar detector which can provide presence, volume, lane occupancy and speed information for a minimum of twelve discreet zones. The detector shall meet the following minimum performance specifications without being affected by wind, rain, snow, fog or needing to be recalibrated over time:

- Per direction volume accuracy 95%
- Per lane volume accuracy 90%
- Per direction average speed accuracy + or – 5 MPH
- Per lane average speed accuracy + or – 10 MPH
- Per direction occupancy accuracy + or – 10%
- Per lane occupancy accuracy + or – 20%
- Detectable area 6 – 250 feet with detection over barriers.

The flow monitor shall operate thru a Frequency Modulated Continuous Wave Operation. The flow monitor shall be able to detect stationary vehicles within the beam path. Flow monitors that utilize the “Doppler Effect” for detection will not be accepted. The flow monitor shall detect the presence of vehicles in 2 foot wide or less radial range slices in the path of the microwave beam. The Traffic Flow Monitor shall be capable of being installed in either a side-mounted or a forward-looking configuration.

The mean time between failures (MTBF) of the unit in its operating environment shall be 90000 hours (10 years) or greater.

**Materials:**

**Dual radar** traffic flow monitor with minimum Radar Operating frequency 24 GHz with a 245 MHz Bandwidth

The approximate size of the unit shall be 13.2 x 10.6 x 6 in or smaller and the approximate weight shall be 4.2 pounds or less. The enclosure shall be rugged and shall meet the requirements of NEMA-4X and IP-65 or better. The enclosure shall be sealed to protect the unit from wind, dust and airborne particles, and exposure to moisture. The operating limits of the unit shall be as follows:

Operating temperature Range:-37 to 74° C or better for all equipment including regulated power supply and serial to Ethernet converter.

Humidity: Up to 95% Relative Humidity

Wind: Winds up to 90 mph

The performance of the unit shall not be degraded by wind, precipitation, snow, or dust. The Traffic Flow Monitor shall not require cleaning and shall maintain performance ratings over a wide range of ambient temperature changes without needing to be recalibrated.

The unit shall operate within a range of 12-24V AC or DC. The unit shall contain a sensor that will shut down the unit if the maximum peak voltage is exceeded. The maximum power consumption for the individual unit shall be approximately 8.1 watts. The unit shall be capable of automatically recovering from power failure within 5 seconds.

An AC regulated power supply with fuse and surge suppression shall be provided for each traffic flow monitor and installed on the wiring panel assembly in the (TMSC) or (TSMHC). The AC supply output shall provide the required operating voltage to the traffic flow monitor, and conform to the temperature range noted above. The output of the power supply must be able to power a minimum of two or more traffic flow monitors. The Contractor shall consider the voltage drop of the TFM cable wiring when determining the type and size of power cable provided for use. At sites that require more than one (1) traffic flow monitor, a single regulated

power supply that can power the required number of traffic flow monitors may be substituted as long as the proper amperage and operating voltage is obtained at the TFM unit.

The interface at the unit consists of a single MS connector which provides power to the unit and two serial communication lines for central communication and interface setup/testing. Central communications shall be RS-485/Ethernet and the setup/testing interface shall be RS-232. The TFM shall be optically isolated that will protect the internal circuits against surges of up to 6KV. Data format of the serial port shall be standard binary NRZ 8 bits data, 1 stop bit, no parity which will be used for field setup only. An optional external serial to 10/100 Base-T Ethernet port must be supplied with the unit for communication back to the operations center. The Ethernet port shall support TCP, UDP, IP, ARP, ICMP, and Ethernet MAC protocols. The transmission speed for the TCP/IP interface shall be 1200bps to 115Kbps. The Serial to Ethernet converter communication must be fully compatible with our existing Advanced Traffic Management Software (CRESCENT).

Bracket: The mounting assembly shall be Aluminum or stainless steel and shall support a minimum load of 15 pounds. The bracket support shall be aluminum or stainless steel material supplied by the manufacturer of the detector unit. The bracket shall allow limited freedom of rotation on three axes.

The brackets shall be attached with manufacturer approved  $\frac{3}{4}$  inch wide, .025 inch (0.6mm) thick, stainless steel bands or to a concrete wall/bridge using 2 stainless steel expansion bolts of sufficient length and diameter to support 100 pounds.

Cables:The power and RS-232/422/485 communication cable between the flow monitor and the camera hub cabinet shall consist of multiple twisted pairs of stranded AWG #22 to #12 wires with a common shield rated at 300V with a temperature rating of 105° C (Belden #9516 or approved equal) and shall be UV-resistant. The contractor will be responsible for determining and supplying the proper power cable size for the TFM and remote media converter based upon the distance from the TMSC or TMSMHC to the remote cabinet and the wattage of the traffic flow monitor.

If required the auxiliary detector cabinet shall be NEMA 4-X rated, weather resistant, and shall allow the entrance of the necessary cables. The cabinet shall be constructed of aluminum, and be constructed in accordance with the Department's Functional Specifications for Traffic Signal Equipment. The minimum dimensions of the cabinet shall be as follows: 406mm (16 inches) wide, 460 mm (18 inches) high, and 200 mm (8 inches) deep. The cabinet shall include a hinged door with a corbin style locking mechanism. The lock shall be CONN 2 keyed. A catalog cut of the proposed detector cabinet shall be included in the shop drawing submittal for this item.

The detector must be able to communicate using the EIS RTMS X2/X3 protocol. The detector must be able to support a 30 second polled mode operation. The detector must report actual speeds of zero values in instances where no vehicles pass in front of the detector during a polling period. The RTMS X2/X3 protocol must be compatible with our ATMS central software (Crescent).

## **Construction Methods:**

Installation of the Traffic Flow monitor consists of the following steps:

1. If needed the Contractor shall calculate the required AC power wire size required for installation in the traffic management system/mini-hub cabinet if distances exceed 100feet from the power supply to the detector. A copy of the calculations and selected wire size shall be recorded and supplied to the Engineer for review. It is the Contractor's responsibility to ensure that the proper operating voltage is provided to the traffic flow monitor unit.
2. Secure mounting bracket to the pole or other designated location (bolts or banding supplies required) facing the required detection zones as shown on the site plans with the mount pointed downwards according to the manufacturers setup instructions. Refer to the manufacturer's installation height/setback charts for proper mounting height on the pole. Straps should be left adjustable before final tightening for possible fine-tune adjustments.
3. Aim the unit according to the manufacturer's installation manual. Apply silicon dielectric compound into the electrical connector at the base of the sensor.
4. Install the cable from the unit to the cabinet.
5. Connect the cable supplying power and delivering the Flow monitor outputs. Twist the outer ring of the MS connector clockwise until it locks.
6. Installation of the power supply, cabling and connectors within the (TMSC) or (TMSMHC). The Contractor shall properly connect the power and data communications surge suppression devices (supplied as part of the cabinet item) to the traffic flow monitor cables.
7. Measurement and recording of the operating voltage measured at the traffic flow monitor unit. Verify that the operating voltage is within the manufacturer's specified range.
8. Installation of the auxiliary detector cabinet (where required)
9. Connect a PC, at either the cabinet or the auxiliary detection cabinet, and perform set-up as recommended by the manufacturer.

The MS connector pins must be crimped to the cable conductors, assembled, and tested prior to installation and pulling of cable on-site. Pins must be crimped, not soldered, onto the cable conductors. Cable strain relief measures should be provided as recommended by manufacturer. The manufacturer shall provide a standard RS-232 5 m cable for set-up purposes, which shall include power leads, a DB9 RS-232 connector, and an RJ45 Ethernet Port.

Connections at the TMSC or TMSMHC with no Auxiliary Detector Cabinet:

The RS-232 test and setup cable will be installed inside the TMSC or TMSMHC; the contractor will loop the cable within the enclosure and tie up so that the cable is not touching the bottom of the cabinet. The secondary RS-485 communications cable shall be attached to the external serial to Ethernet converter in the (TMSC) or (TMSMHC). The RJ 45 Category 6 cable from the serial to Ethernet converter will then be patched into the Ethernet port sharing device or 10/100 Ethernet switch.

#### Connections at the Auxiliary Detector Cabinet:

At the locations where an auxiliary detector cabinet is to be installed, the Contractor will loop the RS-232 test cable within the enclosure and tie up so that the cable is not touching the bottom of the cabinet. The secondary RS-485 communications shall be connected to a manufacturer approved surge arrestor within the Auxiliary Detector cabinet. The secondary RS-485 shall then be installed into the TMSC or TMSMHC and connect to the external serial to Ethernet converter. The serial to Ethernet converter shall connect into the Ethernet port sharing device or 10/100 Ethernet switch.

Cables shall be installed neatly between adjoining equipment and shall be secured to rigid structures using appropriate fastening devices. Cable and connectors shall not be stressed during or after installation. A written procedure for cable preparation and connectorization shall be provided to the Engineer for approval. Manufacturer descriptions of all equipment required to do the work shall be included. The ITS integrator will be required to make all communication terminations for this item.

The Contractor will be responsible for setting up the Traffic Flow Monitor Unit at the various locations. **The manufacturer will be available and will conduct on-site visits as necessary to provide technical expertise.** The approved ITS integrator will be responsible for calibrating and setting up the units to detect the required number of lanes as shown on the site plans. The ITS integrator will perform the set-up process at all of the locations and have the unit configured to detect vehicles in the specified lanes.

Anchor bolts for conduit supports and bracket supports shall be drilled and anchored into sound concrete only. The anchorage system shall be installed per the manufacturer's recommendations. If existing reinforcement is encountered during drilling, the hole shall be abandoned, filled with non-shrink grout and relocated as directed by the Engineer. After installation of the supports, tighten all chemical anchor bolts to the torque as recommended by the anchorage system manufacturer.

The TFM units shall be calibrated upon installation to provide accurate volume, speed and occupancy traffic data using software provided by the manufacturer. The Contractor shall provide a laptop computer for calibration and testing. The configurations at each site shall be saved and provided to the Department for future use. The filenames used at the various sites shall be in a format agreeable to the Department.



The Contractor shall have the manufacturer's representatives on-site to oversee the installation, testing and calibration of the TFM to ensure all manufacturer requirements are satisfied.

Testing:

The Contractor shall carry out proof of performance testing to ensure that the TFM units provide adequate quality of the traffic data. The contractor shall submit test procedures detailing the methodology of the test activities to be performed. Two copies of the test procedure shall be submitted to the Department for review and approval three weeks prior to commencing testing.

The Contractor is required to perform manual validation of traffic volumes and traffic speeds for 100% of TFM units installed under this contract. The validation shall include two 15 minute periods performed during peak and off-peak periods. The Contractor shall document the test results in accordance with the quality control test procedures and submit the results to the Department. The Department's representatives will witness the validation testing.

Upon successful completion of the installation test and approval by the Engineer, a 30-day System Operational Test for each TMSMHC site shall commence. During the course of this test, the system must function continuously in accordance with the specifications for the duration of the test. If a malfunction occurs within the stated time frame, the Contractor shall make all necessary repairs to the system and re-establish proper operation. Upon approval of the Engineer, the 30-day test will begin anew. The system must operate for a full thirty (30) consecutive days without malfunction before the system will be accepted by the Engineer. The Contractor shall refer to "Notice To Contractor – 30 Day System Operational Test" for additional testing requirements. The Contractor shall coordinate the 30-day System Operational Test with other pertinent items in this contract.

Spare Equipment:

As part of this item the Contractor shall supply two (2) spare Traffic flow monitor assemblies and all associated cabling, mounting brackets, power supplies, cabling, and surge arrestors.

Warranty:

The manufacturer shall warranty the product to be free from defects in material and workmanship for a period of two years from the date of acceptance. The manufacturer shall also warranty the operation of the firmware and software provided with the units.

**Method of Measurement:**

This item will be measured for payment by the actual number of complete Traffic Flow Monitor units installed, configured, and accepted. No separate measurement will be made for spare TFM assemblies to be furnished as part of this item.

**Basis of Payment:**

This work will be paid for at the contract unit price each for “Traffic Flow Monitor” complete-in-place, which price shall include all materials, and all equipment, tools, labor and work incidental thereto. The price shall also include all necessary auxiliary detector cabinets, brackets, power supplies, spare equipment, all power and communication cabling and connectors. This price shall also include furnishing, set-up, installing, warranty, and testing of the traffic flow monitor. The cost of the spare TFM’s shall be included in this unit cost.

**ITEM #1113604A – OPTICAL FIBER CABLE, SINGLE MODE, LOOSE BUFFER TUBE CABLE, 6 FIBER**

**ITEM #1113621A – OPTICAL FIBER CABLE, SINGLE MODE, LOOSE BUFFER TUBE CABLE, 72 FIBER**

**ITEM #1113627A – OPTICAL FIBER CABLE, SINGLE MODE, LOOSE BUFFER TUBE CABLE, 144 FIBER**

**Description:**

This Item specifies the requirements for furnishing, installing in conduit, splicing, and terminating fiber optic cables. As part of this item, the Contractor shall install a pull tape in all innerducts within the contract limits of work, as necessary to install the fiber optic cable and future fiber optic cable.

**Materials:**

A. General

1. The fiber optic cable supplied in this project shall be certified by the manufacturer to use 100% corning glass in order to be completely compatible with the existing fiber cable supplied under Project 63-548/42-288. The cable shall be compatible with Fitel/Lucent single jacket loose tube fiber optic cable with DryBlock Core. The Contractor shall provide proof of compatibility to the Department with the appropriate shop drawings and catalog cut submittals.
2. Outdoor fiber optic cable shall be installed in conduit, spliced as required and terminated in Camera-Hub Cabinets and Mini-Hub Cabinets, as shown on the Drawings.
3. Plenum-rated indoor fiber optic cable shall be installed inside the State Transportation Building within existing conduits, spliced as required and terminated at the fiber optic patch panel, as shown on the Drawings.
4. The fiber optic cable, splices, connectors and interconnect panels shall meet all requirements stated in this Specification.
5. All optical fiber cables used in this project shall be from the same manufacturer. That manufacturer shall be regularly engaged in the production of fiber optic cables. Each optical fiber cable for this project shall be dielectric, loose tube, duct-type.

B. Applicable Publications

1. Publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation. All Fiber Optic Communication System hardware shall be compliant with the following specifications:

Electronics Industries Association (EIA):

- a. EIA-310-C Racks, Panels, and Associated Equipment.
  - b. EIA-359-A Colors for Color Identification and Coding.
  - c. EIA-422-A Electrical Characteristics of Balanced Voltage Digital Interface Circuits.
  - d. EIA-TIA-455-A Standard Test Procedures for Fiber Optic Fibers, Cable Transducer Sensors, Connecting and Terminating Devices and Other Fiber Optic Components.
  - e. EIA-455-6B Cable Retention Test Procedure for Fiber Optic Cable Interconnecting Devices.
  - f. EIA-485 Standard for Electrical Characteristics of Generators and Receivers for use in Balanced Digital Multipoint Systems.
  - g. TIA/EIA-598-A Optical Fiber Cable Color Coding.
2. USDA Rural Utilities Service (RUS) 7 CFR 1755.900.
  3. ANSI/ICEA Standard for Fiber Optic Outside Plant Communications Cable, ANSI/ICEA S-87-640-1992.
  4. UL-listed OFNR
  5. CSA-listed FT-4

C. Outdoor Fiber Optic Cable Requirements

1. The cable shall be an accepted product of the United States Department of Agriculture Rural Utilities Service (RUS) 7 CFR 1755.900 and meet the requirements of the ANSI-ICEA Standard for Fiber Optic Outside Plant Communications Cable, ANSI/ICEA S-87-640-1992.
2. The Outdoor Fiber Optic Cable shall be stranded loose tube cable with the required number of fibers as shown in the Contract Drawings. The buffer tubes shall contain 12 fibers per tube unless otherwise noted in the Contract.

3. The Contractor shall provide manufacturer's documentation certifying that the Outdoor Fiber Optic Cable complies with the following performance requirements:
  - a. When tested in accordance with FOTP-3, "Procedure to Measure Temperature Cycling Effects on Optical Fibers, Optical Cable, and Other Passive Fiber Optic Components," the change in attenuation at extreme operational temperatures -40°F and +158°F (-40°C and +70°C) shall not exceed 0.2 dB/km at 1550 nm for single-mode fiber.
  - b. When tested in accordance with FOTP-82, "Fluid Penetration Test for Fluid-Blocked Fiber Optic Cable." a one meter length of unaged cable shall withstand a one meter static head or equivalent continuous pressure of water for cable end.
  - c. When tested in accordance with FOTP-81, "Compound Flow (Drip) Test for Filled Fiber Optic Cable", the cable shall exhibit no flow (drip or leak) of filling and/or flooding material at 149°F (65°C).
  - d. When tested in accordance with FOTP-41, "Compressive Loading Resistance of Fiber Optic Cables," the cable shall withstand a minimum compressive load of 220 N/cm (125 lbf/in) applied uniformly over the length of the sample. The load shall be applied at the rate of 1/10 in to 3/4 in (3 mm to 20 mm) per minute and maintained for ten minutes. The change in attenuation shall not exceed 0.4 dB during loading and 0.2 dB after loading at 1550 nm for single-mode fiber.
  - e. When tested in accordance with FOTP-104, "Fiber Optic Cable Cyclic Flexing Test," the cable shall withstand 25 mechanical flexing cycles around a sheave diameter not greater than 20 times the cable diameter. The change in attenuation shall not exceed 0.1 dB at 1550 nm for single-mode fiber.
  - f. When tested in accordance with FOTP-25, "Repeated Impact Testing of Fiber Optic Cables and Cable Assemblies," the cable shall withstand 25 impact cycles. The change in attenuation shall not exceed 0.2 dB at 1550 nm for single-mode fiber.
  - g. When tested in accordance with FOTP-33, "Fiber Optic Cable Tensile Loading and Bending Test," using a maximum mandrel and sheave diameter of 22 in (560 mm), the cable shall withstand a tensile load of 608 lbf (2700 N). The change in attenuation shall not exceed 0.2 dB during loading and 0.1 dB after loading at 1550 nm for single-mode fiber.
  - h. When tested in accordance with FOTP-85, "Fiber Optic Cable Twist Test," a length of cable no greater than 13 feet (4 meters) shall withstand 10 cycles of

mechanical twisting. The change in attenuation shall not exceed 0.1 dB at 1550 nm for single-mode fiber.

- i. When tested in accordance with FOTP-181, "Lightning Damage Susceptibility Test for Optic Cables with Metallic Components," the cable shall withstand a simulated lightning strike with a peak value of the current pulse equal to 105 kA without loss of fiber continuity. A damped oscillatory test current shall be used with a maximum time-to-peak value of 15  $\mu$ s (which corresponds to a minimum frequency of 16.7 kHz) and a maximum frequency of 1800000 rpm (30 kHz). The time to half-value of the waveform envelope shall be from 40 - 70  $\mu$ s.
  - j. When tested in accordance with FOTP-37, "Low or High Temperature Bend Test for Fiber Optic Cable", the cable shall withstand four full turns around a mandrel of  $\leq 10$  times the cable diameter for non-armored cables and  $\leq 20$  times the cable diameter for armored cables after conditioning for four hours at test temperatures of -22°F and +140°F (-30°C and +60°C). Neither the inner or outer surfaces of the jacket shall exhibit visible cracks, splits, tears or other openings. Optical continuity shall be maintained throughout the test.
4. All optical fibers, coatings, tubes, metals and jackets shall be free of roughness, porosity, blisters, splits and voids in accordance with good manufacturing practice.
  5. The color coding and position of fibers / buffer tubes within the cable shall be in accordance with TIA/EIA-598-A "Optical Fiber Cable Color Coding". Fibers shall be colored with ultraviolet curable ink. In buffer tubes containing multiple fibers, the colors shall be stable across the specified storage and operating temperature range and not subject to fading or smearing onto adjacent fibers or into the gel filing material. Color materials shall not cause fibers to stick together.
  6. The buffer tubes shall be resistant to external forces and shall meet the buffer tube cold bend and shrinkback requirements of 7 CFR 1755.900.
  7. The cable shall be suitable for operation over a temperature range of -22°F to +158°F (-30°C to +70°C) and shall be suitable for installation in outdoor ducts.
  8. The cable shall provide mechanical support and protection for the specified number of fibers.
  9. The central anti-buckling member shall consist of a dielectric, glass reinforced plastic (GRP) rod. The GRP rod shall be coated with a black colored thermoplastic when required to achieve dimensional sizing to accommodate buffer tubes/fillers.
  10. All interstices within the cable outer jacket and within each buffer tube shall be filled with a compound to prevent the ingress and migration of water. The compound shall

- be a non-hygroscopic, non-nutritive to fungus, electrically non-conductive, homogeneous gel that is nontoxic and dermatologically safe. The gel shall be free from dirt and foreign matter. Some leakage of the compound is permitted, however, there shall be no bulk flow of compound out of the cable over the specified operating temperature range which could impact on the waterproofness of the cable. The gel shall be readily removable with conventional nontoxic solvents.
11. Buffer tubes shall be stranded around the dielectric central member using the reverse oscillation, or "S-Z", stranding process. Water blocking yarn(s) shall be applied longitudinally along the central member during stranding.
  12. A water blocking tape shall be applied longitudinally around the outside of the stranded tubes/fillers. The tape shall be held in place by a single polyester binder yarn. The water blocking tape shall be non-nutritive to fungus and electrically non-conductive.
  13. The cable shall be able to withstand a maximum pulling tension of 6071bf (2700 N) during installation without any resulting damage. Tensile strength shall be provided by dielectric yarns. The high tensile strength dielectric yarns shall be helically stranded evenly around the cable core.
  14. The outer jacket of the cable shall be constructed of medium or high density polyethylene. The minimum nominal jacket thickness shall be 1/20 inch (1.4 mm). Jacketing material shall be applied directly over the tensile strength members and water blocking tape. The polyethylene shall contain carbon black to provide ultraviolet light protection and shall not promote the growth of fungus. MDPE jacket material shall be as defined by ASTM D1248, Type II, Class C and Grades J4, E7 and E8.
  15. The cable shall contain at least one ripcord under the sheath (outer cable jacket) for easy sheath removal of all-dielectric cable.
  16. The cable jacket shall be marked with manufacturer's name, sequential meter or foot markings, month, year or quarter year of manufacture, and a telecommunications handset symbol, as required by Section 350G of the National Electrical Safety Code. The actual length of the cable shall be within 1% of the length markings.
  17. Materials used in the cable shall not produce hydrogen in a concentration large enough to cause any degradation in the transmission performance of the optical fibers.
  18. Materials used in the cable shall not support galvanic action.

D. Single Mode Optical Fibers

1. The Single Mode fiber shall consist of a doped silica core surrounded by a concentric silica cladding. The fiber shall be matched clad design.
2. The dispersion un-shifted or dispersion flattened single mode fiber shall conform to the following specifications:
  - a. The Single Mode fiber core shall have a diameter of between 8.3 to 9  $\mu\text{m}$  inclusive with a tolerance of  $\pm 1.3 \mu\text{m}$ .
  - b. The Single Mode fiber cladding shall have an outer diameter of 125  $\mu\text{m}$  with a tolerance of  $\pm 1.0 \mu\text{m}$ .
  - c. The core-to-cladding offset shall not be greater than 0.6  $\mu\text{m}$ .
  - d. The cladding Non-Circularity shall not be greater than 1.0% defined as:  
(1- Minimum Cladding Diameter/Maximum Cladding Diameter) x 100
  - e. The Single Mode fiber shall be coated with a protective polymer to preserve the strength of the fiber. The coating shall be removable by mechanical or chemical means. The coating shall retain its color when subject to the manufacturer's recommended fiber cleaning and splicing preparation methods.
  - f. The SM fiber shall have attenuation and bandwidth specified at two wavelength windows.
    - i. The first wavelength window shall be at and around 1310 nm.
    - ii. The second wavelength window shall be at and around 1550 nm.
3. The mean optical attenuation at 1310 nm shall not be greater than 0.4 dB/km with a standard deviation not greater than 0.05 dB/km. The maximum attenuation of any continuous length of SM fiber at 1310 nm shall not exceed 0.45 dB/km.
4. The mean optical attenuation at 1550 nm shall not be greater than 0.3 dB/km with a standard deviation not greater than 0.06 dB/km. The maximum attenuation of any continuous length of SM fiber shall not exceed 0.36 dB/km.
5. The fiber attenuation shall not vary more than 0.2 dB/km over the specified cable operational temperature range.
6. The fiber optical bandwidth at 1310 nm or 1550 nm shall be equal to or greater than 1000 MHz-Km.
7. The zero dispersion wavelength shall be at a wavelength of  $1310 \pm 10 \text{ nm}$ .



8. The maximum dispersion at 1550 nm shall not exceed 18 ps / (nm-km).
9. The maximum dispersion in the wavelength range of 1285 to 1330 nm shall not exceed 3.2 ps / (nm-km).

E. Fiber Optic Distribution Cable

1. This item consists of furnishing and installing optical fiber cables and connectors of the size and type specified at the locations shown on the Drawings or as indicated by the Engineer, in accordance with these Specifications.
2. The Contractor shall provide multiple fiber, stranded, loose tube cable with single mode fiber that shall be suitable for placement in an underground environment as shown in the Drawings.
3. The optical fiber capacity of the fiber optic distribution cables to be supplied and installed under this Contract will vary in capacity according to network topology and traffic requirements. The current minimum requirements are for distribution cable to be of the following capacities: 72 SM **Refer to Drawing**, Fiber Optic Cable Plant. (Note SM refers to the number of Single Mode fibers within a cable segment.)
4. The Contractor shall provide a manufacturer's certification that the offered cable complies with all optical and mechanical requirements set forth in this Specification. Any deviation of the offered cable from the specifications set forth herein shall be clearly noted in the Contractor's proposal.
5. All optical fiber distribution cable used on this project shall be from the same manufacturer. Each optical fiber cable shall be all dielectric, duct type, loose tube and shall conform to these Specifications.

F. Fiber Optic Drop Cables

1. Drop cables are used for connecting Traffic management system cabinets, Traffic management system Mini-Hub cabinets and Variable Message Sign (VMS) cabinets to the fiber optic distribution (trunk) cable or between cabinets.
2. The Drop Cable shall consist of single mode fibers housed in a protective jacket. The end of the fiber installed at the Traffic Management system cabinet, Traffic Management system Mini-Hub cabinet, or VMS cabinet shall be terminated in a patch panel. The other end of the drop cable shall be spliced into a fiber optic distribution cable at an underground Splice Closure within an adjacent pull box. When drop cables are run between two cabinets the cable shall be terminated in a patch panel at both ends.

3. For drop cables landing in each traffic management system cabinet, VMS cabinet or any Incident management system (IMS) cabinet with a fiber count of 12 or less, the contractor shall furnish a 19" rack mounted patch panel with six SC fiber connectors.
4. The exact number of Drop Cables at each Splice Closure shall be in accordance with the Contract. The Contractor shall employ the most efficient means of meeting the Drop Cable requirements, as approved by the Engineer.
5. The attenuation of Drop Cable after installation, not including the connector loss, shall not exceed 0.1 dB measured at 1310 nm and 1550 nm.

G. Fiber Optic Connectors

1. The ST connector shall have a ceramic ferrule with a nickel plated nut and body. SC connectors shall have a ceramic insert.
2. The connector shall be of the ST-type or SC-type and fully compatible with the fiber optic cable utilized and the mating jacks to which they will be attached.
3. The connector shall be compatible with an ultra physical contact (UPC) finish. All connectors shall be polished to a UPC finish such that the return loss per mated pair of connectors is at least 25 dB. The return loss when the connector is mated with previously installed connectors shall be at least 18 dB.
4. The connector mean loss shall not be greater than 0.2 dB with a standard deviation of not greater than 0.1 dB.
5. Index matching fluids or gels shall not be used.
6. The connector loss shall not vary more than 0.1 dB after 500 repeated matings.
7. The connector shall withstand an axial load of 30 lb (135 N).
8. The connectors shall be attached in accordance with the manufacturer's recommended materials, equipment and practices.
9. The connector shall be suitable for the intended environment and shall meet the following environmental conditions.

- a. Operating Temperature: -4°F to +122°F (-20 to +50o C)
- b. Storage Temperature: -22°F to +140°F (-30 to +60o C)
- c. The connector loss shall not vary more than 0.2 dB over the operating temperature range.
- d. Connectors shall be protected by a suitably installed waterproof protection cap.

#### H. Pull Tape

1. The poly-line installed to verify the integrity of the conduit system shall be ¼” (6 mm) polypropylene.
2. 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. WP1250PDP1250P, or approved equal, for cable sizes of less than 97 fibers. NEPTCO Part No. WP1800PDP1800P, or approved equal, shall be used for cable size of 97-288 fibers.
3. 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

#### I. Fiber Optic Cable Fabrication

##### 1. Packing and Shipment

- a. The cable shall be supplied on reels. Top and bottom end of the cable shall be available for testing. Both ends of the cable shall be sealed to prevent ingress of moisture.
- b. The optical cable shall be in one continuous length per reel with no factory splices in the fiber. Each reel shall be marked to indicate the direction the reel should be rolled to prevent loosening of the cable. Installation procedures and technical support shall be furnished upon request.
- c. Each reel shall have the following information clearly labeled on it:

- i. Customer
- ii. Customer order number
- iii. Reel number
- iv. Destination
- v. Ship date
- vi. Manufactured date
- vii. Manufacturer's name
- viii. Cable code
- ix. Length of cable

J. Warranty

1. All equipment supplied for this shall be warranted for parts and labor by the vendor certified by the manufacturer against defects and failures, which may occur through normal use for a minimum period of one (1) year from the date of installation. A copy of the warranty must be presented to the Engineer after installation of the cable and equipment.

K. Quality Assurance

1. The Contractor shall have a Quality Assurance Program in place.
2. A minimum of ten (10) year's experience in the design, manufacture, and testing of Fiber Optic Cable and Connectors is required. The cable and connectors shall be designed and manufactured according to world class quality standards. The manufacturer shall be ISO 9001 certified.

**Construction Methods:**

A. Submittals

1. Submit:
  - a. Functional block diagrams, cabling diagrams, and point to point cabling details, including locations of all distribution cable splice points (both drop cable splices and reel-end splices).
  - b. As built drawings including a cable route diagram indicating the actual cable route and "foot marks" for all interchanges, intersections, directional change points in the cable routing, and all termination points. The Contractor shall record these points during cable installation. Cable system "as-built" drawings showing the exact cable route shall be provided by the Contractor to ConnDOT.

Information such as the location of slack cable and its quantity shall also be recorded in the cable route diagram.

- c. Product data, manufacturer's test certifications, installation manuals, materials, system configuration options and features, and accessories.
- d. Shop Drawings shall be completely dimensioned and shall indicate the intended installation method and details.
- e. Specifications of cable, connectors, and fiber splice kits.
- f. Operating and maintenance manuals for all equipment.
- g. Vendor Optical Time Domain Reflectometer (OTDR) certification for each reel of fiber optic cable listing each specification compliant fiber by fiber color code and group color code.

**B. Delivery, Storage, and Handling**

1. The Contractor shall deliver, store, handle and install all materials and equipment in such a manner as not to degrade quality, serviceability or appearance.
2. The Contractor shall be responsible for storage of the materials and equipment prior to installation in a clean, dry location free from construction dust, precipitation and excess moisture.
3. Contractor shall be required to replace any damaged materials and equipment, as determined by the Engineer, at no additional cost to the owner.
4. Cable shall be transported to site using cable reel trailers.
5. Care shall be taken at all times to avoid scraping, denting, or otherwise damaging the cable before, during or after installation. Damaged cable shall be replaced by the Contractor without additional compensation.
6. Sufficient slack shall be pulled to allow cable cutting and connection to communications equipment.

**C. Conduit Testing and Pull Tape Installation**

1. The intention of the conduit testing is to verify the integrity of the innerduct or conduit system to determine if the fiber optic cable can be installed.
2. All testing shall be performed using the procedures and mandrel size recommended by the multicell or conduit manufacturer to install a poly-line within the innerduct or conduit system.

3. 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.
4. In the event that a blockage is identified as part of the conduit testing and verification process of an existing multi-duct conduit, the Contractor shall alert the Engineer. At the Engineer's direction, the Contractor shall clean the obstructed section of the existing conduit. The work associated with clearing existing sections of obstructed multiduct conduit will be paid on an hourly basis in accordance with the requirements of Item 1008907A – Cleaning Existing Conduit.
5. For new multi-duct conduit installed by the Contractor under this contract, any blockages shall be cleared to the satisfaction of the Engineer. The cost of clearing blockages in new multi-duct conduit will be included in the bid price for the Multiduct Conduit items.
6. The Contractor shall install the detectable pull tape after conduit testing has been completed.
7. The Contractor shall install detectable pull tape, by hand pulling, blowing, or via vacuum method, into the innerduct or conduit system.

D. Installation in Ducts

1. Cable shall be installed in innerduct, duct or conduit in the field in accordance with the Contract Drawings.
2. Fiber Optic Distribution Cable shall be installed in the lowest innerduct (relative to ground level). Where more than one cable is to be installed in a conduit, the mid-level innerduct shall be used, and the highest level innerduct shall be reserved.
3. The Contractor shall install pull tape in the existing innerducts as necessary to install the fiber optic cable. A 6.5 ft (2.0 m) length of pull tape shall be left coiled, tied, and accessible in each cabinet, vault, maintenance hole and junction box. The pull tape shall be installed according to manufacturer recommendations and shall be “free” and NOT helical about communications cables.
4. The Contractor shall install cables in innerducts consistently throughout the project; crossover of a cable from one innerduct to another is not allowed.
5. Duct ends shall have all rough ends smoothed to prevent scraping the cable.
6. Where cable will be installed directly in conduit with no innerduct, a stiff bristle brush shall be pulled through each section of duct before pulling cable.

7. The Contractor shall not exceed the manufacturer's recommended safe pulling tension and minimum bending radius during delivery and installation.
8. A manufacturer's recommended lubricant shall be applied to the cable to reduce friction between the cable and the duct.
9. A cable grip shall be attached to the cables so that no direct force is applied to the optical fiber. The cable grip shall have a ball bearing swivel to prevent the cable from twisting during pulling.
10. Cable rollers and feeders and winch cable blocks shall be used to guide the cable freely into the duct and at maintenance hole locations.
11. Mechanical aids and pulling cable or ropes shall be used as required.
12. The Contractor shall employ personnel at as many pull points as need be to achieve the longest continuous cable segment as possible to reduce the need for excessive main-line splices.
13. Personnel equipped with two-way radios shall be stationed at each maintenance hole, cabinet and communications vault at which the cable is to be pulled to observe and lubricate the cable.
14. Where mechanical pulling is required (i.e. all runs greater than 164 ft (50 m)), a dynamometer shall be used to record installation tension and a tension limiting device shall be used to prevent exceeding the maximum pulling tension as defined by the cable manufacturer. The maximum pulling tension shall be recorded for each run of cable. The cable shall be taken up at intermediate pulling points with an intermediate cable take-up device as approved by the Engineer to prevent over tension on the cable. Cable pulls shall be continuous and steady between pull points and shall not be interrupted until the entire run of cable has been pulled.
15. Trunk fiber cable segment lengths shall be the maximum tolerable length within the maximum pulling tension defined by the manufacturer. The number of trunk cable reel-end splices shall be minimized. The Contractor shall provide a plan to the Engineer showing the reel-end splice point locations following a field investigation of the conduit and shall not install cable until receiving the Engineer's approval of the reel-end splice location plan. The Contractor shall obtain the Engineer's approval for all required changes to the reel-end splice point location plans. Cable segments installed with reel-end splices not approved by the Engineer will be replaced by the Contractor at no additional cost to the Department.
16. The Contractor shall be responsible for ensuring the cable length is sufficient to allow for connection between the communication equipment and the splice enclosures

- including provision for slack, vertical runs, cable necessary for splicing, wastage and cable to allow for the removal of the splice enclosure for future splicing.
17. Drop Cables shall be of length suitably long to be connected to the rack mounted patch panel within the Traffic management system cabinet, VMS cabinet, or IMS cabinet. Sufficient slack shall be left at each end to allow removal of the rack mounted patch panel for relocation anywhere within the cabinet.
  18. Drop Cable fibers in the Mini-Hub Cabinet shall be spliced to pig-tails in a rack-mounted patch panel/splice closure provided by others. Splicing shall be in accordance with the requirements specified elsewhere in these Specifications and as shown on the Drawings. All unused fibers shall be properly terminated in accordance with manufacturer recommendations.
  19. All cable ends, connectors, and fiber optic jacks shall be protected from moisture ingress by using properly sealed caps.
  20. Following installation of the cable in the ducts, all duct entrances at pedestals and cabinets shall be sealed with duct sealing compound to prevent the ingress of moisture, foreign materials, and rodents.
  21. 20 feet (6 m) of cable going to and coming from each Splice Closure shall be coiled in the first pull box on each side of each closure. In addition, 50 feet (15 m) of cable shall be left coiled in the first pull box on each side of all surface mounted conduit systems.
  22. Where trunk cable terminations are left "dead ended", 100 feet (25 m) of cable shall be left coiled.
  23. All coiled cables shall be securely fastened in place with a minimum of four galvanized steel conduit straps.
  24. Fish line shall be installed in all communications ducts or conduits along with fiber optic communication cables. A 6ft. 6 in (2.0 m) length of fish line shall be left coiled, tied and accessible in each cabinet, vault, maintenance hole and junction box. The fish line shall be installed according to manufacturer specifications and shall be "free" and NOT helical about communications cables.
  25. At intermediate pulling points, to prevent over tension on the cable, the cable shall be either taken up with an intermediate cable take up device as approved by the Engineer, or all excess cable shall be laid out on the ground in a figure eight configuration before subsequent installation.
  26. Following installation in duct, a label shall be affixed to each cable end in a pull box or cable vault and the label shall contain the following information:



27. Customer order number

- x. Reel number
- xi. Ship date
- xii. Manufactured date
- xiii. Manufacturer's name
- xiv. Cable designation as shown on the Drawings
- xv. Length of cable to next reel-end splice point
- xvi. Location of other end of cable (reel-end splice point)
- xvii. Cable test data

E. Splicing

1. Splicing of the cable shall only be permitted at splice closure or field fiber optic interconnect panel locations as indicated in the Drawings, unless authorized by the Engineer.
2. The Contractor shall prepare for splicing the designated fibers of the cable to the Drop Cables connecting the communications equipment located in the traffic management system cabinet and traffic management system minihub cabinet. Sufficient cable shall be coiled in the vault/cabinet to allow for consumption during the splicing and to permit the splice closure to be removed from the vault/cabinet for future splicing.
3. At least 3 feet of each fiber shall be stored in the splice trays. The Contractor shall further splice all additional fibers provided in order to meet the fiber requirements specified in the Contract and including any fibers provided which are additional to the Contract requirements.

F. Testing

1. Test Documentation
  - a. The Contractor shall be responsible for all testing and documentation required to establish approval and acceptance of this Item.
  - b. The Contractor shall submit test procedures and documented test results to the Engineer. The test procedures shall document the nature of test activities to be performed.

- c. The test procedures shall be submitted to the Engineer prior to initiation of the testing. The procedures will be returned to the Contractor within two week indicating either “accepted” or “make corrections noted”. If corrections are required, the Contractor shall submit revisions within 1 week.
- d. Four copies of the final test procedures shall be submitted to the Engineer prior to commencement of testing.

## 2. Pre-Installation Testing

- a. Reels of cable shall be tested for attenuation prior to installation in ducts. The Contractor shall measure and record the attenuation of 100% of the total single mode fibers on each reel. Attenuation shall meet or exceed the specified performance requirements in accordance with the Contract.
- b. The Contractor shall ensure that specifications for the fiber optic cable are met prior to installation.

## 3. Proof of Performance Testing

- a. The Contractor shall measure the attenuation per kilometer of fiber in each length of cable after installation.
- b. The Contractor shall measure the attenuation of a randomly selected minimum of 10% of the total single mode fibers, which will be connected to equipment.
- c. All (100%) of optical fibers assigned to be spare or reserved shall be individually tested for optical attenuation.
- d. The Contractor shall sequence the fibers which are to be measured after each pull, such that the same fibers are not measured on consecutive lengths.
- e. The Contractor shall record the reel number from which the cable came, the identification of the fibers measured and the attenuation in dB/km of the fibers measured.
- f. The Contractor shall measure and record the splice quality of each fusion splice performed. The Engineer shall be provided with access to interim results.

#### 4. Optical Time Domain Reflectometer (OTDR) Testing

- a. The Contractor shall perform single mode Fiber OTDR testing after each cable has been installed.
- b. The Contractor shall provide the Engineer with information regarding OTDR test equipment make and model with the equipment calibration procedures and certification dates prior to conducting the test routine.
- c. An OTDR shall be used for backscattered light measurements. The OTDR shall operate at a nominal wavelength of 1310 nm and 1550 nm and shall include all necessary hardware required to couple it with single mode fiber.
- d. The backscatter light measurement of each single mode fiber and each single mode optical link shall be measured in both directions and at both 1310 nm and 1550 nm wavelengths. Each single mode optical link shall be defined as being the total length of interconnected single mode fibers and the splices which form a continuous end-to-end optical link.
- e. The Contractor shall maintain a test result record of each single mode optical link and each single mode fiber by means of printer copy of the OTDR measured cable attenuation profile. All single mode optical links shall be identified in the test results by identifying the cabinet site and patch panel fiber at which the OTDR was connected.
- f. The test results shall include the following measurements:
  - i. Total length of the single mode link
  - ii. Total attenuation of the single mode link
  - iii. Attenuation of each splice in the link under test
  - iv. Attenuation per kilometer of each interconnected fiber in the link under test
  - v. Identification of each fiber including location, patch panel, and labeled fiber designator.
- g. Attenuation shall be measured in decibels referencing optical power.
- h. Each End to End single mode fiber shall be tested to meet the performance requirements in accordance with the Contract. Fiber strands failing this test shall be re-terminated and re-tested. A copy of the fiber test with identifiers shall be provided to the engineer. The test results shall include detailed information for

each fiber and a summary cover sheet listing losses for each fiber tested at 1310 and 1550 nm.

**Method of Measurement:** Work under this item shall be measured for payment by the actual number of linear feet of Fiber Optic Cable furnished and installed, as specified and shown on the Drawings.

**Basis of Payment:** The work to be done under this item shall be paid at the Contract unit price for each foot of the Fiber Optic Cable furnished and installed as described in this Specification. This work shall include all cable, connectors, rack mounted patch panels, equipment, splicing equipment, testing, materials and incidental items required to satisfy these Specifications.

Cleaning of existing conduit, when required and directed by the Engineer, will be paid separately under Item #1008907A "Clean Existing Conduit".

Splice enclosures will be furnished and installed separately under Item #1112241A "Fiber Optic Cable Splice Enclosure".

PAY ITEMS

PAY UNIT

Optical Fiber Cable – SM, LB Tube Cable, 6 Fiber	LF
Optical Fiber Cable – SM, LB Tube Cable, 72 Fiber	LF
Optical Fiber Cable – SM, LB Tube Cable, 144 Fiber	LF

**ITEM #1113726A – NO. 20 AWG, 6 TWISTED PAIR COMMUNICATION CABLE**

**Article M.16.14 - Control Cable**

3 - Cable Add the following:

The communication cable shall be solid conductor, shielded, twisted pair with 600 V polyethylene insulation and polyethylene jacket. The 6 Pair cable shall conform in all respects to IMSA Specification 20-2. The Contractor shall furnish a manufacturers warranty that the cable is resistant to damage and deterioration by sustained contact with greases and oil.

**Article 11.13.03 - Construction Methods Add the following:**

Communication cable shall be installed in new and existing conduit, handholes, or attached to utility poles as shown on the plans or as directed by the Engineer. Communication cable shall be installed continuously without splices from termination point to termination point. Cable termination shall be only on an approved termination panel inside the controller cabinet and on terminal blocks inside a cable closure (type A).

**Article 11.13.04 - Method of Measurement: Add the following:**

3. The quantity of communication cable to be paid for under these items shall be the actual number of linear feet (meters) of the cable specified, installed, tested, terminated at the points specified, and accepted in place.

**Article 11.13.05 - Basis of Payment: Add the following:**

3. Communication Cable shall be paid for at the contract unit price per linear foot (meter) for "No. 20 AWG, 6 Twisted Pair Communication Cable" which price shall include furnishing, installing, connecting and testing the communication cable of the type specified. The price shall also include furnishing all labor, tools, materials, equipment, storage, transportation and other incidentals necessary to complete the work.

Pay Item  
No. 20 AWG, 6 Twisted Pair Communication Cable

Pay Unit  
L.F. (m)

## **ITEM #1113813A – REMOVAL OF EXISTING ATMS**

### **Description:**

This Item includes the work for removal of the existing portable Variable Message Signs (VMS) in the project area.

The project equipment is identified on the Contract Drawings for the project.

### **Materials:**

There are no specific material requirements for the work under this item, as the work entails turn-off of the existing system and removal of equipment. If the use of any materials is required for the removals, then said equipment shall be in conformance with the Standard Specifications, Form 817.

### **Construction Methods:**

The removal of the ATMS shall be as follows:

The Contractor shall request and receive (in writing) permission to remove this equipment and shall not remove the VMS equipment until permission to remove the VMS equipment has been granted by the Engineer. Only after the Contractor has received written permission from the Department shall the ATMS be turned off and shall the removal of the existing equipment begin. The equipment shall only be removed within the limitations of operations herein; refer to Notice to Contractor - Incident Management System Equipment Installations and Section 1.08 – Prosecution and Progress.

Each of the existing locations shown on the contract plans shall have the VMS sign removed as noted. The following material shall be salvaged to ConnDOT:

- Two existing, portable Variable Message Signs at locations along I-691

The Contractor shall contact the ConnDOT Maintenance Contractor, John Lombardo from Semac Electric at 860-604-7546 to arrange the salvage of the above noted materials. Semac Electric will remove the salvaged materials from the Construction site, as necessary.

All remaining IMS equipment that is removed shall be disposed of by the Contractor at his expense. This equipment includes but shall not limited to the following:

- Portable VMS Concrete Foundations
- Portable VMS concrete blocks for leveling surface

The process for removing the system shall not interfere with any equipment and operation of the newly installed IMS system equipment. Each of the existing locations shown on the contract plans shall have the VMS removed and salvaged to ConnDOT. Any foundations shall be demolished to 12” below grade and backfilled to 6 inches (150 mm) below finished grade. Top soil shall then be placed to 1 inch (25 mm) above finished grade, then fertilized and seeded. Fertilizing and seeding shall be in accordance with pertinent provisions of Section 9.45.

The Contractor shall submit a detailed schedule of the work under this item to the Engineer for review, including days required to remove equipment.

The Contractor shall implement appropriate and approved construction signing patterns in accordance with Maintenance and Protection of Traffic herein these special provisions and contract drawings.

Prior to completion of the work under this item, the Contractor shall solicit the Department for concurrence on the equipment removed.

**Method of Measurement:**

Work under this item shall not be measured for payment. A lump sum fee will be provided for the total removal work under this item, “Removal of Existing ATMS”.

**Basis of Payment:**

The work to be done under this item shall be paid for at the Contract lump sum price for “Removal of Existing ATMS”, which price shall include all materials, hardware, labor, transportation of removed materials, tools, equipment and incidentals necessary to complete this work. Cost shall also include all backfilling, grading, topsoil and seeding for restoration of areas where concrete blocks and/or foundations are removed.

**ITEM #1201216A – OVERHEAD CANTILEVER SIGN SUPPORT (TYPE VMS 1)****ITEM #1201602A – SIDE MOUNTED VMS SUPPORT (TYPE 2)**

Section 12.01 is Amended as Follows:

**DESCRIPTION:**

This item consists of furnishing, fabricating, surface preparation, transporting, and erecting a galvanized overhead cantilever sign support (Type VMS 1) and a 2 post and framed side mounted VMS support (Type 2) at the locations shown on the plans or as directed by the Engineer. This item shall not include the anchor bolt assemblies, the actual sign panels, or concrete foundations.

**MATERIALS:**

The materials for this work shall conform to the requirements of Section M.06 – Metals and the following:

1. For Overhead Truss Sign Supports: M.18.01 1.A, Form 817.
2. For Overhead Cantilever Sign Supports: Structural tubing shall conform to the requirements of ASTM A500, Grade B. Structural tubing shall be manufactured by a member of the Steel Tube Institute of North America.
3. Structural steel shapes and shims shall conform to the requirements of AASHTO M270, Grade 50F2.
4. Steel for shear pins shall conform to the requirements of AASHTO M270, Grade 50 (ASTM A709, Grade 50)
5. High strength bolts shall conform to ASTM A325, Type 1. Nuts shall conform to either ASTM A563, Grade DH or ASTM A194, Grade 2H. Flat-hardened washers shall conform to ASTM F436. Bolts, nuts and washers shall be mechanically galvanized in conformance with ASTM B695, Class 50. The nuts shall be overtapped to the minimum amount required for the fastener assembly and shall be lubricated with a lubricant containing a visible dye so a visual check can be made for the lubricant at the time of the field installation. Galvanized bolts shall be tension tested after galvanizing.
6. Compressible washer type direct tension indicators (load indicating washers) shall conform to the requirements of ASTM F959, Type 8.8, and shall be galvanized in conformance with ASTM B695, Class 50.
7. All stainless steel nuts, bolts, cap screws, plates and washers shall be nickel-stainless steel conforming to AISI 300 series.



8. Threaded rods shall conform to the requirements of ASTM A449, Type 1.
9. Threaded material for anchor rods shall conform to ASTM F1554, Grade 105.
10. Bonded bushings, couplings and square head plugs shall conform to the requirements of ASTM A105.
11. Hot-dip galvanizing of all steel, except shims, shall conform to the requirements of AASHTO M111.
12. All steel, except shims, shall meet the Charpy V-notch impact testing requirements for ASTM A709/A709M, Grade 50F2.
13. Zinc Rich Field Primer for touch-up shall conform to the requirements of Federal Specification TT-P-641-Type I, and ASTM A780. The use of aerosol spray cans shall not be permitted.
14. Polyurethane sealant for filling the slotted holes in the base plate shall conform to the requirements of ASTM D5893.
15. Neoprene gasket material for the access openings shall conform to ASTM D1056, Grade 2A2 OR 2A3. Other grades of neoprene approved by the Engineer may be used.
16. Bare copper wire shall conform to M.15.13.
17. Ground rods shall be 16mm in diameter by 2.4m long copper clad steel. The copper cladding shall be a minimum thickness of 3mm. The ground clamp shall be an approved square head bolt type.
18. Closed cell elastomer for sealing between the foundation and base plate shall conform to ASTM D1056, Grade RE-41 B2 and shall have a pressure-sensitive adhesive backing on one side.
19. Certified Test Reports and Materials Certificates will be required in accordance with Article 1.06.07 for the hot-dip galvanizing.
20. Any material substitutions or changes to member sizes shown on the plans shall not result in a reduction of strength or change in section properties.

#### SUBMITTALS:

Prior to any fabrication, the Contractor shall submit shop drawings in accordance with Article 1.05.02 (3) to the Engineer for review and approval. The title block of shop drawings shall include, at a minimum, the following information: fabricator's name and address; city(ies) or town(s) where the project is located; location(s) where the material is to be used; ConnDOT project number; Federal aid project number (when applicable); name of the general contractor; date of drawing and date of all revisions.

Shop drawings for any fabricated steel product will not be accepted from anyone other than fabricator(s) approved by the Engineer.

Working Drawings:

At least 15 days before erecting posts and trusses, the Contractor shall submit an Erection Plan to the Engineer to include the following:

- proposed equipment to be used;
- calculations and lift points to maintain the truss assembly in plumb position during placement;
- detailed erection instructions and drawings of all structures; and
- the proposed scheme for traffic control during the erection of the posts and trusses.

Ensure that the plan includes the method to install walkways, luminaires, signs, and miscellaneous attachments (as applicable) within the same work period that the trusses are erected unless otherwise approved by the Engineer.

**CONSTRUCTION METHODS:**

1. Before starting fabrication, the Contractor shall determine the actual locations and elevations of the foundations.
2. The Contractor shall submit to the Engineer, no less than 48 hours prior to the start of fabrication, the name and location of the fabrication shop where the work will be done so that arrangements can be made for an audit of the facility and the assignment of a Department Quality Assurance Inspector.
3. Two sets of schematic cross sections for each sign support location shall be submitted to the Engineer prior to fabricating. These drawings shall include but not be limited to the following:
  - a. The location and elevation of the foundation actually determined by the Contractor.
  - b. The lengths of each member (post heights and arm lengths).
  - c. Locations of sign panels and lane arrangements.
  - d. Roadway minimum clearances from sign support structures and sign panels.
  - e. The type of protective barrier, if any, and the appropriate offset from the barrier to the near face of the support foundation.
  - f. The applicable DOT Standard Sheet revision date or Prequalified Fabrication Detail revision date.
4. Once the Engineer has reviewed and accepted the Contractor's roadway plans and cross section in accordance with the sign support foundation specification, shop drawings for this item shall be submitted to the Engineer in accordance with Article 1.05.02. If any of the

Contractor’s fabrication details differ from those shown on the plans, the proposed changes shall be submitted in writing for approval before including them on shop drawing submissions. Prequalified fabrication details may then be prepared for approval.

5. No work covered by the prequalified fabrication details shall be done until 3 copies of the details have been submitted to the Engineer for review and approved by the Engineer. Once a prequalified fabrication detail has been approved, a copy will go on record in the offices of Materials Testing and Bridge Design. This copy may be referenced on future contracts.
6. The tubular sign supports shall be completely shop fabricated except for bolting of connections and splices.
7. Fabrication of the sign support shall conform to the requirements of Articles 6.03.03-3.
8. To prevent warping of the tubular members, base plates, connection plates and splice plates during welding of the plates, precautions such as the use of steel strongbacks bolted to the plates shall be utilized. Fabricated members which are warped and do not fit properly during the trial fit up shall be rejected.
9. For cold bent plates used in fabricating posts, the steel shall be heated to 1,100°F after bending. With the exception of seams, no plates shall be welded or holes punched in the posts until the steel has received the proper thermal treatment in accordance with ASTM A143, Article 6.3.
10. After the tubular members have been completely fabricated, including cambering, but prior to galvanizing, all connections and splices shall be trial fitted and bolted in the fabricator's shop. The fabricated members may be rejected by the Engineer if the mating surfaces of the plates have a gap greater than 1/8" (3 mm) at any location prior to the bolting. If after the shop bolting, the interface of the plates are not in contact at each bolt location, the fabricated members may be rejected by the Engineer. Bolts used for the trial shop fit-up shall not be reused in the final field assembly.
11. The horizontal member on the Tubular Sign Support Structure shall be checked for proper residual camber prior to it being galvanized. Horizontal members with splices shall be bolted together with temporary bolts for checking camber. With the horizontal member supported at its ends, the residual camber shall be measured at mid-span and the member shall be rejected if the camber does not fall within the following limits:

Minimum Residual Camber	Span/ 1000
Maximum Residual Camber	Span/ 500

12. Steel surface defects such as fins, slivers, tears, delaminations, burrs, sharp edges and other defects shall be ground down with the use of a power disc grinder or other tools approved by the Engineer, to afford as close to a continuous surface characteristic as possible. Defects that, in the opinion of the inspection personnel, are so large or deep that grinding may not rectify the defect, shall be referred to the Engineer for resolution.

13. After the posts and the horizontal members have been fabricated, welds ground smooth, flux and splatter removed, they shall be hot-dipped galvanized in accordance with AASHTO M111. All welding, drilling of holes, and any other fabrication practices that would damage the galvanized coating shall be completed prior to galvanizing the post and strut components.
14. All pieces shall be galvanized in a single dip. Double-dipping shall not be used. No welding shall be performed after galvanizing.
15. Each lot of steel so treated shall bear a label clearly showing the name of the galvanizer, the ASTM specification used for the galvanizing and complete instructions for touch-up/repair of damaged material. Fabrications and materials shall be packed with sufficient dunnage and padding to protect finished surfaces.
16. After galvanizing the supports and prior to shipping, the Contractor shall assemble the structure to ensure that all the pieces fit together.
17. Mating surfaces of the post and arm plates or splice and connection plates, just prior to assembly, shall be wire brushed to mark and score the zinc surface without appreciably removing any material.
18. With the exception of bolted strut-to-post connections, assembly of bolted connections and splices shall conform to the applicable requirements of Article 6.03.03-4(f), amended as follows:
  - a. The bolts shall be installed with the direct tension indicator under the bolt head. The nut shall be turned to tighten the bolt and reduce the gap in the indicators to less than 0.005".
  - b. The bolts and direct tension indicators shall not be reused. If it becomes necessary to loosen a bolt previously tensioned, the bolt and direct tension indicator shall be discarded. Retightening previously tightened bolts, which may have been loosened by the tightening of adjacent bolts shall not be considered as reuse.
19. Connections of the horizontal struts to the posts shall be made in accordance with the following sequence:
  - a. Bolts shall be tightened with properly calibrated wrenches or by turn-of-nut method to provide  $\frac{1}{2}$  of the minimum bolt tension ( $\frac{1}{2}$  of the required nut rotation) from snug tight conditions as indicated in the DOT Standard Specification, Section 60.3.03-4(f), Tables A and B, respectively. This is to prevent damage to the tapped threads in the steel plates that are welded to the posts.
  - b. Bolts shall be sequentially tightened from the middle of the connection out, beginning with the bolts located closest to the horizontal centerline of the strut, maintaining symmetry of the bolts.
20. The posts shall be securely bolted to their bases and shall be plumb or slightly raked back from the roadway upon completion of erection.

21. All damaged areas of the galvanizing shall be properly prepared and touched-up. Damaged zinc shall be touched-up in accordance with ASTM A780. Spray aerosol cans of zinc rich primer will not be permitted.
22. The void between the top of the concrete foundation and underside of the base plate shall be sealed with closed cell elastomer as shown on the plans.
23. The slots in the base at the anchor bolts shall be completely filled with polyurethane sealant.
24. The ground conductor shall be installed as shown on the plans.

**METHOD OF MEASUREMENT:**

This work will be measured for payment by the number of units of "Overhead Cantilever Sign Support (Type VMS 1)" or "Side Mounted VMS Support (Type 2)" installed and accepted.

**BASIS OF PAYMENT:**

This work shall be paid for at the contract unit price each for "Overhead Cantilever Sign Support (Type VMS 1)" and "Side Mounted VMS Support (Type 2)" complete in place, which price shall include all materials, equipment, labor, tools, and work incidental thereto.

## **ITEM #1202247A – OVERHEAD CANTILEVER SIGN SUPPORT FOUNDATION (TYPE VMS 1)**

## **ITEM #1203109A – SIDE MOUNTED SIGN FOUNDATION**

**Description:** Work under this item shall consist of the selection and construction of foundation(s) for the “Overhead Cantilever Sign Support” and/or “Side Mounted Sign” structures and all work incidental to this construction as shown on the plans and in conformance with these specifications. The Contractor shall construct the footing foundation as shown on the plans. All work shall conform to the requirements of this Special Provision and Section 7.01 of the Standard Specifications.

### **Contractor Qualifications:**

The Contractor or Subcontractor(s) performing the work to install drilled shaft or spread footing foundations shall submit documentation to the Engineer for approval that demonstrates experience of key staff with the proposed work as it relates to the requirements of this contract. At a minimum, this documentation shall include the following:

- List of key staff that will be involved in the construction of the traffic structure foundations, to include the supervisor for the foundation installations and proposed equipment operator(s).
- Resumes for each key staff member that will be involved in the construction of the traffic structure foundations. Resumes shall identify the following for each individual:
  - A minimum of two (2) previously completed construction projects where the key staff member has performed their proposed job function in the construction of traffic structure foundations. Each cited project shall have included a minimum of four (4) new drilled shaft foundations for overhead sign structures. A minimum of one (1) project shall have included the installation of a foundation requiring either a rock socket or Rock-In-Foundation Excavation.
  - A minimum of 5 years’ experience in the performance of the proposed work for all field supervisory personnel.
  - The individual’s role/job function and overall responsibilities for each identified project.
  - The number & type of traffic structure foundations that were installed for each project.
  - Client reference for each project.

In addition, the Contractor shall submit to the Engineer for approval a list of proposed equipment that will be used for the installation of the traffic structure foundations proposed in the project.

**Materials:**

Materials for Drilled Shaft Foundations shall conform to the requirements of Section 7.01 of the Standard Specifications and the following:

Class “A” Concrete shall conform to the requirements of Section 6.01, 7.01 and Article M.03.

Concrete for drilled shafts shall attain a 28-day compressive strength of 4,000 PSI (28 MPa) and have a maximum aggregate size of No. 8 stone.

Reinforcing steel shall conform to the requirements of Section 6.02 and Article M.06.01. Anchor plate shall conform to the requirements of AASHTO M270, Grade 345, galvanized. Anchor rods shall conform to ASTM F1554, Grade 725 and shall be galvanized as shown on the plans in accordance with ASTM A153M, Class C. The internal threads of nuts shall be retapped after galvanizing to accommodate the increased diameter of the bolts.

Leveling and lock nuts shall conform to ASTM A563, Grade DH and shall be galvanized in accordance with ASTM A153M, Class C. Lock nuts shall also be self-locking of the prevailing torque reusable type and shall conform to the requirements of Article M.18.02.

Washers shall conform to ASTM F436M, Type 1 and shall be quenched, tempered and galvanized in accordance with ASTM A153M, Class C.

Rigid metal conduit, ground rod sleeves and related hardware and end caps shall be galvanized steel conduit and shall conform to Section M.15.09.

Bare copper wire shall conform to M.15.13.

Zinc-rich field primer for touch up shall conform to the requirements of Federal Specification TT-P-641-Type 1 and ASTM A780. The use of aerosol spray cans shall not be permitted.

Ground rods shall be 5/8” (16mm) in diameter by 12’ (3.6m) long copper clad steel. The copper cladding shall be a minimum thickness of 0.12” (3mm). The ground clamp shall be a square-head bolt type approved for direct burial.

Any admixtures proposed for use in the bentonite slurry shall be approved by the Engineer. Bentonite slurry properties may be adjusted to suit field conditions with the approval of the Engineer. Polymer or other slurry materials may be submitted to the Engineer for review.

**Construction Methods:**Working Drawings

Prior to submission of shop drawings, the Contractor shall obtain a field survey and prepare and submit for review, a roadway plan and cross section, drawn to scale, at the location of each sign

support foundation in accordance with Article 1.05.02. The plan and cross section shall include, at a minimum, the following information:

- foundation type
- orientation of the structure, foundation and VMS with respect to the roadway
- elevation view of the structure, foundation and VMS, oriented perpendicular to the sign face
- roadway cross section, including lane and shoulder locations, widths and elevations within the limits of the truss arm
- ground elevations at the top/bottom of slope, center of the posts and pertinent points on the slope beyond the foundation to establish grade and accurately determine depth of cover to critical points of foundation
- existing/proposed roadside barrier type and location
- for overhead cantilever structures, minimum vertical clearance to the bottom of the support beams and distance to the truss centerline from the top of roadway high point within the limits of the truss arm
- for side mounted structures, minimum lateral offset from curb/edge of pavement to VMS
- post height (measured from top of foundation to center of truss for overhead cantilever; measured from top of foundation to bottom of VMS for side mounted structures), top of foundation/pedestal elevation
- pedestal and pile cap heights (for overhead cantilever drilled shaft alternate)
- bottom of foundation elevation (for spread footing alternate)
- excavation limits and temporary sheet piling limits (if required)
- work areas

The Contractor is responsible for the location and proper orientation of the sign support foundation.

The Contractor shall submit a foundation constructability plan which includes the following:

- Access to the area including the following, when applicable:
  - Temporary road
  - Removal of guide rails or concrete barriers
  - Utility locations and drainage installations that could obstruct construction
  - Clearing and grubbing (this shall be accomplished in accordance with Section 2.01)
- Traffic Protection including the following applicable considerations:
  - Temporary guide rails and/or concrete barriers
  - Maintenance and Protection of Traffic Control Plans for work that cannot be accomplished using the Typical Traffic Control Plans (All work to install the foundation shall be accomplished in accordance with Article 1.08.04 – Prosecution & Progress and item 0971001A- Maintenance & Protection of Traffic unless otherwise approved in writing by the Engineer).

### Shop Drawings



Once the Engineer has reviewed and accepted the Contractor's roadway plan and cross section, shop drawings for the foundation reinforcement and anchorage shall be submitted to the Engineer in accordance with Article 1.05.02. As part of the submittals for the overhead cantilever foundation reinforcement and drilled shaft, the Contractor shall include details and/or work procedure for support of the reinforcement cage.

### Drilled Shaft Foundation

A drilled shaft foundation unit consists of two drilled shafts, one pile cap and one pedestal. Drilled shafts shall be constructed in accordance with Section 7.01 – Drilled Shafts and Section 12.02 – Overhead Sign Support Foundation of the ConnDOT Standard Specifications for Roads, Bridges, and Incidental Construction.

This work may require rock excavation, drilling rock or using slurry filled shafts through whatever materials are encountered to reach the depths indicated on the plans and specifications. The Contractor shall submit a sequence plan outlining drilling, casing, slurry, reinforcement and concrete placement procedures for the Engineer to review.

All excavations shall conform to the current OSHA and other applicable local, state and federal regulations. It is the Contractor's responsibility to ensure the stability of the excavations.

Prior to drilled shaft construction, the grade in the vicinity of the shafts shall be constructed to the finished grade.

The hole shall be drilled to the minimum depth specified and shall be examined for straightness. A suitable temporary casing or slurry shall be furnished and placed when required to prevent caving/sloughing of the granular soils before concrete is placed. The Contractor is responsible for maintaining the stability of the shaft excavation. While the casing is being withdrawn, a sufficient head of concrete should be maintained above the bottom of the casing, to prevent "necking" of the shaft due to sloughing soils. Concrete placed near the surface should be in full contact with the undisturbed soil to provide lateral stability for the full length of the shaft. An uncased hole shall only be allowed if the Contractor can ensure a stable dry excavation. All loose material existing at the bottom of the hole after drilling operations have been completed shall be removed before placing concrete in the hole. The hole shall be covered when left unattended.

Perform shaft drilling by combinations of auguring, rotary drilling, down-the-hole hammer, reverse circulation drilling, claming, scraping or other means approved by the Engineer. Use such means as will minimize over excavation and loosening and caving of material outside the designed shaft foundation dimensions.

If bedrock is encountered, the Engineer shall be notified to inspect and determine the elevation of the top of competent rock. The top of rock will be considered as the point where rock, defined as bedded deposits and conglomerate deposits exhibiting the physical characteristics and difficulty of rock removal as determined by the Engineer, is encountered which cannot be drilled with earth augers and/or underreaming tools configured to be effective in the soils indicated in the contract documents, and requires the use of special rock augers, core barrels, air tools, blasting, or other

methods of hand excavation. Bedrock is anticipated to be encountered within the depths of the drilled shafts at the following structures:

- VMS-691W-02

Minimum required lengths of rock socket shall be determined from the table provided in the contract plans (refer to VMS Cantilever Sign Support Foundation Details) based on the depth to the top of rock from the foundation grade level. The Contractor shall construct the appropriate sign support foundation depending on the field conditions as shown on the plans and as approved by the Engineer.

It is the Contractor's responsibility to utilize proper equipment and methodology to drill through the boulders. It should be noted that boulders may also be encountered at other structure locations.

Provisions shall be made to minimize surface water infiltration into the shaft excavations. Dry construction should be allowed if less than one foot (305 mm) of water accumulates in the bottom of a hole without pumping over a one hour period, the excavation remains stable and any loose material and water can be removed prior to placement of concrete. Dry construction would allow for free-fall concrete provided the Contractor can place the concrete without hitting the reinforcing steel. Wet construction would be used for all other applications.

Groundwater may be encountered during drilled shaft construction, so concrete shall be placed using a concrete pump or tremie pipe in accordance with the specifications.

When slurry is used in the drilling process, it shall be a mineral slurry. The slurry shall have both a mineral grain size that will remain in suspension and sufficient viscosity and gel characteristics to transport excavated material to a suitable screening system. The percentage and specific gravity of the material used to make the suspension shall be sufficient to maintain the stability of the excavation and to allow proper concrete placement. The level of the slurry shall be maintained at a height sufficient to prevent caving of the hole.

The mineral slurry shall be premixed thoroughly with clean fresh water at a temperature above 41°F (5°C) and adequate time allotted for hydration prior to introduction into the shaft excavation. Maintain shaft foundation excavations full of slurry to within 2 feet (610mm) of the top of the casing and at least 4 feet (1219mm) above the existing water level during drilling until the concrete placement is essentially complete. Circulate or agitate the slurry during drilling operations and immediately prior to concrete placement. Maintain the slurry requirements at all times, including non-working periods and stoppages. Provide continuous circulation or agitation, if necessary, to meet these requirements.

Control tests using suitable apparatus shall be carried out by the Contractor on the mineral slurry to determine density, viscosity, and pH. An acceptable range of values for those physical properties is shown in the following table:

## Range of Values (at 68° F (20°C))

<b>Property (Units)</b>	<b>Time of Slurry Introduction</b>	<b>Time of Concreting (in Hole)</b>	<b>Test Method</b>
Density (kg/m <sup>3</sup> )	1030 to 1107	1030 to 1201	Density Balance
Density (lb/ft <sup>3</sup> )	64 to 69	64 to 69	
Viscosity (seconds per quart)	28 to 45	28 to 45	Marsh Cone
pH	8 to 11	8 to 11	pH paper or meter

Before placing reinforcing steel in a slurry filled shaft, all loose debris from the bottom shall be removed by a large capacity air-lift system or submersible pump. Concreting shall not start until the alignment, dimension, and cleanliness of the shaft excavation has been verified by the Engineer.

Carefully lower reinforcing steel in drilled shaft immediately after cleaning the bottom as herein specified. Dropping or forcing cages into the shaft will not be allowed. If the reinforcing steel does not properly and smoothly enter the shaft, it shall be retrieved and the shaft adjusted and properly cleaned as specified until the reinforcing fits smoothly. Repair or replace any damaged reinforcing cage to the satisfaction of the Engineer.

The steel reinforcing cage shall be placed and firmly held with approved centering devices at least 4 inches (100mm) wide to insure the alignment of the reinforcing within the hole. Thin concrete or plastic rollers will not be allowed.

The depth of drilling shall be checked immediately prior to concrete placement in the presence of the Engineer.

Immediately prior to placing concrete, the Engineer will inspect and verify the cleanliness of the shaft. If the inspection indicates that sediment has accumulated at the bottom of excavation, the Contractor shall remove all steel and reclean the shaft.

Start placement of concrete in the shaft as soon as possible, but no more than four hours after completion of slurry and bottom cleaning, and no more than two hours after reinforcing steel cage placement. Proceed continuously until completion of concreting. If the time limitations specified above are exceeded, remove the cage and reclean the bottom as specified.

Place concrete in the slurry filled shaft by the tremie method in such a manner that the concrete displaces the slurry from bottom and rises like a liquid, and mixing of concrete with the slurry will not occur. The concrete shall be placed through a top metal hopper and into a rigid leak-proof elephant trunk tremie pipe sufficiently large enough to permit free flow of concrete. The tremie pipe shall be located so that it can be removed without disturbing the position of the reinforcing.

Initially, there shall be a suitable plug at the bottom of the tremie pipe that will not discharge concrete until the concrete head has at least reached the top level of the slurry.

The intent is that bentonite slurry not be permitted to contaminate the concrete as the concrete is initially introduced to the tremie pipe. Thereafter, a positive concrete head shall be maintained throughout. The bottom of the tremie pipe shall be inside the concrete for at least a depth of 60 inches (1524mm), and this depth shall be maintained throughout. The concrete level shall be horizontal during the pouring operations. No horizontal movement of the tremie pipe will be permitted. The concreting of the shaft shall proceed continuously to 12 inches (305mm) above the final top of shaft elevation to produce a monolithic shaft foundation, with uncontaminated concrete for the design shaft length.

If unsuitable bearing soil (i.e., different from the anticipated foundation bearing materials) is encountered during drilling of the drilled shafts, the Engineer shall be immediately informed to determine remedial options.

The concrete shall be finished in conformance with the pertinent requirements of Subarticle 6.01.03-10.

Casings, if used in drilling operations, shall be removed from the hole. The casing may be removed as concrete is placed provided a 60 inch (1524mm) head of concrete is maintained to prevent “necking” of the shaft due to sloughing soils, or the casing may be removed after the concrete has been poured, provided that the concrete has not been set. Separation of the concrete by hammering or otherwise vibrating the casing during withdrawal operations shall be avoided. Concrete placed near the surface shall be in full contact with the undisturbed soil to provide lateral stability for the full length of the shaft.

The maximum allowable horizontal variation of the center of the top of the drilled shaft from the required location shall be 0.5% of the shaft diameter.

The concrete shaft shall not be out of plumb by more than 1% of the total length.

Shaft excavation operations should not be performed within three diameters of a newly poured shaft within 24 hours of the placement of concrete.

The ground surface at each shaft location shall be re-compacted if disturbed during construction in order to minimize lateral deflection of the shafts.

#### Spread Footing Foundation

A spread footing foundation unit consists of one footing, one lower pedestal and one pedestal. Spread footing foundations shall be constructed in accordance with the requirements of Section 12.02.03.

## General

The top of the concrete foundation shall be level within  $\pm 1/8"$  (3mm).

The anchor bolt locations shall be in accordance with shop drawings for the sign support structure.

Anchor bolt assemblies shall conform to the requirements shown on the plans and shall be embedded in the concrete, which shall be placed to within the minimum distance of the finished surface of the stem as shown on the plans. A template to hold the required anchor bolt assemblies, ground rod sleeve and conduit in their correct position shall be used. Each bolt of the anchor bolt assembly shall be fitted with two leveling nuts. As-built anchor bolt locations shall be provided to the steel sign support fabricator to insure proper fit of the support base plates on the foundation anchor bolts.

The leveling template shall be clamped in position by two leveling nuts at each anchor bolt. These leveling nuts shall be adjusted to assure a truly level finished foundation surface at the proper elevations.

After the sign support has been erected and the nuts fully tightened, the bolts, nuts and washers shall be coated with Zinc Rich Field Primer as directed by the Engineer.

The space between the leveling template and pedestal concrete shall be hollow.

All conduit ends terminating below grade shall be capped with a malleable iron cap. All above grade conduit ends shall be terminated with an insulated bonding bushing with tinned insert. The number of conduits in the foundation shall be as shown on the plans. Additional conduits are to be installed as required.

Ground rod and ground wire shall be installed as shown on the plans.

The disturbed ground along the access path to the shaft locations shall be restored and protected from erosion within 5 calendar days of the completion of the foundation construction.

**Method of Measurement:** This work will be measured for payment by the number of foundation units of the type specified, completely installed and accepted. Foundations for cantilever truss sign supports will be measured for payment as one foundation unit. Foundations for side mounted sign supports will be measured for payment as two foundation units.

**Basis of Payment:** The work will be paid for at the contract unit price each for "Cantilever Truss Sign Support Foundation" or "Side Mounted Sign Foundation" complete in place, which price shall include field survey, layout, materials, construction access path, drilling, rock socket, temporary casing, slurry, excavation, cutting and removing existing pavement, granular fill, backfill, concrete, reinforcing, anchor bolts, rigid metal conduits, PVC weep holes, ground rod, ground wire, clamps and surface treatments to be restored, as directed by the Engineer,

and all equipment, labor, tools and work incidental thereto.

When rock is encountered within the limits of excavation, its removal will be paid for at the Contract unit price per vertical foot (vertical meter) for "Rock-in-Foundation Excavation," which price includes any additional excavation to remove the rock and any additional concrete required to fill the excavation beyond the designed foundation hole dimensions. Rock-in-foundation excavation is defined as rock in definite ledge formation, boulders, or portions of boulders, cement masonry structures, concrete structures or Portland cement concrete pavement with a cross-sectional area that exceeds 50% of the cross-sectional area of the designed foundation hole.

No additional payment will be made for the Contractor to test the slurry when it is used to construct a drilled shaft foundation.

Temporary sheeting, if required, will not be paid for separately, but will be included as part of the work.

Borrow, if required, will not be paid for separately, but will be included as part of the work.

Temporary traffic control items, eradication of existing pavement markings and permanent pavement markings will not be paid for separately, but will be included as part of the work.

The removal of existing roadside barrier systems, installation and removal of temporary roadside barrier systems and resetting existing roadside barrier systems will not be paid for separately, but will be included as part of the work.

The temporary support, protection and restoration of utilities (if necessary), including existing underground wiring, conduits, drainage structures, pipes and underdrain systems within the excavation limits will not be paid for separately, but will be included as part of the work.

The restoration of existing surface treatments (pavement, slope protection, topsoil & seed, etc.) in all areas disturbed by the work, including temporary access paths, will not be paid for separately, but will be included as part of the work. The Engineer will determine the type, thickness and horizontal limits of the surface treatments to be restored.

The installation of new or upgraded permanent roadside barrier systems, if required, will not be paid for as part of this work, but will be paid for under separate items.

**ITEM #1206023A – REMOVAL AND RELOCATION OF EXISTING SIGNS**

Section 12.06 is supplemented as follows:

**Article 12.06.01 – Description is supplemented with the following:**

Work under this item shall consist of the removal and/or relocation of designated side-mounted extruded aluminum and sheet aluminum signs, sign posts, sign supports, and foundations where indicated on the plans or as directed by the Engineer. Work under this item shall also include furnishing and installing new sign posts and associated hardware for signs designated for relocation.

**Article 12.06.03 – Construction Methods is supplemented with the following:**

The Contractor shall take care during the removal and relocation of existing signs, sign posts, and sign supports that are to be relocated so that they are not damaged. Any material that is damaged shall be replaced by the Contractor at no cost to the State.

Foundations and other materials designated for removal shall be removed and disposed of by the Contractor as directed by the Engineer and in accordance with existing standards for Removal of Existing Signing.

Sheet aluminum signs designated for relocation are to be re-installed on new sign posts.

**Article 12.06.04 – Method of Measurement is supplemented with the following:**

Payment under Removal and Relocation of Existing Signs shall be at the contract lump sum price which shall include all extruded aluminum and sheet aluminum signs, sign posts, and sign supports designated for relocation, all new sign posts and associated hardware for signs designated for relocation, all extruded aluminum signs, sheet aluminum signs, sign posts and sign supports designated for scrap, and foundations and other materials designated for removal and disposal, and all work and equipment required.

**Article 12.06.05 – Basis of Payment is supplemented with the following:**

This work will be paid for at the contract lump sum price for “Removal and Relocation of Existing Signs” which price shall include relocating designated extruded aluminum and sheet aluminum signs, sign posts, and sign supports, providing new posts and associated hardware for relocated signs, removing and disposing of foundations and other materials, and all equipment, material, tools and labor incidental thereto. This price shall also include removing, loading, transporting, and unloading of extruded aluminum signs, sheet aluminum signs, sign posts, and sign supports designated for scrap and all equipment, material, tools and labor incidental thereto.

<u>Pay Item</u>	<u>Pay Unit</u>
Removal and Relocation of Existing Signs	L.S.

**ITEM #1806226A – PRE-WARNING VEHICLE**

**Description:** Work under this item shall include furnishing, deploying and maintaining a Truck-Mounted Impact Attenuator equipped with a changeable message sign (CMS) for use as a Pre-Warning Vehicle (PWV) in a rolling road block operation on limited access highways. Impact attenuators shall only be truck-mounted. The message on the sign shall warn motorists of slow or stopped traffic conditions.

**Materials:** The Truck-Mounted Impact Attenuator shall meet the requirements of Article 18.06.02, except replace all instances of “flashing arrow,” “arrow sign,” and “arrow” with “CMS”.

The CMS shall meet the requirements of Article 11.31.02, with the following amendments:

**1. Physical Characteristics of the CMS**

- a) Mounting – The CMS shall be truck mounted only
- b) Sign Display Dimensions – Width of 6 feet, height of 4 feet

**2. Visual Characteristics of the CMS Display**

- a) Sign Type – CMS shall have a LED display only
- b) Color – CMS shall have black background with orange, yellow, or amber legend
- c) Characters – Letter height shall be 13 inches; Single stroke
- d) Visibility– CMS brightness must provide for visibility at 1/2 mile
- e) Message – The message shall read as follows, or shall be as directed by the Engineer:

Frame 1: SLOWED TRAFFIC AHEAD

Frame 2: BE PREPARED TO STOP

Or

Frame 1: STOPPED TRAFFIC AHEAD

Frame 2: BE PREPARED TO STOP

**Construction Methods:** The PWV shall be initially positioned in the right shoulder ½ mile prior to the rolling road block operation.

If a traffic queue reaches the PWV’s initial location, the Contractor shall slowly reverse the PWV along the shoulder to position itself prior to the new back of queue.

The Contractor shall meet the requirements of Article 18.06.03.

**Method of Measurement:** This work will be measured for payment by the actual number of hours that the Pre-Warning Vehicle is used to alert motorists of slowed or stopped traffic ahead.

**Basis of Payment:** This work will be paid for at the Contract unit price per hour for “Pre-Warning Vehicle,” which shall include the furnishing and use of the pre-warning vehicle and a driver, attenuator reflector, flashing lights, changeable message sign, and all equipment, materials, tools, labor, disposal of damaged Truck-Mounted Impact Attenuator components and work incidental thereto.

Pay Item	Pay Unit
Pre-warning Vehicle	hr



## **PERMITS AND/OR REQUIRED PROVISIONS**

The following Permits and/or Supplemental to Form 817 and Required Provisions follow this page and are hereby made part of this Contract.

- **PERMITS AND/OR PERMIT APPLICATIONS**

CTDOT Flood Management General Certification

Issue Date April 11, 2018

- **SUPPLEMENTAL SPECIFICATIONS TO STANDARD SPECIFICATIONS FORM 817**

- **Construction Contracts - Required Contract Provisions (FHWA Funded Contracts)**

Project No.: 171-413/414  
Description: Incident Management Installations along I-91 & I-691 in the in the towns of Berlin, Cromwell, Meriden, Middlefield, Middletown, Newington, Rocky Hill Southington

**m e m o r a n d u m**

Date: 04/02/2018

**to:** Mr. Michael E. Masayda  
Trans. Principal Engineer  
Hydraulics and Drainage  
Bureau of Engineering and Construction

**from:** Susan M. Libatique  
Trans. Principal Engineer  
Bureau of Engineering and Construction

Digitally signed by  
Nilesh Patel  
Date: 2018.03.29  
08:53:47-04'00'

Please review this request for Flood Management General Certification and indicate your concurrence below.

**Certification** (to be completed by designer)

*I have read the Flood Management General Certification and the descriptions for the approved DOT minor activities. This project qualifies for the Flood Management General Certification under:*

- (X) Minor Safety Improvements and Streetscape Projects
- ( ) Roadway Repaving, Maintenance & Underground Utilities
- ( ) Minor Stormwater Drainage Improvements
- ( ) Removal of Sediment or Debris from a Floodplain
- ( ) Wetland Restoration Creation or Enhancement
- ( ) Scour Repairs at Structures; (*Must acquire DEEP Fisheries Concurrence to be eligible*)
- ( ) Guide Rail Installation
- ( ) Deck and Superstructure Replacements
- ( ) Minor Bridge Repairs and Access
- ( ) Fisheries Enhancements
- ( ) Surveying and Testing
- ( ) Bicycle / Pedestrian, Multi Use Trails and Enhancement Projects

*The following required documentation is attached in support of this certification:*

- Project description
- Location plan
- Description of Floodplain involvement and how project qualifies for general certification
- 8-1/2" by 11" excerpt copy of the FEMA Flood Insurance Rate Map (FIRM) and Floodway Boundary Map (if applicable)
- Design plans (located on ProjectWise under Project 171-413 '310 Review Documents', dated 2/6/2018) with FEMA floodplain and floodway boundaries plotted, cross sections and profiles, as necessary, that clearly depict the floodplain involvement
- FEMA 100-year flood elevation plotted on elevation view (for structures)

Print Name: Thomas P. Daley

Title: Gannett Fleming, Inc.

Signature: Digitally signed by Thomas Daley  
Date: 2018.03.28 13:50:20-04'00'

Date:

**Concurrence** (to be completed by Hydraulics and Drainage)

Based on the documentation submitted, I hereby concur that the project qualifies for Flood Management General Certification.

***If there are any changes to the proposed activities within the floodplain or floodway, the project must be re-submitted for review and approval.***

Signature

Date 4-11-18

## **FM General Qualification Justification**

Project Nos. 171-413 & 171-414

Incident Management Installations along I-91 and I-691

Berlin, Cromwell, Meriden, Middlefield, Middletown, Newington, Rocky Hill, and Southington

The following is a summary of the potential impacts to defined flood zones within the project area:

### Project No. 171-413

- Along I-91, there is a combined length of approximately 1,500 feet across 2 flood zone areas where new fiber optic conduit will be installed in trench. These areas are both located in at the southerly end of the project (south of I-691).
- Along Route 9, there is a combined length of approximately 1,800 feet across 2 flood zone areas where new fiber optic conduit will be installed in trench.
- In the area of the Route 9 interchange, there is approximately 1,100 feet of existing fiber optic cable conduit along I-91 southbound that falls within flood zones. This existing conduit and fiber optic cable will remain; there is no proposed work in these areas.
- There are 3 locations where we are installing new fiber optic cable on structure over a flood zone area. The surface mounted conduit will be attached to the bridge structure that is spanning the flood zone area, so there should be no impacts as a result of this work.
- None of the existing or proposed CCTV's fall within flood zone areas.

### Project No. 171-414

- Along I-691, there is a combined length of approximately 1,800 feet across 2 flood zone areas where new fiber optic conduit will be installed in trench.
- Along Route 15, there is a length of approximately 270 feet across one flood zone area where new fiber optic conduit will be installed in trench.
- There are 3 locations where we are installing new fiber optic cable on structure over a flood zone. The surface mounted conduit will be attached to the bridge structure that is spanning the flood zone area, so there should be no impacts as a result of this work.
- One proposed CCTV (CCTV-691W-01) falls within a flood zone area. This CCTV is located near Peck Lane, approximately 3,000 feet east of I-84.
- None of the proposed VMS's fall within flood zone areas.

The proposed work under both projects will not permanently alter the topography within these designated flood zone areas. The only permanent work within the flood zone areas will be the installation of new underground conduits with fiber optic cable and the installation of one new CCTV structure. The installation of the proposed conduit in these areas will include the excavation of a 2-foot wide trench to a depth of 46 inches. The conduit will be installed and then the trench will be backfilled and the surface area will be restored. All trenches will be backfilled the same day as excavation. For the installation of CCTV-691W-01, the work will consist of a drilled shaft excavation, 4'-6" in diameter (approximately 6 cubic yards of soil will be removed). This will be followed by the placement of a reinforced concrete foundation that will project out of the excavated hole by less than 12 inches. The surrounding area will remain undisturbed. The work associated the excavation and concrete placement should all be completed in less than two days.

No grade changes are proposed within the floodplain and thus the proposed activities qualify for a Flood Management General Certification under Category 1 (Minor Safety improvements, Streetscape, and Transportation Facility and Enhancement Projects).

***Project No. 171-413***  
**Incident Management System Installation**  
**Closed Circuit Television Cameras (CCTV) on**  
**I-91 between Route 9 and Route 15/I-691 interchange**

Project No. 171-413 will install 15 new CCTV Camera Sites, 16 Traffic Flow Monitors (TFM), 13 miles of trunkline fiber optic cable installed in new conduit, and 4 miles of trunkline fiber optic cable installed in existing conduit. This project will meet federal regulations 23 CFR 9.40.9 to 9.40.11 by implementing a systems engineering analysis.

CCTV and Traffic Flow Monitor Installations

The new CCTV Ground Mounted Camera Cabinets and Camera Lowering Devices shall be located and surveyed based upon obtaining the best sightlines to minimize the number of camera sites. New branch conduit shall be installed between the new Camera Cabinet, newly installed electric service cabinets, and newly installed fiber optic cable pullboxes. One or two Traffic Flow Monitors will be installed on Camera Lowering Device poles to detect lanes in one or both directions of I-91. At the two existing VMS cabinets along I-91 at Country Club Road, a 6 fiber optic branch cable will be run to the nearest CCTV camera(s) for redundant communications to the Newington Operations Center.

Fiber Optic Cable and Conduit Installation

New trunkline 144 fiber optic cable and 4 inch multicell conduit shall be installed along I-91 from the route 9/I-91 interchange in Cromwell to route 15/I-91 interchange in Meriden (Murdock Avenue). This new trunkline installation will extend fiber optic conduit and cable along I-91 to connect 15 new CCTV camera sites back to the existing Main Fiber Hub located in Hartford at the I-84/I-91 interchange and Newington Operations Center.

New 144 fiber optic cable shall be installed from the Newington Operations Center in existing 4 inch multicell along Route 5/15 Southbound to the Route 9 interchange in Berlin. The 144 fiber optic cable shall then continue along Route 9 Southbound to the I-91/ Route 9 interchange (Cromwell) in new 4 inch multicell conduit. A new 144 fiber cable shall be installed from the I-91/Route 9 interchange Northbound along I-91 to the West Street overpass (Rocky Hill) in existing 4 inch multicell. The new 144 fiber cable to the west street overpass will be used to connect the Rocky Hill Signal lab, various closed loop signal systems, and serve as an alternate communications path for incident management equipment back to the Newington Operations Center.

***Project No. 171-414***  
**Incident Management System Installation**  
**Along I-691, Southington and Meriden**

Project No. 171-414 will install 14 new CCTV Camera Sites, 14 Traffic Flow Monitors (TFM), 3 new Variable Message Signs (VMS) and 10 miles of trunkline fiber optic cable installed in new conduit along I-691 and Route 66. An additional 2 miles of fiber optic cable will be installed in new conduit along Route 15. This project will meet federal regulations 23 CFR 9.40.9 to 9.40.11 by implementing a systems engineering analysis.

Fiber Optic Cable and Conduit Installation

New trunkline 144 fiber optic cable and 4 inch multicell conduit shall be installed along I-691 from the I-84 interchange in Southington to the I-91 interchange in Meriden. This trunkline shall continue along Route 66 from the I-91 interchange to the intersection with Route 147 (Baileyville Road) in Middlefield. An additional two miles of 144 fiber optic cable will be installed in 4 inch multicell conduit extending north from I-691 along Route 15. This new trunkline installation will connect with a propose fiber optic trunkline to be installed along I-91 under Project 171-413.

CCTV and Traffic Flow Monitor Installations

The new CCTV Ground Mounted Camera Cabinets and Camera Lowering Devices shall be located and surveyed based upon obtaining the best sightlines to minimize the number of camera sites. New branch conduit shall be installed between the new Camera Cabinet, newly installed electric service cabinets, and newly installed fiber optic cable pullboxes. One or two Traffic Flow Monitors will be installed on Camera Lowering Device poles to detect lanes in one or both directions of I-691 and Route 66.

Variable Message Signs (VMS) installations

The Variable Message Signs (VMS) installations on I-691 and Route 66 will be utilize Rear Access VMS “Type B” signs installed on Overhead Cantilever Truss Sign Structures. The new VMS installations shall be located and surveyed based upon obtaining the best sightlines and electrical/communications service connections, as determined by a field review.

**Construction Contracts - Required Contract Provisions  
(FHWA Funded Contracts)**

**Index**

1. Federal Highway Administration (FHWA) Form 1273 (Revised May 1, 2012)
2. Title VI of the Civil Rights Act of 1964 / Nondiscrimination Requirements
3. Contractor Work Force Utilization (Federal Executive Order 11246) / Specific Equal Employment Opportunity
4. Requirements of Title 49, CFR , Part 26, Participation by DBEs
5. Contract Wage Rates
6. Americans with Disabilities Act of 1990, as Amended
7. Connecticut Statutory Labor Requirements
  - a. Construction, Alteration or Repair of Public Works Projects; Wage Rates
  - b. Debarment List - Limitation on Awarding Contracts
  - c. Construction Safety and Health Course
  - d. Awarding of Contracts to Occupational Safety and Health Law Violators Prohibited
  - e. Residents Preference in Work on Other Public Facilities (Not Applicable to Federal Aid Contracts)
8. Tax Liability - Contractor's Exempt Purchase Certificate (CERT – 141)
9. Executive Orders (State of CT)
10. Non Discrimination Requirement (pursuant to section 4a-60 and 4a-60a of the Connecticut General Statutes, as revised)
11. Whistleblower Provision
12. Connecticut Freedom of Information Act
  - a. Disclosure of Records
  - b. Confidential Information
13. Service of Process
14. Substitution of Securities for Retainages on State Contracts and Subcontracts
15. Health Insurance Portability and Accountability Act of 1996 (HIPAA)
16. Forum and Choice of Law
17. Summary of State Ethics Laws

18. Audit and Inspection of Plants, Places of Business and Records
19. Campaign Contribution Restriction
20. Tangible Personal Property
21. Bid Rigging and/or Fraud – Notice to Contractor
22. Consulting Agreement Affidavit
23. Federal Cargo Preference Act Requirements (46 CFR 381.7(a)-(b))

**Index of Exhibits**

- EXHIBIT A – FHWA Form 1273 (Begins on page 14)
- EXHIBIT B – Title VI Contractor Assurances (page 35)
- EXHIBIT C – Contractor Work Force Utilization (Federal Executive Order 11246) / Equal Employment Opportunity (page 36)
- EXHIBIT D – Health Insurance Portability and Accountability Act of 1996 (HIPAA) (page 43)
- EXHIBIT E - Campaign Contribution Restriction (page 51)
- EXHIBIT F – Federal Wage Rates (Attached at the end)
- EXHIBIT G - State Wage Rates (Attached at the end)

### **1. Federal Highway Administration (FHWA) Form 1273**

The Contractor shall comply with the Federal Highway Administration (FHWA), Form 1273 attached at Exhibit A, as revised, which is hereby made part of this contract. The Contractor shall also require its subcontractors to comply with the FHWA – Form 1273 and include the FHWA – Form 1273 as an attachment to all subcontracts and purchase orders.

### **2. Title VI of the Civil Rights Act of 1964 / Nondiscrimination Requirements**

The Contractor shall comply with Title VI of the Civil Rights Act of 1964 as amended (42 U.S.C. 2000 et seq.), all requirements imposed by the regulations of the United States Department of Transportation (49 CFR Part 21) issued in implementation thereof, and the Title VI Contractor Assurances attached hereto at Exhibit B, all of which are hereby made a part of this Contract.

### **3. Contractor Work Force Utilization (Federal Executive Order 11246) / Equal Employment Opportunity**

- (a) The Contractor shall comply with the Contractor Work Force Utilization (Federal Executive Order 11246) / Equal Employment Opportunity requirements attached at Exhibit C and hereby made part of this Contract, whenever a contractor or subcontractor at any tier performs construction work in excess of \$10,000. These goals shall be included in each contract and subcontract. Goal achievement is calculated for each trade using the hours worked under each trade.
- (b) Companies with contracts, agreements or purchase orders valued at \$10,000 or more will develop and implement an Affirmative Action Plan utilizing the ConnDOT Affirmative Action Plan Guideline. This Plan shall be designed to further the provision of equal employment opportunity to all persons without regard to their race, color, religion, sex or national origin, and to promote the full realization of equal employment opportunity through a positive continuation program. Plans shall be updated as required by ConnDOT.

### **4. Requirements of Title 49, Code of Federal Regulations (CFR), Part 26, Participation by DBEs, as may be revised.**

Pursuant to 49 CFR 26.13, the following paragraph is part of this Contract and shall be included in each subcontract the Contractor enters into with a subcontractor:

“The Contractor, subrecipient or subcontractor shall not discriminate on the basis of race, color, national origin, or sex in the performance of this contract. The Contractor shall carry out applicable requirements of 49 CFR Part 26, Participation by DBEs, in the award and administration of U.S. DOT-assisted contracts. Failure by the Contractor to carry out these requirements is a material breach of this Contract, which may result in the termination of this contract or such other remedy as ConnDOT (recipient) deems appropriate, which may include, but is not limited to: (1) Withholding monthly progress payments, (2) Assessing sanctions, (3) Liquidated damages; and/or, (4) Disqualifying the contractor from future bidding as non-responsible.”



## 5. Contract Wage Rates

The Contractor shall comply with:

The Federal and State wage rate requirements indicated in Exhibits F and G hereof, as revised, are hereby made part of this Contract. The Federal wage rates (Davis-Bacon Act) applicable to this Contract shall be the Federal wage rates that are current on the US Department of Labor website (<http://www.wdol.gov/dba.aspx>) as may be revised 10 days prior to bid opening. These applicable Federal wage rates will be physically incorporated in the final contract document executed by both parties. The Department will no longer physically include revised Federal wage rates in the bid documents or as part of addenda documents, prior to the bid opening date. During the bid advertisement period, bidders are responsible for obtaining the appropriate Federal wage rates from the US Department of Labor website.

To obtain the latest Federal wage rates go to the US Department of Labor website (link above). Under Davis-Bacon Act, choose "Selecting DBA WDs" and follow the instruction to search the latest wage rates for the State, County and Construction Type. Refer to the Notice to Contractor (NTC) - Federal Wage Determinations (Davis Bacon Act).

If a conflict exists between the Federal and State wage rates, the higher rate shall govern.

Prevailing Wages for Work on State Highways; Annual Adjustments. With respect to contracts for work on state highways and bridges on state highways, the Contractor shall comply with the provisions of Section 31-54 and 31-55a of the Connecticut General Statutes, as revised.

As required by Section 1.05.12 (Payrolls) of the State of Connecticut, Department of Transportation's Standard Specification for Roads, Bridges and Incidental Construction (FORM 816), as may be revised, every Contractor or subcontractor performing project work on a Federal aid project is required to post the relevant prevailing wage rates as determined by the United States Secretary of Labor. The wage rate determinations shall be posted in prominent and easily accessible places at the work site.

## 6. Americans with Disabilities Act of 1990, as Amended

This provision applies to those Contractors who are or will be responsible for compliance with the terms of the Americans with Disabilities Act of 1990, as amended (42 U.S.C. 12101 et seq.), (Act), during the term of the Contract. The Contractor represents that it is familiar with the terms of this Act and that it is in compliance with the Act. Failure of the Contractor to satisfy this standard as the same applies to performance under this Contract, either now or during the term of the Contract as it may be amended, will render the Contract voidable at the option of the State upon notice to the contractor. The Contractor warrants that it will hold the State harmless and indemnify the State from any liability which may be imposed upon the State as a result of any failure of the Contractor to be in compliance with this Act, as the same applies to performance under this Contract.

## 7. Connecticut Statutory Labor Requirements

**(a) Construction, Alteration or Repair of Public Works Projects; Wage Rates.** The Contractor shall comply with Section 31-53 of the Connecticut General Statutes, as revised. The wages paid on an hourly basis to any person performing the work of any mechanic, laborer or worker on the work herein contracted to be done and the amount of payment or contribution paid or payable on behalf of each such person to any employee welfare fund, as defined in subsection (i)

of section 31-53 of the Connecticut General Statutes, shall be at a rate equal to the rate customary or prevailing for the same work in the same trade or occupation in the town in which such public works project is being constructed. Any contractor who is not obligated by agreement to make payment or contribution on behalf of such persons to any such employee welfare fund shall pay to each mechanic, laborer or worker as part of such person's wages the amount of payment or contribution for such person's classification on each pay day.

**(b) Debarment List. Limitation on Awarding Contracts.** The Contractor shall comply with Section 31-53a of the Connecticut General Statutes, as revised.

**(c) Construction Safety and Health Course.** The Contractor shall comply with section 31-53b of the Connecticut General Statutes, as revised. The contractor shall furnish proof to the Labor Commissioner with the weekly certified payroll form for the first week each employee begins work on such project that any person performing the work of a mechanic, laborer or worker pursuant to the classifications of labor under section 31-53 of the Connecticut General Statutes, as revised, on such public works project, pursuant to such contract, has completed a course of at least ten hours in duration in construction safety and health approved by the federal Occupational Safety and Health Administration or, has completed a new miner training program approved by the Federal Mine Safety and Health Administration in accordance with 30 CFR 48 or, in the case of telecommunications employees, has completed at least ten hours of training in accordance with 29 CFR 1910.268.

Any employee required to complete a construction safety and health course as required that has not completed the course, shall have a maximum of fourteen (14) days to complete the course. If the employee has not been brought into compliance, they shall be removed from the project until such time as they have completed the required training.

Any costs associated with this notice shall be included in the general cost of the contract. In addition, there shall be no time granted to the contractor for compliance with this notice. The contractor's compliance with this notice and any associated regulations shall not be grounds for claims as outlined in Section 1.11 – "Claims".

**(d) Awarding of Contracts to Occupational Safety and Health Law Violators Prohibited.** The Contract is subject to Section 31-57b of the Connecticut General Statutes, as revised.

**(e) Residents Preference in Work on Other Public Facilities. NOT APPLICABLE TO FEDERAL AID CONTRACTS.** Pursuant to Section 31-52a of the Connecticut General Statutes, as revised, in the employment of mechanics, laborers or workmen to perform the work specified herein, preference shall be given to residents of the state who are, and continuously for at least six months prior to the date hereof have been, residents of this state, and if no such person is available, then to residents of other states

## **8. Tax Liability - Contractor's Exempt Purchase Certificate (CERT – 141)**

The Contractor shall comply with Chapter 219 of the Connecticut General Statutes pertaining to tangible personal property or services rendered that is/are subject to sales tax. The Contractor is responsible for determining its tax liability. If the Contractor purchases materials or supplies pursuant to the Connecticut Department of Revenue Services' "Contractor's Exempt Purchase Certificate (CERT-141)," as may be revised, the Contractor acknowledges and agrees that title to such materials and supplies installed or placed in the project will vest in the State simultaneously with passage of title

from the retailers or vendors thereof, and the Contractor will have no property rights in the materials and supplies purchased.

Forms and instructions are available anytime by:

Internet: Visit the DRS website at [www.ct.gov/DRS](http://www.ct.gov/DRS) to download and print Connecticut tax forms; or Telephone: Call 1-800-382-9463 (Connecticut calls outside the Greater Hartford calling area only) and select Option 2 or call 860-297-4753 (from anywhere).

## 9. Executive Orders

This contract is subject to the provisions of Executive Order No. Three of Governor Thomas J. Meskill, promulgated June 16, 1971, concerning labor employment practices, Executive Order No. Seventeen of Governor Thomas J. Meskill, promulgated February 15, 1973, concerning the listing of employment openings and Executive Order No. Sixteen of Governor John G. Rowland promulgated August 4, 1999, concerning violence in the workplace, all of which are incorporated into and are made a part of the contract as if they had been fully set forth in it. The contract may also be subject to Executive Order No. 14 of Governor M. Jodi Rell, promulgated April 17, 2006, concerning procurement of cleaning products and services and to Executive Order No. 49 of Governor Dannel P. Malloy, promulgated May 22, 2015, mandating disclosure of certain gifts to public employees and contributions to certain candidates for office. If Executive Order No. 14 and/or Executive Order No. 49 are applicable, they are deemed to be incorporated into and are made a part of the contract as if they had been fully set forth in it. At the Contractor's request, the Department shall provide a copy of these orders to the Contractor.

## 10. Non Discrimination Requirement (pursuant to section 4a-60 and 4a-60a of the Connecticut General Statutes, as revised): References to "minority business enterprises" in this Section are not applicable to Federal-aid projects/contracts. Federal-aid projects/contracts are instead subject to the Federal Disadvantaged Business Enterprise Program.

(a) For purposes of this Section, the following terms are defined as follows:

- i. "Commission" means the Commission on Human Rights and Opportunities;
- ii. "Contract" and "contract" include any extension or modification of the Contract or contract;
- iii. "Contractor" and "contractor" include any successors or assigns of the Contractor or contractor;
- iv. "gender identity or expression" means a person's gender-related identity, appearance or behavior, whether or not that gender-related identity, appearance or behavior is different from that traditionally associated with the person's physiology or assigned sex at birth, which gender-related identity can be shown by providing evidence including, but not limited to, medical history, care or treatment of the gender-related identity, consistent and uniform assertion of the gender-related identity or any other evidence that the gender-related identity is sincerely held, part of a person's core identity or not being asserted for an improper purpose.
- v. "good faith" means that degree of diligence which a reasonable person would exercise in the performance of legal duties and obligations;
- vi. "good faith efforts" shall include, but not be limited to, those reasonable initial efforts necessary to comply with statutory or regulatory requirements and additional or substituted efforts when it is determined that such initial efforts will not be sufficient to comply with such requirements;
- vii. "marital status" means being single, married as recognized by the State of Connecticut, widowed, separated or divorced;

- viii. "mental disability" means one or more mental disorders, as defined in the most recent edition of the American Psychiatric Association's "Diagnostic and Statistical Manual of Mental Disorders", or a record of or regarding a person as having one or more such disorders;
- ix. "minority business enterprise" means any small contractor or supplier of materials fifty-one percent or more of the capital stock, if any, or assets of which is owned by a person or persons: (1) who are active in the daily affairs of the enterprise, (2) who have the power to direct the management and policies of the enterprise, and (3) who are members of a minority, as such term is defined in subsection (a) of Connecticut General Statutes § 32-9n; and
- x. "public works contract" means any agreement between any individual, firm or corporation and the State or any political subdivision of the State other than a municipality for construction, rehabilitation, conversion, extension, demolition or repair of a public building, highway or other changes or improvements in real property, or which is financed in whole or in part by the State, including, but not limited to, matching expenditures, grants, loans, insurance or guarantees.

For purposes of this Section, the terms "Contract" and "contract" do not include a contract where each contractor is (1) a political subdivision of the State, including, but not limited to, a municipality, (2) a quasi-public agency, as defined in Conn. Gen. Stat. Section 1-120, (3) any other state, including but not limited to any federally recognized Indian tribal governments, as defined in Conn. Gen. Stat. Section 1-267, (4) the federal government, (5) a foreign government, or (6) an agency of a subdivision, agency, state or government described in the immediately preceding enumerated items (1), (2), (3), (4) or (5).

- (b) (1) The Contractor agrees and warrants that in the performance of the Contract such Contractor will not discriminate or permit discrimination against any person or group of persons on the grounds of race, color, religious creed, age, marital status, national origin, ancestry, sex, gender identity or expression, intellectual disability, mental disability or physical disability, including, but not limited to, blindness, unless it is shown by such Contractor that such disability prevents performance of the work involved, in any manner prohibited by the laws of the United States or of the State of Connecticut; and the Contractor further agrees to take affirmative action to insure that applicants with job-related qualifications are employed and that employees are treated when employed without regard to their race, color, religious creed, age, marital status, national origin, ancestry, sex, gender identity or expression, intellectual disability, mental disability or physical disability, including, but not limited to, blindness, unless it is shown by the Contractor that such disability prevents performance of the work involved; (2) the Contractor agrees, in all solicitations or advertisements for employees placed by or on behalf of the Contractor, to state that it is an "affirmative action-equal opportunity employer" in accordance with regulations adopted by the Commission; (3) the Contractor agrees to provide each labor union or representative of workers with which the Contractor has a collective bargaining Agreement or other contract or understanding and each vendor with which the Contractor has a contract or understanding, a notice to be provided by the Commission, advising the labor union or workers' representative of the Contractor's commitments under this section and to post copies of the notice in conspicuous places available to employees and applicants for employment; (4) the Contractor agrees to comply with each provision of this Section and Connecticut General Statutes §§ 46a-68e and 46a-68f and with each regulation or relevant order issued by said Commission pursuant to Connecticut General Statutes §§ 46a-56, 46a-68e and 46a-68f; and (5) the Contractor agrees to provide the Commission on Human Rights and Opportunities with such information requested by the Commission, and permit access to pertinent books, records and accounts, concerning the

employment practices and procedures of the Contractor as relate to the provisions of this Section and Connecticut General Statutes § 46a-56. If the contract is a public works contract, the Contractor agrees and warrants that he will make good faith efforts to employ minority business enterprises as subcontractors and suppliers of materials on such public works projects.

- (c) Determination of the Contractor's good faith efforts shall include, but shall not be limited to, the following factors: The Contractor's employment and subcontracting policies, patterns and practices; affirmative advertising, recruitment and training; technical assistance activities and such other reasonable activities or efforts as the Commission may prescribe that are designed to ensure the participation of minority business enterprises in public works projects.
- (d) The Contractor shall develop and maintain adequate documentation, in a manner prescribed by the Commission, of its good faith efforts.
- (e) The Contractor shall include the provisions of subsection (b) of this Section in every subcontract or purchase order entered into in order to fulfill any obligation of a contract with the State and such provisions shall be binding on a subcontractor, vendor or manufacturer unless exempted by regulations or orders of the Commission. The Contractor shall take such action with respect to any such subcontract or purchase order as the Commission may direct as a means of enforcing such provisions including sanctions for noncompliance in accordance with Connecticut General Statutes §46a-56; provided if such Contractor becomes involved in, or is threatened with, litigation with a subcontractor or vendor as a result of such direction by the Commission, the Contractor may request the State of Connecticut to enter into any such litigation or negotiation prior thereto to protect the interests of the State and the State may so enter.
- (f) The Contractor agrees to comply with the regulations referred to in this Section as they exist on the date of this Contract and as they may be adopted or amended from time to time during the term of this Contract and any amendments thereto.
- (g) (1) The Contractor agrees and warrants that in the performance of the Contract such Contractor will not discriminate or permit discrimination against any person or group of persons on the grounds of sexual orientation, in any manner prohibited by the laws of the United States or the State of Connecticut, and that employees are treated when employed without regard to their sexual orientation; (2) the Contractor agrees to provide each labor union or representative of workers with which such Contractor has a collective bargaining Agreement or other contract or understanding and each vendor with which such Contractor has a contract or understanding, a notice to be provided by the Commission on Human Rights and Opportunities advising the labor union or workers' representative of the Contractor's commitments under this section, and to post copies of the notice in conspicuous places available to employees and applicants for employment; (3) the Contractor agrees to comply with each provision of this section and with each regulation or relevant order issued by said Commission pursuant to Connecticut General Statutes § 46a-56; and (4) the Contractor agrees to provide the Commission on Human Rights and Opportunities with such information requested by the Commission, and permit access to pertinent books, records and accounts, concerning the employment practices and procedures of the Contractor which relate to the provisions of this Section and Connecticut General Statutes § 46a-56.
- (h) The Contractor shall include the provisions of the foregoing paragraph in every subcontract or purchase order entered into in order to fulfill any obligation of a contract with the State and such provisions shall be binding on a subcontractor, vendor or manufacturer unless exempted by

regulations or orders of the Commission. The Contractor shall take such action with respect to any such subcontract or purchase order as the Commission may direct as a means of enforcing such provisions including sanctions for noncompliance in accordance with Connecticut General Statutes § 46a-56; provided, if such Contractor becomes involved in, or is threatened with, litigation with a subcontractor or vendor as a result of such direction by the Commission, the Contractor may request the State of Connecticut to enter into any such litigation or negotiation prior thereto to protect the interests of the State and the State may so enter.”

The Nondiscrimination Certifications can be found at the Office of Policy and Management website.

<http://www.ct.gov/opm/cwp/view.asp?a=2982&Q=390928>

## 11. Whistleblower Provision

The following clause is applicable if the Contract has a value of Five Million Dollars (\$5,000,000) or more.

**Whistleblowing.** This Contract may be subject to the provisions of Section 4-61dd of the Connecticut General Statutes. In accordance with this statute, if an officer, employee or appointing authority of the Contractor takes or threatens to take any personnel action against any employee of the Contractor in retaliation for such employee's disclosure of information to any employee of the contracting state or quasi-public agency or the Auditors of Public Accounts or the Attorney General under the provisions of subsection (a) of such statute, the Contractor shall be liable for a civil penalty of not more than five thousand dollars for each offense, up to a maximum of twenty per cent of the value of this Contract. Each violation shall be a separate and distinct offense and in the case of a continuing violation, each calendar day's continuance of the violation shall be deemed to be a separate and distinct offense. The State may request that the Attorney General bring a civil action in the Superior Court for the Judicial District of Hartford to seek imposition and recovery of such civil penalty. In accordance with subsection (f) of such statute, each large state contractor, as defined in the statute, shall post a notice of the provisions of the statute relating to large state contractors in a conspicuous place which is readily available for viewing by the employees of the Contractor.

## 12. Connecticut Freedom of Information Act

**(a) Disclosure of Records.** This Contract may be subject to the provisions of section 1-218 of the Connecticut General Statutes. In accordance with this statute, each contract in excess of two million five hundred thousand dollars between a public agency and a person for the performance of a governmental function shall (a) provide that the public agency is entitled to receive a copy of records and files related to the performance of the governmental function, and (b) indicate that such records and files are subject to FOIA and may be disclosed by the public agency pursuant to FOIA. No request to inspect or copy such records or files shall be valid unless the request is made to the public agency in accordance with FOIA. Any complaint by a person who is denied the right to inspect or copy such records or files shall be brought to the Freedom of Information Commission in accordance with the provisions of sections 1-205 and 1-206 of the Connecticut General Statutes.

**(b) Confidential Information.** The State will afford due regard to the Contractor's request for the protection of proprietary or confidential information which the State receives from the Contractor. However, all materials associated with the Contract are subject to the terms of the FOIA and all corresponding rules, regulations and interpretations. In making such a request, the Contractor may not merely state generally that the materials are proprietary or confidential in nature and not, therefore, subject to release to third parties. Those particular sentences, paragraphs, pages or sections that the Contractor believes are exempt from disclosure under the FOIA must be specifically identified as such. Convincing explanation

and rationale sufficient to justify each exemption consistent with the FOIA must accompany the request. The rationale and explanation must be stated in terms of the prospective harm to the competitive position of the Contractor that would result if the identified material were to be released and the reasons why the materials are legally exempt from release pursuant to the FOIA. To the extent that any other provision or part of the Contract conflicts or is in any way inconsistent with this section, this section controls and shall apply and the conflicting provision or part shall not be given effect. If the Contractor indicates that certain documentation is submitted in confidence, by specifically and clearly marking the documentation as "CONFIDENTIAL," DOT will first review the Contractor's claim for consistency with the FOIA (that is, review that the documentation is actually a trade secret or commercial or financial information and not required by statute), and if determined to be consistent, will endeavor to keep such information confidential to the extent permitted by law. See, *e.g.*, Conn. Gen. Stat. §1-210(b)(5)(A-B). The State, however, has no obligation to initiate, prosecute or defend any legal proceeding or to seek a protective order or other similar relief to prevent disclosure of any information that is sought pursuant to a FOIA request. Should the State withhold such documentation from a Freedom of Information requester and a complaint be brought to the Freedom of Information Commission, the Contractor shall have the burden of cooperating with DOT in defense of that action and in terms of establishing the availability of any FOIA exemption in any proceeding where it is an issue. In no event shall the State have any liability for the disclosure of any documents or information in its possession which the State believes are required to be disclosed pursuant to the FOIA or other law.

### **13. Service of Process**

The Contractor, if not a resident of the State of Connecticut, or, in the case of a partnership, the partners, if not residents, hereby appoints the Secretary of State of the State of Connecticut, and his successors in office, as agent for service of process for any action arising out of or as a result of this Contract; such appointment to be in effect throughout the life of this Contract and six (6) years thereafter.

### **14. Substitution of Securities for Retainages on State Contracts and Subcontracts**

This Contract is subject to the provisions of Section 3-112a of the General Statutes of the State of Connecticut, as revised.

### **15. Health Insurance Portability and Accountability Act of 1996 (HIPAA)**

The Contractor shall comply, if applicable, with the Health Insurance Portability and Accountability Act of 1996 and, pursuant thereto, the provisions attached at Exhibit D, and hereby made part of this Contract.

### **16. Forum and Choice of Law**

Forum and Choice of Law. The parties deem the Contract to have been made in the City of Hartford, State of Connecticut. Both parties agree that it is fair and reasonable for the validity and construction of the Contract to be, and it shall be, governed by the laws and court decisions of the State of Connecticut, without giving effect to its principles of conflicts of laws. To the extent that any immunities provided by Federal law or the laws of the State of Connecticut do not bar an action against the State, and to the extent that these courts are courts of competent jurisdiction, for the purpose of venue, the complaint shall be made returnable to the Judicial District of Hartford only or shall be

brought in the United States District Court for the District of Connecticut only, and shall not be transferred to any other court, provided, however, that nothing here constitutes a waiver or compromise of the sovereign immunity of the State of Connecticut. The Contractor waives any objection which it may now have or will have to the laying of venue of any Claims in any forum and further irrevocably submits to such jurisdiction in any suit, action or proceeding.

### **17. Summary of State Ethics Laws**

Pursuant to the requirements of section 1-101qq of the Connecticut General Statutes, the summary of State ethics laws developed by the State Ethics Commission pursuant to section 1-81b of the Connecticut General Statutes is incorporated by reference into and made a part of the Contract as if the summary had been fully set forth in the Contract.

### **18. Audit and Inspection of Plants, Places of Business and Records**

- (a) The State and its agents, including, but not limited to, the Connecticut Auditors of Public Accounts, Attorney General and State's Attorney and their respective agents, may, at reasonable hours, inspect and examine all of the parts of the Contractor's and Contractor Parties' plants and places of business which, in any way, are related to, or involved in, the performance of this Contract. For the purposes of this Section, "Contractor Parties" means the Contractor's members, directors, officers, shareholders, partners, managers, principal officers, representatives, agents, servants, consultants, employees or any one of them or any other person or entity with whom the Contractor is in privity of oral or written contract and the Contractor intends for such other person or entity to Perform under the Contract in any capacity.
- (b) The Contractor shall maintain, and shall require each of the Contractor Parties to maintain, accurate and complete Records. The Contractor shall make all of its and the Contractor Parties' Records available at all reasonable hours for audit and inspection by the State and its agents.
- (c) The State shall make all requests for any audit or inspection in writing and shall provide the Contractor with at least twenty-four (24) hours' notice prior to the requested audit and inspection date. If the State suspects fraud or other abuse, or in the event of an emergency, the State is not obligated to provide any prior notice.
- (d) The Contractor shall keep and preserve or cause to be kept and preserved all of its and Contractor Parties' Records until three (3) years after the latter of (i) final payment under this Agreement, or (ii) the expiration or earlier termination of this Agreement, as the same may be modified for any reason. The State may request an audit or inspection at any time during this period. If any Claim or audit is started before the expiration of this period, the Contractor shall retain or cause to be retained all Records until all Claims or audit findings have been resolved.
- (e) The Contractor shall cooperate fully with the State and its agents in connection with an audit or inspection. Following any audit or inspection, the State may conduct and the Contractor shall cooperate with an exit conference.
- (f) The Contractor shall incorporate this entire Section verbatim into any contract or other agreement that it enters into with any Contractor Party.

### **19. Campaign Contribution Restriction**

For all State contracts, defined in Conn. Gen. Stat. §9-612(f)(1) as having a value in a calendar year of \$50,000 or more, or a combination or series of such agreements or contracts having a value of \$100,000 or more, the authorized signatory to this contract expressly acknowledges receipt of the State Elections Enforcement Commission's notice advising state contractors of state campaign contribution and solicitation prohibitions, and will inform its principals of the contents of the notice, as set forth in "Notice to Executive Branch State Contractors and Prospective State Contractors of Campaign Contribution and Solicitation Limitations," a copy of which is attached hereto and hereby made a part of this contract, attached as Exhibit E.



## 20. Tangible Personal Property

- (a) The Contractor on its behalf and on behalf of its Affiliates, as defined below, shall comply with the provisions of Conn. Gen. Stat. §12-411b, as follows:
- (1) For the term of the Contract, the Contractor and its Affiliates shall collect and remit to the State of Connecticut, Department of Revenue Services, any Connecticut use tax due under the provisions of Chapter 219 of the Connecticut General Statutes for items of tangible personal property sold by the Contractor or by any of its Affiliates in the same manner as if the Contractor and such Affiliates were engaged in the business of selling tangible personal property for use in Connecticut and had sufficient nexus under the provisions of Chapter 219 to be required to collect Connecticut use tax;
  - (2) A customer's payment of a use tax to the Contractor or its Affiliates relieves the customer of liability for the use tax;
  - (3) The Contractor and its Affiliates shall remit all use taxes they collect from customers on or before the due date specified in the Contract, which may not be later than the last day of the month next succeeding the end of a calendar quarter or other tax collection period during which the tax was collected;
  - (4) The Contractor and its Affiliates are not liable for use tax billed by them but not paid to them by a customer; and
  - (5) Any Contractor or Affiliate who fails to remit use taxes collected on behalf of its customers by the due date specified in the Contract shall be subject to the interest and penalties provided for persons required to collect sales tax under chapter 219 of the general statutes.
- (b) For purposes of this section of the Contract, the word "Affiliate" means any person, as defined in section 12-1 of the general statutes, that controls, is controlled by, or is under common control with another person. A person controls another person if the person owns, directly or indirectly, more than ten per cent of the voting securities of the other person. The word "voting security" means a security that confers upon the holder the right to vote for the election of members of the board of directors or similar governing body of the business, or that is convertible into, or entitles the holder to receive, upon its exercise, a security that confers such a right to vote. "Voting security" includes a general partnership interest.
- (c) The Contractor represents and warrants that each of its Affiliates has vested in the Contractor plenary authority to so bind the Affiliates in any agreement with the State of Connecticut. The Contractor on its own behalf and on behalf of its Affiliates shall also provide, no later than 30 days after receiving a request by the State's contracting authority, such information as the State may require to ensure, in the State's sole determination, compliance with the provisions of Chapter 219 of the Connecticut General Statutes, including, but not limited to, §12-411b.

## 21. Bid Rigging and/or Fraud – Notice to Contractor

The Connecticut Department of Transportation is cooperating with the U.S. Department of Transportation and the Justice Department in their investigation into highway construction contract bid rigging and/or fraud.

A toll-free "HOT LINE" telephone number 800-424-9071 has been established to receive information from contractors, subcontractors, manufacturers, suppliers or anyone with knowledge of bid rigging and/or fraud, either past or current. The "HOT LINE" telephone number will be available during normal working hours (8:00 am – 5:00 pm EST). Information will be treated confidentially and anonymity respected.

## 22. Consulting Agreement Affidavit

The Contractor shall comply with Connecticut General Statutes Section 4a-81(a) and 4a-81(b), as revised. Pursuant to Public Act 11-229, after the initial submission of the form, if there is a change in the information contained in the form, a contractor shall submit the updated form, as applicable, either

(i) not later than thirty (30) days after the effective date of such change or (ii) prior to execution of any new contract, whichever is earlier.

The Affidavit/Form may be submitted in written format or electronic format through the Department of Administrative Services (DAS) website.

### **23. Cargo Preference Act Requirements (46 CFR 381.7(a)-(b)) – Use of United States Flag Vessels**

The Contractor agrees to comply with the following:

(a) ***Agreement Clauses.***

- (1) Pursuant to Pub. L. 664 ([43 U.S.C. 1241\(b\)](#)) at least 50 percent of any equipment, materials or commodities procured, contracted for or otherwise obtained with funds granted, guaranteed, loaned, or advanced by the U.S. Government under this agreement, and which may be transported by ocean vessel, shall be transported on privately owned United States-flag commercial vessels, if available.
- (2) Within 20 days following the date of loading for shipments originating within the United States or within 30 working days following the date of loading for shipments originating outside the United States, a legible copy of a rated, ‘on-board’ commercial ocean bill-of-lading in English for each shipment of cargo described in paragraph (a)(1) of this section shall be furnished to both the Contracting Officer (through the prime contractor in the case of subcontractor bills-of-lading) and to the Division of National Cargo, Office of Market Development, Maritime Administration, Washington, DC 20590.

(b) ***Contractor and Subcontractor Clauses.*** The contractor agrees—

- (1) To utilize privately owned United States-flag commercial vessels to ship at least 50 percent of the gross tonnage (computed separately for dry bulk carriers, dry cargo liners, and tankers) involved, whenever shipping any equipment, material, or commodities pursuant to this contract, to the extent such vessels are available at fair and reasonable rates for United States-flag commercial vessels.
- (2) To furnish within 20 days following the date of loading for shipments originating within the United States or within 30 working days following the date of loading for shipments originating outside the United States, a legible copy of a rated, ‘on-board’ commercial ocean bill-of-lading in English for each shipment of cargo described in paragraph (b) (1) of this section to both the Contracting Officer (through the prime contractor in the case of subcontractor bills-of-lading) and to the Division of National Cargo, Office of Market Development, Maritime Administration, Washington, DC 20590.
- (3) To insert the substance of the provisions of this clause in all subcontracts issued pursuant to this contract.

**EXHIBIT A**

FHWA-1273 -- Revised May 1, 2012

**REQUIRED CONTRACT PROVISIONS  
FEDERAL-AID CONSTRUCTION CONTRACTS**

- I. General
- II. Nondiscrimination
- III. Nonsegregated Facilities
- IV. Davis-Bacon and Related Act Provisions
- V. Contract Work Hours and Safety Standards Act Provisions
- VI. Subletting or Assigning the Contract
- VII. Safety: Accident Prevention
- VIII. False Statements Concerning Highway Projects
- IX. Implementation of Clean Air Act and Federal Water Pollution Control Act
- X. Compliance with Governmentwide Suspension and Debarment Requirements
- XI. Certification Regarding Use of Contract Funds for Lobbying

**I. GENERAL**

1. Form FHWA-1273 must be physically incorporated in each construction contract funded under Title 23 (excluding emergency contracts solely intended for debris removal). The contractor (or subcontractor) must insert this form in each subcontract and further require its inclusion in all lower tier subcontracts (excluding purchase orders, rental agreements and other agreements for supplies or services).

The applicable requirements of Form FHWA-1273 are incorporated by reference for work done under any purchase order, rental agreement or agreement for other services. The prime contractor shall be responsible for compliance by any subcontractor, lower-tier subcontractor or service provider.

Form FHWA-1273 must be included in all Federal-aid design-build contracts, in all subcontracts and in lower tier subcontracts (excluding subcontracts for design services, purchase orders, rental agreements and other agreements for supplies or services). The design-builder shall be responsible for compliance by any subcontractor, lower-tier subcontractor or service provider.

Contracting agencies may reference Form FHWA-1273 in bid proposal or request for proposal documents, however, the Form FHWA-1273 must be physically incorporated (not referenced) in all contracts, subcontracts and lower-tier subcontracts (excluding purchase orders, rental agreements and other agreements for supplies or services related to a construction contract).

2. Subject to the applicability criteria noted in the following sections, these contract provisions shall apply to all work performed on the contract by the contractor's own organization and with the assistance of workers under the contractor's immediate superintendence and to all work performed on the contract by piecework, station work, or by subcontract.

3. A breach of any of the stipulations contained in these Required Contract Provisions may be sufficient grounds for withholding of progress payments, withholding of final payment, termination of the contract, suspension / debarment or any other action determined to be appropriate by the contracting agency and FHWA.

4. Selection of Labor: During the performance of this contract, the contractor shall not use convict labor for any purpose within the limits of a construction project on a Federal-aid highway unless it is labor performed by convicts who are on parole, supervised release, or probation. The term Federal-aid highway does not include roadways functionally classified as local roads or rural minor collectors.

## II. NONDISCRIMINATION

The provisions of this section related to 23 CFR Part 230 are applicable to all Federal-aid construction contracts and to all related construction subcontracts of \$10,000 or more. The provisions of 23 CFR Part 230 are not applicable to material supply, engineering, or architectural service contracts.

In addition, the contractor and all subcontractors must comply with the following policies: Executive Order 11246, 41 CFR 60, 29 CFR 1625-1627, Title 23 USC Section 140, the Rehabilitation Act of 1973, as amended (29 USC 794), Title VI of the Civil Rights Act of 1964, as amended, and related regulations including 49 CFR Parts 21, 26 and 27; and 23 CFR Parts 200, 230, and 633.

The contractor and all subcontractors must comply with: the requirements of the Equal Opportunity Clause in 41 CFR 60-1.4(b) and, for all construction contracts exceeding \$10,000, the Standard Federal Equal Employment Opportunity Construction Contract Specifications in 41 CFR 60-4.3.

Note: The U.S. Department of Labor has exclusive authority to determine compliance with Executive Order 11246 and the policies of the Secretary of Labor including 41 CFR 60, and 29 CFR 1625-1627. The contracting agency and the FHWA have the authority and the responsibility to ensure compliance with Title 23 USC Section 140, the Rehabilitation Act of 1973, as amended (29 USC 794), and Title VI of the Civil Rights Act of 1964, as amended, and related regulations including 49 CFR Parts 21, 26 and 27; and 23 CFR Parts 200, 230, and 633.

The following provision is adopted from 23 CFR 230, Appendix A, with appropriate revisions to conform to the U.S. Department of Labor (US DOL) and FHWA requirements.

**1. Equal Employment Opportunity:** Equal employment opportunity (EEO) requirements not to discriminate and to take affirmative action to assure equal opportunity as set forth under laws, executive orders, rules, regulations (28 CFR 35, 29 CFR 1630, 29 CFR 1625-1627, 41 CFR 60 and 49 CFR 27) and orders of the Secretary of Labor as modified by the provisions prescribed herein, and imposed pursuant to 23 U.S.C. 140 shall constitute the EEO and specific affirmative action standards for the contractor's project activities under this contract. The provisions of the Americans with Disabilities Act of 1990 (42 U.S.C. 12101 et seq.) set forth under 28 CFR 35 and 29 CFR 1630 are incorporated by reference in this contract. In the execution of this contract, the contractor agrees to comply with the following minimum specific requirement activities of EEO:

a. The contractor will work with the contracting agency and the Federal Government to ensure that it has made every good faith effort to provide equal opportunity with respect to all of its terms and conditions of employment and in their review of activities under the contract.

b. The contractor will accept as its operating policy the following statement:

"It is the policy of this Company to assure that applicants are employed, and that employees are treated during employment, without regard to their race, religion, sex, color, national origin, age or disability. Such action shall include: employment, upgrading, demotion, or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship, pre-apprenticeship, and/or on-the-job training."

**2. EEO Officer:** The contractor will designate and make known to the contracting officers an EEO Officer who will have the responsibility for and must be capable of effectively administering and promoting an active EEO program and who must be assigned adequate authority and responsibility to do so.

**3. Dissemination of Policy:** All members of the contractor's staff who are authorized to hire, supervise, promote, and discharge employees, or who recommend such action, or who are substantially involved in such action, will be made fully cognizant of, and will implement, the contractor's EEO policy and contractual responsibilities to provide EEO in each grade and classification of employment. To ensure that the above agreement will be met, the following actions will be taken as a minimum:

a. Periodic meetings of supervisory and personnel office employees will be conducted before the start of work and then not less often than once every six months, at which time the contractor's EEO policy and its implementation will be reviewed and explained. The meetings will be conducted by the EEO Officer.

b. All new supervisory or personnel office employees will be given a thorough indoctrination by the EEO Officer, covering all major aspects of the contractor's EEO obligations within thirty days following their reporting for duty with the contractor.

c. All personnel who are engaged in direct recruitment for the project will be instructed by the EEO Officer in the contractor's procedures for locating and hiring minorities and women.

d. Notices and posters setting forth the contractor's EEO policy will be placed in areas readily accessible to employees, applicants for employment and potential employees.

e. The contractor's EEO policy and the procedures to implement such policy will be brought to the attention of employees by means of meetings, employee handbooks, or other appropriate means.

**4. Recruitment:** When advertising for employees, the contractor will include in all advertisements for employees the notation: "An Equal Opportunity Employer." All such advertisements will be placed in publications having a large circulation among minorities and women in the area from which the project work force would normally be derived.

a. The contractor will, unless precluded by a valid bargaining agreement, conduct systematic and direct recruitment through public and private employee referral sources likely to yield qualified minorities and women. To meet this requirement, the contractor will identify sources of potential minority group employees, and establish with such identified sources procedures whereby minority and women applicants may be referred to the contractor for employment consideration.

b. In the event the contractor has a valid bargaining agreement providing for exclusive hiring hall referrals, the contractor is expected to observe the provisions of that agreement to the extent that the system meets the contractor's compliance with EEO contract provisions. Where implementation of

such an agreement has the effect of discriminating against minorities or women, or obligates the contractor to do the same, such implementation violates Federal nondiscrimination provisions.

c. The contractor will encourage its present employees to refer minorities and women as applicants for employment. Information and procedures with regard to referring such applicants will be discussed with employees.

**5. Personnel Actions:** Wages, working conditions, and employee benefits shall be established and administered, and personnel actions of every type, including hiring, upgrading, promotion, transfer, demotion, layoff, and termination, shall be taken without regard to race, color, religion, sex, national origin, age or disability. The following procedures shall be followed:

a. The contractor will conduct periodic inspections of project sites to insure that working conditions and employee facilities do not indicate discriminatory treatment of project site personnel.

b. The contractor will periodically evaluate the spread of wages paid within each classification to determine any evidence of discriminatory wage practices.

c. The contractor will periodically review selected personnel actions in depth to determine whether there is evidence of discrimination. Where evidence is found, the contractor will promptly take corrective action. If the review indicates that the discrimination may extend beyond the actions reviewed, such corrective action shall include all affected persons.

d. The contractor will promptly investigate all complaints of alleged discrimination made to the contractor in connection with its obligations under this contract, will attempt to resolve such complaints, and will take appropriate corrective action within a reasonable time. If the investigation indicates that the discrimination may affect persons other than the complainant, such corrective action shall include such other persons. Upon completion of each investigation, the contractor will inform every complainant of all of their avenues of appeal.

**6. Training and Promotion:**

a. The contractor will assist in locating, qualifying, and increasing the skills of minorities and women who are applicants for employment or current employees. Such efforts should be aimed at developing full journey level status employees in the type of trade or job classification involved.

b. Consistent with the contractor's work force requirements and as permissible under Federal and State regulations, the contractor shall make full use of training programs, i.e., apprenticeship, and on-the-job training programs for the geographical area of contract performance. In the event a special provision for training is provided under this contract, this subparagraph will be superseded as indicated in the special provision. The contracting agency may reserve training positions for persons who receive welfare assistance in accordance with 23 U.S.C. 140(a).

c. The contractor will advise employees and applicants for employment of available training programs and entrance requirements for each.

d. The contractor will periodically review the training and promotion potential of employees who are minorities and women and will encourage eligible employees to apply for such training and promotion.

**7. Unions:** If the contractor relies in whole or in part upon unions as a source of employees, the contractor will use good faith efforts to obtain the cooperation of such unions to increase opportunities for minorities and women. Actions by the contractor, either directly or through a contractor's association acting as agent, will include the procedures set forth below:

a. The contractor will use good faith efforts to develop, in cooperation with the unions, joint training programs aimed toward qualifying more minorities and women for membership in the unions and increasing the skills of minorities and women so that they may qualify for higher paying employment.

b. The contractor will use good faith efforts to incorporate an EEO clause into each union agreement to the end that such union will be contractually bound to refer applicants without regard to their race, color, religion, sex, national origin, age or disability.

c. The contractor is to obtain information as to the referral practices and policies of the labor union except that to the extent such information is within the exclusive possession of the labor union and such labor union refuses to furnish such information to the contractor, the contractor shall so certify to the contracting agency and shall set forth what efforts have been made to obtain such information.

d. In the event the union is unable to provide the contractor with a reasonable flow of referrals within the time limit set forth in the collective bargaining agreement, the contractor will, through independent recruitment efforts, fill the employment vacancies without regard to race, color, religion, sex, national origin, age or disability; making full efforts to obtain qualified and/or qualifiable minorities and women. The failure of a union to provide sufficient referrals (even though it is obligated to provide exclusive referrals under the terms of a collective bargaining agreement) does not relieve the contractor from the requirements of this paragraph. In the event the union referral practice prevents the contractor from meeting the obligations pursuant to Executive Order 11246, as amended, and these special provisions, such contractor shall immediately notify the contracting agency.

**8. Reasonable Accommodation for Applicants / Employees with Disabilities:** The contractor must be familiar with the requirements for and comply with the Americans with Disabilities Act and all rules and regulations established there under. Employers must provide reasonable accommodation in all employment activities unless to do so would cause an undue hardship.

**9. Selection of Subcontractors, Procurement of Materials and Leasing of Equipment:** The contractor shall not discriminate on the grounds of race, color, religion, sex, national origin, age or disability in the selection and retention of subcontractors, including procurement of materials and leases of equipment. The contractor shall take all necessary and reasonable steps to ensure nondiscrimination in the administration of this contract.

a. The contractor shall notify all potential subcontractors and suppliers and lessors of their EEO obligations under this contract.

b. The contractor will use good faith efforts to ensure subcontractor compliance with their EEO obligations.

**10. Assurance Required by 49 CFR 26.13(b):**

a. The requirements of 49 CFR Part 26, and the State DOT's U.S. DOT-approved DBE program are incorporated by reference.

b. The contractor or subcontractor shall not discriminate on the basis of race, color, national origin, or sex in the performance of this contract. The contractor shall carry out applicable requirements of 49 CFR Part 26, in the award and administration of DOT-assisted contracts. Failure by the contractor to carry out these requirements is a material breach of this contract, which may result in the termination of this contract or such other remedy as the contracting agency deems appropriate.

**11. Records and Reports:** The contractor shall keep such records as necessary to document compliance with the EEO requirements. Such records shall be retained for a period of three years following the date of the final payment to the contractor for all contract work and shall be available at reasonable times and places for inspection by authorized representatives of the contracting agency and the FHWA.

a. The records kept by the contractor shall document the following:

(1) The number and work hours of minority and non-minority group members and women employed in each work classification on the project;

(2) The progress and efforts being made in cooperation with unions, when applicable, to increase employment opportunities for minorities and women; and

(3) The progress and efforts being made in locating, hiring, training, qualifying, and upgrading minorities and women;

b. The contractors and subcontractors will submit an annual report to the contracting agency each July for the duration of the project, indicating the number of minority, women, and non-minority group employees currently engaged in each work classification required by the contract work. This information is to be reported on [Form FHWA-1391](#). The staffing data should represent the project work force on board in all or any part of the last payroll period preceding the end of July. If on-the-job training is being required by special provision, the contractor will be required to collect and report training data. The employment data should reflect the work force on board during all or any part of the last payroll period preceding the end of July.

### III. NONSEGREGATED FACILITIES

This provision is applicable to all Federal-aid construction contracts and to all related construction subcontracts of \$10,000 or more.

The contractor must ensure that facilities provided for employees are provided in such a manner that segregation on the basis of race, color, religion, sex, or national origin cannot result. The contractor may neither require such segregated use by written or oral policies nor tolerate such use by employee custom. The contractor's obligation extends further to ensure that its employees are not assigned to perform their services at any location, under the contractor's control, where the facilities are segregated. The term "facilities" includes waiting rooms, work areas, restaurants and other eating areas, time clocks, restrooms, washrooms, locker rooms, and other storage or dressing areas, parking lots, drinking fountains, recreation or entertainment areas, transportation, and housing provided for employees. The contractor shall provide separate or single-user restrooms and necessary dressing or sleeping areas to assure privacy between sexes.



#### IV. DAVIS-BACON AND RELATED ACT PROVISIONS

This section is applicable to all Federal-aid construction projects exceeding \$2,000 and to all related subcontracts and lower-tier subcontracts (regardless of subcontract size). The requirements apply to all projects located within the right-of-way of a roadway that is functionally classified as Federal-aid highway. This excludes roadways functionally classified as local roads or rural minor collectors, which are exempt. Contracting agencies may elect to apply these requirements to other projects.

The following provisions are from the U.S. Department of Labor regulations in 29 CFR 5.5 “Contract provisions and related matters” with minor revisions to conform to the FHWA-1273 format and FHWA program requirements.

##### 1. Minimum wages

a. All laborers and mechanics employed or working upon the site of the work, will be paid unconditionally and not less often than once a week, and without subsequent deduction or rebate on any account (except such payroll deductions as are permitted by regulations issued by the Secretary of Labor under the Copeland Act (29 CFR part 3)), the full amount of wages and bona fide fringe benefits (or cash equivalents thereof) due at time of payment computed at rates not less than those contained in the wage determination of the Secretary of Labor which is attached hereto and made a part hereof, regardless of any contractual relationship which may be alleged to exist between the contractor and such laborers and mechanics.

Contributions made or costs reasonably anticipated for bona fide fringe benefits under section 1(b)(2) of the Davis-Bacon Act on behalf of laborers or mechanics are considered wages paid to such laborers or mechanics, subject to the provisions of paragraph 1.d. of this section; also, regular contributions made or costs incurred for more than a weekly period (but not less often than quarterly) under plans, funds, or programs which cover the particular weekly period, are deemed to be constructively made or incurred during such weekly period. Such laborers and mechanics shall be paid the appropriate wage rate and fringe benefits on the wage determination for the classification of work actually performed, without regard to skill, except as provided in 29 CFR 5.5(a)(4). Laborers or mechanics performing work in more than one classification may be compensated at the rate specified for each classification for the time actually worked therein: Provided, That the employer's payroll records accurately set forth the time spent in each classification in which work is performed. The wage determination (including any additional classification and wage rates conformed under paragraph 1.b. of this section) and the Davis-Bacon poster (WH-1321) shall be posted at all times by the contractor and its subcontractors at the site of the work in a prominent and accessible place where it can be easily seen by the workers.

b. (1) The contracting officer shall require that any class of laborers or mechanics, including helpers, which is not listed in the wage determination and which is to be employed under the contract shall be classified in conformance with the wage determination. The contracting officer shall approve an additional classification and wage rate and fringe benefits therefore only when the following criteria have been met:

(i) The work to be performed by the classification requested is not performed by a classification in the wage determination; and

(ii) The classification is utilized in the area by the construction industry; and

(iii) The proposed wage rate, including any bona fide fringe benefits, bears a reasonable relationship to the wage rates contained in the wage determination.

(2) If the contractor and the laborers and mechanics to be employed in the classification (if known), or their representatives, and the contracting officer agree on the classification and wage rate (including the amount designated for fringe benefits where appropriate), a report of the action taken shall be sent by the contracting officer to the Administrator of the Wage and Hour Division, Employment Standards Administration, U.S. Department of Labor, Washington, DC 20210. The Administrator, or an authorized representative, will approve, modify, or disapprove every additional classification action within 30 days of receipt and so advise the contracting officer or will notify the contracting officer within the 30-day period that additional time is necessary.

(3) In the event the contractor, the laborers or mechanics to be employed in the classification or their representatives, and the contracting officer do not agree on the proposed classification and wage rate (including the amount designated for fringe benefits, where appropriate), the contracting officer shall refer the questions, including the views of all interested parties and the recommendation of the contracting officer, to the Wage and Hour Administrator for determination. The Wage and Hour Administrator, or an authorized representative, will issue a determination within 30 days of receipt and so advise the contracting officer or will notify the contracting officer within the 30-day period that additional time is necessary.

(4) The wage rate (including fringe benefits where appropriate) determined pursuant to paragraphs 1.b.(2) or 1.b.(3) of this section, shall be paid to all workers performing work in the classification under this contract from the first day on which work is performed in the classification.

c. Whenever the minimum wage rate prescribed in the contract for a class of laborers or mechanics includes a fringe benefit which is not expressed as an hourly rate, the contractor shall either pay the benefit as stated in the wage determination or shall pay another bona fide fringe benefit or an hourly cash equivalent thereof.

d. If the contractor does not make payments to a trustee or other third person, the contractor may consider as part of the wages of any laborer or mechanic the amount of any costs reasonably anticipated in providing bona fide fringe benefits under a plan or program, Provided, That the Secretary of Labor has found, upon the written request of the contractor, that the applicable standards of the Davis-Bacon Act have been met. The Secretary of Labor may require the contractor to set aside in a separate account assets for the meeting of obligations under the plan or program.

## **2. Withholding**

The contracting agency shall upon its own action or upon written request of an authorized representative of the Department of Labor, withhold or cause to be withheld from the contractor under this contract, or any other Federal contract with the same prime contractor, or any other federally-assisted contract subject to Davis-Bacon prevailing wage requirements, which is held by the same prime contractor, so much of the accrued payments or advances as may be considered necessary to pay laborers and mechanics, including apprentices, trainees, and helpers, employed by the contractor or any subcontractor the full amount of wages required by the contract. In the event of failure to pay any laborer or mechanic, including any apprentice, trainee, or helper, employed or working on the site of the work, all or part of the wages required by the contract, the contracting agency may, after written notice to the contractor, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds until such violations have ceased.

### 3. Payrolls and basic records

a. Payrolls and basic records relating thereto shall be maintained by the contractor during the course of the work and preserved for a period of three years thereafter for all laborers and mechanics working at the site of the work. Such records shall contain the name, address, and social security number of each such worker, his or her correct classification, hourly rates of wages paid (including rates of contributions or costs anticipated for bona fide fringe benefits or cash equivalents thereof of the types described in section 1(b)(2)(B) of the Davis-Bacon Act), daily and weekly number of hours worked, deductions made and actual wages paid. Whenever the Secretary of Labor has found under 29 CFR 5.5(a)(1)(iv) that the wages of any laborer or mechanic include the amount of any costs reasonably anticipated in providing benefits under a plan or program described in section 1(b)(2)(B) of the Davis-Bacon Act, the contractor shall maintain records which show that the commitment to provide such benefits is enforceable, that the plan or program is financially responsible, and that the plan or program has been communicated in writing to the laborers or mechanics affected, and records which show the costs anticipated or the actual cost incurred in providing such benefits. Contractors employing apprentices or trainees under approved programs shall maintain written evidence of the registration of apprenticeship programs and certification of trainee programs, the registration of the apprentices and trainees, and the ratios and wage rates prescribed in the applicable programs.

b. (1) The contractor shall submit weekly for each week in which any contract work is performed a copy of all payrolls to the contracting agency. The payrolls submitted shall set out accurately and completely all of the information required to be maintained under 29 CFR 5.5(a)(3)(i), except that full social security numbers and home addresses shall not be included on weekly transmittals. Instead the payrolls shall only need to include an individually identifying number for each employee ( e.g. , the last four digits of the employee's social security number). The required weekly payroll information may be submitted in any form desired. Optional Form WH-347 is available for this purpose from the Wage and Hour Division Web site at <http://www.dol.gov/esa/whd/forms/wh347instr.htm> or its successor site. The prime contractor is responsible for the submission of copies of payrolls by all subcontractors. Contractors and subcontractors shall maintain the full social security number and current address of each covered worker, and shall provide them upon request to the contracting agency for transmission to the State DOT, the FHWA or the Wage and Hour Division of the Department of Labor for purposes of an investigation or audit of compliance with prevailing wage requirements. It is not a violation of this section for a prime contractor to require a subcontractor to provide addresses and social security numbers to the prime contractor for its own records, without weekly submission to the contracting agency..

(2) Each payroll submitted shall be accompanied by a "Statement of Compliance," signed by the contractor or subcontractor or his or her agent who pays or supervises the payment of the persons employed under the contract and shall certify the following:

(i) That the payroll for the payroll period contains the information required to be provided under §5.5 (a)(3)(ii) of Regulations, 29 CFR part 5, the appropriate information is being maintained under §5.5 (a)(3)(i) of Regulations, 29 CFR part 5, and that such information is correct and complete;

(ii) That each laborer or mechanic (including each helper, apprentice, and trainee) employed on the contract during the payroll period has been paid the full weekly wages earned, without rebate, either directly or indirectly, and that no deductions have been made either directly or indirectly from the full wages earned, other than permissible deductions as set forth in Regulations, 29 CFR part 3;

(iii) That each laborer or mechanic has been paid not less than the applicable wage rates and fringe benefits or cash equivalents for the classification of work performed, as specified in the applicable wage determination incorporated into the contract.

(3) The weekly submission of a properly executed certification set forth on the reverse side of Optional Form WH-347 shall satisfy the requirement for submission of the "Statement of Compliance" required by paragraph 3.b.(2) of this section.

(4) The falsification of any of the above certifications may subject the contractor or subcontractor to civil or criminal prosecution under section 1001 of title 18 and section 231 of title 31 of the United States Code.

c. The contractor or subcontractor shall make the records required under paragraph 3.a. of this section available for inspection, copying, or transcription by authorized representatives of the contracting agency, the State DOT, the FHWA, or the Department of Labor, and shall permit such representatives to interview employees during working hours on the job. If the contractor or subcontractor fails to submit the required records or to make them available, the FHWA may, after written notice to the contractor, the contracting agency or the State DOT, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds. Furthermore, failure to submit the required records upon request or to make such records available may be grounds for debarment action pursuant to 29 CFR 5.12.

#### **4. Apprentices and trainees**

a. Apprentices (programs of the USDOL).

Apprentices will be permitted to work at less than the predetermined rate for the work they performed when they are employed pursuant to and individually registered in a bona fide apprenticeship program registered with the U.S. Department of Labor, Employment and Training Administration, Office of Apprenticeship Training, Employer and Labor Services, or with a State Apprenticeship Agency recognized by the Office, or if a person is employed in his or her first 90 days of probationary employment as an apprentice in such an apprenticeship program, who is not individually registered in the program, but who has been certified by the Office of Apprenticeship Training, Employer and Labor Services or a State Apprenticeship Agency (where appropriate) to be eligible for probationary employment as an apprentice.

The allowable ratio of apprentices to journeymen on the job site in any craft classification shall not be greater than the ratio permitted to the contractor as to the entire work force under the registered program. Any worker listed on a payroll at an apprentice wage rate, who is not registered or otherwise employed as stated above, shall be paid not less than the applicable wage rate on the wage determination for the classification of work actually performed. In addition, any apprentice performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed. Where a contractor is performing construction on a project in a locality other than that in which its program is registered, the ratios and wage rates (expressed in percentages of the journeyman's hourly rate) specified in the contractor's or subcontractor's registered program shall be observed.

Every apprentice must be paid at not less than the rate specified in the registered program for the apprentice's level of progress, expressed as a percentage of the journeymen hourly rate specified in the applicable wage determination. Apprentices shall be paid fringe benefits in accordance with the

provisions of the apprenticeship program. If the apprenticeship program does not specify fringe benefits, apprentices must be paid the full amount of fringe benefits listed on the wage determination for the applicable classification. If the Administrator determines that a different practice prevails for the applicable apprentice classification, fringes shall be paid in accordance with that determination.

In the event the Office of Apprenticeship Training, Employer and Labor Services, or a State Apprenticeship Agency recognized by the Office, withdraws approval of an apprenticeship program, the contractor will no longer be permitted to utilize apprentices at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

b. Trainees (programs of the USDOL).

Except as provided in 29 CFR 5.16, trainees will not be permitted to work at less than the predetermined rate for the work performed unless they are employed pursuant to and individually registered in a program which has received prior approval, evidenced by formal certification by the U.S. Department of Labor, Employment and Training Administration.

The ratio of trainees to journeymen on the job site shall not be greater than permitted under the plan approved by the Employment and Training Administration.

Every trainee must be paid at not less than the rate specified in the approved program for the trainee's level of progress, expressed as a percentage of the journeyman hourly rate specified in the applicable wage determination. Trainees shall be paid fringe benefits in accordance with the provisions of the trainee program. If the trainee program does not mention fringe benefits, trainees shall be paid the full amount of fringe benefits listed on the wage determination unless the Administrator of the Wage and Hour Division determines that there is an apprenticeship program associated with the corresponding journeyman wage rate on the wage determination which provides for less than full fringe benefits for apprentices. Any employee listed on the payroll at a trainee rate who is not registered and participating in a training plan approved by the Employment and Training Administration shall be paid not less than the applicable wage rate on the wage determination for the classification of work actually performed. In addition, any trainee performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed.

In the event the Employment and Training Administration withdraws approval of a training program, the contractor will no longer be permitted to utilize trainees at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

c. Equal employment opportunity. The utilization of apprentices, trainees and journeymen under this part shall be in conformity with the equal employment opportunity requirements of Executive Order 11246, as amended, and 29 CFR part 30.

d. Apprentices and Trainees (programs of the U.S. DOT).

Apprentices and trainees working under apprenticeship and skill training programs which have been certified by the Secretary of Transportation as promoting EEO in connection with Federal-aid highway construction programs are not subject to the requirements of paragraph 4 of this Section IV. The straight time hourly wage rates for apprentices and trainees under such programs will be established by the particular programs. The ratio of apprentices and trainees to journeymen shall not be greater than permitted by the terms of the particular program.

**5. Compliance with Copeland Act requirements.** The contractor shall comply with the requirements of 29 CFR part 3, which are incorporated by reference in this contract.

**6. Subcontracts.** The contractor or subcontractor shall insert Form FHWA-1273 in any subcontracts and also require the subcontractors to include Form FHWA-1273 in any lower tier subcontracts. The prime contractor shall be responsible for the compliance by any subcontractor or lower tier subcontractor with all the contract clauses in 29 CFR 5.5.

**7. Contract termination: debarment.** A breach of the contract clauses in 29 CFR 5.5 may be grounds for termination of the contract, and for debarment as a contractor and a subcontractor as provided in 29 CFR 5.12.

**8. Compliance with Davis-Bacon and Related Act requirements.** All rulings and interpretations of the Davis-Bacon and Related Acts contained in 29 CFR parts 1, 3, and 5 are herein incorporated by reference in this contract.

**9. Disputes concerning labor standards.** Disputes arising out of the labor standards provisions of this contract shall not be subject to the general disputes clause of this contract. Such disputes shall be resolved in accordance with the procedures of the Department of Labor set forth in 29 CFR parts 5, 6, and 7. Disputes within the meaning of this clause include disputes between the contractor (or any of its subcontractors) and the contracting agency, the U.S. Department of Labor, or the employees or their representatives.

**10. Certification of eligibility.**

a. By entering into this contract, the contractor certifies that neither it (nor he or she) nor any person or firm who has an interest in the contractor's firm is a person or firm ineligible to be awarded Government contracts by virtue of section 3(a) of the Davis-Bacon Act or 29 CFR 5.12(a)(1).

b. No part of this contract shall be subcontracted to any person or firm ineligible for award of a Government contract by virtue of section 3(a) of the Davis-Bacon Act or 29 CFR 5.12(a)(1).

c. The penalty for making false statements is prescribed in the U.S. Criminal Code, 18 U.S.C. 1001.

**V. CONTRACT WORK HOURS AND SAFETY STANDARDS ACT**

The following clauses apply to any Federal-aid construction contract in an amount in excess of \$100,000 and subject to the overtime provisions of the Contract Work Hours and Safety Standards Act. These clauses shall be inserted in addition to the clauses required by 29 CFR 5.5(a) or 29 CFR 4.6. As used in this paragraph, the terms laborers and mechanics include watchmen and guards.

**1. Overtime requirements.** No contractor or subcontractor contracting for any part of the contract work which may require or involve the employment of laborers or mechanics shall require or permit any such laborer or mechanic in any workweek in which he or she is employed on such work to work in excess of forty hours in such workweek unless such laborer or mechanic receives compensation at a rate not less than one and one-half times the basic rate of pay for all hours worked in excess of forty hours in such workweek.

**2. Violation; liability for unpaid wages; liquidated damages.** In the event of any violation of the clause set forth in paragraph (1.) of this section, the contractor and any subcontractor responsible

therefor shall be liable for the unpaid wages. In addition, such contractor and subcontractor shall be liable to the United States (in the case of work done under contract for the District of Columbia or a territory, to such District or to such territory), for liquidated damages. Such liquidated damages shall be computed with respect to each individual laborer or mechanic, including watchmen and guards, employed in violation of the clause set forth in paragraph (1.) of this section, in the sum of \$10 for each calendar day on which such individual was required or permitted to work in excess of the standard workweek of forty hours without payment of the overtime wages required by the clause set forth in paragraph (1.) of this section.

**3. Withholding for unpaid wages and liquidated damages.** The FHWA or the contacting agency shall upon its own action or upon written request of an authorized representative of the Department of Labor withhold or cause to be withheld, from any moneys payable on account of work performed by the contractor or subcontractor under any such contract or any other Federal contract with the same prime contractor, or any other federally-assisted contract subject to the Contract Work Hours and Safety Standards Act, which is held by the same prime contractor, such sums as may be determined to be necessary to satisfy any liabilities of such contractor or subcontractor for unpaid wages and liquidated damages as provided in the clause set forth in paragraph (2.) of this section.

**4. Subcontracts.** The contractor or subcontractor shall insert in any subcontracts the clauses set forth in paragraph (1.) through (4.) of this section and also a clause requiring the subcontractors to include these clauses in any lower tier subcontracts. The prime contractor shall be responsible for compliance by any subcontractor or lower tier subcontractor with the clauses set forth in paragraphs (1.) through (4.) of this section.

## VI. SUBLETTING OR ASSIGNING THE CONTRACT

This provision is applicable to all Federal-aid construction contracts on the National Highway System.

1. The contractor shall perform with its own organization contract work amounting to not less than 30 percent (or a greater percentage if specified elsewhere in the contract) of the total original contract price, excluding any specialty items designated by the contracting agency. Specialty items may be performed by subcontract and the amount of any such specialty items performed may be deducted from the total original contract price before computing the amount of work required to be performed by the contractor's own organization (23 CFR 635.116).

a. The term “perform work with its own organization” refers to workers employed or leased by the prime contractor, and equipment owned or rented by the prime contractor, with or without operators. Such term does not include employees or equipment of a subcontractor or lower tier subcontractor, agents of the prime contractor, or any other assignees. The term may include payments for the costs of hiring leased employees from an employee leasing firm meeting all relevant Federal and State regulatory requirements. Leased employees may only be included in this term if the prime contractor meets all of the following conditions:

- (1) the prime contractor maintains control over the supervision of the day-to-day activities of the leased employees;
- (2) the prime contractor remains responsible for the quality of the work of the leased employees;
- (3) the prime contractor retains all power to accept or exclude individual employees from work on the project; and

(4) the prime contractor remains ultimately responsible for the payment of predetermined minimum wages, the submission of payrolls, statements of compliance and all other Federal regulatory requirements.

b. "Specialty Items" shall be construed to be limited to work that requires highly specialized knowledge, abilities, or equipment not ordinarily available in the type of contracting organizations qualified and expected to bid or propose on the contract as a whole and in general are to be limited to minor components of the overall contract.

2. The contract amount upon which the requirements set forth in paragraph (1) of Section VI is computed includes the cost of material and manufactured products which are to be purchased or produced by the contractor under the contract provisions.

3. The contractor shall furnish (a) a competent superintendent or supervisor who is employed by the firm, has full authority to direct performance of the work in accordance with the contract requirements, and is in charge of all construction operations (regardless of who performs the work) and (b) such other of its own organizational resources (supervision, management, and engineering services) as the contracting officer determines is necessary to assure the performance of the contract.

4. No portion of the contract shall be sublet, assigned or otherwise disposed of except with the written consent of the contracting officer, or authorized representative, and such consent when given shall not be construed to relieve the contractor of any responsibility for the fulfillment of the contract. Written consent will be given only after the contracting agency has assured that each subcontract is evidenced in writing and that it contains all pertinent provisions and requirements of the prime contract.

5. The 30% self-performance requirement of paragraph (1) is not applicable to design-build contracts; however, contracting agencies may establish their own self-performance requirements.

## **VII. SAFETY: ACCIDENT PREVENTION**

This provision is applicable to all Federal-aid construction contracts and to all related subcontracts.

1. In the performance of this contract the contractor shall comply with all applicable Federal, State, and local laws governing safety, health, and sanitation (23 CFR 635). The contractor shall provide all safeguards, safety devices and protective equipment and take any other needed actions as it determines, or as the contracting officer may determine, to be reasonably necessary to protect the life and health of employees on the job and the safety of the public and to protect property in connection with the performance of the work covered by the contract.

2. It is a condition of this contract, and shall be made a condition of each subcontract, which the contractor enters into pursuant to this contract, that the contractor and any subcontractor shall not permit any employee, in performance of the contract, to work in surroundings or under conditions which are unsanitary, hazardous or dangerous to his/her health or safety, as determined under construction safety and health standards (29 CFR 1926) promulgated by the Secretary of Labor, in accordance with Section 107 of the Contract Work Hours and Safety Standards Act (40 U.S.C. 3704).

3. Pursuant to 29 CFR 1926.3, it is a condition of this contract that the Secretary of Labor or authorized representative thereof, shall have right of entry to any site of contract performance to inspect or investigate the matter of compliance with the construction safety and health standards and to carry out



the duties of the Secretary under Section 107 of the Contract Work Hours and Safety Standards Act (40 U.S.C.3704).

### **VIII. FALSE STATEMENTS CONCERNING HIGHWAY PROJECTS**

This provision is applicable to all Federal-aid construction contracts and to all related subcontracts.

In order to assure high quality and durable construction in conformity with approved plans and specifications and a high degree of reliability on statements and representations made by engineers, contractors, suppliers, and workers on Federal-aid highway projects, it is essential that all persons concerned with the project perform their functions as carefully, thoroughly, and honestly as possible. Willful falsification, distortion, or misrepresentation with respect to any facts related to the project is a violation of Federal law. To prevent any misunderstanding regarding the seriousness of these and similar acts, Form FHWA-1022 shall be posted on each Federal-aid highway project (23 CFR 635) in one or more places where it is readily available to all persons concerned with the project:

18 U.S.C. 1020 reads as follows:

"Whoever, being an officer, agent, or employee of the United States, or of any State or Territory, or whoever, whether a person, association, firm, or corporation, knowingly makes any false statement, false representation, or false report as to the character, quality, quantity, or cost of the material used or to be used, or the quantity or quality of the work performed or to be performed, or the cost thereof in connection with the submission of plans, maps, specifications, contracts, or costs of construction on any highway or related project submitted for approval to the Secretary of Transportation; or

Whoever knowingly makes any false statement, false representation, false report or false claim with respect to the character, quality, quantity, or cost of any work performed or to be performed, or materials furnished or to be furnished, in connection with the construction of any highway or related project approved by the Secretary of Transportation; or

Whoever knowingly makes any false statement or false representation as to material fact in any statement, certificate, or report submitted pursuant to provisions of the Federal-aid Roads Act approved July 1, 1916, (39 Stat. 355), as amended and supplemented;

Shall be fined under this title or imprisoned not more than 5 years or both."

### **IX. IMPLEMENTATION OF CLEAN AIR ACT AND FEDERAL WATER POLLUTION CONTROL ACT**

This provision is applicable to all Federal-aid construction contracts and to all related subcontracts.

By submission of this bid/proposal or the execution of this contract, or subcontract, as appropriate, the bidder, proposer, Federal-aid construction contractor, or subcontractor, as appropriate, will be deemed to have stipulated as follows:

1. That any person who is or will be utilized in the performance of this contract is not prohibited from receiving an award due to a violation of Section 508 of the Clean Water Act or Section 306 of the Clean Air Act.

2. That the contractor agrees to include or cause to be included the requirements of paragraph (1) of this Section X in every subcontract, and further agrees to take such action as the contracting agency may direct as a means of enforcing such requirements.

## **X. CERTIFICATION REGARDING DEBARMENT, SUSPENSION, INELIGIBILITY AND VOLUNTARY EXCLUSION**

This provision is applicable to all Federal-aid construction contracts, design-build contracts, subcontracts, lower-tier subcontracts, purchase orders, lease agreements, consultant contracts or any other covered transaction requiring FHWA approval or that is estimated to cost \$25,000 or more – as defined in 2 CFR Parts 180 and 1200.

### **1. Instructions for Certification – First Tier Participants:**

a. By signing and submitting this proposal, the prospective first tier participant is providing the certification set out below.

b. The inability of a person to provide the certification set out below will not necessarily result in denial of participation in this covered transaction. The prospective first tier participant shall submit an explanation of why it cannot provide the certification set out below. The certification or explanation will be considered in connection with the department or agency's determination whether to enter into this transaction. However, failure of the prospective first tier participant to furnish a certification or an explanation shall disqualify such a person from participation in this transaction.

c. The certification in this clause is a material representation of fact upon which reliance was placed when the contracting agency determined to enter into this transaction. If it is later determined that the prospective participant knowingly rendered an erroneous certification, in addition to other remedies available to the Federal Government, the contracting agency may terminate this transaction for cause of default.

d. The prospective first tier participant shall provide immediate written notice to the contracting agency to whom this proposal is submitted if any time the prospective first tier participant learns that its certification was erroneous when submitted or has become erroneous by reason of changed circumstances.

e. The terms "covered transaction," "debarred," "suspended," "ineligible," "participant," "person," "principal," and "voluntarily excluded," as used in this clause, are defined in 2 CFR Parts 180 and 1200. "First Tier Covered Transactions" refers to any covered transaction between a grantee or subgrantee of Federal funds and a participant (such as the prime or general contract). "Lower Tier Covered Transactions" refers to any covered transaction under a First Tier Covered Transaction (such as subcontracts). "First Tier Participant" refers to the participant who has entered into a covered transaction with a grantee or subgrantee of Federal funds (such as the prime or general contractor). "Lower Tier Participant" refers any participant who has entered into a covered transaction with a First Tier Participant or other Lower Tier Participants (such as subcontractors and suppliers).

f. The prospective first tier participant agrees by submitting this proposal that, should the proposed covered transaction be entered into, it shall not knowingly enter into any lower tier covered transaction with a person who is debarred, suspended, declared ineligible, or voluntarily excluded from

participation in this covered transaction, unless authorized by the department or agency entering into this transaction.

g. The prospective first tier participant further agrees by submitting this proposal that it will include the clause titled "Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion-Lower Tier Covered Transactions," provided by the department or contracting agency, entering into this covered transaction, without modification, in all lower tier covered transactions and in all solicitations for lower tier covered transactions exceeding the \$25,000 threshold.

h. A participant in a covered transaction may rely upon a certification of a prospective participant in a lower tier covered transaction that is not debarred, suspended, ineligible, or voluntarily excluded from the covered transaction, unless it knows that the certification is erroneous. A participant is responsible for ensuring that its principals are not suspended, debarred, or otherwise ineligible to participate in covered transactions. To verify the eligibility of its principals, as well as the eligibility of any lower tier prospective participants, each participant may, but is not required to, check the Excluded Parties List System website (<https://www.epls.gov/>), which is compiled by the General Services Administration.

i. Nothing contained in the foregoing shall be construed to require the establishment of a system of records in order to render in good faith the certification required by this clause. The knowledge and information of the prospective participant is not required to exceed that which is normally possessed by a prudent person in the ordinary course of business dealings.

j. Except for transactions authorized under paragraph (f) of these instructions, if a participant in a covered transaction knowingly enters into a lower tier covered transaction with a person who is suspended, debarred, ineligible, or voluntarily excluded from participation in this transaction, in addition to other remedies available to the Federal Government, the department or agency may terminate this transaction for cause or default.

\* \* \* \* \*

## 2. Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion – First Tier Participants:

a. The prospective first tier participant certifies to the best of its knowledge and belief, that it and its principals:

(1) Are not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from participating in covered transactions by any Federal department or agency;

(2) Have not within a three-year period preceding this proposal been convicted of or had a civil judgment rendered against them for commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (Federal, State or local) transaction or contract under a public transaction; violation of Federal or State antitrust statutes or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, or receiving stolen property;

(3) Are not presently indicted for or otherwise criminally or civilly charged by a governmental entity (Federal, State or local) with commission of any of the offenses enumerated in paragraph (a)(2) of this certification; and

(4) Have not within a three-year period preceding this application/proposal had one or more public transactions (Federal, State or local) terminated for cause or default.

b. Where the prospective participant is unable to certify to any of the statements in this certification, such prospective participant shall attach an explanation to this proposal.

## **2. Instructions for Certification - Lower Tier Participants:**

(Applicable to all subcontracts, purchase orders and other lower tier transactions requiring prior FHWA approval or estimated to cost \$25,000 or more - 2 CFR Parts 180 and 1200)

a. By signing and submitting this proposal, the prospective lower tier is providing the certification set out below.

b. The certification in this clause is a material representation of fact upon which reliance was placed when this transaction was entered into. If it is later determined that the prospective lower tier participant knowingly rendered an erroneous certification, in addition to other remedies available to the Federal Government, the department, or agency with which this transaction originated may pursue available remedies, including suspension and/or debarment.

c. The prospective lower tier participant shall provide immediate written notice to the person to which this proposal is submitted if at any time the prospective lower tier participant learns that its certification was erroneous by reason of changed circumstances.

d. The terms "covered transaction," "debarred," "suspended," "ineligible," "participant," "person," "principal," and "voluntarily excluded," as used in this clause, are defined in 2 CFR Parts 180 and 1200. You may contact the person to which this proposal is submitted for assistance in obtaining a copy of those regulations. "First Tier Covered Transactions" refers to any covered transaction between a grantee or subgrantee of Federal funds and a participant (such as the prime or general contract). "Lower Tier Covered Transactions" refers to any covered transaction under a First Tier Covered Transaction (such as subcontracts). "First Tier Participant" refers to the participant who has entered into a covered transaction with a grantee or subgrantee of Federal funds (such as the prime or general contractor). "Lower Tier Participant" refers any participant who has entered into a covered transaction with a First Tier Participant or other Lower Tier Participants (such as subcontractors and suppliers).

e. The prospective lower tier participant agrees by submitting this proposal that, should the proposed covered transaction be entered into, it shall not knowingly enter into any lower tier covered transaction with a person who is debarred, suspended, declared ineligible, or voluntarily excluded from participation in this covered transaction, unless authorized by the department or agency with which this transaction originated.

f. The prospective lower tier participant further agrees by submitting this proposal that it will include this clause titled "Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion-Lower Tier Covered Transaction," without modification, in all lower tier covered transactions and in all solicitations for lower tier covered transactions exceeding the \$25,000 threshold.

g. A participant in a covered transaction may rely upon a certification of a prospective participant in a lower tier covered transaction that is not debarred, suspended, ineligible, or voluntarily excluded from the covered transaction, unless it knows that the certification is erroneous. A participant is responsible for ensuring that its principals are not suspended, debarred, or otherwise ineligible to participate in covered transactions. To verify the eligibility of its principals, as well as the eligibility of any lower tier prospective participants, each participant may, but is not required to, check the Excluded Parties List System website (<https://www.epls.gov/>), which is compiled by the General Services Administration.

h. Nothing contained in the foregoing shall be construed to require establishment of a system of records in order to render in good faith the certification required by this clause. The knowledge and information of participant is not required to exceed that which is normally possessed by a prudent person in the ordinary course of business dealings.

i. Except for transactions authorized under paragraph e of these instructions, if a participant in a covered transaction knowingly enters into a lower tier covered transaction with a person who is suspended, debarred, ineligible, or voluntarily excluded from participation in this transaction, in addition to other remedies available to the Federal Government, the department or agency with which this transaction originated may pursue available remedies, including suspension and/or debarment.

\* \* \* \* \*

**Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion--Lower Tier Participants:**

1. The prospective lower tier participant certifies, by submission of this proposal, that neither it nor its principals is presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from participating in covered transactions by any Federal department or agency.

2. Where the prospective lower tier participant is unable to certify to any of the statements in this certification, such prospective participant shall attach an explanation to this proposal.

\* \* \* \* \*

**XI. CERTIFICATION REGARDING USE OF CONTRACT FUNDS FOR LOBBYING**

This provision is applicable to all Federal-aid construction contracts and to all related subcontracts which exceed \$100,000 (49 CFR 20).

1. The prospective participant certifies, by signing and submitting this bid or proposal, to the best of his or her knowledge and belief, that:

a. No Federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of any Federal agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.

b. If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any Federal agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant, loan, or cooperative agreement, the undersigned shall complete and submit Standard Form-LLL, "Disclosure Form to Report Lobbying," in accordance with its instructions.

2. This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by 31 U.S.C. 1352. Any person who fails to file the required certification shall be subject to a civil penalty of not less than \$10,000 and not more than \$100,000 for each such failure.

3. The prospective participant also agrees by submitting its bid or proposal that the participant shall require that the language of this certification be included in all lower tier subcontracts, which exceed \$100,000 and that all such recipients shall certify and disclose accordingly.

**EXHIBIT B****TITLE VI CONTRACTOR ASSURANCES**

During the performance of this Contract, the contractor, for itself, its assignees and successors in interest (hereinafter referred to as the "Contractor") agrees as follows:

**1. Compliance with Regulations:** The Contractor shall comply with the regulations relative to nondiscrimination in federally assisted programs of the United States Department of Transportation (hereinafter, "USDOT"), Title 49, Code of Federal Regulations, Part 21, as they may be amended from time to time (hereinafter referred to as the "Regulations"), which are herein incorporated by reference and made a part of this contract.

**2. Nondiscrimination:** The Contractor, with regard to the work performed by it during the Contract, shall not discriminate on the grounds of race, color, national origin, sex, age, or disability in the selection and retention of subcontractors, including procurements of materials and leases of equipment. The Contractor shall not participate either directly or indirectly in the discrimination prohibited by Subsection 5 of the Regulations, including employment practices when the Contract covers a program set forth in Appendix B of the Regulations.

**3. Solicitations for Subcontracts, Including Procurements of Materials and Equipment:**

In all solicitations either by competitive bidding or negotiation made by the Contractor for work to be performed under a subcontract, including procurements of materials or leases of equipment, each potential subcontractor or supplier shall be notified by the Contractor of the Contractor's obligations under this contract and the Regulations relative to nondiscrimination on the grounds of race, color, national origin, sex, age, or disability.

**4. Information and Reports:** The Contractor shall provide all information and reports required by the Regulations or directives issued pursuant thereto and shall permit access to its books, records, accounts, other sources of information, and its facilities as may be determined by the Connecticut Department of Transportation (ConnDOT) or the Funding Agency (FHWA, FTA and FAA) to be pertinent to ascertain compliance with such Regulations, orders, and instructions. Where any information required of a Contractor is in the exclusive possession of another who fails or refuses to furnish this information, the Contractor shall so certify to ConnDOT or the Funding Agency, as appropriate, and shall set forth what efforts it has made to obtain the information.

**5. Sanctions for Noncompliance:** In the event of the Contractor's noncompliance with the nondiscrimination provisions of this Contract, the ConnDOT shall impose such sanctions as it or the Funding Agency may determine to be appropriate, including, but not limited to:

- A. Withholding contract payments until the Contractor is in-compliance; and/or
- B. Cancellation, termination, or suspension of the Contract, in whole or in part.

**6. Incorporation of Provisions:** The Contractor shall include the provisions of paragraphs 1 through 5 in every subcontract, including procurements of materials and leases of equipment, unless exempt by the Regulations or directives issued pursuant thereto. The Contractor shall take such action with respect to any subcontract or procurement as the ConnDOT or the Funding Agency may -direct as a means of enforcing such provisions including sanctions for noncompliance. Provided, however, that in the event a Contractor becomes involved in, or is threatened with, litigation with a subcontractor or supplier as a result of such direction, the Contractor may request the ConnDOT to enter into such litigation to protect the interests of the Funding Agency, and, in addition, the Contractor may request the United States to enter into such litigation to protect the interests of the United States

**EXHIBIT C****CONTRACTOR WORKFORCE UTILIZATION (FEDERAL EXECUTIVE ORDER 11246) /  
EQUAL EMPLOYMENT OPPORTUNITY  
(Federal - FHWA)****1. Project Workforce Utilization Goals:**

These goals are applicable to all the Contractor's construction work (whether or not it is Federal or Federally assisted or funded) performed in the covered area. If the contractor performs construction work in a geographical area located outside of the covered area, it shall apply the goals established for the geographical area where the work is actually performed.

Whenever the Contractor, or any Subcontractor at any tier, subcontracts a portion of the work involving any construction trade, it shall physically include in each subcontract in excess of \$10,000 the provisions of these specifications which contain the applicable goals for minority and female participation.

The goals for minority and female utilization are expressed in percentage terms for the contractor's aggregate work-force in each trade on all construction work in the covered area, are referenced in the attached Appendix A.

**2. Executive Order 11246**

The Contractor's compliance with Executive Order 11246 and 41-CFR Part 60-4 shall be based on its implementation of the specific affirmative action obligations required by the specifications set forth in 41 CFR 60-4.3(A) and its efforts to meet the goals established for the geographical area where the contract is to be performed. The hours of minority and female employment and training must be substantially uniform throughout the length of the contract, and in each trade, and the contractor shall make a good faith effort to employ minorities and women evenly on each of its projects. The transfer of minority or female employees or trainees from contractor to contractor or from project to project for the sole purpose of meeting the contractor's goals shall be a violation of the contract, the Executive Order and the regulations in 41 CFR Part 60-4. Compliance with the goals will be measured against the total work hour performed.

If the Contractor is participating (pursuant to 41 CFR 60-4.5) in a Hometown Plan approved by the U.S. Department of Labor in the covered area either individually or through an association, its affirmative action obligations on all work in the Plan area (including goals and timetables) shall be in accordance with that Plan for those trades which have unions participating in the Plan. Contractors must be able to demonstrate their participation in and compliance with the provisions of any such Hometown Plan. Each Contractor or Subcontractor participating in an approved Plan is individually required to comply with its obligations under the EEO clause, and to make a good faith effort to achieve each goal under the Plan in each trade in which it has employees. The overall good faith performance by other Contractors or subcontractors toward a goal in an approved Pan does not excuse any covered Contractor's or subcontractor's failure to take good faith efforts to achieve the plan goals and timetables.

The Contractor shall implement the specific affirmative action standards provided in a through p of these specifications. The goals set forth in the solicitation from which this contract resulted are expressed as percentages of the total hours of employment and training of minority and



female utilization the Contractor should reasonably be able to achieve in each construction trade in which it has employees in the covered area. Covered Construction contractors performing construction work in geographical areas where they do not have a federal or federally assisted construction contract shall apply the minority and female goals established for the geographical area where the work is being performed. Goals are published periodically in the Federal Register in notice form and such notices may be obtained from any Office of Federal Contract Compliance Programs (OFCCP) Office or from Federal procurement contracting officers. The Contractor is expected to make substantially uniform progress in meeting its goals in each craft during the period specified.

Neither the provisions of any collective bargaining agreement, nor the failure by a union with whom the Contractor has a collective bargaining agreement, to refer either minorities or women shall excuse the Contractor's obligations under these specifications, Executive Order 11246, or the regulations promulgated pursuant hereto.

In order for the nonworking training hours of apprentices and trainees to be counted in meeting the goals, such apprentices and trainees must be employed by the Contractor during the training period, and the Contractor must have made a commitment to employ the apprentices and trainees at the completion of their training, subject to the availability of employment opportunities. Trainees must be trained pursuant to training programs approved by the U.S. Department of Labor.

The Contractor shall take specific affirmative actions to ensure equal employment opportunity. The evaluation of the Contractor's compliance with these specifications shall be based upon its effort to achieve maximum results from its actions. The Contractor shall document these efforts fully, and shall implement affirmative action steps at least as extensive as the following:

- a. Ensure and maintain a working environment free of harassment, intimidation, and coercion at all sites; and in all facilities at which the Contractor's employees are assigned to work. The Contractor, where possible, will assign two or more women to each construction project. The Contractor shall specifically ensure that all foremen, superintendents, and other on-site supervisory personnel are aware of and carry out the Contractor's obligation to maintain such a working environment, with specific attention to minority or female individuals working at such sites or in such facilities.
- b. Establish and maintain a current list of minority and female recruitment sources, provide written notification to minority and female recruitment sources and to community organizations when the Contractor or its unions have employment opportunities available, and maintain a record of the organizations' responses.
- c. Maintain a current file of the names, addresses and telephone numbers of each minority and female off the street applicant and minority or female referral from a union, a recruitment source or community organization and of what action was taken with respect to each such individual. If such individual was sent to the union hiring hall for referral and was not referred back to the Contractor by the union or, if referred, not employed by the Contractor, this shall be documented in the file with the reason thereafter; along with whatever additional actions the Contractor may have taken.
- d. Provide immediate written notification to the Director when the Union or Unions with which the Contractor has a collective bargaining agreement has not referred to the Contractor a minority person or women sent by the Contractor, or when the Contractor has other

information that the Union referral process has impeded the Contractor's efforts to meet its obligations.

- e. Develop on-the-job training opportunities and/or participate in training programs for the area which expressly include minorities and women, including upgrading programs and apprenticeship and trainee programs relevant to the Contractor's employment needs, especially those programs funded or approved by the Department of Labor. The Contractor shall provide notice of these programs to the sources compiled under b above.
- f. Disseminate the Contractor's EEO policy by providing notice of the policy to unions and training programs and requesting their cooperation in assisting the Contractor in meeting its EEO obligations; by including it in any policy manual and collective bargaining agreement; by publicizing it in the company newspaper, annual report, etc.; by specific review of the policy with all management personnel and with all minority and female employees at least once a year; and by posting the company EEO Policy on bulletin boards accessible to all employees at each location where construction work is performed.
- g. Review, at least annually, the company EEO Policy and affirmative action obligations under these specifications with all employees having any responsibility for hiring, assignment, layoff, termination or other employment, decisions including specific Foreman, etc. prior to the initiation of construction work at any job site. A written record shall be made and maintained identifying the time and place of these meetings, persons attending, subject matter discussed, and disposition of the subject matter.
- h. Disseminate the Contractor's EEO Policy externally by including it in any advertising in the news media, specifically including minority and female news media, and providing written notification to and discussing the Contractor's EEO policy with other Contractors and subcontractors with whom the Contractor does or anticipates doing business.
- i. Direct its recruitment efforts, both oral and written, to minority female and community organizations, to schools with minority and female students and to minority and female recruitment and training organizations serving the Contractor's recruitment area and employment needs. Not later than one month prior to the date for the acceptance of applications for apprenticeship or other training by any recruitment source, the contractor shall send written notification to organizations such as the above, describing the openings, screening procedures and tests to be used in the selection process.
- j. Encourage present minority and female employees to recruit other minority persons and women and, where reasonable, provide after school, summer and vacation employment to minority and female youth both on the site and in other areas of a Contractor's work-force.
- k. Validate all tests and other selection requirements where there is an obligation to do so under 41 CFR Part 60-3.
- l. Conduct, at least annually, an inventory and evaluation at least of all minority and female personnel for promotional opportunities and encourage these employees to seek or to prepare for, through appropriate training, etc., such opportunities.
- m. Ensure that seniority practices, job classifications, work assignments and other personnel practices, do not have a discriminatory effect by continually monitoring all personnel and

employment related activities to ensure that the EEO policy and the Contractor's obligations under these specifications are being carried out.

- n. Ensure that all facilities and company activities are non-segregated except that separate or single user toilet and necessary changing facilities shall be provided to assure privacy between the sexes.
- o. Document and maintain a record of all solicitations of offers for subcontracts from minority and female construction contractors and suppliers, including circulation of solicitations to minority and female contractor associations and other business associations.
- p. Conduct a review at least annually of all supervisors' adherence to and performance under the Contractor's EEO policies and affirmative action obligations.

Contractors are encouraged to participate in voluntary associations which assist in fulfilling one or more of their affirmative action obligations (a through p). The efforts of a contractor association, joint contractor union, contractor community, or other similar group of which the contractor is a member and participant, may be asserted as fulfilling any one or more of its obligations under a through p of these specifications provided that the contractor actively participates in the group, makes every effort to assure that the group has a positive impact on the employment of minorities and women in the industry, ensures that the concrete benefits of the program are reflected in the Contractor's minority and female work-force participation, makes a good faith effort to meet with individual goals and timetables, and can provide access to documentation which demonstrates the effectiveness of actions taken on behalf of the Contractor. The obligation to comply, however, is the Contractor's and failure of such a group to fulfill an obligation shall not be a defense for the Contractor's noncompliance.

A single goal for minorities and a separate single goal for women have been established. The Contractor, however, is required to provide equal employment opportunity and to take affirmative action for all minority groups, both male and female, and all women, both minority and non-minority. Consequently, the Contractor may be in violation of Executive Order 11246 if a particular group is employed in a substantially disparate manner, (for example, even though the Contractor has achieved its goals for women generally, the Contractor may be in violation of the Executive Order if a specific minority group of women is under utilized).

The Contractor shall not use the goals and timetables or affirmative action standards to discriminate against any person because of race, color, religion, sex, or national origin.

The Contractor shall not enter into any Subcontract with any person or firm debarred from Government contracts pursuant to Executive Order 11246.

The Contractor shall carry out such sanctions and penalties for violation of these specifications and of the Equal Opportunity Clause, including suspension, termination and cancellation of existing subcontracts as may be imposed or ordered pursuant to Executive Order 11246, as amended, and its implementing regulations by the Office of Federal Contract Compliance Programs. Any Contractor who fails to carry out such sanctions and penalties shall be in violation of these specifications and Executive Order 11246, as amended.

The Contractor, in fulfilling its obligations under these specifications, shall implement specific affirmative action steps, at least as extensive as those standards prescribed in these

specifications, so as to achieve maximum results from its efforts to ensure equal employment opportunity. If the Contractor fails to comply with the requirements of the Executive Order, the implementing regulations, or these specifications, the Director shall proceed in accordance with 41 CFR 60-4.8.

The Contractor shall designate a responsible official to monitor all employment related activity to ensure that the company EEO policy is being carried out, to submit reports relating to the provisions hereof as may be required by the Government and to keep records. Records shall at least include for each employee the name, address, telephone numbers, construction trade, union affiliation if any, employee identification number when assigned, social security number, race, sex, status, (e.g. mechanic, apprentice, trainee, helper, or laborer) dates of changes in status, hours worked per week in the indicated trade, rate of pay, and locations at which the work was performed. Records shall be maintained in an easily understandable and retrievable form; however, to the degree that existing records satisfy this requirement, contractors shall not be required to maintain separate records.

Nothing herein provided shall be construed as a limitation upon the application of their laws which establish different standards of compliance or upon the application of requirements for the hiring of local or other area residents (e.g. those under the Public Works Employment Act of 1977 and the Community Development Block Grant Program).

The Director of the Office of Federal Contract Compliance Programs, from time to time, shall issue goals and timetables for minority and female utilization which shall be based on appropriate workforce, demographic or other relevant data and which shall cover construction projects or construction contracts performed in specific geographical areas. The goals, which shall be applicable to each construction trade in a covered contractor's or timetables, shall be published as notices in the Federal Register, and shall be inserted by the Contracting officers and applicants, as applicable, in the Notice required by 41 CFR 60-4.2.

**FEDERALLY FUNDED OR ASSISTED PROJECTS****APPENDIX A****(Labor Market Goals)****Standard Metropolitan Statistical Area (SMSA)****Female****Minority**

<b>Bridgeport – Stamford – Norwalk – Danbury</b>	<b>10.2%</b>
<b>6.9%</b>	

Bethel	Bridgeport	Brookfield	Danbury
Darien	Derby	Easton	Fairfield
Greenwich	Milford	Monroe	New Canaan
New Fairfield	Newton	Norwalk	Redding
Shelton	Stamford	Stratford	Trumbull
Weston	Westport	Wilton	

<b>Hartford – Bristol – New Britain</b>	<b>6.9%</b>
<b>6.9%</b>	

Andover	Avon	Berlin	Bloomfield
Bolton	Bristol	Burlington	Canton
Colchester	Columbia	Coventry	Cromwell
East Granby	East Hampton	East Hartford	East Windsor
Ellington	Enfield	Farmington	Glastonbury
Granby	Hartford	Hebron	Manchester
Marlborough	New Britain	New Hartford	Newington
Plainville	Plymouth	Portland	Rocky Hill
Simsbury	South Windsor	Southington	Stafford
Suffield	Tolland	Vernon	West Hartford
Wethersfield	Willington	Windsor	Windsor Locks

<b>New Haven – Waterbury – Meriden</b>	<b>9.0%</b>
<b>6.9%</b>	

Beacon Falls	Bethany	Branford	Cheshire
Clinton	East Haven	Guilford	Hamden
Madison	Meriden	Middlebury	Naugatuck
New Haven	North Branford	North Haven	Orange
Prospect	Southbury	Thomaston	Wallingford
Waterbury	Watertown	West Haven	Wolcott
Woodbridge	Woodbury		

<b>New London – Norwich</b>	<b>4.5%</b>
<b>6.9%</b>	

Bozrah	East Lyme	Griswold	Groton
Ledyard	Lisbon	Montville	New London
Norwich	Old Lyme	Old Saybrook	Preston
Sprague	Stonington	Waterford	

**Non SMSA**

**Female**

**Minority**

<b>Litchfield – Windham</b>			<b>5.9%</b>
<b>6.9%</b>			
Abington	Ashford	Ballouville	Bantam
Barkhamsted	Bethlehem	Bridgewater	Brooklyn
Canaan	Canterbury	Central Village	Cahplin
Colebrook	Cornwall	Cornwall Bridge	Danielson
Dayville	East Canaan	East Killingly	East Woodstock
Eastford	Falls Village	Gaylordsville	Goshen
Grosvenor Dale	Hampton	Harwinton	Kent
Killigly	Lakeside	Litchfield	Moosup
Morris	New Milford	New Preston	New Preston Marble Dale
Norfolk	North Canaan	No. Grosvenordale	North Windham
Oneco	Pequabuck	Pine Meadow	Plainfield
Pleasant Valley	Pomfret	Pomfret Center	Putnam
Quinebaug	Riverton	Rogers	Roxbury
Salisbury	Scotland	Sharon	South Kent
South Woodstock	Sterling	Taconic	Terryville
Thompson	Torrington	Warren	Warrenville
Washington	Washington Depot	Wauregan	West Cornwall
Willimantic	Winchester	Winchester Center	Windham
Winsted	Woodstock	Woodstock Valley	

**EXHIBIT D****Health Insurance Portability and Accountability Act of 1996 (“HIPAA”).**

- (a) If the Contactor is a Business Associate under the requirements of the Health Insurance Portability and Accountability Act of 1996 (“HIPAA”), the Contractor must comply with all terms and conditions of this Section of the Contract. If the Contractor is not a Business Associate under HIPAA, this Section of the Contract does not apply to the Contractor for this Contract.
- (b) The Contractor is required to safeguard the use, publication and disclosure of information on all applicants for, and all clients who receive, services under the Contract in accordance with all applicable federal and state law regarding confidentiality, which includes but is not limited to HIPAA, more specifically with the Privacy and Security Rules at 45 C.F.R. Part 160 and Part 164, subparts A, C, and E; and
- (c) The State of Connecticut Agency named on page 1 of this Contract (hereinafter the “Department”) is a “covered entity” as that term is defined in 45 C.F.R. § 160.103; and
- (d) The Contractor, on behalf of the Department, performs functions that involve the use or disclosure of “individually identifiable health information,” as that term is defined in 45 C.F.R. § 160.103; and
- (e) The Contractor is a “business associate” of the Department, as that term is defined in 45 C.F.R. § 160.103; and
- (f) The Contractor and the Department agree to the following in order to secure compliance with the HIPAA, the requirements of Subtitle D of the Health Information Technology for Economic and Clinical Health Act (hereinafter the HITECH Act), (Pub. L. 111-5, sections 13400 to 13423), and more specifically with the Privacy and Security Rules at 45 C.F.R. Part 160 and Part 164, subparts A, C, and E.
- (g) Definitions
  - (1) “Breach shall have the same meaning as the term is defined in section 13400 of the HITECH Act (42 U.S.C. §17921(1))
  - (2) “Business Associate” shall mean the Contractor.
  - (3) “Covered Entity” shall mean the Department of the State of Connecticut named on page 1 of this Contract.
  - (4) “Designated Record Set” shall have the same meaning as the term “designated record set” in 45 C.F.R. § 164.501.
  - (5) “Electronic Health Record” shall have the same meaning as the term is defined in section 13400 of the HITECH Act (42 U.S.C. §17921(5))

- (6) "Individual" shall have the same meaning as the term "individual" in 45 C.F.R. § 160.103 and shall include a person who qualifies as a personal representative as defined in 45 C.F.R. § 164.502(g).
  - (7) "Privacy Rule" shall mean the Standards for Privacy of Individually Identifiable Health Information at 45 C.F.R. part 160 and parts 164, subparts A and E.
  - (8) "Protected Health Information" or "PHI" shall have the same meaning as the term "protected health information" in 45 C.F.R. § 160.103, limited to information created or received by the Business Associate from or on behalf of the Covered Entity.
  - (9) "Required by Law" shall have the same meaning as the term "required by law" in 45 C.F.R. § 164.103.
  - (10) "Secretary" shall mean the Secretary of the Department of Health and Human Services or his designee.
  - (11) "More stringent" shall have the same meaning as the term "more stringent" in 45 C.F.R. § 160.202.
  - (12) "This Section of the Contract" refers to the HIPAA Provisions stated herein, in their entirety.
  - (13) "Security Incident" shall have the same meaning as the term "security incident" in 45 C.F.R. § 164.304.
  - (14) "Security Rule" shall mean the Security Standards for the Protection of Electronic Protected Health Information at 45 C.F.R. part 160 and parts 164, subpart A and C.
  - (15) "Unsecured protected health information" shall have the same meaning as the term as defined in section 13402(h)(1)(A) of HITECH. Act. (42 U.S.C. §17932(h)(1)(A)).
- (h) Obligations and Activities of Business Associates.
- (1) Business Associate agrees not to use or disclose PHI other than as permitted or required by this Section of the Contract or as Required by Law.
  - (2) Business Associate agrees to use appropriate safeguards to prevent use or disclosure of PHI other than as provided for in this Section of the Contract.
  - (3) Business Associate agrees to use administrative, physical and technical safeguards that reasonably and appropriately protect the confidentiality, integrity, and availability of electronic protected health information that it creates, receives, maintains, or transmits on behalf of the Covered Entity.
  - (4) Business Associate agrees to mitigate, to the extent practicable, any harmful effect that is known to the Business Associate of a use or disclosure of PHI by Business Associate in violation of this Section of the Contract.



- (5) Business Associate agrees to report to Covered Entity any use or disclosure of PHI not provided for by this Section of the Contract or any security incident of which it becomes aware.
- (6) Business Associate agrees to insure that any agent, including a subcontractor, to whom it provides PHI received from, or created or received by Business Associate, on behalf of the Covered Entity, agrees to the same restrictions and conditions that apply through this Section of the Contract to Business Associate with respect to such information.
- (7) Business Associate agrees to provide access, at the request of the Covered Entity, and in the time and manner agreed to by the parties, to PHI in a Designated Record Set, to Covered Entity or, as directed by Covered Entity, to an Individual in order to meet the requirements under 45 C.F.R. § 164.524.
- (8) Business Associate agrees to make any amendments to PHI in a Designated Record Set that the Covered Entity directs or agrees to pursuant to 45 C.F.R. § 164.526 at the request of the Covered Entity, and in the time and manner agreed to by the parties.
- (9) Business Associate agrees to make internal practices, books, and records, including policies and procedures and PHI, relating to the use and disclosure of PHI received from, or created or received by, Business Associate on behalf of Covered Entity, available to Covered Entity or to the Secretary in a time and manner agreed to by the parties or designated by the Secretary, for purposes of the Secretary determining Covered Entity's compliance with the Privacy Rule.
- (10) Business Associate agrees to document such disclosures of PHI and information related to such disclosures as would be required for Covered Entity to respond to a request by an Individual for an accounting of disclosures of PHI in accordance with 45 C.F.R. § 164.528 and section 13405 of the HITECH Act (42 U.S.C. § 17935) and any regulations promulgated thereunder.
- (11) Business Associate agrees to provide to Covered Entity, in a time and manner agreed to by the parties, information collected in accordance with clause h. (10) of this Section of the Contract, to permit Covered Entity to respond to a request by an Individual for an accounting of disclosures of PHI in accordance with 45 C.F.R. § 164.528 and section 13405 of the HITECH Act (42 U.S.C. § 17935) and any regulations promulgated thereunder. Business Associate agrees at the Covered Entity's direction to provide an accounting of disclosures of PHI directly to an individual in accordance with 45 C.F.R. § 164.528 and section 13405 of the HITECH Act (42 U.S.C. § 17935) and any regulations promulgated thereunder.
- (12) Business Associate agrees to comply with any state or federal law that is more stringent than the Privacy Rule.
- (13) Business Associate agrees to comply with the requirements of the HITECH Act relating to privacy and security that are applicable to the Covered Entity and with the requirements of 45 C.F.R. sections 164.504(e), 164.308, 164.310, 164.312, and 164.316.

- (14) In the event that an individual requests that the Business Associate (a) restrict disclosures of PHI; (b) provide an accounting of disclosures of the individual's PHI; or (c) provide a copy of the individual's PHI in an electronic health record, the Business Associate agrees to notify the covered entity, in writing, within two business days of the request.
- (15) Business Associate agrees that it shall not, directly or indirectly, receive any remuneration in exchange for PHI of an individual without (1) the written approval of the covered entity, unless receipt of remuneration in exchange for PHI is expressly authorized by this Contract and (2) the valid authorization of the individual, except for the purposes provided under section 13405(d)(2) of the HITECH Act,(42 U.S.C. § 17935(d)(2)) and in any accompanying regulations
- (16) Obligations in the Event of a Breach
- A. The Business Associate agrees that, following the discovery of a breach of unsecured protected health information, it shall notify the Covered Entity of such breach in accordance with the requirements of section 13402 of HITECH (42 U.S.C. 17932(b) and the provisions of this Section of the Contract.
- B. Such notification shall be provided by the Business Associate to the Covered Entity without unreasonable delay, and in no case later than 30 days after the breach is discovered by the Business Associate, except as otherwise instructed in writing by a law enforcement official pursuant to section 13402 (g) of HITECH (42 U.S.C. 17932(g)) . A breach is considered discovered as of the first day on which it is, or reasonably should have been, known to the Business Associate. The notification shall include the identification and last known address, phone number and email address of each individual (or the next of kin of the individual if the individual is deceased) whose unsecured protected health information has been, or is reasonably believed by the Business Associate to have been, accessed, acquired, or disclosed during such breach.
- C. The Business Associate agrees to include in the notification to the Covered Entity at least the following information:
1. A brief description of what happened, including the date of the breach and the date of the discovery of the breach, if known.
  2. A description of the types of unsecured protected health information that were involved in the breach (such as full name, Social Security number, date of birth, home address, account number, or disability code).
  3. The steps the Business Associate recommends that individuals take to protect themselves from potential harm resulting from the breach.
  4. A detailed description of what the Business Associate is doing to investigate the breach, to mitigate losses, and to protect against any further breaches.
  5. Whether a law enforcement official has advised either verbally or in writing the Business Associate that he or she has determined that notification or notice to

individuals or the posting required under section 13402 of the HITECH Act would impede a criminal investigation or cause damage to national security and; if so, include contact information for said official.

- D. Business Associate agrees to provide appropriate staffing and have established procedures to ensure that individuals informed by the Covered Entity of a breach by the Business Associate have the opportunity to ask questions and contact the Business Associate for additional information regarding the breach. Such procedures shall include a toll-free telephone number, an e-mail address, a posting on its Web site and a postal address. Business Associate agrees to include in the notification of a breach by the Business Associate to the Covered Entity, a written description of the procedures that have been established to meet these requirements. Costs of such contact procedures will be borne by the Contractor.
- E. Business Associate agrees that, in the event of a breach, it has the burden to demonstrate that it has complied with all notifications requirements set forth above, including evidence demonstrating the necessity of a delay in notification to the Covered Entity.

(i) Permitted Uses and Disclosure by Business Associate.

(1) General Use and Disclosure Provisions Except as otherwise limited in this Section of the Contract, Business Associate may use or disclose PHI to perform functions, activities, or services for, or on behalf of, Covered Entity as specified in this Contract, provided that such use or disclosure would not violate the Privacy Rule if done by Covered Entity or the minimum necessary policies and procedures of the Covered Entity.

(2) Specific Use and Disclosure Provisions

(A) Except as otherwise limited in this Section of the Contract, Business Associate may use PHI for the proper management and administration of Business Associate or to carry out the legal responsibilities of Business Associate.

(B) Except as otherwise limited in this Section of the Contract, Business Associate may disclose PHI for the proper management and administration of Business Associate, provided that disclosures are Required by Law, or Business Associate obtains reasonable assurances from the person to whom the information is disclosed that it will remain confidential and used or further disclosed only as Required by Law or for the purpose for which it was disclosed to the person, and the person notifies Business Associate of any instances of which it is aware in which the confidentiality of the information has been breached.

(C) Except as otherwise limited in this Section of the Contract, Business Associate may use PHI to provide Data Aggregation services to Covered Entity as permitted by 45 C.F.R. § 164.504(e)(2)(i)(B).

(j) Obligations of Covered Entity.

- (1) Covered Entity shall notify Business Associate of any limitations in its notice of privacy practices of Covered Entity, in accordance with 45 C.F.R. § 164.520, or to the extent that such limitation may affect Business Associate's use or disclosure of PHI.
  - (2) Covered Entity shall notify Business Associate of any changes in, or revocation of, permission by Individual to use or disclose PHI, to the extent that such changes may affect Business Associate's use or disclosure of PHI.
  - (3) Covered Entity shall notify Business Associate of any restriction to the use or disclosure of PHI that Covered Entity has agreed to in accordance with 45 C.F.R. § 164.522, to the extent that such restriction may affect Business Associate's use or disclosure of PHI.
- (k) Permissible Requests by Covered Entity. Covered Entity shall not request Business Associate to use or disclose PHI in any manner that would not be permissible under the Privacy Rule if done by the Covered Entity, except that Business Associate may use and disclose PHI for data aggregation, and management and administrative activities of Business Associate, as permitted under this Section of the Contract.
- (l) Term and Termination.
- (1) Term. The Term of this Section of the Contract shall be effective as of the date the Contract is effective and shall terminate when the information collected in accordance with clause h. (10) of this Section of the Contract is provided to the Covered Entity and all of the PHI provided by Covered Entity to Business Associate, or created or received by Business Associate on behalf of Covered Entity, is destroyed or returned to Covered Entity, or, if it is infeasible to return or destroy PHI, protections are extended to such information, in accordance with the termination provisions in this Section.
  - (2) Termination for Cause Upon Covered Entity's knowledge of a material breach by Business Associate, Covered Entity shall either:
    - (A) Provide an opportunity for Business Associate to cure the breach or end the violation and terminate the Contract if Business Associate does not cure the breach or end the violation within the time specified by the Covered Entity; or
    - (B) Immediately terminate the Contract if Business Associate has breached a material term of this Section of the Contract and cure is not possible; or
    - (C) If neither termination nor cure is feasible, Covered Entity shall report the violation to the Secretary.
  - (3) Effect of Termination
    - (A) Except as provided in (l)(2) of this Section of the Contract, upon termination of this Contract, for any reason, Business Associate shall return or destroy all PHI received from Covered Entity, or created or received by Business Associate on behalf of Covered Entity. Business Associate shall also provide the information collected in accordance with clause h. (10) of this Section of the Contract to the Covered Entity

within ten business days of the notice of termination. This provision shall apply to PHI that is in the possession of subcontractors or agents of Business Associate. Business Associate shall retain no copies of the PHI.

(B) In the event that Business Associate determines that returning or destroying the PHI is infeasible, Business Associate shall provide to Covered Entity notification of the conditions that make return or destruction infeasible. Upon documentation by Business Associate that return or destruction of PHI is infeasible, Business Associate shall extend the protections of this Section of the Contract to such PHI and limit further uses and disclosures of PHI to those purposes that make return or destruction infeasible, for as long as Business Associate maintains such PHI. Infeasibility of the return or destruction of PHI includes, but is not limited to, requirements under state or federal law that the Business Associate maintains or preserves the PHI or copies thereof.

(m) Miscellaneous Provisions.

(1) Regulatory References. A reference in this Section of the Contract to a section in the Privacy Rule means the section as in effect or as amended.

(2) Amendment. The Parties agree to take such action as is necessary to amend this Section of the Contract from time to time as is necessary for Covered Entity to comply with requirements of the Privacy Rule and the Health Insurance Portability and Accountability Act of 1996, Pub. L. No. 104-191.

(3) Survival. The respective rights and obligations of Business Associate shall survive the termination of this Contract.

(4) Effect on Contract. Except as specifically required to implement the purposes of this Section of the Contract, all other terms of the Contract shall remain in force and effect.

(5) Construction. This Section of the Contract shall be construed as broadly as necessary to implement and comply with the Privacy Standard. Any ambiguity in this Section of the Contract shall be resolved in favor of a meaning that complies, and is consistent with, the Privacy Standard.

(6) Disclaimer. Covered Entity makes no warranty or representation that compliance with this Section of the Contract will be adequate or satisfactory for Business Associate's own purposes. Covered Entity shall not be liable to Business Associate for any claim, civil or criminal penalty, loss or damage related to or arising from the unauthorized use or disclosure of PHI by Business Associate or any of its officers, directors, employees, contractors or agents, or any third party to whom Business Associate has disclosed PHI contrary to the provisions of this Contract or applicable law. Business Associate is solely responsible for all decisions made, and actions taken, by Business Associate regarding the safeguarding, use and disclosure of PHI within its possession, custody or control.

(7) Indemnification. The Business Associate shall indemnify and hold the Covered Entity harmless from and against any and all claims, liabilities, judgments, fines, assessments, penalties, awards and any statutory damages that may be imposed or assessed pursuant to HIPAA, as amended or the

HITECH Act, including, without limitation, attorney's fees, expert witness fees, costs of investigation, litigation or dispute resolution, and costs awarded thereunder, relating to or arising out of any violation by the Business Associate and its agents, including subcontractors, of any obligation of Business Associate and its agents, including subcontractors, under this section of the contract, under HIPAA, the HITECH Act, the Privacy Rule and the Security Rule.

## Notice to Executive Branch State Contractors and Prospective State Contractors of Campaign Contribution and Solicitation Limitations

This notice is provided under the authority of Connecticut General Statutes §9-612(g)(2), as amended by P.A. 10-1, and is for the purpose of informing state contractors and prospective state contractors of the following law (*italicized words are defined on the reverse side of this page*).

### CAMPAIGN CONTRIBUTION AND SOLICITATION LIMITATIONS

No *state contractor, prospective state contractor, principal of a state contractor or principal of a prospective state contractor*, with regard to a *state contract or state contract solicitation* with or from a state agency in the executive branch or a quasi-public agency or a holder, or principal of a holder of a valid prequalification certificate, shall make a contribution to (i) an exploratory committee or candidate committee established by a candidate for nomination or election to the office of Governor, Lieutenant Governor, Attorney General, State Comptroller, Secretary of the State or State Treasurer, (ii) a political committee authorized to make contributions or expenditures to or for the benefit of such candidates, or (iii) a party committee (which includes town committees).

In addition, no holder or principal of a holder of a valid prequalification certificate, shall make a contribution to (i) an exploratory committee or candidate committee established by a candidate for nomination or election to the office of State senator or State representative, (ii) a political committee authorized to make contributions or expenditures to or for the benefit of such candidates, or (iii) a party committee.

On and after January 1, 2011, no state contractor, prospective state contractor, principal of a state contractor or principal of a prospective state contractor, with regard to a state contract or state contract solicitation with or from a state agency in the executive branch or a quasi-public agency or a holder, or principal of a holder of a valid prequalification certificate, shall **knowingly solicit** contributions from the state contractor's or prospective state contractor's employees or from a *subcontractor or principals of the subcontractor* on behalf of (i) an exploratory committee or candidate committee established by a candidate for nomination or election to the office of Governor, Lieutenant Governor, Attorney General, State Comptroller, Secretary of the State or State Treasurer, (ii) a political committee authorized to make contributions or expenditures to or for the benefit of such candidates, or (iii) a party committee.

### DUTY TO INFORM

State contractors and prospective state contractors are required to inform their principals of the above prohibitions, as applicable, and the possible penalties and other consequences of any violation thereof.

### PENALTIES FOR VIOLATIONS

Contributions or solicitations of contributions made in violation of the above prohibitions may result in the following civil and criminal penalties:

**Civil penalties**—Up to \$2,000 or twice the amount of the prohibited contribution, whichever is greater, against a principal or a contractor. Any state contractor or prospective state contractor which fails to make reasonable efforts to comply with the provisions requiring notice to its principals of these prohibitions and the possible consequences of their violations may also be subject to civil penalties of up to \$2,000 or twice the amount of the prohibited contributions made by their principals.

**Criminal penalties**—Any knowing and willful violation of the prohibition is a Class D felony, which may subject the violator to imprisonment of not more than 5 years, or not more than \$5,000 in fines, or both.

### CONTRACT CONSEQUENCES

In the case of a state contractor, contributions made or solicited in violation of the above prohibitions may result in the contract being voided.

In the case of a prospective state contractor, contributions made or solicited in violation of the above prohibitions shall result in the contract described in the state contract solicitation not being awarded to the prospective state contractor, unless the State Elections Enforcement Commission determines that mitigating circumstances exist concerning such violation.

The State shall not award any other state contract to anyone found in violation of the above prohibitions for a period of one year after the election for which such contribution is made or solicited, unless the State Elections Enforcement Commission determines that mitigating circumstances exist concerning such violation.

Additional information may be found on the website of the State Elections Enforcement Commission, [www.ct.gov/seec](http://www.ct.gov/seec). Click on the link to "Lobbyist/Contractor Limitations."

## DEFINITIONS

“State contractor” means a person, business entity or nonprofit organization that enters into a state contract. Such person, business entity or nonprofit organization shall be deemed to be a state contractor until December thirty-first of the year in which such contract terminates. “State contractor” does not include a municipality or any other political subdivision of the state, including any entities or associations duly created by the municipality or political subdivision exclusively amongst themselves to further any purpose authorized by statute or charter, or an employee in the executive or legislative branch of state government or a quasi-public agency, whether in the classified or unclassified service and full or part-time, and only in such person's capacity as a state or quasi-public agency employee.

“Prospective state contractor” means a person, business entity or nonprofit organization that (i) submits a response to a state contract solicitation by the state, a state agency or a quasi-public agency, or a proposal in response to a request for proposals by the state, a state agency or a quasi-public agency, until the contract has been entered into, or (ii) holds a valid prequalification certificate issued by the Commissioner of Administrative Services under section 4a-100. “Prospective state contractor” does not include a municipality or any other political subdivision of the state, including any entities or associations duly created by the municipality or political subdivision exclusively amongst themselves to further any purpose authorized by statute or charter, or an employee in the executive or legislative branch of state government or a quasi-public agency, whether in the classified or unclassified service and full or part-time, and only in such person's capacity as a state or quasi-public agency employee.

“Principal of a state contractor or prospective state contractor” means (i) any individual who is a member of the board of directors of, or has an ownership interest of five per cent or more in, a state contractor or prospective state contractor, which is a business entity, except for an individual who is a member of the board of directors of a nonprofit organization, (ii) an individual who is employed by a state contractor or prospective state contractor, which is a business entity, as president, treasurer or executive vice president, (iii) an individual who is the chief executive officer of a state contractor or prospective state contractor, which is not a business entity, or if a state contractor or prospective state contractor has no such officer, then the officer who duly possesses comparable powers and duties, (iv) an officer or an employee of any state contractor or prospective state contractor who has *managerial or discretionary responsibilities with respect to a state contract*, (v) the spouse or a *dependent child* who is eighteen years of age or older of an individual described in this subparagraph, or (vi) a political committee established or controlled by an individual described in this subparagraph or the business entity or nonprofit organization that is the state contractor or prospective state contractor.

“State contract” means an agreement or contract with the state or any state agency or any quasi-public agency, let through a procurement process or otherwise, having a value of fifty thousand dollars or more, or a combination or series of such agreements or contracts having a value of one hundred thousand dollars or more in a calendar year, for (i) the rendition of services, (ii) the furnishing of any goods, material, supplies, equipment or any items of any kind, (iii) the construction, alteration or repair of any public building or public work, (iv) the acquisition, sale or lease of any land or building, (v) a licensing arrangement, or (vi) a grant, loan or loan guarantee. “State contract” does not include any agreement or contract with the state, any state agency or any quasi-public agency that is exclusively federally funded, an education loan, a loan to an individual for other than commercial purposes or any agreement or contract between the state or any state agency and the United States Department of the Navy or the United States Department of Defense.

“State contract solicitation” means a request by a state agency or quasi-public agency, in whatever form issued, including, but not limited to, an invitation to bid, request for proposals, request for information or request for quotes, inviting bids, quotes or other types of submittals, through a competitive procurement process or another process authorized by law waiving competitive procurement.

“Managerial or discretionary responsibilities with respect to a state contract” means having direct, extensive and substantive responsibilities with respect to the negotiation of the state contract and not peripheral, clerical or ministerial responsibilities.

“Dependent child” means a child residing in an individual's household who may legally be claimed as a dependent on the federal income tax of such individual.

“Solicit” means (A) requesting that a contribution be made, (B) participating in any fund-raising activities for a candidate committee, exploratory committee, political committee or party committee, including, but not limited to, forwarding tickets to potential contributors, receiving contributions for transmission to any such committee or bundling contributions, (C) serving as chairperson, treasurer or deputy treasurer of any such committee, or (D) establishing a political committee for the sole purpose of soliciting or receiving contributions for any committee. Solicit does not include: (i) making a contribution that is otherwise permitted by Chapter 155 of the Connecticut General Statutes; (ii) informing any person of a position taken by a candidate for public office or a public official, (iii) notifying the person of any activities of, or contact information for, any candidate for public office; or (iv) serving as a member in any party committee or as an officer of such committee that is not otherwise prohibited in this section.

“Subcontractor” means any person, business entity or nonprofit organization that contracts to perform part or all of the obligations of a state contractor's state contract. Such person, business entity or nonprofit organization shall be deemed to be a subcontractor until December thirty first of the year in which the subcontract terminates. “Subcontractor” does not include (i) a municipality or any other political subdivision of the state, including any entities or associations duly created by the municipality or political subdivision exclusively amongst themselves to further any purpose authorized by statute or charter, or (ii) an employee in the executive or legislative branch of state government or a quasi-public agency, whether in the classified or unclassified service and full or part-time, and only in such person's capacity as a state or quasi-public agency employee.

“Principal of a subcontractor” means (i) any individual who is a member of the board of directors of, or has an ownership interest of five per cent or more in, a subcontractor, which is a business entity, except for an individual who is a member of the board of directors of a nonprofit organization, (ii) an individual who is employed by a subcontractor, which is a business entity, as president, treasurer or executive vice president, (iii) an individual who is the chief executive officer of a subcontractor, which is not a business entity, or if a subcontractor has no such officer, then the officer who duly possesses comparable powers and duties, (iv) an officer or an employee of any subcontractor who has managerial or discretionary responsibilities with respect to a subcontract with a state contractor, (v) the spouse or a dependent child who is eighteen years of age or older of an individual described in this subparagraph, or (vi) a political committee established or controlled by an individual described in this subparagraph or the business entity or nonprofit organization that is the subcontractor.



**EXHIBIT F**

(federal wage rate package will be inserted here for final executed contract only. Refer to NTC – Federal Wage Determinations )

**EXHIBIT G**

(state wages will be inserted here)