

Billerica, MA

Reconstruction of Boston Road (Route 3A)

MassDOT Highway Division Project File # 605178

August 2021

SPECIAL PROVISIONS

100% SUBMISSION

08/03/2021



BETA

315 Norwood Park South
2nd Floor
Norwood, Massachusetts 02062
781.255.1982
www.BETA-Inc.com

SPECIAL PROVISIONS

BILLERICA

Rehabilitation on Boston Road (Route 3A) from Billerica Town Center to Floyd Street

Labor participation goals for this Project shall be 15.3% for minorities and 6.9% for women for each job category. The goals are applicable to both Contractor's and Subcontractor's on-site construction workforce. Refer to Document 00820 for details.

SCOPE OF WORK

The work consists of but is not limited to bicycle, pedestrian, and roadway and traffic improvements along a section of Boston Road (Route 3A), from Simmons Lane southerly to the Danforth Village Driveway, in the town of Billerica. The work primarily consists of full depth roadway reconstruction, widening, pavement milling and overlay, sidewalk reconstruction, curb ramps, installation of new granite curb, stormwater improvements, signs and pavement markings, street lighting, undergrounding of overhead utilities, and other various items to complete the improvements. The work also includes modifying the cross-section of the roadway to incorporate a 13' center turning lane (Two-Way Left -Turn Lane), installing a new traffic signal at the Good Street intersection, and the installation of a shared use path as an extension of the Yankee Doodle Bike Path, connecting the Billerica High School on Good Street to the Marshall Middle School access path off Heritage Road. The project will include other improvements in accordance with the plans and these Special Provisions.

All work under this Contract shall be done in conformance with the *2021 Standard Specifications for Highways and Bridges*, the *2017 Construction Standard Details*, the *Traffic Management Plans and Detail Drawings*, *MassDOT Work Zone Safety Temporary Traffic Control*, the *1990 Standard Drawings for Signs and Supports*; the *2015 Overhead Signal Structure and Foundation Standard Drawings*, the *2009 Manual on Uniform Traffic Control Devices (MUTCD)* with Massachusetts Amendments; the *1968 Standard Drawings for Traffic Signals and Highway Lighting*; *The American Standard for Nursery Stock*; the Plans and these Special Provisions.

CONTRACTOR QUESTIONS AND ADDENDUM ACKNOWLEDGEMENTS

Prospective bidders are required to submit all questions to the Construction Contracts Engineer by 1:00 P.M. on the Thursday before the scheduled bid opening date. Any questions received after this time will not be considered for review by the Department.

Contractors should email questions and addendum acknowledgements to the following email address massdotSpecifications@dot.state.ma.us The MassDOT project file number and municipality is to be placed in the subject line.

SUBSECTION 7.05 INSURANCE REQUIREMENTS**B. Public Liability Insurance**

The insurance requirements set forth in this section are in addition to the requirements of the Standard Specifications and supersede all other requirements.

Paragraphs 1 and 2

The Massachusetts Department of Transportation and applicable railroads shall be named as additional insureds.

Paragraph 4

Asbestos Liability Insurance shall be obtained for this project. The Contractor and the Massachusetts Department of Transportation shall be named as additional insureds.

COVID 19 GUIDELINES AND PROCEDURES

Commonwealth of Massachusetts COVID-19 GUIDELINES AND PROCEDURES FOR ALL CONSTRUCTION SITES AND WORKERS AT ALL PUBLIC WORK dated March 2020 as amended shall be adhered to.

It is the Contractor's responsibility to stay current with any changes or addendums issued to these guidelines. For copies of the guidelines go to:

<https://www.mass.gov/covid-19-guidelines-and-procedures-for-all-construction-sites-and-workers-at-all-public-work>

These Guidelines and Procedures will remain in effect until further notice. At the start of the Work the Contractor is required to submit a letter to the Engineer certifying that the Contractor is in compliance with CDC, OSHA and the Commonwealth's COVID-19 guidelines. The certification applies to the general contractor as well as all subcontractors engaged with the Work covered under this contract. No Work will be allowed to begin until the letter is submitted and approved by the Engineer. In addition, on a daily basis, the Contractor is required to submit a copy of the MassDOT Contractor COVID-19 Guidelines Compliance Checklist to the Engineer. If the Contractor fails to submit the daily checklist no work will be allowed until one is submitted. Any items checked with a NO will require immediate corrective action by the Contractor before any Work can begin.

Per Subsection 5.09 – Inspection of the Work - the Contractor is required to provide assistance to the Engineer to make a complete and detailed inspection of the work. That assistance includes furnishing equipment to perform the inspection, therefore the Contractor will be required to provide CDC compliant Personal Protective Equipment (PPE) to Department personnel field staff. The CDC compliant PPE shall consist of face masks, gloves and eye protection.

All costs associated with compliance with this provision are considered to be incidental to the contract cost and therefore the contractor will not be entitled to any additional compensation.

ACCESS MASSDOT HIGHWAY INFORMATION ON WEBSITE

Access MassDOT Highway Information related to Construction, Design/Engineering, Contractor/Vendor Information, Approved Materials and Fabricators, Manuals, Publications and Forms at:

<http://www.mass.gov/massdot/highway>

CONTRACTOR/SUBCONTRACTOR CERTIFICATION – CONTRACT COMPLIANCE

(Revision 03-23-10)

Pursuant to 23 C.F.R. § 633.101 et seq., the Federal Highway Administration requires each contractor to “insert in each subcontract, except as excluded by law or regulation, the required contract provisions contained in Form FHWA–1273 and further requires their inclusion in any lower tier subcontract that may in turn be made. The required contract provisions of Form FHWA–1273 shall not be incorporated by reference in any case. The prime contractor shall be responsible for compliance by any subcontractor or lower tier subcontractor with the requirements contained in the provisions of Form FHWA–1273.” The prime contractor shall therefore comply with the reporting and certification requirements provided in MassDOT’s CONTRACTOR/SUBCONTRACTOR CERTIFICATION Form (DOT-DIST-192) certifying compliance with 23 C.F.R. § 633.101 for each subcontract agreement entered into by the contractor. The contractor shall provide a fully executed original copy of said CONTRACTOR/SUBCONTRACTOR CERTIFICATION Form to MassDOT upon execution of any subcontract agreement. Failure to comply with the reporting and certification requirement of the CONTRACTOR/SUBCONTRACTOR CERTIFICATION Form may result in action against the prequalification status of the prime contractor with MassDOT.

CONTRACT AWARD AND NOTICE TO PROCEED PROCEDURES

(Amending and Supplementing Subsections 3.03 and 3.05)

The prepared Contract Package is to be completed in duplicate by the successful Bidder who shall execute and deliver the Contract Package and furnish the required surety to the Department. The date of the Contract shall be the date of the Bidder’s signature and shall be typed on all forms by the successful Bidder. The Contract Package consists of the contract forms for execution all of which must be returned. These documents are available on www.bidx.com as a separate file.

The company’s corporate seal should be affixed to both the Contract and bonds.

The Board of Director’s Vote will indicate who is authorized to sign and execute the Contract and bonds and affix the corporate seal. The vote shall show that said vote is in full force and effect and has not been amended or rescinded. The vote of the board of directors should be dated the same date as indicated on the contract form and should bear the imprint of the company’s corporate seal.

NOTIFICATION OF FUNDING SOURCES FOR WORK TO BE PAID BY OTHERS

This Contract contains work that shall be paid by the Town of Billerica. The said Town shall be responsible for construction costs associated with a Non-Participating Agreement with MassDOT.

In addition, this Contract has an agreement with the Town of Billerica, whereas when the construction costs for the contract scope exceed the total participating contract bid price by more than ten percent (10%), the City/Town shall be responsible for the amount over 110% of the total participating contract bid price.

HOLIDAY WORK RESTRICTIONS

(Supplementing Subsection 7.09)

The District Highway Director (DHD) may authorize work to continue during these specified time periods if it is determined by the District that the work will not negatively impact the traveling public. DHD may allow work in those areas on a case by case basis and where work is behind barrier and will not impact traffic

Below are the holiday work restrictions:

New Years Day (Federal Holiday)

No work on major arterial roadways from 5:00 AM on the day before until the normal start of business on the next subsequent business day. No work on local roadways on the holiday without permission by the DHD and the local police chief.

Martin Luther King's Birthday (Federal Holiday)

No work restrictions due to traffic concerns, however work on local roadways requires permission by the DHD and local police chief.

President's Day (Federal Holiday)

No work restrictions due to traffic concerns, however work on local roadways requires permission by the DHD and local police chief.

Evacuation Day (Suffolk County State Holiday)

No work restrictions due to traffic concerns.

Patriot's Day (State Holiday)

Work restrictions will be in place for Districts 3 and 6 along the entire Boston Marathon route and any other locations that the DHD in those districts determine are warranted so as to not to impact the marathon. All other districts work restrictions will be as per DHD.

Mother's Day

No work on Western Turnpike and Metropolitan Highway System from 5:00 AM on the Friday before, until the normal start of business on the following day.

Memorial Day (Federal Holiday)

No work on major arterial roadways from 5:00 AM on the Friday before, until the normal start of business on the following day.

HOLIDAY WORK RESTRICTIONS (Continued)**Bunker Hill Day (Suffolk County State Holiday)**

No work restrictions due to traffic concerns.

Independence Day (Federal Holiday)

No work on major arterial roadways from 5:00 AM on the day before until the normal start of business on the next subsequent business day. No work on local roadways on the holiday without permission by the DHD and the local police chief.

Labor Day (Federal Holiday)

No work on major arterial roadways from 5:00 AM on the Friday before, until the normal start of business on the following day.

Columbus Day (Federal Holiday)

No work on major arterials from 5:00 AM on the Friday before, until the normal start of business on the following day

Veterans' Day (Federal Holiday)

No work restrictions due to traffic concerns.

Thanksgiving Day (Federal Holiday)

No work on major arterials from 5:00 AM two days before until the normal start of business on the following Monday.

Christmas Day (Federal Holiday)

No work on major arterial roadways from 5:00 AM on the day before until the normal start of business on the next subsequent business day.

SHOP DRAWING SUBMITTAL (Supplementing Subsection 5.02)

The following is a list of items and materials that require shop drawing approval. Also see special provisions for these items.

Traffic Control Equipment

- Traffic Signal equipment (catalog cuts)
- Detector splices (catalog cuts)
- Mast Arm design calculations
- Mast Arm hanger assemblies (catalog cuts)
- Emergency Preemption equipment (catalog cuts)

Street Lighting

- Luminaires, including lamps, ballast (manufacturer's data and shop dwgs)
- Lamp Sockets and Lamp holders (manufacturer's data)
- Independent Testing Laboratory Photometric Data
- Lighting Standards & Brackets (manufacturer's data and shop dwgs.)
- Street light poles, foundation and load Center

SHOP DRAWING SUBMITTAL (Continued)**Utility Undergrounding Materials**

Utility approved conduit, manholes and handholes

Streetscape Improvements

Brick Pavers (product data, unit samples and sample panels)

All shop drawing related calculations shall be stamped by a Professional Engineer registered in Massachusetts. Above procedure shall also be used for submission of catalog cuts.

BIDDERS LIST

Pursuant to the provisions of 49 CFR 26.11 all official bidders will be required to report the names, addresses and telephone numbers of all firms that submitted bids or quotes in connection with this project. Failure to comply with a written request for this information within 15 business days may result in a recommendation to the Prequalification Committee that prequalification status be suspended until the information is received.

The Department will survey all firms that have submitted bids or quotes during the previous year prior to setting the annual goal and shall request that each firm report its age and gross receipts for the year.

ENGINEERS EQUIPMENT

The following shall be provided for the Engineer as incidental to the project and will become the property of the Massachusetts Department of Transportation.

- Twelve three ring binders, one inch thick with clear covers and side pockets
- One set of Project Ledger Covers-with Posts, National model number 94-592 or equivalent

WORK SCHEDULE

(Supplementing Subsection 8.02)

No work, including the setting up and taking down of work zone traffic control devices shall be done on existing roadways areas between the hours of 7:00-9:00 AM and 4:00-6:00 PM. Work shall be permitted in areas outside and off the roadway during these periods.

No work shall be done on this contract on Saturdays, Sundays, or Holidays. Work will not be allowed the day before or the day after a long weekend which involves a Holiday without prior approval by the Engineer.

The Town of Billerica organizes a parade on the second weekend of September traveling through the project area. The Contractor shall coordinate his/her schedule with the Town and no work shall be done during the day of the parade. The Contractor shall make the roadway and sidewalks (on both sides) presentable and accessible prior to the parade. The roadway shall be temporary patched for a minimum of two lanes, with no milling allowed prior to the parade.

CONCURRENT WORK BY OTHERS WITHIN PROJECT LIMITS

The Contractor's attention is directed to Project Utilities Coordination (PUC) form and the significant amount of utility relocation/installation work on this Project. Close coordination is required with all utility companies during this Project. The Contractor may work concurrently with the utility companies but must provide them sufficient space to operate unimpeded. The Contractor is required to coordinate his activities with all work by others within and adjacent to the Project limits.

No additional payments will be allowed for any disruption of work schedule caused by or required to coordinate work in this Contract and work to be performed by others.

MATERIALS FOR MAST ARMS

All materials for traffic signal mast arms shall be steel. The use of aluminum will not be allowed. Mast arms shall be conforming to M8.18.4, B. Steel and as described under Section 815 – Mast Arm Structures.

PROPRIETARY PRODUCTS

A letter discussing ornamental streetlighting (Item 823.93, 823.94, and 823.95) and ornamental mast arms (Item 815.1 and Item 815.3) as a proprietary specification pursuant to M.G.L. c. 30, § 39M(b) has been filed with MassDOT.

ENVIRONMENTAL CONTROLS

The Order of Conditions issued by the Conservation Commission has been included in the appendix of these Special Provisions and made part of these Special Provisions. **(OOC will be included at the next submission)**

Payment for work required by the Order of Conditions, unless otherwise provided for, shall be considered incidental to other items, and no additional payment shall be made for this work.

MATERIALS REMOVED AND STACKED

(Supplementing Subsections 580.64, 630.63)

Materials directed to be removed and stacked which are the property of the Town of Billerica, shall be removed and stacked by the contractor and transported to the town yard by the town forces. All materials shall be neatly stacked as directed by the Town of Billerica highway and/or water/sewer superintendents. In addition, all materials stacked shall be signed for by said superintendents.

If the Town of Billerica highway and/or water/sewer superintendents and the Engineer determines that any part of the stacked materials are unsuitable for re-use by the Town of Billerica, the Department, or if other owners decide to abandon part or all of their materials, such materials shall become the property of the Contractor and he shall dispose of them away from the site.

MONITORING WELLS

All monitoring wells within the project area shall be maintained, protected, and adjusted to be even with the final grade. The Contractor shall be responsible for the repair or replacement, at his own expense, of any damage to monitoring wells caused by his acts or neglect, and shall leave them in the same condition as they existed prior to commencement of the work. The Contractor shall coordinate with the owners of all monitoring wells within the project area. At least 72 hours in advance of any work affecting monitoring wells, the Contractor shall notify the well owner and at the same time provide such notice in writing to the Engineer. The Contractor shall also coordinate with all well owners to allow access to monitoring wells during construction activities if requested.

ENVIRONMENTAL PERMITTING

An Order of Conditions has been obtained from the Billerica Conservation Commission under the Wetlands Protection Act for proposed work in and around wetland resource areas. If field conditions and/or Contractor-proposed erection, demolition, storage, or other procedures not originally allowed by existing environmental permits require work to occur in or otherwise impact water or wetland resource areas, the Contractor is advised that no associated work can occur until all required environmental permits have been either amended or obtained allowing such work. The Contractor must notify the District 4 Highway Director and Resident Engineer in writing at least 60 days prior to desired commencement of the proposed activity. All environmental submittals, including any contact with Local, State, or Federal environmental agencies, must be coordinated with the District 4 Environmental Engineer. The Contractor is expected to fully cooperate with requests for information and provide same in a timely manner. The Contractor is further advised that the Department will not entertain a delay claim due to the time required to modify or obtain the environmental permits.

MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION FILE NUMBER SIGN

This project is subject to Massachusetts General Laws, Chapter 131, Section 40 as amended. Signs shall be in accordance with the latest MassDOT Construction Standards. All costs for the manufacture, erection, maintenance, moving, and removal of the signs shall be absorbed by the contractor with no additional compensation other than the contract unit prices.

For this project the Massachusetts Department of Environmental Protection File Number is **XX-XXXX**. (File number will be included at the next submission)

NORTHERN LONG-EARED BAT PROTECTION

The U.S. Fish and Wildlife Service (USFWS) has listed the northern long-eared bat as threatened under the Endangered Species Act (ESA) and the following requirements exist to protect the bat and its habitat.

This project has been consulted with the USFWS through the Optional Framework to Streamline Section 7 Consultation and is consistent with the Programmatic Biological Opinion under the authority of section 4(d) of the Endangered Species Act and the Final 4(d) Rule published in the Federal Register on January 14, 2016. No conservation measures or time of year restrictions on tree cutting are required. If additional cutting is proposed by the Contractor that is outside the scope of this contract, additional review is required by the MassDOT Highway Division's Environmental Services Section, additional review may be required by the USFWS, and time of year restrictions could apply to such tree cutting.

EMERALD ASH BORER ADVISORY

To the extent possible, all trees and brush shall be disposed on site, typically chipped and spread in place. When trees or brush must be removed, such as in urban, or otherwise populated areas, Contractor shall identify proposed location for disposal, and provide written notification to the Engineer for approval. Disposal shall be in city or town of project, or at minimum, within county, of construction operations.

DEWATERING

The Contractor's attention is directed to construction operations which may occur in wetland areas, streams, culverts at brooks and/or surface or subsurface areas where surface water or groundwater may exist or accumulate. All dewatering and related work shall be conducted in such a manner as to prevent siltation or contamination of any adjacent resource area. Pumping discharge shall not be allowed to enter directly or indirectly into any wetland resource area without prior treatment (filter bags, silt sacks, settling basins, etc.) The Contractor shall include under each pertinent item all labor, materials and equipment necessary to dewater the affected areas for proper installation of the respective items. No additional compensation will be made for dewatering but shall be considered incidental and included in the price for each respective item.

SHEETING & SHORING

The Contractor is advised that construction operations may require support of excavation and dewatering for the installation of drainage structures; pipes; protection of existing buildings; existing structures and utilities, etc. The Contractor shall submit his/her proposed means and methods of providing support of excavation, including design calculations, and dewatering stamped by a Massachusetts Registered Professional Structural Engineer to the Engineer for review and approval. No separate measurement or payment shall be made for support of excavation and all labor, materials and equipment necessary to furnish, install, maintain and remove any support of excavation, as required for the safe and proper performance of the work, shall be considered incidental to the Item to which it pertains.

In addition, no separate measurement or payment shall be made for dewatering and all labor, materials and equipment necessary to dewater the work area, properly treat, and dispose of, any water shall be considered incidental to the Item to which it pertains.

NOTICE TO OWNERS OF UTILITIES

(Supplementing Subsection 7.13)

Written notice shall be given by the Contractor to all public service corporations or municipal and State officials owning or having charge of publicly or privately owned utilities of his intention to commence operations affecting such utilities at least one (1) week in advance of the commencement of such operations. The Contractor shall, at the same time, file a copy of such notice with the Engineer. The Contractor shall ensure that all affected utilities / agencies are notified.

Before the Contractor begins any work or operation that might damage subsurface structures, he/she shall carefully locate all such structures and conduct his operations so as to avoid any damage to them.

The following website lists the names and addresses of the utilities may be affected, but the completeness of the list is not guaranteed:

<https://www.mass.gov/info-details/utility-contacts-by-district-and-municipality>

Select District 4

Select the Town (Billerica), and then locate the utility

Town officials are shown at website <http://www.mass.gov>

Print “Cities and Towns” in the Search box, then Select Massachusetts **Cities and Towns** link, then select alphabetically the required Town.

The following is the name and addresses of the agency which may be affected and must be notified. Completeness is not guaranteed by the Department. The Contractor shall assure that all affected agencies are notified.

BILLERICA - Pole Data

<u>Municipality</u>	<u>Pole Set Responsibility</u>	<u>Updated</u>
BILLERICA	National Grid	3/28/2008

District Utility/Constructability Engineer

<u>County</u>	<u>District</u>	<u>Contact</u>	<u>Phone</u>	<u>Email</u>
Middlesex	4	Ray Stinson	857-368-4135	Ray.Stinson@dot.state.ma.us

Utility Data

Electric						
<u>Company</u>	<u>Address</u>	<u>City</u>	<u>State</u>	<u>Zip</u>	<u>Updated</u>	
National Grid Electric	548 Haydenville Road	Leeds	MA	01053	12/4/2018	

<u>Contact</u>	<u>Office</u>	<u>Extension</u>	<u>Email</u>
Sandra Annis	413-582-7424		sandra.annis@nationalgrid.com12/21/2018

Gas						
<u>Company</u>	<u>Address</u>	<u>City</u>	<u>State</u>	<u>Zip</u>	<u>Updated</u>	
National Grid Gas	40 Sylvan Road	Waltham	MA	02451	9/20/2019	

<u>Contact</u>	<u>Office</u>	<u>Extension</u>	<u>Email</u>
Melissa Owens	781-907-2845		Melissa.Owens@nationalgrid.com9/4/2012

<u>Company</u>	<u>Address</u>	<u>City</u>	<u>State</u>	<u>Zip</u>	<u>Updated</u>
Tennessee Gas Pipeline Company	8 Anngina Drive	Enfield	CT	06082	8/17/2010

<u>Contact</u>	<u>Office</u>	<u>Extension</u>	<u>Email</u>
David Wood	860-763-6005		KMEncroachmentsNorth@kindermorgan.com5/20/2020

Telephone						
<u>Company</u>	<u>Address</u>	<u>City</u>	<u>State</u>	<u>Zip</u>	<u>Updated</u>	
Verizon	385 Myles Standish Blvd.	Taunton	MA	02780	11/8/2013	

<u>Contact</u>	<u>Office</u>	<u>Extension</u>	<u>Email</u>
Karen Mealey	774-409-3160		karen.m.mealey@verizon.com8/29/2012

Water						
<u>Company</u>	<u>Address</u>	<u>City</u>	<u>State</u>	<u>Zip</u>	<u>Updated</u>	
Billerica DPW	365 Boston Road - Room G11	Billerica	MA	01821	7/26/2010	

<u>Contact</u>	<u>Office</u>	<u>Extension</u>	<u>Email</u>
Abdul Alkhatib	978-671-1313		aalkhatib@town.billerica.ma.us10/26/2018

Sewer						
<u>Company</u>	<u>Address</u>	<u>City</u>	<u>State</u>	<u>Zip</u>	<u>Updated</u>	
Billerica DPW	365 Boston Road - Room G11	Billerica	MA	01821	7/26/2010	
<u>Contact</u>	<u>Office</u>	<u>Extension</u>	<u>Email</u>			
Abdul Alkhatib	978-671-1313		aalkhatib@town.billerica.ma.us	10/26/2018		
Railroad						
<u>Company</u>	<u>Address</u>	<u>City</u>	<u>State</u>	<u>Zip</u>	<u>Updated</u>	
PanAm Railways	Iron Horse Park	North Billerica	MA	01862	4/15/2009	
<u>Contact</u>	<u>Office</u>	<u>Extension</u>	<u>Email</u>			
Ted Krug	978-663-1077		tkrug@panam.com	4/5/2017		
<u>Company</u>	<u>Address</u>	<u>City</u>	<u>State</u>	<u>Zip</u>	<u>Updated</u>	
MBTA Document Control Group	500 Arborway	Boston	MA	02130	4/16/2020	
<u>Contact</u>	<u>Office</u>	<u>Extension</u>	<u>Email</u>			
Tyler Scott			tscott@mbta.com	4/16/2020		
Cable						
<u>Company</u>	<u>Address</u>	<u>City</u>	<u>State</u>	<u>Zip</u>	<u>Updated</u>	
Comcast Cable Corporation	PO Box 6505, 5 Omni Way	Chelmsford	MA	01824	8/8/2018	
<u>Contact</u>	<u>Office</u>	<u>Extension</u>	<u>Email</u>			
Wendy Brown	978-848-5163		Wendy_Brown@comcast.com	4/8/2019		
<u>Company</u>	<u>Address</u>	<u>City</u>	<u>State</u>	<u>Zip</u>	<u>Updated</u>	
AT&T / Teleport Communications America, c/o Siena Engineering Group	50 Mall Road – Suite 203	Burlington	MA	01803	4/15/2014	
<u>Contact</u>	<u>Office</u>	<u>Extension</u>	<u>Email</u>			
Hayleigh Walker	781-221-8400	x7023	Hayleigh.Walker@sienaengineeringgroup.com	1/3/2018		
<u>Company</u>	<u>Address</u>	<u>City</u>	<u>State</u>	<u>Zip</u>	<u>Updated</u>	
FirstLight	359 Corporate Drive	Portsmouth	NH	03801	10/3/2019	
<u>Contact</u>	<u>Office</u>	<u>Extension</u>	<u>Email</u>			
Paulie Polacke			ppolacke@firstlight.net	11/25/2019		
<u>Company</u>	<u>Address</u>	<u>City</u>	<u>State</u>	<u>Zip</u>	<u>Updated</u>	
Crown Castle	80 Central Street	Boxborough	MA	01719	1/18/2018	
<u>Contact</u>	<u>Office</u>	<u>Extension</u>	<u>Email</u>			
Mark Bonanno	508 616 7818		mark.bonanno@crowncastle.com	7/17/2018		

Fire Alarm

<u>Company</u>	<u>Address</u>	<u>City</u>	<u>State</u>	<u>Zip</u>	<u>Updated</u>
Billerica Fire Alarm	8 Good Street	Billerica	MA	01821	6/21/2013
<u>Contact</u>	<u>Office</u>	<u>Extension</u>	<u>Email</u>		
Joseph Bukoiemski	978 671 0941		jbukoiemski@billericafire.com 1/26/2016		
DPW					
<u>Company</u>	<u>Address</u>	<u>City</u>	<u>State</u>	<u>Zip</u>	<u>Updated</u>
Billerica Town Engineer	365 Boston Road-Room 609	Billerica	MA	01821	7/8/2015
<u>Contact</u>	<u>Office</u>	<u>Extension</u>	<u>Email</u>		
Kelley Conway	978-671-1300		kconway@town.billerica.ma.us 10/26/2018		
Other					
<u>Company</u>	<u>Address</u>	<u>City</u>	<u>State</u>	<u>Zip</u>	<u>Updated</u>
MCI-Verizon Business	P.O. Box 600	Charlton	MA	01507	2/22/2017
<u>Contact</u>	<u>Office</u>	<u>Extension</u>	<u>Email</u>		
Stephen Parretti	508-248-1305		stephen.parretti@verizon.com 7/24/2017		
<u>Company</u>	<u>Address</u>	<u>City</u>	<u>State</u>	<u>Zip</u>	<u>Updated</u>
Zayo Group	2 Royce Lane	Westfield	MA	01886	12/8/2020
<u>Contact</u>	<u>Office</u>	<u>Extension</u>	<u>Email</u>		
Richard Moran	978-844-7525		richard.moran@zayo.com 1/14/2013		
<u>Company</u>	<u>Address</u>	<u>City</u>	<u>State</u>	<u>Zip</u>	<u>Updated</u>
Raytheon Company	880 Technology Park Drive, MS-T4051	Billerica	MA	01821	4/3/2015
<u>Contact</u>	<u>Office</u>	<u>Extension</u>	<u>Email</u>		
Douglas Flynn	978-436-8554		flynn@raytheon.com 4/3/2015		
<u>Company</u>	<u>Address</u>	<u>City</u>	<u>State</u>	<u>Zip</u>	<u>Updated</u>
Lowell Regional Transit Authority	115 Thorndike Street	Lowell	MA	01852	4/3/2015
<u>Contact</u>	<u>Office</u>	<u>Extension</u>	<u>Email</u>		
David Bradley	978-458-9673		Lrta1@aol.com 4/3/2015		

The Contractor shall coordinate his/her work with the work required to be performed by any private utility owner for this project. No additional compensation or time extensions shall be allowed for delays as a result of work required to be performed by a private utility owner.

If a pole needs to be held by the utility in order to sustain them securely in place during placement of (drainage structures, pipe, etc.), the Contractor will be solely responsible for all costs charged by the utility owner for this service. All costs in connection shall be included in the unit prices for the various items.

NATIONAL GRID EMERGENCY TELEPHONE NUMBERS

GAS:

Emergency: 1-800-233-5325

New Service: 1- 877-696-4743

Customer Support: 1-800-732-3400

ELECTRIC:

Outage/ Emergency: 1-800-465-1212

New Service: 1-800-375-4730

Customer Support: 1-800-322-3223

PERMITS AND LICENSES (Supplementing Subsection 7.03)

Before any electrical connections are made the Contractor shall submit copies of the current licenses of all electricians who will perform the electrical work along with a copy of the master electrician's license. Within ten (10) days after Notice to Proceed, the Contractor shall submit a list of the Journeyman Electricians (MA license) who will perform the electrical work in this contract, along with copies of each Journeyman Electrician's current Massachusetts license.

DRAINAGE (Supplementing Subsection 7.13)

It shall be the Contractor's responsibility to maintain proper drainage at all times in the areas under construction until the final system is put into use.

If the roadway is to be left at base course over the winter months, only catch basins at low points and those structures identified by the Engineer shall be adjusted to base course grade. Winter pavement grade adjustment of these structures, with the exception of new structures, will be paid for under Item 220. Concrete collars will not be necessary for temporary grades.

The castings of all structures, which are required to be set or reset under this project shall not be set complete in place to the final grade until after the bituminous concrete binder course has been completed and top course is scheduled to be completed within 2 weeks.

Before placement of top course material begins, utility structures shall be adjusted to final grade. Utility structures shall be exposed above binder grade for not more than 48 hours before placement of surface course material will be required.

All new pipes and structures within the limits of this contract shall be left in a clean and operable condition at the completion of the work.

All the above work shall be included under the relevant drainage item without additional compensation therefore. Any adjustments made to new drainage structures will be included under the contract unit price for the respective structures including winter shutdown and low point adjustments.

PROJECT 605178-SUMMARY OF POTENTIALLY IMPACTING RELEASES AND HASP RECOMMENDATIONS

The following is a summary of the information obtained during the file review for the release sites at 325 Boston Road and 344-346 Boston Road.

RTN 3-0031806, 325 Boston Road, State Roadway

- This site consists of a 340-foot stretch of Boston Road and a few small areas of the eastern shoulder of the road in front of 327, 336, and 340 Boston Road.
- RTN 3-0031806 was assigned to the site in 2013 due to a diesel fuel release to the roadway associated with a vehicle accident.
- Petroleum-contaminated soil and sediment was removed from the eastern shoulder of the road, as well as from a catch basin.
- Post-excavation sampling found low concentrations of petroleum in soil within the release area.
- The top foot of soil on the eastern shoulder of Boston Road between approximately Sta 18+50 and Sta 21+25 may be contaminated with petroleum constituents.

RTN 3-0033311, 344-346 Boston Road, Commercial Property

- This site consists of a vacant commercial property; the property had been previously used as a gasoline station from at least 1939 until the 1980s. Following the mid-1980s various small retail stores and a landscaping company operated out of the former gasoline station building, with the adjacent larger building being occupied by an antiques shop.
- RTN 3-0033311 was assigned to the site in 2016, based on a subsurface investigation to determine whether a hazardous materials release had occurred on the property. □ Volatile Petroleum Hydrocarbons (VPH) and Extractable Petroleum Hydrocarbons (EPH), in some cases in excess of applicable reportable concentrations, were found in soil at depths ranging from two to ten feet below grade surface (bgs).
- VPH and EPH were found in groundwater (located at depths one to nine feet bgs) at levels in excess of applicable reportable concentrations.
- A Permanent Solution with No Conditions (PSNC) was submitted for the site in 2016 after a Method 3 Risk Analysis found no significant risk to human health, the environment, public safety or public welfare.
- There is a small area of overlap between the PS boundaries and the area impacted by the MassDOT project on the eastern side of Boston Road at approximately Sta 24+00.
- Groundwater in this portion of the site is recorded as being seven feet bgs and should not be encountered by any of the anticipated work.
- Excavation in this portion of the site should not be deeper than one foot bgs and thus contaminated soil should not be encountered, but the construction contractor must be aware that they are operating within a known hazardous materials release site and be especially attentive to the potential to encounter soil and/or groundwater contamination.

PROJECT 605178-SUMMARY OF POTENTIALLY IMPACTING RELEASES AND HASP RECOMMENDATIONS (Continued)

Based on the information obtained during the DEP file review, contamination may exist in the project area. Residual contamination may be present in the soil located on the eastern side of Boston Road between stations 18+50 and 21+25 and at station 24+00. Please see the uploaded specifications: Item 180.01 (Environmental Health and Safety Program), Item 180.02 (Personal Protection Level C Upgrade), Item 180.03 (Licensed Site Professional Services), Item 181.11 (Disposal of Unregulated Soil), Item 181.12 (Disposal of Regulated Soil – In-State Facility), Item 181.13 (Disposal of Regulated Soil – Out-of-State Facility), Item 181.14 (Disposal of Hazardous Waste).

RAILROAD

Based upon the historical use of the railroad right-of-way (ROW) that crosses Boston Road at approximately Sta 25+00 as a railroad line, it is expected that residual contamination is present and it is likely that contaminated soils will be encountered in the project area. It is possible that residual levels of polycyclic aromatic hydrocarbons, trace levels of metals, pesticides (such as lead arsenate), and constituents of oil or fuel (petroleum products), coal ash from engines, and creosote from ties could be present in soil. The proposed construction activities will result in handling of and exposure to potentially contaminated soil.

To be consistent with MassDEP's Best Management Practices for Controlling Exposure to Soil During the Development of Rail Trails or working in vicinity of rail road, an effort must be made to minimize the amount of excavated material (ballast rock and soil) removed from the project area. The Contractor can only reused excavation material within the project limits, soil may be reused on-site, outside of wetland areas and their associated buffer zones (reuse of excavated soil within or adjacent to wetland areas is not recommended).

VALUE ENGINEERING CHANGE PROPOSAL

This Subsection defines the conditions and requirements which apply to Value Engineering Change Proposals ("VECPs"). The purpose of this provision is to encourage the Contractor to propose changes in certain project requirements that will maintain the project's functional requirements at a savings in contract time, contract price, or both. The net savings obtained by using a VECP that meets the conditions and requirements set forth here will be shared by the Contractor and MassDOT.

VECP's under this provision are to be initiated, developed and submitted to MassDOT by the Contractor. The VECP must show the contemplated changes to the Drawings, Specifications and other requirements in the Contract. When a VECP submitted pursuant to this section is fully accepted by MassDOT, the VECP will be implemented by the Contractor and paid using the current cost and resource loaded schedule. Contractor shall demonstrate that the VECP is equal to, or better than, the original design or material; that there is an interest in public safety within the VECP; that there is a life-cycle cost benefit; and/or that end users will benefit from the shortened schedule. VECPs shall be consistent with the MassHighway/MassDOT Standard Specifications for Highways and Bridges and other applicable reference documents and directives. Any proposed

deviation from these documents will need to be clearly identified in the VECP Proposal Documents, and must be approved by MassDOT's Chief Engineer before accepting this VECP.

- A. In order to be considered for MassDOT review each VECP shall:
1. Be clearly labeled pursuant to this Subsection;
 2. Yield a net savings at least two hundred and fifty thousand (250,000.00) Dollars and/or a net saving of contract completion duration of at least three (3) months;
 3. The proposed changes to contract items must:
 - a. maintain the specified items' required functions (service life, reliability);
 - b. meet applicable safety regulations and codes;
 - c. material substitutions must be in accordance with DOT prequalified/preapproved products and must be tested in accordance with standard material specs/testing methods (and considering all relevant environmental, load, and other relevant factors);
 - d. show economy of operation, ease of maintenance, ease of construction, and necessary standardized features and appearance; and
 4. Shall not require an extension of Contract Time or Contract Milestones, with the exception of cases when there are anticipated significant cost saving.

The thresholds above are considered to be a general guideline. MassDOT will consider VECPs outside of these thresholds if a significant benefit is demonstrated. Additionally, notwithstanding this VECP process, MassDOT will consider minor revisions in the form of a Contract Modification.

Further, any VECP submitted shall be in sufficient detail to clearly define the proposed change. The Contractor's failure to provide information of the type, detail and in a format to facilitate the MassDOT's review, may be grounds for rejection of the VECP. Additionally, the Contractor will not be entitled to any equitable adjustment or increased Time, due to any aspect of any of the proposed VECP including permitting, right of way, utility coordination or delayed responses by MassDOT. If, after the progression of the work associated with the executed Contract Modification for the VECP, any additional costs are realized by the Contractor or any of the sub-consultants, sub-contractors, or suppliers, the Contractor shall be obligated to pay for any and all costs.

- B. The following initial items shall be provided by the Contractor for MassDOT's review. *Items 1-6 need to be submitted prior to the start of MassDOT's review of the VECP and item 7 is an important consideration for the pricing of the VECP and the timeline of the proposed VECP schedule.*
1. **VECP Description:** A description of the difference between the existing and the proposed Contract requirements, and the comparative advantages and disadvantages of each;

VALUE ENGINEERING CHANGE PROPOSAL (Continued)

2. ***VECP Change Listing:*** A listing of the Contract requirements that will need to be changed, modified, or reviewed as well as the proposed Contract document changes in the Instructions to Bidders, Contract, Standard Specifications, General Requirements and Special Provisions required by the VECP.
3. ***Construction Schedule Update:*** Any changes in the Contract Time(s) or Contract Milestone(s), that will result from acceptance of the VECP, shall be accompanied by a contemporaneous schedule analysis (*i.e., the Contractor's baseline schedule submission, all past/required monthly schedule updates, a detailed assessment of all past delays, and a resource loaded Critical Path Method schedule as specified in Section 8.0 / Subsection 8.02 of this Contract*) of the projected Work that remains including the proposed VECP related schedule changes (*inclusive of the timeline to review accept the VECP and the timeline for implementing the design changes*) in the remaining work. This shall be submitted in the form of a Proposal Schedule until the VECP has been formally accepted. Note: All of this information is to be updated, recertified, and formally accepted by MassDOT before final acceptance of this this VECP is issued.
4. ***Date for MassDOT's Acceptance:*** A statement that clearly justifies the date by which the VECP must be accepted to obtain the maximum price reduction, noting any effect upon the Contract Time(s) and/or Contract Milestone(s). This statement must include a narrative that demonstrates the most recent construction schedule has been utilized to justify that proposed acceptance date (*e.g. "in order to start to fabricate critical materials, authorization must be provided to work on the shop drawings by no later than [date]"*). The Contractor should allow for at least sixty (60) to ninety (90) days for acceptance by MassDOT once all of the VECP documentation has been provided. Acceptance shall mean that MassDOT has received a finalized and executed contract modification. However, this is a proposed Contract change.

The Contractor is fully obligated to progress the Work of the original Contract and MassDOT is not liable for any delays or costs that may occur in the review phase of any VECP proposal.

5. ***Cost and Savings Estimates:*** A detailed estimate of the anticipated net savings, calculated as follows:
 - a. ***Original Scope:*** Isolate the cost of performing the original contract construction activities, in accordance with the original Contract Documents, as originally bid by the Contractor, that are anticipated to be superseded by the VECP. *This cost is to include any original contract scope that is anticipated to be altered or eliminated by the VECP such as, shop drawing preparation, inspection work, testing, maintenance of traffic, or any other original contract costs, that have yet to have been performed at the time of this VECP submission.*
 - b. ***New VECP Scope:*** Calculate the cost of performing the comparable construction activities associated with the VECP.

VALUE ENGINEERING CHANGE PROPOSAL (Continued)

- c. ***Contractor's Engineer & Inspection:*** Calculate the cost of engineering, inspection, and design work by the Contractor's Engineer/Designer. This should be a realistic estimate of the costs of any required engineering, design and review work by the Contractor's Engineer.
- d. ***MassDOT's Costs:*** MassDOT's estimate of costs to perform engineering/design reviews, cost estimate reviews, schedule reviews, and any other administrative costs to review and recommend implementation of the proposed VECP. (*including all anticipated increased costs to MassDOT on other Contracts and all anticipated follow-on increased costs to MassDOT, if any*) as provided by MassDOT. MassDOT's estimated costs must be included the VECP calculation and will be provided by MassDOT in support of the VECP evaluation process.
- e. ***Other Costs:*** Estimated costs associated with any revisions to other project related costs, such as Environmental Permits or Right of Way acquisitions, including other agency or municipality costs, as provided by MassDOT.

Net Savings:

The net savings to be split between MassDOT and the Contractor shall be calculated using the items above as follows: $a - (b+c+d+e) = \text{net savings}$

6. *The Contractor shall also provide:*

- a. A proposed Change Order, which explains and justifies any required Equitable Adjustment in the Contract Price.
- b. The Contractor's actual costs expended for developing the VECP as of the date of the VECP submission;

7. *Design Changes and Drawings:* The costs that are outlined above should be inclusive of the following design and engineering responsibilities.

- a. Design changes shall be prepared and stamped by the Contractor's professional designer and/or engineer. In addition, in the development of the VECP; the Contractor is responsible for anticipating and managing all aspects associated with any VECP design work that must be performed by a licensed Engineer.
- b. The Contractor's engineer must analyze and stamp all components of any aspect of the project that has been redesigned, changed, or altered as a result of this VECP.
- c. The Contractor's engineer shall provide all calculations and supporting design/engineering documentation that was utilized to develop the changes and stamped drawings. These will be used by MassDOT's Designer-of-Record to review the VECP changes. The Contractor is limited to selecting only those engineer's that have been pre-qualified by MassDOT's A&E Board.

VALUE ENGINEERING CHANGE PROPOSAL (Continued)

- d. MassDOT's Designer-of-Record will review and respond to all completed design submissions related to this VECP within thirty (30) calendar days, unless determined to be a non-critical path item.
- e. MassDOT will be responsible for estimating and managing MassDOT's Designer-of-Record during the VECP review and implementation. Should any significant conflicts arise, between the Contractor's Engineer and MassDOT's Designer-of-Record, the DOT and the Contractor will work expeditiously to resolve the conflict. Should this type of conflict continue for greater than five (5) days, the Contractor is to bear all financial and time related impacts of such delay and must seek to resolve the design conflict, in an acceptable manner to MassDOT. The resolution of this conflict will be funded at the Contractor's expense – exclusive of the net saving that was agreed to at the execution of the contract modification for this VECP.
- f. The Contractor's Engineer may also be required to inspect the construction work. The Contractor is to include such anticipated inspection costs in the initial VECP.
- g. MassDOT's Designer of Record will remain the Designer-of-Record for the entire Project. Any costs incurred in the use of MassDOT's Designer-of-Record by MassDOT or Contractor associated with the review of a VECP are to be included in the calculated net savings.

- C. Approval of the VECP shall not occur until a Contract Modification, incorporating the VECP, is issued by MassDOT and properly executed by the Contractor. MassDOT may accept or reject part or all of any VECP at any time prior to an executed Contract Modification for the applicable VECP. The decision of MassDOT, concerning acceptance or rejection of any VECP, shall be final and shall not be subject to dispute resolution.

It is expected that several weeks may go by before the final VECP documentation has been executed with a Contract Modification. Therefore, MassDOT intends to make certain that the initial cost estimate information has not changed before entering into a Contract Modification. As the VECP evaluation process is finalized, and prior to the signed Contract Modification for the VECP, the Contractor and MassDOT must re-certify the current status of the originally proposed cost and/or schedule savings.

Until a contract modification is issued and schedule and cost/savings re-certification is complete and accepted by MassDOT, the Contractor shall remain obligated to perform the Work in accordance with the terms and conditions of the original Contract Documents.

Upon completion of the work associated with the VECP, MassDOT may require verification that the VECP savings has been achieved.

- D. VECPs will be processed (distributed, reviewed, commented upon, accepted or rejected) expeditiously (pursuant to M.G.L. c. 30, § 39R); however, as this is an elective modification to the contract, MassDOT shall not be liable for any delay or cost in the review and acceptance of the VECP. During the review of the VECP, the Contractor remains obligated

to progress the original Contract scope, and schedule, as planned; until a Contract Modification, accepting the Contractor re-certified VECP, has been executed by MassDOT.

The Contractor has the right to withdraw part, or all of any VECP, prior to acceptance by MassDOT. Such withdrawal shall be made in writing to the Engineer. The Contractor shall state the period of time, from the date of the initial VECP submittal, that the VECP shall remain valid and feasible. Revision of this validity and feasibility period shall be allowed only by mutual agreement of the Contractor and the Engineer in writing.

If the Contractor desires to withdraw the proposal prior to the expiration of this period for non-technical reason, MassDOT reserves the right to recover all actual costs that have been incurred to MassDOT.

If the Contractor withdraws the VEC Proposal, MassDOT reserves the right to proceed with the VECP or any portion of the VECP as a normal change and the Contractor waives any right it may have had to share in net savings thereunder.

For purposes of this provision, expiration of the time established by the Contractor for approval shall be considered as withdrawal by the Contractor if MassDOT requests an extension of that time and the Contractor does not provide a written extension.

- E. With regard to unknown conditions or sub-surface work, in general, the expectation is that the Contractor and MassDOT will strive to gain enough knowledge about the risks in order to provide a forward-priced Change Proposal. Therefore, any costs to fully evaluate the proposal, such as additional borings and/or test pits, must be considered in the cost evaluation of whether the VECP is worth pursuing. However, if it is impractical to gather conclusive exploratory information, before the VECP is executed, MassDOT may consider provisions in the VECP that clearly identifies the risk sharing (cost and time) related specifically to the unknown/sub-surface conditions. If these VECP provisions are acceptable to MassDOT they are to include supplemental language to provide a determination of the final savings/cost, and time impacts, no later than 45 days after the sub-surface work is completed. All other aspects of the VECP, unrelated to these Provisions, will be binding upon execution of the VECP.

EQUIVALENT SINGLE AXLE LOADS (ESALS)

The estimated traffic level to be used for SUPERPAVE HMA mixture designs for this contract, expressed in Equivalent Single Axle Loads (ESALs) for the design travel lane over a 20-year period, is 0.3-10.0 Million 18-kip (80-kn) ESALs.

SUBSECTION 8.14 UTILITY COORDINATION, DOCUMENTATION, AND MONITORING RESPONSIBILITIES

A. GENERAL

In accordance with the provisions of Section 8.00 Prosecution and Progress, utility coordination is a critical aspect to this Contract. This section defines the responsibility of the Contractor and MassDOT, with regard to the initial utility relocation plan and changes that occur as the prosecution of the Work progresses. The Engineer, with assistance from the Contractor shall coordinate with Utility companies that are impacted by the Contractor's operations. To support this effort, the Contractor shall provide routine and accurate schedule updates, provide notification of delays, and provide documentation of the steps taken to resolve any conflicts for the temporary and/or permanent relocations of the impacted utilities. The Contractor shall provide copies to the Engineer of the Contractor communication with the Utility companies, including but not limited to:

- Providing advanced notice, for all utility-related meetings initiated by the Contractor.
- Providing meeting minutes for all utility-related meetings that the Contractor attends.
- Providing all test pit records.
- Request for Early Utility work requirements of this section (see below).
- Notification letters for any proposed changes to Utility start dates and/or sequencing.
- Written notification to the Engineer of all apparent utility delays within seven (7) Calendar Days after a recognized delay to actual work in the field – either caused by a Utility or the Contractor.
- Any communication, initiated by the Contractor, associated with additional Right-of-Way needs in support of utility work.
- Submission of completed Utility Completion Forms.

B. PROJECT UTILITY COORDINATION (PUC) FORM

The utility schedule and sequence information provided in the Project Utility Coordination Form (if applicable) is the best available information at the time of the bid and has been considered in setting the contract duration. The Contractor shall use all of this information in developing the bid price and the Baseline Schedule Submission, inclusive of the individual utility durations sequencing requirements, and any work that has been noted as potentially concurrent utility installations.

C. INITIATION OF UTILITY WORK

The Engineer will issue all initial notice-to-proceed dates to each Utility company based on either the:

- 1) Contractor's accepted Baseline Schedule
- 2) An approved Early Utility Request in the form of an Early Utility sub-net schedule (in accordance with the requirements of this Subsection)
- 3) An approved Proposal Schedule

C.1 - BASELINE SCHEDULE – UTILITY BASIS

The Contractor shall provide a Baseline Schedule submission in accordance with the requirements of Subsection 8.02 and inclusive of all of the information provided in the PUC Form that has been issued in the Contract documents. This is to include the utility durations, sequencing of work, allowable concurrent work, and all applicable considerations that have been depicted on the PUC Form.

SUBSECTION 8.14 (Continued)

C.2 – EARLY UTILITY REQUEST – (aka SUBNET SCHEDULE) PRIOR TO THE BASELINE
All early utility work is defined as any anticipated/required utility relocations that need to occur prior to the Baseline Schedule acceptance. In all cases of proposed early utility relocation, the Contractor shall present all known information at the pre-construction conference in the form of a ‘sub-net’ schedule showing when each early utility activity needs to be issued a notice-to-proceed. The Contractor shall provide advance notification of this intent to request early utility work in writing at or prior to the Pre-Construction meeting. Prior to officially requesting approval for early utility work, the Contractor shall also coordinate with MassDOT and all utility companies (private, state or municipal) which may be impacted by the Contract. If this request is acceptable to the Utilities and to MassDOT, the Engineer will issue a notice-to-proceed to the affected Utilities, based on these accepted dates.

C.3 – PROPOSAL SCHEDULE - CHANGES TO THE PUC FORM

If the Contractor intends to submit a schedule (in accordance with MassDOT Standard Specifications, Division I, Subsection 8.02) that contains durations or sequencing that vary from those provided in the Project Utility Coordination (PUC) Form, the Contractor must submit this as an intended change, in the form of a Proposal Schedule and in accordance with MassDOT Standard Specifications, Division I, Subsection 8.02. These proposed changes are subject to the approval of the Engineer and the impacted utilities, in the form of this Proposal Schedule and a proposed revision to the PUC form. The Contractor shall not proceed with any changes of this type without written authorization from the Engineer, that references the approved Proposal Schedule and PUC form changes. The submission of the Baseline Schedule should not include any of these types of proposed utility changes and should not delay the submission of the Baseline Schedule. As a prerequisite to the Proposal Schedule submission, and in advance of the utility notification(s) period, the Contractor shall coordinate the proposed utility changes with the Engineer and the utility companies, to develop a mutually agreed upon schedule, prior to the start of construction.

D. UTILITY DELAYS

The Contractor shall notify the Engineer upon becoming aware that a Utility owner is not advancing the work in accordance with the approved utility schedule. Such notice shall be provided to the Engineer no later than seven (7) calendar days after the occurrence of the event that the Contractor believes to be a utility delay. After such notice, the Engineer and the Contractor shall continue to diligently seek the Utility Owner’s cooperation in performing their scope of Work.

In order to demonstrate that a critical path delay has been caused by a third-party Utility, the Contractor must demonstrate, through the requirements of the monthly Progress Schedule submissions and the supporting contract records associated with Subsection 8.02, 8.10 and 8.14, that the delays were beyond the control of the Contractor.

SUBSECTION 8.14 (Continued)

All documentation provided in this section is subject to the review and verification of the Engineer and, if required, the Utility Owner. In accordance with MassDOT Specifications, Division I, Subsection 8.10, a Time Extension will be granted for a delay caused by a Utility, only if the actual duration of the utility work is in excess of that shown on the Project Utility Coordination Form, and only if;

- 1) proper Notification of Delay was provided to MassDOT in accordance with the time requirements that are specified in this Section
- 2) the utility delay is a critical path impact to the Baseline Schedule (or most recently approved Progress Schedule)

E. LOCATION OF UTILITIES

The locations of existing utilities are shown on the Contract drawings as an approximation only. The Contractor shall perform a pre-construction utility survey, including any required test pits, to determine the location of all known utilities no later than thirty (30) calendar days before commencing physical site work in the affected area.

F. POST UTILITY SURVEY – NOTIFICATION

Following completion of a utility survey of existing locations, the Contractor will be responsible to notify the Engineer of any known conflicts associated with the actual location of utilities prior to the start of the work. The Engineer and the Contractor will coordinate with any utility whose assets are to be affected by the Work of this Contract. A partial list of utility contact information is provided in the Project Utility Coordination Form.

G. MEETINGS AND COOPERATION WITH UTILITY OWNERS

The Contractor shall notify the Engineer in advance of any meeting they initiate with a Utility Owner's representative to allow MassDOT to participate in the meeting if needed.

Prior to the Pre-Construction Meeting, the Contractor should meet with all Utility Owners who will be required to perform utility relocations within the first 6 months of the project, to update the affected utilities of the Project Utility Coordination Form and all other applicable Contract requirements that impact the Utilities. The Contractor shall copy the Engineer on any correspondence between the Utility Owner and the Contractor.

H. FORCE ACCOUNT / UTILITY MONITORING REQUIREMENTS

The Engineer will be responsible for recording daily Utility work force reports. The start, suspension, re-start, and completion dates of each of the Utilities, within each phase of the utility relocation work, will be monitored and agreed to by the Engineer and the Contractor as the work progresses.

I. ACCESS AND INSPECTION

The Contractor shall be responsible for allowing Utility owners access to their own utilities to perform the relocations and/or inspections. The Contractor shall schedule their work accordingly so as not to delay or prevent each utility from maintaining their relocation schedule.

SUBSECTION 8.02 SCHEDULE OF OPERATIONS

Replace this subsection with the following:

An integrated cost and schedule controls program shall be implemented by the Contractor to track and document the progress of the Work from Notice to Proceed (NTP) through the Contractor Field Completion (CFC) Milestone. The Contractor's schedules will be used by the Engineer to monitor project progress, plan the level-of-effort required by the Department's work force and consultants and as a critical decision-making tool. Accordingly, the Contractor shall ensure that it complies fully with the requirements specified herein and that its schedules are both accurate and updated as required by the specification throughout the life of the project. Detailed requirements are provided in Division II, Section 722 Construction Scheduling.

COMPLIANCE WITH THE NATIONAL DEFENSE AUTHORIZATION ACT

(Supplementing Subsection 7.01)

On all projects, the "Prohibition on Certain Telecommunications and Video Surveillance Services or Equipment" Regulation (2 CFR 200.216) prohibits the Contractor from using or furnishing the following telecommunications equipment or services:

- Telecommunications equipment produced by Huawei Technologies Company or ZTE Corporation (or any subsidiary or affiliate of such entities).
- For the purpose of public safety, security of government facilities, physical security surveillance of critical infrastructure, and other national security purposes, video surveillance and telecommunications equipment produced by Hytera Communications Corporation, Hangzhou Hikvision Digital Technology Company, or Dahua Technology Company (or any subsidiary or affiliate of such entities).
- Telecommunications or video surveillance services provided by such entities or using such equipment.
- Telecommunications or video surveillance equipment or services produced or provided by an entity that the Secretary of Defense, in consultation with the Director of the National Intelligence or the Director of the Federal Bureau of Investigation, reasonably believes to be an entity owned or controlled by, or otherwise connected to, the government of a covered foreign country.

This prohibition applies to all products manufactured by the aforementioned companies, including any individual components or parts.

By submitting a bid on a project, the Contractor certifies that all work will be in compliance with the terms of 2 CFR 200.216. The Contractor shall submit a COC indicating compliance with the above provisions for all telecommunications equipment or services included in the Contract.

Payment for the item in which the materials are incorporated may be withheld until these COCs are received. Any cost involved in furnishing the certificate(s) shall be borne by the Contractor.

SECTION 722 CONSTRUCTION SCHEDULING

DESCRIPTION

722.20 General

The Contractor's approach to prosecution of the Work shall be disclosed to the Department by submission of a Critical Path Method (CPM) schedule and a cost/resource loaded Construction Schedule when required in this Subsection. These requirements are in addition to, and not in limitation of, requirements imposed in other sections.

The requirements for scheduling submissions are established based on the Project Value at the time of the bid and are designated as Type A, B, C or D. The definitions of these Schedule Requirement Types are summarized below. Complete descriptions of all detailed requirements are established elsewhere in this specification.

Type A – for all Site-Specific Contracts with a Project Value over \$20 Million

- Schedule Planning Session
- Baseline CPM Schedule
- Monthly Update CPM Schedule
- Short-term Construction Schedule
- Contract Schedule Update Meeting
- Resource-Loading
- Resources Graphic Reporting
- Cash Flow Projections from the CPM
- Cash Flow Charts
- Cost-loaded CPM
- Contractor-furnished CPM software, computer and training

Type B – for all Site-Specific Contracts with a Project Value between \$10 Million and \$20 Million

- Schedule Planning Session
- Baseline CPM Schedule
- Monthly Update CPM Schedule
- Short-term Construction Schedule
- Contract Schedule Update Meeting
- Cost-loaded CPM
- Resource-Loading
- Monthly Projected Spending Report (PSR)
- Contractor-furnished CPM software, computer and training

SECTION 722 (Continued)

Type C – for all Site-Specific Contracts with a Project Value between \$3 Million and \$10 Million

- Schedule Planning Session
- Baseline CPM Schedule
- Monthly Update CPM Schedule
- Short-term Construction Schedule
- Contract Schedule Update Meeting
- Monthly Projected Spending Report (PSR)
- Contractor-furnished CPM software, computer and training

Type D - for all contracts with a Project Value less than \$3 Million; various locations contracts of any dollar amount; contracts with durations less than one-hundred and eighty (180) Calendar Days; and other contracts as determined by the Engineer.

- Bar chart schedule updated monthly or at the request of the Engineer (See Section 722.62.B - Bar Charts.)
- Monthly Projected Spending Report (PSR) (See Section 722.62.F - Projected Spending Reports.)

MATERIALS, EQUIPMENT, PERSONNEL**722.40 General****A. Software Requirements (Types A, B and C)**

The Contractor shall use Primavera P6 computer scheduling software.

In addition to the requirements of Section 740 – Engineer’s Field Office and Equipment, the Contractor shall provide to the Department one (1) copy of the scheduling software, one (1) software license and one (1) computer capable of running the scheduling software for the duration of the Contract. This computer and software shall be installed in the Engineer’s Field Office within twenty-eight (28) Calendar Days after Notice to Proceed. The computer and software shall be maintained and serviced as recommended by the computer manufacturer and/or as required by the Engineer during the duration of the Contract at no additional cost to the Department. The Contractor shall provide professional training in the basic use of the software for up to eight (8) Department employees. The trainer shall be approved by the Engineer. This training shall be provided within twenty-eight (28) Calendar Days after Notice to Proceed.

B. Scheduler Requirements

For all schedule types, if the Contractor plans to use outside scheduling services, the scheduler shall be approved as a subcontractor by the Engineer.

For Type A, B and C Schedules the name of the Contractor’s Project Scheduler together with his/her qualifications shall be submitted to the Department for approval by the Engineer within seven (7) Calendar Days after NTP. The Project Scheduler shall have a minimum of five [5] years of project CPM scheduling experience, three [3] years of which shall be on projects of similar scope and value as the project for which the Project Scheduler is being proposed. References shall be provided from past projects that can attest to the capabilities of the Project Scheduler.

SECTION 722 (Continued)**CONSTRUCTION METHODS****722.60 General****A. Schedule Planning Session**

(Types A, B and C)

The Contractor shall conduct a schedule planning session within seven (7) Calendar Days after the Contractor receives the NTP and prior to submission of the Baseline Schedule. This session will be attended by the Department and its consultants. During this session, the Contractor shall present its planned approach to the project including, but not limited to:

1. the Work to be performed by the Contractor and its subcontractors;
2. the planned construction sequence and phasing; planned crew sizes;
3. summary of equipment types, sizes, and numbers to be used for each work activity;
4. all early work related to third party utilities;
5. identification of the most critical submittals and projected submission timelines;
6. estimated durations of major work activities;
7. the anticipated Critical Path of the project and a summary of the activities on that Critical Path;
8. a summary of the most difficult schedule challenges the Contractor is anticipating and how it plans to manage and control those challenges;
9. a summary of the anticipated quarterly cash flow over the life of the project.

This will be an interactive session and the Contractor shall answer all questions that the Department and its consultants may have. The Contractor shall provide a minimum of five (5) copies of a written summary of the information presented and discussed during the session to the Engineer. The Contractor's Baseline Schedule and accompanying Schedule Narrative shall incorporate the information discussed at this Schedule Planning Session.

B. Schedule Reviews by the Department (All Types)

1. Baseline Schedule Reviews

The Engineer will respond to the Baseline Schedule Submission within thirty (30) Calendar Days of receipt providing comments, questions and/or disposition that either accepts the schedule or requires revision and resubmittal. Baseline Schedules shall be resubmitted within fifteen (15) Calendar Days after receipt of the Engineer's comments.

2. Contract Progress Schedule / Monthly Update Reviews

The Engineer will respond to each submittal within twenty one (21) Calendar Days. Schedules shall be resubmitted by the Contractor within five (5) Calendar Days after receipt of the Engineer's comments.

Failure to submit schedules as and when required could result in the withholding of full or partial pay estimate payments by the Engineer.

SECTION 722 (Continued)**722.61 Schedule Content and Preparation Requirements**
(Types A, B and C unless otherwise noted)

Each Contract Progress Schedule shall fully conform to these requirements.

A. LOGIC

The schedules shall divide the Work into activities with appropriate logic ties to show:

1. conformance with the requirements of this Section and Division I, Subsection 8.02 - Schedule of Operations
2. the Contractor's overall approach to the planning, scheduling and execution of the Work
3. conformance with any additional sequences of Work required by the Contract Documents, including, but not limited to, Subsection 8.03 - Prosecution of Work and Subsection 8.06 – Limitations of Operations.

B. ACTIVITIES

The schedules shall clearly define the progression of the Work from NTP to Contractor Field Completion (CFC) by using separate activities for each of the following items:

1. NTP
2. Each component of the Work defined by specific activities
3. Detailed activities to satisfy permit requirements
4. Procurement of fabricated materials and equipment with long lead times, including time for review and approval of submittals required before purchasing
5. The preparation and submission of shop drawings, procedures and other required submittals, with a planned duration that is to be demonstrated to the Engineer as reasonable
6. The review and return of shop drawings, procedures and other required submittals, approved or with comments, the duration of which shall be thirty (30) Calendar Days, unless otherwise specified or as approved by the Engineer
7. Interfaces with adjacent work, utility companies, other public agencies, sensitive abutters, and/or any other third party work affecting the Contract
8. The Critical Path, clearly defined and organized
9. Float shall be clearly identified
10. Access Restraints – restrictions on access to areas of the Work that are defined by the Department in the bid package, in Subsection 8.06 – Limitations of Operations or elsewhere in the Contract
11. Milestones listed in Subsection 8.03 - Prosecution of Work or elsewhere in the Contract Documents
12. Subcontractor approvals at fifteen (15) Calendar Days from submittal to response
13. Full Beneficial Use (FBU) Contract Milestone per the requirements of Subsection 8.03 - Prosecution of Work
14. Contractor's request for validation of FBU (ready to open to traffic)
15. The Department's confirmation of completed work to allow for FBU

SECTION 722 (Continued)

16. Substantial Completion Contract Milestone per the requirements of Subsections 7.15 - Claims Against Contractors for Payment of Labor, Materials and Other Purposes and 8.03 - Prosecution of Work
17. Contractor's request for validation of Substantial Completion
18. Punchlist Completion Period of at least thirty (30) Calendar Days per the requirements of Subsections 5.11 - Final Acceptance, 7.15 - Claims Against Contractors for Payment of Labor, Materials and Other Purposes and 8.03 - Prosecution of Work
19. Contractor confirmation that all punchlist work and documentation has been completed
20. Physical Completion of the Work Contract Milestone per the requirements of Subsections 5.11 - Final Acceptance and 8.03 - Prosecution of Work
21. Documentation Completion per the requirements of Subsections 5.11 - Final Acceptance and 8.03 - Prosecution of Work
22. Contractor Field Completion Contract Milestone per the requirements of Subsections 5.11 - Final Acceptance and 8.03 - Prosecution of Work
23. Utility work to be performed in accordance with the Project Utility Coordination (PUC) Form as provided in Section 8.14 - Utilities Coordination, Documentation and Monitoring Responsibilities
24. Traffic work zone set-up and removal, night work and phasing
25. Early Utility Relocation (by others) that has been identified in the Contract
26. Right-of-Way (ROW) takings that have been identified in the Contract
27. Material Certifications
28. Work Breakdown Structure in accordance with the MassDOT-Highway Division Contractor Construction Schedule Toolkit located on the MassDOT-Highway Division website at:
<https://www.mass.gov/info-details/massdot-highway-contractors-schedule-toolkit>
29. For Type A and B Contracts only: All items to be paid, including all Unit Price and Lump Sum pay items, shall be identified by activity. This shall include all non-construction activities such as engineering work; purchase of permanent materials and equipment, purchase of structural steel stock, equipment procurement, equipment delivery to the site or storage location and the representative amount of overhead/indirect costs that was included in the Contractor's Bid Prices.

C. EARLY AND LATE DATES

Early Dates shall be based on proceeding with the Work or a designated part of the Work exactly on the date when the corresponding Contract Time commences. Late Dates shall be based on completing the Work or a designated part of the Work exactly on the corresponding Contract Time, even if the Contractor anticipates early completion.

SECTION 722 (Continued)**D. DURATIONS**

Activity durations shall be in Work Days. Planned Original Durations shall be established with consideration to resources and production rates that correspond to the Contractor's Bid Price. Within all of the Department-required schedules, the Contractor shall plan the Work using durations for all physical construction activities of no less than one (1) Work Day and no greater than fourteen (14) Work Days, unless approved by the Engineer as part of the Baseline Schedule Review.

Should there be an activity with a duration that is determined by the Engineer to be unreasonable, the Contractor will be asked to provide a basis of the duration using bid documents, historic production rates for similar work, or other form of validation that is acceptable to the Engineer. Should the Contractor and the Engineer be unable to agree on reasonable activity durations, the Engineer will, at a minimum, note the disagreement in the Baseline Schedule Review along with a duration the Engineer considers reasonable and the basis for that duration. A schedule that contains a substantial number of activities with durations that are deemed unreasonable by the Engineer will not be accepted.

E. MATERIALS ON HAND (for Types A and B only)

The Contractor shall identify in the Baseline Schedule all items of permanent materials (Materials On Hand) for which the Contractor intends to request payment prior to the incorporation of such items into the Work.

F. ACTIVITY DESCRIPTIONS

The Contractor shall use activity descriptions in all schedules that clearly describe the work to be performed using a combination of words, structure numbers, station numbers, bid item numbers, work breakdown structure (WBS) and/or elevations in a concise and compact label as specified in the MassDOT-Highway Division Contractor Construction Schedule Toolkit located on the MassDOT-Highway Division website at:

<https://www.mass.gov/info-details/massdot-highway-contractors-schedule-toolkit>

G. ACTIVITY IDENTIFICATION NUMBERS

The Contractor shall use the activity identification numbering system specified in the MassDOT-Highway Division Contractor Construction Schedule Toolkit located online at the address above.

H. ACTIVITY CODES

The Contractor shall use the activity codes specified in the MassDOT-Highway Division Contractor Construction Schedule Toolkit located online at the address above.

I. CALENDARS

Different calendars may be created and assigned to all activities or to individual activities. Calendars define the available hours of work in each Calendar Day, holidays and general or project-specific non-Work Days such as Fish Migration Periods, time of year (TOY) restrictions and/or area roadway restrictions.

SECTION 722 (Continued)

Examples of special calendars include, but are not limited to:

- Winter Shutdown Period, specific work is required by separate special provision to be performed during the winter. See Special Provision 8.03 (if applicable)
- Peak traffic hours on heavily traveled roadways. This shall be from 6:30 am to 9:30 am and from 3:30 pm to 7:00 pm, unless specified differently elsewhere in the Contract.
- Special requirements by sensitive abutters, railroads, utilities and/or other state agencies as defined in the Contract.
- Cape Cod and the Islands Summer Roadway Work Restrictions: A general restriction against highway and bridge construction is enforced between Memorial Day and Labor Day, unless otherwise directed by the Engineer. Refer to the Project Special Provisions for specific restrictions.
- Cape Ann Summer Roadway Work Restrictions: While there are no general restrictions for Cape Ann as there are for Cape Cod and the Islands, project-specific restrictions may be enforced. Refer to the Project Special Provisions for specific restrictions.
- Turtle and/or Fish Migration Periods and/or other in-water work restrictions: Refer to the Project Special Provisions for specific restrictions.
- Working over Waterways Restricted Periods: Refer to the Project Special Provisions for specific restrictions.
- Night-time paving and striping operations, traffic and temperature restrictions: Refer to the Project Special Provisions for specific restrictions.
- Utility Restrictions shall be as specified within the Contract.

J. FLOAT

For the calculation of float in the CPM schedule, the setting for *Retained Logic* is required for all schedule submissions, starting with the Baseline Schedule Submission. Should the Contractor have a reason to propose that an alternative calculation setting such as *Progress Override* be used, the Contractor shall obtain the Engineer's approval prior to modifying to this setting.

K. COST AND RESOURCE LOADING (Types A and B only)

For all Type A and B Schedules, the Contractor shall provide a cost and resource-loaded schedule with an accurate allocation of the costs and resources necessary to complete the Work. The costs and resources shall be assigned to all schedule activities in order to enable the Contractor to efficiently execute the Contract requirements and the Engineer to validate the original plan, monitor progress, provide cash flow projections and analyze delays.

1. Each schedule activity shall have an assigned cost that accurately represents the value of the Work. Each schedule activity shall have its resources assigned to it by craft and the anticipated hours to accomplish the work. Each schedule activity's equipment resources shall be assigned to it by equipment type and hours operated. Front-loading or other unbalancing of the cost distribution will not be permitted.
2. The sum of the cost of all schedule activities shall be equal to the Contractor's Bid Price.
3. Indicating the labor hours per individual, per day, by craft and equipment hours/day will be acceptable.

SECTION 722 (Continued)

4. The Engineer reserves the right to use the cost-loading as a means to resolve changes, disputes, time entitlement evaluations, increases or decreases in the scope of Work, unit price renegotiations and/or claims.
5. For all Type A and B Schedules, all subnets, fragnets, Proposal Schedules, and Recovery Schedules shall be cost and resource- loaded to help to quickly validate and monitor the duration of the Work to be performed.
6. For Type A Schedules, cost-loading of the schedule will also be used for cash flow projection purposes.
7. The cost-loading of each activity shall indicate the portion of the cost for that activity that is applicable to a specific bid item (cost account.) The total cost for each cost account must equal the bid item price.
8. For Type A Schedules, each month, the Contractor will be paid using the Cost-loaded CPM activities for Lump Sum payment items. This requirement supersedes any requirements elsewhere in this Contract regarding partial payments of schedule-of-values for all Lump Sum items.

L. NOT TO BE USED IN THE CONTRACTOR'S CPM SCHEDULE

1. Milestones or constraint dates not specified in the Contract
2. Scheduled work not required for the accomplishment of a Contract Milestone
3. Use of activity durations, logic ties and/or sequences deemed unreasonable by the Engineer
4. Delayed starts of follow-on trades
5. Float suppression techniques

722.62 Submittal Requirements

All schedules shall be prepared and submitted in accordance with the requirements listed below.

Each monthly Contract Progress Schedule submittal shall be uniquely identified.

Except as stated elsewhere in this subsection, schedule submittals shall include each of the documents listed below, prepared in two formats, for distribution as follows:

- a. four (4) compact discs (CD); one (1) each for the Office of Project Controls and Performance Oversight (O-PC&PO), the Boston Construction Section Office, the District Construction Office and the Resident Engineer's Office. Additional copies shall be required if the work is performed in more than one district.
- b. two (2) hard copies plotted in color on 24" X 36" paper; one (1) copy each for the District Construction Office and the Resident Engineer's Office. No copies for the O-PC&PO and the Boston Construction Section Office. Additional copies shall be required if the work is performed in more than one district.

SECTION 722 (Continued)**A. Narratives**

A written narrative shall be submitted with every schedule submittal. The narrative shall:

1. itemize and describe the flow of work for all activities on the Critical Path in a format that includes any changes made to the schedule since the previous Contract Progress Schedule / Monthly Update or the Baseline Schedule, whichever is most recent;
2. provide a description of any specification requirements that are not being followed. Identify those that are improvements and those that are not considered to be meeting the requirements;
3. provide all references to any Notice of Delay that has been issued, within the time period of the Contract Progress Schedule Update, by letter to the Engineer. Note that any Notice of Delay that is not issued by letter will not be recognized by the Engineer. See Subsection 722.64.A - Notice of Delay;
4. provide a description of each third-party utility's planned vs. actual progress and note any that are trending late or are late per the durations and commitments as provided in the PUC Form; provide a description of the five (5) most important responses needed from the Department and the need date for the responses in order to maintain the current Schedule of Record;
5. provide a description of all critical issues that are not within the control of the Contractor or the Department (third party) and any impact they had or may have on the Critical Path;
6. provide a description of any possible considerations to improve the probability of completing the project early or on-time;
7. compare Early and Late Dates for activities on the Critical Path and describe reasons for changes in the top three (3) most critical paths ;
8. describe the Contractor's plan, approach, methodologies and resources to be employed for completing the various operations and elements of the Work for the top three (3) most critical paths. For update schedules, describe and propose changes to those plans and verify that a Proposal Schedule is not required;
9. describe, in general, the need for shifts that are not 5 days/week, 8 hours/day, the holidays that are inserted into each calendar and a tabulation of each calendar that has been used in the schedule;
10. describe any out-of-sequence logic and provide an explanation of why each out-of-sequence activity does not require a correction, if one has not been provided, and an adequate demonstration that these changes represent the basis of how these activities will be built, including considerations for resources, dependencies and previously-approved production rates;
11. identify any possible duration increases resulting from actual or anticipated unit price item quantity overruns as compared to the baseline duration, with a corresponding suggestion to mitigate any possible delays to the Critical Path. If the delay is anticipated to impact the Critical Path, refer to Subsections 4.06 - Increased or Decreased Contract Quantities and 8.10 - Determination and Extension of Contract Time for Completion and submit a letter to the Engineer notifying of a potential delay;
12. include a schedule log consisting of the name of the schedule, the data date and the date submitted.

SECTION 722 (Continued)**B. Bar Charts (Types A, B, C and D)**

One (1) time-scaled bar chart containing all activities shall be prepared and submitted using a scale that yields readable plots and that meets the requirements of Subsection 722.61 - Schedule Content and Preparation Requirements. Activities shall be linked by logic ties and shown on their Early Dates. Critical Paths shall be highlighted and Total Float shall be shown for all activities.

A second time-scaled bar chart shall also be prepared containing only the Critical Path or, if the Critical Path is not the longest path, the Longest Path using a scale that yields readable plots and that meets the requirements of Subsection 722.61 - Schedule Content and Preparation Requirements. Activities shall be linked by logic ties and shown on their Early Dates. Total Float shall be shown for all activities.

Bar Charts shall be printed in color and submitted on 11" X 17" paper or, if approved by the Engineer, as a .pdf file.

C. Detailed Activity Schedule Comparisons

A Detailed Activity Schedule Comparison (DASC) is a simple reporting tool in the format of a graphical report that will provide Resident Engineers with immediate, timely and up-to-date information. The DASC consists of an updated bar chart that overlays the current time period's bar chart onto the previous time period's bar chart for an easily-read comparison of progress during the present and previous reporting periods. The DASC shall be prepared and submitted in accordance with the instructions contained in the Construction Schedule Toolkit located on the MassDOT-Highway Division website at:

<https://www.mass.gov/info-details/massdot-highway-contractors-schedule-toolkit>

The reports described in Subsections D, E and F below shall be submitted with all of the schedules listed in Subsection 722.20 - General:

D. Activity Cost Report and Monthly Cash Flow Projections (Type A only)

With each Contractor Quantity Estimate (CQE), the Contractor shall submit an Activity Cost Report and Cash Flow Projection that includes all activities grouped by Contract Bid Item.

The Activity Cost Report shall be generated from the Schedule of Record and shall be the basis of the Monthly Cash Flow Projection. Within each contract Bid Item, activities shall be sequenced by ascending activity identification number and shall show:

1. activity ID and description,
2. forecast start and finish dates for each activity and,
3. when submitted as a revised schedule, actual start and finish dates for each completed activity.

For Unit Price pay items, in addition to the above, estimates to complete and any variance to the estimated Contract quantity shall be shown.

E. Resource Graphs (Type A only)

Monthly and cumulative resource graphs for the remaining Contract period using the Early Dates and Late Dates in the Contract Progress Schedule shall be included as part of each schedule submittal.

SECTION 722 (Continued)**F. Projected Spending Reports (Types B, C and D)**

A Projected Spending Report (PSR) shall be prepared and submitted in accordance with the instructions listed at the end of this section. The PSR shall indicate the monthly spending (cash flow) projection for each month from NTP to Contractor Field Completion (CFC). Each month's actual spending shall be calculated using all CQEs paid during that month. If the difference between the Contractor's monthly projections vs. the actual spending is greater than 10%, the Contractor's monthly spending projection shall be revised and resubmitted within fifteen (15) Calendar Days.

The Projected Spending Report (PSR) shall be depicted in a tabular format and printed in color on 11 x 17-sized paper or larger as approved by the Engineer. For additional instructions and a template for preparing the Projected Spending Report (PSR), refer to the Contractor's Construction Schedule Toolkit located on the MassDOT-Highway Division website at:

<https://www.mass.gov/info-details/massdot-highway-contractors-schedule-toolkit> or consult with the District Construction Scheduler.

722.63. Progress Schedule Requirements**A. Baseline Schedule**

The Baseline Schedule shall be due thirty (30) Calendar Days after Notice to Proceed (NTP.) The Baseline Schedule shall only reflect the Work awarded to the Contractor and shall not include any additional work involving Extra Work Orders or any other type of alleged delay. The Baseline Schedule shall be prepared and submitted in accordance with Subsections 722.61 - Schedule Content and Preparation Requirements and 722.62 - Submittal Requirements. Once the Baseline Schedule has been accepted by the Engineer, with or without comments, it shall represent the as-planned schedule for the Work and become the Contract Progress Schedule of Record until such time as the schedule is updated or revised under Subsections 722.63.C - Contract Progress Schedules / Monthly Updates, 722.64.C - Recovery Schedules and 722.64.D - Proposal Schedules.

The Cost and Resource-Loading information (Types A and B only) shall be provided by the Contractor within forty-five (45) Calendar Days after NTP.

The Engineer's review comments on the Baseline Schedule and the Contractor's responses to them will be maintained for the duration of the Contract and will be used by the Engineer to monitor the Contractor's work progress by comparing it to the Contract Progress Schedule / Monthly Update.

B. Interim Progress-Only Schedule Submissions

The first monthly update of the Contract Progress Schedule/Monthly Update is due within seventy (70) Calendar Days after Notice to Proceed (NTP.) The Baseline Schedule review period ends at sixty (60) Calendar Days after NTP, see Subsection 722.60.B - Schedule Reviews by the Department. If the Baseline Schedule has not been accepted within sixty (60) Calendar Days after NTP, an Interim Progress-Only Schedule shall be due within seventy (70) Calendar Days after NTP. The purpose of the Interim Progress-Only Schedule is to document the actual progress of all activities, including non-construction activities, from NTP until the Baseline Schedule is accepted.

SECTION 722 (Continued)**C. Contract Progress Schedules / Monthly Updates (Types A, B, C and D)**

The first Contract Progress Schedule shall be submitted by the Contractor no later than seventy (70) Calendar Days after NTP. The data date for this first Progress Schedule shall be sixty (60) Calendar Days after NTP. Subsequent Progress Schedules shall be submitted monthly.

Each Contract Progress Schedule shall reflect progress up to the data date. Updated progress shall be limited to as-built sequencing and as-built dates for completed and in-progress activities. As-built data shall include actual start dates, remaining Work Days and actual finish dates for each activity, but shall not change any activity descriptions, the Original Durations, or the Original Resources (as planned at the time of bid), without the acceptance of the Engineer. If any activities have been completed out-of-sequence, the Contractor shall propose new logic ties for affected in-progress and future activities that accurately reflect the previously-approved sequencing. Alternatively, the Contractor may submit to the Engineer for approval an explanation of why an out-of-sequence activity does not require a correction and an adequate demonstration that the changes accurately represent how the activities will be built, including considerations for resources, dependencies and previously approved production rates. Once approved by the Engineer, the Contractor may incorporate the changes in the next Contract Progress Schedule/Monthly Update with the affected activities clearly identified and explained in the Schedule Narrative.

No revisions to logic ties; sequence, description or duration of future activities; or planned resource costs shall be made without prior approval by the Engineer.

Any proposed logic changes for in-progress or future activities shall be submitted to the Engineer for approval before being incorporated into a Contract Progress Schedule. The logic changes must be submitted using a Proposal Schedule or a schedule fragment submission. Once approved by the Engineer, the Contractor may incorporate the logic in the next Contract Progress Schedule/Monthly Update with the affected activities clearly identified and explained in the Schedule Narrative.

For any proposed changes to the original sequence, description or duration of future activities, the Contractor shall submit to the Engineer for approval an explanation of how the proposed description or duration change reflects how the activity will be progressed, including considerations for resources and previously approved production rates. Any description or duration change that does not accurately reflect how the activity will be progressed will not be approved by the Engineer. Once approved by the Engineer, the Contractor may incorporate the changes in the next Contract Progress Schedule/Monthly Update with the affected activities clearly identified and explained in the Schedule Narrative.

Except as otherwise designated by a Contract Modification, no Contract Progress Schedule that extends performance beyond the Contract Time and/or beyond any Contract Milestone shall be approved by the Engineer. The Contractor shall submit a Recovery Schedule if any Contract Progress Schedule/Monthly Update indicates a failure to meet the Contract Dates.

D. Short-Term Construction Schedule

The Contractor shall provide a Short-Term Construction Schedule that details daily work activities, including any multiple shift work that the Contractor intends to conduct, in a bar chart format. The daily activities shall directly correspond to the Contract Progress Schedule activities, with a matching reference to the activity identification number in the Contract Progress Schedule, and may be at a greater level of detail.

SECTION 722 (Continued)

The Short-Term Construction Schedule shall be submitted every two weeks. It shall display all work for a thirty-five (35) Calendar Day period consisting of completed work for the two (2) week period prior and all planned work for the following three (3) week period. The initial submission shall be provided no later than thirty (30) Calendar Days after NTP or as required by the Engineer.

The Contractor shall be prepared to discuss the Short-Term Construction Schedule, in detail, with the Engineer in order to coordinate field inspection staff requirements, the schedule of work affecting abutters and any corresponding work with affected utilities. Short-Term Construction Schedules shall be prepared and submitted in accordance with Subsections 722.61 - Schedule Content and Preparation Requirements and 722.62 - Submittal Requirements.

Failure to submit Short-Term Construction Schedules every two (2) weeks may result in withholding of full or partial payments by the Engineer.

722.64 Impacted Schedule Requirements**A. Notice of Delay**

The Contractor shall notify the Engineer in writing, with copies to the District and State Construction Engineers, within three (3) Calendar Days of the start of any delays to the Critical Path that are caused by actions or inactions that were not within the control of the Contractor. Delay notifications that are not provided in a letter to the Engineer, such as a delay notification in the schedule narrative, will not be recognized as contractual notice in the determination of any Time Extension related to the impacts to the work associated with this specific alleged delay. Should such delay continue for more than one (1) week, the Contractor shall note it in the Schedule Narrative until the delay is no longer impacting the Critical Path for the completion of the Contract Milestones. The Engineer will evaluate the alleged delay and its impact and will respond to the Contractor within ten (10) Calendar Days after receipt of a notice of delay.

B. Time Entitlement Analysis

A Time Entitlement Analysis (TEA) shall consist of a descriptive narrative, prepared in accordance with Subsection 722.62.A - Narratives, and an as-built CPM schedule, which may be in the form of a schedule fragnet (that has been developed from the project's Contract Progress Schedule of Record, and illustrates the impact of a delay to the Critical Path, Contract Milestones and/or Contract Completion Date as required in Subsection 8.10 - Determination and Extension of Contract Time for Completion. TEAs shall also be used to determine the schedule impact of proposed Extra Work Orders (EWO) as also required in Subsection 8.10.

TEAs shall be prepared and submitted in accordance with the requirements of Subsections 722.61 - Schedule Content and Preparation Requirements and 722.62 - Submittal Requirements and shall be based on the Contract Progress Schedule of Record applicable at the start of the delay or impact from an EWO. A TEA fragnet must start with a specific new activity describing the work contained in either a Notice of Delay previously submitted to the Department per Subsection 722.64.A - Notice of Delay or an EWO.

SECTION 722 (Continued)

TEAs shall be submitted:

1. as part of any Extra Work Order that may impact Contract Time,
2. with a request for a Time Extension,
3. within fourteen (14) Calendar Days after a request for a TEA by the Engineer for any other reason.

A TEA shall be submitted to the Engineer before any Time Extension is granted to the Contractor. Time Extensions will not be granted unless the TEA accurately reflects an evaluation of all past delays and the actual events that occurred that impacted the Critical Path. The TEA must also demonstrate a plan for the efficient completion of all of the remaining work through an optimized CPM Schedule. The analysis shall include all delays, including Contractor-caused delays, and shall be subdivided into timeframes and causes of delays.

TEAs shall incorporate any proposed activities, logic ties, resource considerations, and activity costs required to most efficiently demonstrate the schedule impacts in addition to detailing all impacts to existing activities, logic ties, the Critical Path, Contract Milestones and the Contract Completion Date. In addition, TEAs shall accurately reflect any changes made to activities, logic ties, restraints and activity costs, necessitated by an Extra Work Order or other schedule impact, for the completion of the remaining work. The Contractor shall provide TEAs that demonstrate that all delays have been mitigated to the fullest extent possible without requiring an Equitable Adjustment to the original bid basis.

All TEAs shall clearly indicate any overtime hours, additional shifts and the resource that are proposed to be incorporated in the schedule. The Engineer shall have final discretion over the use of overtime hours and additional shifts. The Engineer shall have the right to require that overtime hours and/or additional shifts be used to minimize the duration of Time Extensions if it is determined to be in the best interest of the Department to do so.

When accepted, the changes included in a TEA shall be incorporated into the next Contract Progress Schedule per the requirements of Subsection 722.63.C - Contract Progress Schedules / Monthly Updates.

During the review of any TEA, all Contract Progress Schedules shall continue to be submitted as required.

The Engineer may request that the Contractor prepare a Proposal Schedule or a Recovery Schedule to further mitigate any delays that are shown in the accepted TEA/Contract Progress Schedule.

C. Recovery Schedules

The Contractor shall promptly report to the Engineer all schedule delays during the prosecution of the Work. Except as otherwise designated by a Contract Modification, no Contract Progress Schedule that extends performance beyond the Contract Time and/or beyond any Contract Milestone shall be approved by the Engineer. The Contractor shall submit a Recovery Schedule within fourteen (14) Calendar Days of a Contract Progress Schedule submission that shows failure to meet the Contract Dates. This requirement is critical to the Department's ability to make informed decisions regarding Contract Time and costs.

SECTION 722 (Continued)

During the prosecution of the Work, should the Contractor's progress on a critical operation clearly not meet anticipated production, without cause by fault of the Department, or should a critical activity or series of activities not be staffed in accordance with the Contractor's approved Baseline Schedule resource planning, the Contractor shall be obligated to recover such delay. Recovery Schedules shall be prepared and submitted in accordance with Subsections 722.61 - Schedule Content and Preparation Requirements and 722.62 - Submittal Requirements within fourteen (14) Calendar Days of any of the cases listed above.

Recovery Schedules shall clearly indicate any proposed overtime hours, additional shifts, and the resources that are proposed to be incorporated in to the schedule. The Engineer shall have final discretion over the use of overtime hours and additional shifts and shall have the right to require that overtime hours and/or additional shifts be used to minimize the duration of Time Extensions, without additional compensation for any Contractor delays, if it is determined to be in the best interest of the Department to do so.

During the review of any Recovery Schedule, all Contract Progress Schedules shall continue to be required every month.

The Engineer may request that the Contractor prepare a Recovery Schedule to further mitigate any delays that are shown in an accepted TEA/Contract Progress Schedule.

Changes represented in accepted Recovery Schedules shall be incorporated into the next Contract Progress Schedule.

D. Proposal Schedules

A Proposal Schedule is an alternative schedule used to evaluate proposed changes to the Contract scope or significant alternatives to previously approved approaches to complete the Work, which may include changes to activity durations, logic and sequence. For Types A and B Schedules, the Proposal Schedule shall be cost and resource-loaded.

A Proposal Schedule may be requested by the Department at any time or may be offered by the Contractor. The Engineer may request that the Contractor prepare a Proposal Schedule to further mitigate any delays that are shown in an accepted TEA/Contract Progress Schedule.

The Contractor shall submit the Proposal Schedule within thirty (30) Calendar Days of a request from the Department.

The Proposal Schedule shall not be considered a Schedule of Record until the logic, durations, narrative and basis of the Proposal Schedule have been accepted by the Engineer. If the Proposal Schedule took the form of a fragnet, it must be incorporated into the Contract Progress Schedule of Record showing the current progress of all other activities and the impacts/results of the changes made by the Proposal Schedule before the Proposal Schedule is accepted by the Department.

Proposal Schedules shall clearly indicate any proposed overtime hours, additional shifts, and the resources that are proposed to be incorporated in the schedule. The Engineer shall have final discretion over the use of overtime hours and additional shifts.

Changes represented in accepted Proposal Schedules shall be incorporated into the next Contract Progress Schedule. During the review of any Proposal Schedule, all Contract Progress Schedules shall continue to be required every month.

SECTION 722 (Continued)**E. Disputes (Types A, B, C and D)**

All schedules shall be submitted, reviewed, dispositioned and accepted in the timely manner specified herein so as to provide the greatest possible benefit to the execution of this Contract.

Any dispute concerning the acceptance of a schedule or any other question of fact arising under this subsection shall be determined by the Engineer. Pending resolution of any dispute, the last schedule accepted by the Engineer will remain the Contract Schedule of Record.

COMPENSATION**722.80 Method of Measurement and Basis of Payment (Types A, B, C and D)**

The Special Provisions will specify the fixed-price amount to be paid to the Contractor for the Project Schedule requirements contained herein. Each bidder shall include this lump-sum, fixed-price bid item amount in his/her bid. Failure to do so may be grounds for the rejection of the bid.

All required schedule-related work, including, but not limited to computers, computer software, the planning and coordination with utilities, training, schedule preparation and schedule submittals will be paid for under the fixed price amount.

This fixed price amount is for payment purposes only and is separate from what the Department considers to be the Contractor's General Condition costs. If the Contractor deems it necessary to include additional costs to provide all of the requirements of this section, these additional costs shall be included in the Contractor's overall bid price.

Twenty percent (20%) of this pay item will be paid upon the Engineer's acceptance of the Contractor's Baseline Schedule, prepared and submitted in accordance with Subsection 722.63.A.

The remaining eighty percent (80%) of this pay item will be paid in equal monthly installments distributed across the Contract Duration from Notice to Proceed (NTP) to Contractor Field Completion (CFC), less the 2 months required for the submittal and review of the Baseline Schedule in accordance with the following formula:

$$\text{Monthly Payment} = \frac{\text{Remaining Fixed Price amount (80\% of Item 100.)}}{\text{Contract Duration in whole months} - 2 \text{ months}}$$

The timely and accurate submission of the Baseline Schedule is critical to the Contract and the Department's ability to make informed decisions. Only payments under Item 740 - Engineer's Field Office and Item 748 - Mobilization will be made until the Baseline Schedule is accepted by the Engineer.

SECTION 722 (Continued)

No payment for any other pay item will be processed beyond seventy-five (75) Calendar Days from Notice to Proceed (NTP) until the Baseline Schedule is accepted by the Engineer. Until the Engineer's acceptance of the Baseline Schedule, the combined total of all payments made to the Contractor will be limited to an amount no greater than the total price for Item 748 - Mobilization or 3% of the contract price, whichever is less.

All Contract Progress Schedule Updates submitted later than ten (10) Calendar Days after the CQE (Contract Quantity Estimate) completion date, or greater than forty (40) Calendar Days from the Data Date of the previous submission, will be deemed to be no longer useful and will not qualify for payment. Late submittal of missed Contract Progress Monthly Updates will not result in recovery of the previously forfeited portion of the Schedule of Operations Fixed Price Payment Item.

Failure to submit schedules as and when required may result in the forfeiture of that portion of the Schedule of Operations Fixed Price Payment and/or the withholding of the full or partial CQE payments by the Engineer.

Failure to submit schedules that are acceptable to the Engineer may result in the forfeiture of that portion of the Schedule of Operations Fixed Price Payment and/or the withholding of the full or partial CQE payments by the Engineer.

The Schedule of Operations pay item will be adjusted to pay for only the actual quantity of schedules that have been submitted in accordance with this section.

The Contractor's failure or refusal to comply with the requirements of this Section shall be reasonable evidence that the Contractor is not prosecuting the Work with due diligence and may result in the withholding of full or partial payments by the Engineer.

Should there be a Time Extension granted to the Contractor, the Engineer may provide an Equitable Adjustment for additional Contract Progress Schedule Updates at intervals directed by the Engineer. Item 100. will be the basis for this Equitable Adjustment.

722.82 Payment Items

100.	SCHEDULE OF OPERATIONS - FIXED PRICE	\$70500.00	LUMP SUM
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ITEM 101.**CLEARING AND GRUBBING****ACRE**

The work under this item shall conform to the relevant provisions of Subsection 101 of the Standard Specifications and the following:

All trees, stump, shrubs, and brush between the existing edge of the roadway and proposed top or bottom of slope or tree clearing limits as shown on the plans, or any individual trees called out to be removed shall be removed under Item 101.

The work also includes removal off all trees, stump, shrubs, and brush from the Stormwater treatment area as listed below:

1. Heritage Road Outlet Sediment Trap at Sta 52+30 RT
2. Farmers Lane Outfall at Sta 3+30 RT

No tree including trees in clear & grub area shall be removed prior to approval of the Engineer and the Town of Billerica. The removal of all trees shall be coordinated with the Town of Billerica prior to removal.

The method of disposal of all materials shall be the responsibility of the Contractor and shall be approved by the Engineer. All methods of disposal shall be accomplished in accordance with all applicable Federal, State and local ordinances. Burning on-site will not be permitted.

Compensation for Clearing and Grubbing will be paid for at the contract unit price PER ACRE under Item 101. This shall include full compensation for all labor, equipment, materials, and incidentals for the satisfactory completion of the work, including the services of a certified arborist, labor, material, equipment, and incidental costs required to complete the work.

ITEM 102.2**TREE TRIMMING****LUMP SUM**

Work to be done shall conform to the relevant provisions of Subsection 101 of the Standard Specifications and the following.

The work consists of removing all dead, dying, broken and certain other limbs and branches as described hereinafter and the removal of all stubs of limbs and branches from all designated trees located within the limits work in this contract and the satisfactory disposal of all such removed debris. Also include coordination and trimming of trees for propose utility pole, overhead wires and guy wires for relocated utilities for the project.

All pruning and tree work shall be in conformance with the most current version of the American National Standards Institute (ANSI) Standard Z-133.1 and A300 Standard Practices for Tree, Shrub, and Other Woody Plant Maintenance.

All work under this item will be performed or supervised by the Massachusetts Certified Arborist.

Contractor shall be required to provide a crew, consisting of a bucket truck with operator and grounds man for pruning and removal. The minimum crew shall consist of the following: a supervisor and three tree-trimmers/laborers. The crew shall be equipped with all necessary

equipment needed to complete the work including, but not limited to, pickup trucks, chippers, gas powered chain saws, hand saws, loppers, shears, pruners, branch trimmers, ladders, tree-climbing equipment, etc. Fuel for equipment shall also be considered incidental to this item.

SUBMITTALS

Prior to start of work, the Contractor shall submit to the Engineer the name, certification number and resume of the Massachusetts Certified Arborist referenced herein. Cost for Certified Arborist for all activities pertaining to these Items shall be incidental to this item.

Incidental to this item, the Contractor shall provide to the Engineer one (1) copy of the most current version of the American National Standards Institute (ANSI) Standard Z-133.1 and A300 Standard Practices for Tree, Shrub, and Other Woody Plant Maintenance, Part 1: Pruning. These references shall be kept by the Engineer at his office for the length of the Contract.

DESCRIPTION OF WORK

TREE: Shall be defined as having a diameter of 4 inches or over, measured at a point 3 feet above the average ground.

LIMBS AND BRANCHES: Shall be defined as wood having a diameter of ½ inch or over and wood that has a diameter of less than ½ inch shall be considered a TWIG.

A DYING LIMB OR BRANCH: May have live growth at some point, but shall be removed if found to be in an unhealthy condition.

While it is not the intent that every dead, dying and/or broken twig be removed from trees requiring trimming, the tree worker will be required to remove all such twigs accessible in the areas of the tree in which he/she is working.

If directed by the Engineer, specific trees or parts thereof which are so located that damage may result from dropping shall be reduced by rope or cable lowering.

Tree shaping may be required on trees, where up-branching done under this contract has distorted the natural symmetry of the tree. Tree shaping shall consist of the removal of limbs and branches from other locations of the tree where removal is desirable to restore natural symmetry.

All sucker growth on all tree trunks within the limits of the contract shall be removed from the ground level to the beginning of the main branch system.

Any and all branches extending directly below a street luminaire as to limit the light reaching the street or path/sidewalk surfaces shall be removed and all branches shall be cut back to afford a minimum of 5 foot clearance on all sides of the luminaire. The path/sidewalk surface shall be considered as the area from the edge of the roadway surface to the edge of the path/sidewalk surface farthest from the roadway.

Recognized tree surgery practices direct that all limbs and branches which require removal and all stubs regardless of age be cut NEARLY flush, either to a union with the next larger sound limb, or branch, or NEARLY flush to the trunk of the tree.

By cutting NEARLY, but not quite, flush with the trunk, limb or branch, the "collar" is left at the top of the wound (in the crotch of the union). This will permit the callus growth to cover the wound in a shorter period of time.

METHOD OF MEASUREMENT AND BASIS OF PAYMENT

This work will be paid for at the contract unit price per lump sum tree trimmed, which price shall include full compensation for all labor, materials, equipment, apparatus, tools and incidentals necessary for the satisfactory completion of the work.

ITEM 102.511 TREE PROTECTION – ARMORING & PRUNING EACH

The work under this item shall conform to the relevant provisions of Sections 771 and shall be for furnishing and installing temporary tree trunk protection and for minor limb pruning or removal of lower tree limbs to prevent injury to the tree from construction equipment and activities.

Trunk armoring is for instances where construction activity (the use of heavy equipment) comes close enough to potentially damage the tree trunk or limbs. It is to be used where shown on the plans and as directed by the Engineer.

REFERENCES

If requested, the Contractor shall provide to the Engineer one copy of the latest edition of the American National Standards Institute (ANSI) A300 Standard Practices for Tree, Shrub, and Other Woody Plant Maintenance: Part 1-Pruning and Part 5-Construction Management Standard. Provision of reference shall be incidental to this item.

MATERIALS

Trunk armoring shall be such that it prevents damage to the trunk from construction equipment. Selected material shall be such that installation and removal will not damage the trunk.

Acceptable materials include 2x4 wood cladding with wire or metal strapping, or, for instances when duration of construction activities is less than three months, corrugated plastic pipe mounted with duct tape. Height of cladding shall be from base of tree (including root flare) to the bottom of the first branch, eight feet above the ground, or as required by the Engineer. Material and methods shall be approved by the Engineer.

Other materials or methods may be acceptable if approved by MassDOT Landscape Design or by an Arborist (if included in the contract).

METHODS OF WORK

Prior to construction activities, the Engineer, the Contractor, the Town Tree Warden, and the Arborist (if item is included in the contract), shall review trees noted on the plans to be protected. Final decision as to trees armored and/or pruned shall be per the Engineer.

Care shall be taken to avoid damage to the bark during installation and removal of armoring. Trunk armoring shall be replaced and maintained such that it is effective for as long as required and shall be removed immediately upon completion of work activities adjacent to trees.

Pruning of limbs shall conform to the techniques and standards of the most recent ANSI A300 standards.

DAMAGES & PENALTIES

In the event that trees designated for protection under this item are damaged, including root damage from unapproved trespassing onto the root zone, the Contractor shall, at his own expense obtain an Arborist. The Arborist shall be approved by MassDOT.

If, based on the recommendations of the Arborist, the Engineer determines that damages can be remedied by corrective measures, such as repairing trunk or limb injury, soil compaction remediation, pruning, and/or watering, the damage will be repaired as soon as possible within the appropriate season for such work and according to industry standards.

If the Engineer determines that damages are irreparable, the Contractor shall pay for the damages in the amount of \$500.00 per diameter inch at breast height (DBH) per tree.

Additionally, if the Engineer determines that the damages are such that the tree is sufficiently compromised as to pose a future safety hazard, the tree shall be removed. Tree removal will include clean up of all wood parts, grinding of the stump to a depth sufficient to plant a replacement tree or plant, removal of all chips from the stump site, and filling the resulting hole with topsoil.

METHOD OF MEASUREMENT AND BASIS OF PAYMENT

Item 102.511 will be measured and paid at the contract unit price per each. This will include full compensation for all labor, equipment, materials, and incidentals for the satisfactory completion of the work and the subsequent removal and satisfactory disposal of the protective materials upon completion of the contract.

In the event of tree damage, cost of Arborist services, of remediation measures, and/or tree removal will be borne by the Contractor.

Payment under this item will be scheduled throughout the length of contract:

- 40% of value shall be paid upon installation of trunk armoring and completion of pruning work, if required.
- 60% shall be paid at the end of construction operations that would damage the tree and after protection materials have been removed and properly disposed of by the Contractor. In the event of repairable damages, payment shall be made after the completion of remediation measures.

In the event of irreparable damage due to lack of proper protective measures being take there will be no compensation in addition to the \$500.00 per diameter inch penalty.

ITEM 102.55**ARBORIST****HOUR****DESCRIPTION**

The work under this Item is for the services of a Certified Arborist. Arborist shall be an International Society of Arboriculture (ISA) Certified Arborist or a Massachusetts Certified Arborist. The Arborist shall have at least 10 years of experience in tree care, including tree protection during construction, and shall demonstrate a familiarity with the American National Standards Institute (ANSI) A300 Standard Practices for Tree, Shrub, and Other Woody Plant Maintenance Part 1 Pruning, Part 5 Construction Management Standards, and Part 9 Tree Risk Assessment.

The Arborist's general responsibilities include protecting high priority trees within and adjacent to the project limits, staging areas, and access routes; recommending removal of diseased, damaged or otherwise unhealthy trees that pose a potential safety hazard; evaluating effects of construction on future health of trees close to proposed work; and recommending and/or overseeing tree work and care.

The Arborist for this item shall not be from the same company as the company responsible for selective clearing or tree removal work.

For projects with multiple phases, projects where construction activities (work or stockpiling) shifts, or when otherwise directed by the Engineer, the Arborist shall re-evaluate conditions and provide follow-up recommendations.

SUBMITTALS

- Contractor shall submit to the Engineer for approval by MassDOT Landscape Design the qualifications and experience of the Arborist. Submittal shall include copy of current certification and a resume summarizing specific construction experience (including relevant MassDOT projects) for a minimum of five projects.
- Arborist's Report documenting recommendations shall be submitted to the Engineer and an electronic copy forwarded to MassDOT Landscape Design Section. Report shall include the following:

SCOPE OF WORK

The Arborist shall be responsible for the following tasks:

- Initial Evaluation and Report
 - recommend and prioritize trees that require removal as appropriate to contract scope, project limits, and project intent;
 - review and modify, if necessary, tree protection measures shown on the drawings
 - review and mark limits of protective fencing for trees and groups of trees to be retained;
 - review and recommend protection measures for high priority trees;
 - submit a marked-up Construction Plan that briefly notes recommendations and decisions made in the field;
 - submit a corresponding report including photo documentation;
- Oversight
 - direct or execute pruning of branches and/or roots, air spading, and/or other tree care

- operations
- Special Care
 - oversee tree pruning for health and aesthetics

METHODS

Prior to any work, the Arborist shall walk the site with the Contractor, the Engineer, the Town Tree Warden, and, if specified, the MassDOT Landscape Architect, to review trees, limits of construction activities, and other concerns. Where required for proper assessment of tree impacts, limits of work shall be staked or otherwise marked in the field prior to the site walk.

Trees to be removed shall be painted or otherwise marked.

Trees to be retained shall be marked such that it does not mar or damage the tree and such that marker is not easily removed. As applicable to the work and scope of the project, trees designated for removal or to be retained shall be noted on the plan and/or in the arborist's report and photographed.

Trees designated to remain that are damaged or removed by construction activities shall be noted and photographed for inclusion in inspection reports submitted to the Engineer.

MEASUREMENT AND BASIS OF PAYMENT

Item 102.55 will be measured for payment by the Hour of time spent onsite.

Item 102.55 will be paid at the contract unit price per hour upon submittal and acceptance of Reports described above.

ITEM 127.1

REINFORCED CONCRETE EXCAVATION

CUBIC YARD

The work to be done under this Item shall consist of removing and disposing in accordance with the relevant provisions of Section 120, as shown on the Plans and as directed.

It is anticipated that within project limit Boston Road and Heritage Road may have existing concrete base under HMA pavement. If existing concrete is encountered during excavation, it shall be removed. Concrete shall be sawcut as required for utility trenches and box widening area. The section of concrete shall be removed and disposed of, including reinforcement if encountered. Prior to prosecution of this work, the Contractor shall obtain approval from the Engineer as to the method selected for removal operations.

METHOD OF MEASUREMENT AND BASIS OF PAYMENT

The cement concrete pavement excavation shall be paid for at the contract unit price bid per cubic yard, which price shall be full compensation for labor, materials, equipment, tools, sawcut, disposal of reinforced concrete, and other incidentals necessary to satisfactorily complete the work.

Removal of existing concrete sidewalk and driveway shall be paid under Item 120.

ITEM 129.5**TRACK EXCAVATION****FOOT**

The work under this Item shall be done in conformance with the relevant provisions of Section 120, as required by the Engineer, and the following:

The work under this Item shall consist of the excavation, removal, and proper disposal of the existing steel tracks and concrete foundation with one or two rails, when encountered within the limits of roadway and trench excavation or as required by the Plans or directed by the Engineer.

Item 129.5 Track Excavation will be measured per FOOT as measured along each individual steel rail, in its original encountered position.

BASIS OF PAYMENT

Item 129.5 Track Excavation will be paid for at the Contract unit price, per FOOT, which price shall include the excavation, removal, and proper disposal of the existing steel tracks. Payment shall include all labor, tools, and equipment required to complete the work.

All railroad ties removed shall be weighted and stacked until shipment to an approved disposal facility. Disposal of any wooden ties will be paid for under the Item 184.1 Disposal of Treated Wood Products.

The removal and disposal of all other materials related to the railroad facilities shall be in accordance with and paid for under Item 120 Earth Excavation.

ITEM 153.**CONTROLLED DENSITY FILL - EXCAVATABLE****CUBIC YARD**

The work under this Item shall consist of furnishing and placing controlled density fill in areas where the required compaction is not practicable, in trenches beneath cold plane and overlay areas, and adjacent to structures, in accordance with the relevant provisions of Section 150, as directed by the Engineer, and the following:

The Contractor is made aware that any steel plates required, at the direction of the Engineer, are considered incidental to this item.

Controlled density fill shall meet the requirements of Sections M4.08.0 of the Standard Specifications for controlled density fill - Type 1E or 2E as directed.

METHOD OF MEASUREMENT AND BASIS OF PAYMENT

Item 153. - Controlled Density Fill-Excavatable will be measured and paid for at the Contract unit price per Cubic Yard. This price shall be full compensation for the incidental use of steel plates, and all labor, tools, materials, equipment, transportation, and incidental costs, required to complete the work.

All costs in connection with the use of steel plates shall be considered incidental to the items of work involved. HMA for miscellaneous work shall also be required for this work and shall be paid for under the applicable contract items.

ITEM 180.01 ENVIRONMENTAL HEALTH AND SAFETY PROGRAM LUMP SUM

The work shall consist of ensuring the health and safety of the Contractor's employees and subcontracting personnel, the Engineer, their representatives, the environment, and public welfare from any on-site chemical contamination present in air, soil, water and sediment.

The Contractor shall prepare and implement a site-specific Environmental Health and Safety Plan (EHASP) which has been approved and stamped by a Certified Industrial Hygienist (CIH) and includes the preparer's name and work experience. The EHASP shall include appropriate components required by OSHA Standard 29 CFR 1910.120(b) and the Massachusetts Contingency plan (MCP) 310 CMR 40.0018 and must comply with all applicable state and federal laws, regulations, standards and guidelines, and provide a degree of protection and training appropriate for implementation on the project. The EHASP shall be a dynamic document with provision for change to reflect new information, new practices or procedures, changing site environmental conditions or other situations which may affect site workers and the public. The EHASP shall be developed and implemented independently from the standard construction HASP required to work on all MassDOT construction projects.

Health and safety procedures provided by the Contractor shall comply with all the appropriate regulations that address employee working conditions, including but not limited to standards established by OSHA and National Institute for Occupational Safety and Health (NIOSH). Equipment used for the purpose of health and safety shall be approved by and meet pertinent standards and specifications of the appropriate regulatory agencies.

A copy of the most up-to-date version of the EHASP shall be maintained on-site at all times by the Contractor. The on-site copy shall contain the signature of the Engineer and each on-site employee of the MassDOT, Contractor, and Subcontractors involved with on-site activities. The employee's signature on the EHASP shall be deemed prima facie evidence that the employee has read and understands the plan. Updated copies of signature sheets shall be submitted to the Engineer.

The EHASP shall specify a Contractor Site Safety and Health Officer responsible for implementation of the EHASP and to oversee all construction activities, including handling, storage, sampling and transport, which require contact with or exposure to potentially hazardous materials.

The level of protection, required to ensure the health and safety of on-site personnel will be stipulated in the EHASP. The Site Safety and Health Officer shall implement the EHASP based on changing site and weather conditions, type of operation or activity, chemical compounds identified on-site, concentration of the chemicals, air monitoring data, physical state of the hazardous materials, potential duration of exposure to hazardous materials, dexterity required to perform work, decontamination procedures, necessary personnel and type of equipment to be utilized.

During implementation of the EHASP, a daily log shall be kept by the Site Safety and Health Officer and a copy shall be provided weekly to the Engineer. This log shall be used to record a description of the weather conditions, levels of personal protection being employed, screening data and any other information relevant to on-site environmental safety conditions. The Site Safety and Health Officer shall sign and date the daily log.

METHOD OF MEASUREMENT AND BASIS OF PAYMENT

Preparation and implementation of the Environmental Health and Safety Program, including the monitoring, protection and storage of all contaminated materials, as well as subsequent modifications to the EHASP, will be measured and paid for at the Lump Sum Bid Price.

Payment of 50% of the Environmental Health and Safety Program contract price will be made upon the initial acceptance of the EHASP by the Engineer. Payment of the remaining 50% of the Environmental Health and Safety Program contract price will be made upon completion of the work. The bid price shall include preparation and implementation of the EHASP as well as the cost for its enforcement by the Site Safety and Health Officer along with any necessary revisions and updates. The work of implementing the Environmental Health and Safety Program includes work involving, but not limited to, the monitoring, protection, and storage of all contaminated materials.

ITEM 180.02 **PERSONAL PROTECTION LEVEL C UPGRADE** **HOUR**

The work shall consist of providing appropriate personal protective equipment (PPE) for all personnel in an area either containing or suspected of containing a hazardous environment.

Contingencies for upgrading the level of protection for on-site workers will be identified in the EHASP and the Contractor shall have the capability to implement the personal protection upgrade in a timely manner. The protective equipment and its use shall be in compliance with the EHASP and all appropriate regulations and/or standards for employee working conditions.

Personal Protection Level C Upgrade will be measured and paid only upon upgrade to Level C and will be at the contract unit price, per hour, per worker, required in Level C personal protection. No payment will be made to the Contractor to provide Level D PPE.

ITEM 180.03 **LICENSED SITE PROFESSIONAL SERVICES** **HOUR**

Within limited areas of the project site, soils, sediments and/or groundwater may be contaminated. A Licensed Site Professional (LSP) shall be required to provide the services necessary to comply with the requirements of the MCP. These services may include sampling, analysis and characterization of potentially contaminated media, preparation of Immediate Response Action (IRA) Plans, Utility-Related Abatement Measure (URAM) and Release Abatement Measure (RAM) Plans, Imminent Hazard Evaluations, status reports, transmittal forms, release notification forms, risk assessments, completion statements, and related documents required pursuant to the Massachusetts Contingency Plan (MCP). LSP hours related to the characterization and disposal of contaminated soil and/or sediment are incidental to the disposal items. An estimate of LSP services to be provided shall be submitted to the Engineer for approval before any LSP activity begins.

The name and qualifications of the LSP and all environmental technicians to be assigned to the project shall be submitted to the Engineer for approval at least four weeks prior to initial site activities. The LSP shall have a current, valid license issued by the Massachusetts Board of Registration of Hazardous Waste Site Cleanup Professionals. The LSP shall have significant

experience in the oversight of MCP activities at active construction sites. Qualification packages for the LSP and each technician shall include a resume, all recent work assignments with responsibilities identified (previous 5 years), and applicable training and certifications. A list of all Notices of Noncompliance, Notice of Audit Findings and Enforcement Orders issued by the DEP shall be submitted for all work assignments listed for the LSP and environmental technicians.

The LSP shall evaluate soil and/or sediment with discoloration, odor, and presence of petroleum liquid or sheening on the groundwater surface, or any abnormal gas or materials in the ground which are known or suspected to be oil or hazardous materials. Excavated soil and sediment which is suspected of petroleum contamination shall be field screened using the jar headspace procedures according to established DEP Guidance. All field screening equipment must be pre-approved by the Engineer. The LSP shall ensure proper on site calibration of all field screening instrumentation.

The Engineer shall be contacted immediately when observations or any field screening results verify contamination requiring further analysis, and/or enhanced management of suspect soil and/or sediment. Any enhanced management of contaminated soil to ensure proper stockpiling and storage is incidental to the LSP Services item. The LSP shall adequately characterize subsurface conditions prior to backfill in areas where contaminated material has been excavated. The Engineer shall approve the locations of the testing sites prior to the sampling.

Contaminated soil, sediment and/or groundwater shall be handled in accordance with all applicable state and federal statutes, regulations and policies. The LSP shall adequately characterize contaminated media for comparison to the requirements of the MCP. The Contractor and the LSP shall be aware of the reporting requirements for releases of oil and/or other hazardous material (OHM) as set forth in federal and state laws and regulations, and shall both be held responsible for performing the work in accordance with all applicable Federal and State laws and regulations. The LSP shall maintain written records in a clear and concise format which tracks the excavation, stockpiling, analysis and reuse/disposal of all suspect contaminated soils, sediments and groundwater. These records shall be up-to-date and available to the Engineer on a bi-weekly basis. The LSP shall review and summarize the laboratory data from any analyses performed on contaminated media. A report shall be delivered to the Engineer outlining the material sampling methods, laboratory analysis results and proposed course of action. The laboratory report together with Chain of Custody forms for all analytical results shall be submitted to the Engineer within 14 days after completion of such analyses.

The LSP and Contractor shall be held responsible for the submission of all MCP-related documents to the Engineer at least 14 days in advance of any timeframe specified in the MCP and for the timely submission of data and tracking information as noted within this Item. All documents prepared under this Item must be reviewed and signed by the approved LSP. The Contractor and LSP shall be responsible for all fines, penalties and enforcement requirements imposed by applicable regulatory agencies for failure to meet regulatory and contract timeframes. No compensation will be provided for such fines, penalties and enforcement actions.

The Contractor and the LSP shall be aware of the reporting requirements for releases of oil and/or other hazardous material (OHM) as set forth in federal and state laws and regulations, and shall both be held responsible for performing the work in accordance with all applicable Federal and State laws and regulations.

If the Contractor causes a release of OHM, the Contractor shall be responsible for assessing and remediating the release in accordance with all pertinent State and Federal regulations, including securing the services of a LSP, at his own expense.

The LSP shall coordinate all activities involving both MassDOT and the DEP through the Engineer. Any notification of release shall be approved by the Department before submittal to the DEP, except if an imminent hazard condition exists as defined in 309 CMR 4.03(4)(b).

LABORATORY TESTING IN SUPPORT OF LSP SERVICES

Laboratory testing provides for analytical testing in support of LSP services related to maintaining MCP compliance, such as delineating the extent and type of contamination present. Sampling and testing for disposal purposes are not included.

In order to maintain compliance with the MCP or other regulatory requirements, the LSP shall request approval from the Engineer to obtain samples from various locations and depths within the project area and to perform laboratory analyses on those samples. The samples shall be delivered to a DEP-certified laboratory using proper chain-of-custody documentation for analyses which, depending upon site conditions and suspected and/or identified contaminants of concern, may include, but are not limited to, metals, polychlorinated biphenyls (PCBs), volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), pesticides, polycyclic aromatic hydrocarbons (PAHs), extractable petroleum hydrocarbons (EPHs) and volatile petroleum hydrocarbons (VPHs). Subsequent testing, depending upon initial results, may be required for Toxicity Characteristic Leaching Procedure (TCLP) analyses (EPA Method 1311) for metals.

METHOD OF MEASUREMENT AND BASIS OF PAYMENT

LSP Services for work under this item will be measured per person, per hour of service provided by LSP, Environmental Technicians and other approved personnel. Travel time shall not be included in the billable hours. LSP hours related to soil/sediment disposal (disposal characterization, landfill acceptance, disposal package preparation, etc.) shall be incidental to disposal items.

The quantity and type of laboratory tests must be approved by the Engineer beforehand. The contractor will be reimbursed upon satisfactory written evidence of payment. The contractor may be required to obtain cost estimates from three DEP certified laboratories for the Engineer to choose the service provider. Laboratory testing related to soil/sediment disposal (disposal characterization, landfill acceptance, disposal package preparation, etc.) shall be incidental to disposal items.

LSP Services will be paid at the Contractor bid price for each hour, or fraction thereof, spent to perform the work as described above. The bid price shall be a blended rate that includes the cost of the LSP, environmental technicians and other personnel, the performance of all work tasks and field screening, including required equipment, materials and instrumentation, and production of all documentation described above. All requests for payment must be accompanied by the following information: the names of the personnel associated with the work charged under LSP Services, dates and hours worked, work conducted, including, where appropriate, locations as identified on the construction plans, and a copy of the field diary for the dates submitted.

Laboratory Testing will be reimbursed upon receipt of paid invoices for testing approved by the Engineer.

<u>ITEM 181.11</u>	<u>DISPOSAL OF UNREGULATED SOIL</u>	<u>TON</u>
<u>ITEM 181.12</u>	<u>DISPOSAL OF REGULATED SOIL - IN-STATE FACILITY</u>	<u>TON</u>
<u>ITEM 181.13</u>	<u>DISPOSAL OF REGULATED SOIL - OUT-OF-STATE FACILITY</u>	<u>TON</u>
<u>ITEM 181.14</u>	<u>DISPOSAL OF HAZARDOUS WASTE</u>	<u>TON</u>

The work under these Items shall include the transportation and disposal of contaminated material excavated, or excavated and stockpiled. It shall also include the cost of any additional laboratory analyses required by a particular disposal facility beyond the standard disposal test set.

Excavation of existing subsurface materials may include the excavation of contaminated soils. The Contractor shall be responsible for the proper coordination of characterization, transport and disposal, recycling or reuse of contaminated soils. Disposal, recycling or reuse will be referred to as “disposal” for the purposes of this specification. However, regardless of the use of the term herein, there will be no compensation under these items for reuse within the project limits. The Contractor will be responsible for coordinating the activities necessary for characterization, transport and disposal of contaminated soils. Such coordination will include the Engineer and his/her designee overseeing management of contaminated materials. Contaminated soils must be disposed of in a manner appropriate for the soil classification as described below and in accordance with the applicable laws of local, state and federal authorities. The Contractor shall be responsible for identifying disposal facility (ies) licensed to accept the class of contaminated soils to be managed and assure that the facility can accept the anticipated volume of soil contemplated by the project. The Contractor shall be responsible for hiring a Licensed Site Professional (LSP) and all ancillary professional services including laboratories as needed for this work. The Contractor will be responsible for obtaining all permits, approvals, manifests, waste profiles, Bills of Lading, etc. subject to the approval of the Engineer prior to the removal of the contaminated soil from the site. The Contractor and LSP shall prepare and submit to the Engineer for approval all documents required under the Massachusetts Contingency Plan (MCP) and related laws and environmental regulations to conduct characterization, transport, and disposal of contaminated materials.

CLASSES OF CONTAMINATED SOILS

The Contractor and its LSP shall determine if soil excavated or soil to be excavated is unregulated soil or contaminated soil as defined in this section. Such materials shall be given a designation for purposes of reuse or disposal based on the criteria of the MCP. Soils and sediments which are not suitable for reuse will be given a designation for purposes of off-site disposal based on the characterization data and disposal facility license requirements. The Classes of Contaminated Soils are defined as follows:

UNREGULATED SOIL consists of soil, fill and dredged material with measured levels of oil and hazardous material (OHM) contamination at concentrations below the applicable Reportable Concentrations (RCs) presented in the MCP. Unregulated soil consists of material which may be reused (or otherwise disposed) as fill within the Commonwealth of Massachusetts subject to the non-degradation criteria of the MCP (310 CMR 40.0032(3), in a restricted manner, such that they are sent to a location with equal or higher concentrations of similar contaminants. Disposal areas

include licensed disposal facilities, approved industrial settings in areas which will be capped or covered with pavement or loamed and seeded, and for purposes of this project should be reused as fill within the project site construction corridor whenever possible. The material cannot be placed in residential and/or environmentally sensitive (e.g. wetlands) areas. Under no circumstances shall contaminated soils be placed in an uncontaminated or less contaminated area (including the area above the groundwater table if this area shows no sign of contamination).

The Contractor shall submit to MassDOT the proposed disposal location for unregulated soils for approval. If such a disposal location is not a licensed disposal facility, the Contractor shall submit to the Engineer analytical data to characterize the disposal area sufficiently to verify that the unregulated material generated within the MassDOT construction project limits is equal to or less than the contaminant levels at the disposal site and meets the non-degradation requirements of the MCP. In addition, the Contractor shall provide written confirmation from the owner of the proposed disposal location that they have been provided with the analytical data for both the materials to be disposed as well as the disposal site characterization and that s/he agrees to accept this material. A Material Shipping Record or Bill of Lading, as appropriate, shall be used to track the off-site disposal of unregulated soil and a copy, signed by the disposal facility or property owner, shall be provided to the Engineer in order to document legal disposal of the unregulated material.

The cost of on-site disposal of unregulated soil within the project area will be considered incidental to the item of work to which it pertains.

REGULATED SOIL consists of materials containing measurable levels of OHM that are equal to or exceed the applicable Reportable Concentrations for the site as defined by the MCP, 310 CMR 40.0000. Regulated soil which meets the MCP reuse criteria of the applicable soil/groundwater category for this project area may be reused on site provided that it meets the appropriate geotechnical criteria established by the Engineer. Regulated Soil may be reused (as daily or intermediate cover or pre-cap contouring material) or disposed (as buried waste) at lined landfills within the Commonwealth of Massachusetts or at an unlined landfill that is approved by the Massachusetts Department of Environmental Protection (DEP) for accepting such material, in accordance with DEP Policy #COMM-97-001, or at a similar out-of-state facility. It should be noted that soils which exceed the levels and criteria for disposal at in-state landfills, as outlined in COMM-97-001, may be shipped to an in-state landfill, but require approval from the DEP Division of Solid Waste Management and receiving facility. An additional management alternative for this material is recycling into asphalt. Regulated Soils may also be recycled at a DEP approved recycling facility possessing a Class A recycling permit subject to acceptance by the facility and compliance with DEP Policy #BWSC-94-400. Regulated Soil removed from the site for disposal or treatment must be removed via an LSP approved Bill of Lading, Manifest or applicable material tracking form. This type of facility shall be approved/permitted by the State in which it operates to accept the class of contaminated soil in accordance with all applicable local, state and federal regulations.

HAZARDOUS WASTE consists of materials which must be disposed of at a facility permitted and operated in full compliance with Federal Regulation 40 CFR 260-265, Massachusetts Regulation 310 CMR 30.000, Toxic Substances Control Act (TSCA) regulations, or the equivalent regulations of other states, and all other applicable local, state, and federal regulations. All excavated materials classified as hazardous waste shall be disposed of at an out-of-state permitted facility. This facility shall be a RCRA hazardous waste or TSCA facility, or RCRA hazardous

waste incinerator. This type of facility shall be approved/permitted by the State in which it operates to accept hazardous waste in accordance with all applicable local, state and federal regulations and shall be permitted to accept all contamination which may be present in the soil excavate. The Contractor shall ensure that, when needed, the facility can accept TSCA waste materials i.e. polychlorinated biphenyls (PCBs). Hazardous waste must be removed from the site for disposal or treatment via an LSP approved Manifest.

MONITORING/SAMPLING/TESTING REQUIREMENTS

The Contractor shall be responsible for monitoring, sampling and testing during and following excavation of contaminated soils to determine the specific class of contaminated material. Monitoring, sampling and testing frequency and techniques should be performed in accordance with Item 180.03 – LSP Services. Additional sampling and analysis may be necessary to meet the requirements of the disposal facility license. The cost of such additional sampling and analysis shall be included in the bid cost for the applicable disposal items. The Contractor shall obtain sufficient information to demonstrate that the contaminated soil meets the disposal criteria set by the receiving facility that will accept the material.

No excavated material will be permanently placed on-site or removed for off-site disposal until the results of chemical analyses have been received and the materials have been properly classified. The Contractor shall submit to the Engineer results of field and laboratory chemical analyses tests within seven days after their completion, accompanied by the classification of the material determined by the Contractor, and the intended disposition of the material. The Contractor shall submit to the Engineer for review all plans and documents relevant to LSP services, including but not limited to, all documents that must be submitted to the DEP.

WASTE TRACKING:

Copies of the fully executed Weight Slips/Bills of Lading/ Manifests/Material Shipping Records or other material tracking form received by the Contractor from each disposal facility and for each load disposed of at that facility, shall be submitted to Engineer and the Contractor's LSP within three days of receipt by the Contractor. The Contractor is responsible for preparing and submitting such documents for review and signature by the LSP or other appropriate person with signatory authority, three days in advance of transporting soil off-site. The Contractor shall furnish a form attached to each manifest or other material tracking form for all material removed off-site, certifying that the material was delivered to the site approved for the class of material. If the proposed disposition of the material is for reuse within the project construction corridor, the Contractor shall cooperate with MassDOT to obtain a suitable representative sample(s) of the material to establish its structural characteristics in order to meet the applicable structural requirements as fill for the project.

All material transported off-site shall be loaded by the Contractor into properly licensed and permitted vehicles and transported directly to the selected disposal or recycling facility and be accompanied by the applicable shipping paper. At a minimum, truck bodies must be structurally sound with sealed tail gates, and trucks shall be lined and loads covered with a liner, which shall be placed to form a continuous waterproof tarpaulin to protect the load from wind and rain.

DECONTAMINATION OF EQUIPMENT

Tools and equipment which are to be taken from and reused off site shall be decontaminated in accordance with applicable local, state and federal regulations. This requirement shall include, but not be limited to, all tools, heavy machinery and excavating and hauling equipment used during excavation, stockpiling and handling of contaminated material. Decontamination of equipment is considered incidental to the applicable excavation item.

REGULATORY REQUIREMENTS

The Contractor shall be responsible for adhering to regulations, specifications and recognized standard practices related to contaminated material handling during excavation and disposal activities. MassDOT shall not be responsible at any time for the Contractor's violation of pertinent State or Federal regulations or endangerment of laborers and others. The Contractor shall comply with all rules, regulations, laws, permits and ordinances of all authorities having jurisdiction including, but not limited to, Massachusetts DEP, the U.S. Environmental Protection Agency (EPA), Federal Department of Transportation (DOT), Massachusetts Water Resources Authority (MWRA), the Commonwealth of Massachusetts and other applicable local, state and federal agencies governing the disposal of contaminated soils.

All labor, materials, equipment and services necessary to make the work comply with such regulations shall be provided by the Contractor without additional cost to MassDOT. Whenever there is a conflict or overlap within the regulations, the most stringent provisions shall apply. The Contractor shall reimburse MassDOT for all costs it incurs, including penalties and/or for fines, as a result of the Contractor's failure to adhere to the regulations, specifications, recognized standard practices, etc., that relate to contaminated material handling, transportation and disposal.

SUBMITTALS

I. Summary of Sampling Results, Classification of Material and Proposed Disposal Option.

The following information, presented in tabular format, must be submitted to the Engineer for review and approval prior to any reuse on-site or disposal off-site. This requirement is on-going throughout the project duration. At least two weeks prior to the start of any excavation activity, the Contractor shall submit a tracking template to be used to present the information as stipulated below. Excavation will not begin until the format is acceptable to MassDOT.

Characterization Reports will be submitted for all soil, sediment, debris and groundwater characterized through the sampling and analysis program. Each report will include a site plan which identifies the sampling locations represented in the Report. The Construction Plan sheets may be used as a baseplan to record this information.

The Sampling Results will be presented in tabular format. Each sample will be identified by appropriate identification matching the sample identification shown on the Chain of Custody Record. The sample must also be identified by location (e.g. grid number or stockpile number). For each sample, the following information must be listed: the classification (unregulated, regulated, etc.), proposed disposal option for the stockpile or unit of material represented, and, all analytical results.

Each Characterization Report will include the laboratory analytical report and Chain of Custody Record for the samples included in the Report.

II. Stockpiling, Transport, and Disposal.

At least two weeks prior to the start of any excavation activity, the Contractor shall submit, in writing, the following for review and shall not begin excavation activity until the entire submittal is acceptable to MassDOT.

Excavation and Stockpiling Protocol:

Provide a written description of the management protocols for performing excavation and stockpiling and/or direct loading for transport, referencing the locations and methods of excavating and stockpiling excavated material.

Disposal and Recycling Facilities:

1. Provide the name, address, applicable licenses and approved waste profile for disposal and/or recycling location(s) where contaminated soil will be disposed. Present information substantiating the suitability of proposed sites to receive classifications of materials intended to be disposed there, including the ability of the facility to accept anticipated volumes of material.
2. Provide a summary of the history of compliance actions for each disposal/recycling facility proposed to be used by the Contractor. The compliance history shall include a comprehensive list of any state or federal citations, notices of non-compliance, consent decrees or violations relative to the management of waste (including remediation waste) at the facility. Material should not be sent to facilities which are actively considered by the DEP, USEPA or other responsible agency to be in violation of federal, state or local hazardous waste or hazardous material regulations. MassDOT reserves the right to reject any facility on the basis of poor compliance history.

Transportation:

The name, address, applicable license and insurance certificates of the licensed hauler(s) and equipment and handling methods to be used in excavation, segregation, transport, disposal or recycling.

III. Material Tracking and Analytical Documentation for Reuse/Disposal.

The following documents are required for all excavation, reuse and disposal operations and shall be in the format described. At least two weeks prior to the start of any excavation or demolition activity, the Contractor shall submit the tracking templates required to present the information as stipulated below. Excavation or demolition will not begin until the format is acceptable to MassDOT.

All soils, sediments and demolition debris must be tracked from the point of excavation to stockpiling to onsite treatment/processing operations to off-site disposal or onsite reuse as applicable.

Demolition Debris:

Demolition debris must be tracked if the debris is stockpiled at a location other than the point of origin or if treatment or material processing is conducted. Identification of locations will be based on the station-offset of the location. The tracking table will identify date and point of generation, any field screening such as PID or dust monitoring, visual observations/comments, quantity, and stockpile ID/processing operation location. For each unit of material tracked, the table will also track reuse of the material on-site, providing reuse date, location of reuse as defined by start and end station, width of reuse location by offset, the fill elevation range, quantity, and finish grade for said location. For demolition debris which is not reused on site, the table will also track disposal of the material as defined by disposal date, quantity and disposal facility. The table must provide a reference to any analytical data generated for the material.

Soil/Sediment:

Soil excavation will be identified based on the station-offset of the excavation location limits. The tracking table will identify date and point of generation, any field screening such as PID or dust monitoring, visual observations, quantity, and stockpile number/location. For each unit of material tracked, the table will also track reuse of the material on-site and disposal of the material off-site using the same categories identified for demolition debris above.

METHOD OF MEASUREMENT AND BASIS OF PAYMENT

Disposal of contaminated soil shall be measured for payment by the Ton of actual and verified weight of contaminated materials removed and disposed of. The quantities will be determined only by weight slips issued by and signed by the disposal facility. The most cost-effective, legal disposal method shall be used. The work of the LSP for disposal under all of these items shall be incidental to the work with no additional compensation.

ITEM 181.11 Measurement for Disposal of Unregulated Soil shall be under the Contract Unit Price by the weight, in tons, of contaminated materials removed from the site and transported to and disposed of at an approved location or licensed facility, and includes any and all costs for approvals, permits, fees and taxes, additional testing/characterization required by the facility beyond the standard disposal test set, decontamination procedures, transportation and disposal.

ITEM 181.12 Measurement for Disposal of Regulated Soil – In-State Facility shall be under the Contract Unit Price by the weight in tons of contaminated materials removed from the site and transported to and disposed of at an approved in-state facility, and includes any and all costs for approvals, permits, fees and taxes, testing/characterization required by the facility beyond the standard disposal test set, decontamination procedures, transportation and disposal.

ITEM 181.13 Measurement for Disposal of Regulated Soil - Out-of-State Facility shall be under the Contract Unit Price by the weight in tons of contaminated materials removed from the site and transported to and disposed of at an approved out-of-state facility, and includes any and all costs for approvals, permits, fees and taxes, testing/characterization required by the facility beyond the standard disposal test set, decontamination procedures, transportation and disposal.

ITEM 181.14 Measurement for Disposal of Hazardous Waste shall be under the Contract Unit Price by the weight in tons of hazardous waste removed from the site and transported to and disposed of at the licensed hazardous waste facility, and includes any and all costs for approvals,

permits, fees and taxes, testing/characterization required by the facility beyond the standard disposal test set, decontamination procedures, transportation and disposal.

ITEM 182.1**INSPECTION AND TESTING FOR ASBESTOS****LUMP SUM**

The work shall include the inspecting and testing of all materials suspected of containing asbestos. When any demolition is required to enable the inspection and testing of the suspected material it will be considered incidental to this Item and the Contractor must perform all asbestos handling and testing in accordance with the regulations stated below.

Dust suppression in the form of light water sprays, foams, dust suppressants and calcium chloride will be implemented as required to control dusting during any disturbance of asbestos suspected material. Alternatively, intrusive activities may be reduced or curtailed under high wind or heavy rain conditions, which in the opinion of the Health And Safety Plan (HASP) may pose a safety hazard to the workers.

The Contractor shall employ the services of a Massachusetts licensed "Asbestos Inspector" to inspect the material to determine whether or not "ITEM 182.2 REMOVAL OF ASBESTOS" is required. Should the asbestos inspector determine laboratory testing is required, a state certified laboratory shall be used to perform all necessary tests.

REGULATIONS

U.S. Department of Labor, Occupational Safety and Health Administration, (OSHA) including but not limited to:

- 29 CFR 1910 Section 1001 and 29 CFR 1926 Section 58 Occupational exposure to Asbestos, Tremolite, Anthophyllite and Actinolite, Final Rule
- 29 CFR 1910 Section 134 Respiration Protection
- 29 CFR 1926 Construction Industry
- 29 CFR 1910 Section 2 Access to Employee Exposure and Medical Records
- 29 CFR 1910 Section 1200 Hazard Communication
- 29 CFR 1910 Section 145 Specifications for Accident Prevention Signs and Tags

U.S. Environmental Protection Agency, (EPA) including but not limited to:

- 40 CFR 762, CPTS 62044, FRL 2843-9, Federal Register Vol. 50 no.134, July 12, 1985 p.28530 - 28540 Asbestos Abatement Projects Rule
- 40 CFR 61 Subpart A Regulation for Asbestos
- 40 CFR 61 Subpart M (Revised Subpart B) National Emission Standard for Asbestos

U.S. Department of Transportation 49 CFR 172 and 173

Massachusetts Department of Labor and Industries Regulations, (DLI) including but not limited to:

- 453 CMR 6.00 Removal, Containment and Encapsulation of Asbestos

Massachusetts Department of Environmental Protection (DEP) including but not limited to (supplementing subsection 7.01):

- 310 CMR 7.00, Section 7.09 Odor and Dust, Section 7.10 Noise, Section 7.15 Air Pollution Control Regulations
- 310 CMR 18.00 and 19.00 Solid Waste Regulations

Massachusetts Division of Industrial Safety 45 CMR 10.00

Local Requirements including but not limited to those of Health Departments, Fire Departments and Inspection Services Departments

Wherever there is a conflict or overlap of the above references, the most stringent provision shall apply.

METHOD OF MEASUREMENT AND BASIS OF PAYMENT:

Measurement and payment will be at the contract unit price per Lump Sum for ITEM 182.1 INSPECTION AND TESTING FOR ASBESTOS as specified above including all materials, tools, equipment and labor to complete the inspecting and testing of the asbestos suspected material.

All costs in the connection with the protection of general public, private property, and all costs associated with the proper inspecting and testing of the material shall be included in the price and no additional compensation will be allowed.

<u>ITEM 182.2</u>	<u>REMOVAL OF ASBESTOS</u>	<u>FOOT</u>
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The work shall include the removal and satisfactory disposal of existing asbestos. The Contractor's attention is directed to the fact that existing asbestos shall be inspected and tested prior to removal, to determine if special removal and disposal is required. The Contractor shall follow all the rules and regulations stated in "ITEM 182.1 INSPECTION AND TESTING FOR ASBESTOS". If asbestos is present, the Contractor shall follow all the rules and regulations stated in the section "REMOVAL AND DISPOSAL OF ASBESTOS CONTAINING MATERIALS", under this item. The Contractor should notify and coordinate his/her efforts with the proper utility accordingly.

REMOVAL AND DISPOSAL OF ASBESTOS CONTAINING MATERIALS

This section specifies the requirements for the handling and removal of asbestos containing material. The Contractor must perform all asbestos handling and removal work in accordance with these specifications and the following additional requirements.

U.S. Department of Labor, Occupational Safety and Health Administration, (OSHA) including but not limited to:

- 29 CFR 1910 Section 1001 and 29 CFR 1926 Section 58 Occupational exposure to Asbestos, Tremolite, Anthophyllite and Actinolite, Final Rule
- 29 CFR 1910 Section 134 Respiration Protection
- 29 CFR 1926 Construction Industry

29 CFR 1910 Section 2 Access to Employee Exposure
and Medical Records
29 CFR 1910 Section 1200 Hazard Communication
29 CFR 1910 Section 145 Specifications for Accident
Prevention Signs and Tags

U.S. Environmental Protection Agency, (EPA) including but not limited to:

40 CFR 762, CPTS 62044, FRL 2843-9, Federal Register Vol. 50 no.134, July 12, 1985
p.28530 - 28540 Asbestos Abatement Projects Rule
40 CFR 61 Subpart A Regulation for Asbestos
40 CFR 61 Subpart M (Revised Subpart B) National Emission Standard for Asbestos

U.S. Department of Transportation 49 CFR 172 and 173

Massachusetts Department of Labor and Industries Regulations, (DLI) including but not limited
to:

453 CMR 6.00 Removal, Containment and Encapsulation of Asbestos

Massachusetts Department of Environmental Protection (DEP) including but not limited to
(supplementing subsection 7.01):

310 CMR 7.00, Section 7.09 Odor and Dust, Section 7.10 Noise, Section 7.15 Air
Pollution Control Regulations
310 CMR 18.00 and 19.00 Solid Waste Regulations

Massachusetts Division of Industrial Safety 45 CMR 10.00

Local Requirements including but not limited to those of Health Departments, Fire Departments
and Inspection Services Departments

Wherever there is a conflict or overlap of the above references, the most stringent provision shall
apply.

All asbestos material shall be removed and properly disposed of by a contractor or subcontractor
with a current Massachusetts Abatement Contractors License issued by the Department of Labor
and Industries. Work shall be supervised by a competent person as required by OSHA in 29 CFR
1926 to ensure regulatory compliance. This person must have completed a course at an EPA
Training Center or equivalent course in asbestos abatement procedures, have had a minimum of
four years on-the-job training and meet any additional requirements set forth in 29 CFR 1926 for
a Competent Person. This person must also be certified by the Commonwealth as an Asbestos
Abatement Supervisor and Asbestos Abatement Project Designer as required by 453 CMR 6.00.

Asbestos removal work shall be coordinated with all other work under the contract and shall be
completed prior to performing any activities which could disturb the asbestos material or produce
airborne asbestos fibers.

Dust suppression in the form of light water sprays, foams, dust suppressants and calcium chloride

will be implemented as required to control dusting during trenching and excavation. Alternatively, intrusive activities may be reduced or curtailed under high wind or heavy rain conditions, which in the opinion of the Health and Safety Plan (HASP) may pose a safety hazard to the workers.

NOTIFICATION AND PERMITS

The Contractor shall prepare a formal pre-notification form at least ten (10) days prior to the start of asbestos removal work. This form must be submitted to the appropriate Regional Office of the Massachusetts Department of Environmental Protection and to the U.S. Environmental Protection Agency Region I Air and Hazardous Material Division. A copy of the submitted forms must be provided to the Engineer and kept at the work site.

Prior to starting any work, the Contractor shall also obtain any required asbestos removal permit(s) from the city/town. A copy of the permit(s) must be provided to the Engineer and posted at the work site.

The Contractor shall also obtain and pay all other applicable asbestos waste transportation and disposal permits, licenses and fees.

STANDARD OPERATING PROCEDURES

The standard operating procedure shall ensure the following:

1. Proper site security including posting of warning signs and restricting access to prevent unauthorized entry into the work spaces.
2. Proper protective clothing and respiratory protection prior to entering the work spaces.
3. Safe work practices including provisions for communications; exclusion of eating, drinking, smoking, or use of procedures or equipment that would in any way reduce the effectiveness of respiratory protection or other engineering controls.
4. Proper exit practices from the work space through the showering and decontamination facilities.
5. Removing asbestos containing material in ways that minimize release of fibers.
6. Packing, labeling, loading, transporting and disposing of contaminated material in a way that minimizes or prevents exposure and contamination.
7. Emergency evacuation of personnel, for medical or safety (fire and smoke) so that exposure will be minimized.
8. Safety from accidents in the work space, especially from electrical shocks, slippery surfaces and entanglements in loose hoses and equipment.
9. Provisions for effective supervision and OSHA - specified personnel air monitoring for exposure during work.

REQUIRED SUBMITTALS

The Contractor shall submit to the Engineer the following listed items at least ten (10) calendar days prior to the start of asbestos work. No asbestos removal work activities shall commence until these items are reviewed by the Engineer, unless otherwise waived. Submittals shall be clearly labeled and in sufficient detail to enable the Engineer to form an opinion as to its conformity to the specifications.

1. Name, experience and DLI certification of proposed Supervisors and Foreman responsible for asbestos work.
2. Summary of workforce by disciplines and a notarized statement documenting that all proposed workers, by name, have received all required medical exams and have been properly trained and certified for asbestos removal work, respirator use and appropriate Massachusetts DLI, EPA and OSHA standards.
3. Notarized statement that workers are physically fit and able to wear and use the type of respiratory protection proposed for the project. Notarized certification signed by an officer of the abatement contracting firm that exposure measurements, medical surveillance and worker training records are being kept in conformance with 29 CFR 1926.
4. Written plan of action and standard operating procedures (HASP) to include: location and layout of decontamination areas; sequencing of asbestos work; detailed schedule of work activities by date and interface with other project activities which affect work performance; methods used to assure safety and security; worker protection and exposure monitoring; contingency and emergency evacuation procedures; detailed description of methods to be employed to control pollution; waste handling procedures.
5. Written respiratory protection program specifying level of protection intended for each operation required by the project and details of daily inspection and maintenance elements.
6. Copies of the U.S. EPA, State and local asbestos removal pre-notification forms. If applicable, lists and copies of all permits, licenses, or manifests which will be applied for and used.
7. Name, location and applicable approval certificates for primary and secondary landfill for disposal of asbestos-containing or asbestos contaminated waste. Name, address and licenses number(s) of hauler permitted to transport waste. (Submit copies of completed manifests upon disposal).

The Contractor must provide copies of daily inspection and record logs upon request of the Engineer, at any time during project. This information will include but is not limited to work area entry data, respirator inspections and maintenance, HEPA-exhaust inspections and maintenance and other work applicable activities or reports of accidents or unusual events.

METHOD OF MEASUREMENT

ITEM 182.2 will be measured by the FOOT for the complete removal and disposal of the asbestos containing material.

BASIS OF PAYMENT

Payment will be at the contract unit price per FOOT for ITEM 182.2 REMOVAL OF ASBESTOS, as specified above including all materials, tools, equipment and labor necessary to complete the work specified above.

All costs in connection with the protection of the general public, private property and all costs associated with the proper disposal of the material removed shall be included in the price and no additional compensation will be allowed.

ITEM 184.1 **DISPOSAL OF TREATED WOOD PRODUCTS** **TON**
(Rev 08/09/2016)

Work under this item shall include the transportation and disposal of all treated existing wood product as directed by the Engineer.

The timber components of the existing structure are suspected to be treated with creosote, pentachlorophenol and/or CCA. This item shall include all costs for sampling, laboratory testing, loading, transportation and disposal of the treated wood. The Contractor is required to submit disposal manifests to the Engineer prior to the completion of the project. All aspects of this Item are to be completed in accordance with state and federal regulations.

COMPENSATION

Measurement and payment will be by the weight, in tons, of treated timber transported and accepted at a licensed facility. The work shall be considered full compensation for all labor, tools, equipment, materials, testing, loading, transportation, approvals, and permits necessary for the completion of the work.

<u>ITEM 201.</u>	<u>CATCH BASIN</u>	<u>EACH</u>
<u>ITEM 202.</u>	<u>MANHOLE</u>	<u>EACH</u>
<u>ITEM 202.15</u>	<u>MANHOLE – 5 FOOT DIAMETER</u>	<u>EACH</u>
<u>ITEM 202.16</u>	<u>MANHOLE – 6 FOOT DIAMETER</u>	<u>EACH</u>
<u>ITEM 203.1</u>	<u>DIVERSION MANHOLE</u>	<u>EACH</u>
<u>ITEM 203.2</u>	<u>WATER QUALITY INLET</u>	<u>EACH</u>
<u>ITEM 204.11</u>	<u>GUTTER INLET – SPECIAL</u>	<u>EACH</u>

The work to be done under these Items shall conform to the relevant provisions of Subsection 200 of the Standard Specifications, and the following:

All catch basins shall be constructed as shown in MassDOT Standard Drawing E 201.4.0 with 4 foot sump (deep sump), unless otherwise noted on the plans.

Flat top sections shall be substituted for conical sections in areas of low cover. Flat top structures shall have a minimum 28 day compressive strength of 4000 psi, reinforced for AASHTO H-20 loading with ASTM A 615 Grade 60 steel. No additional payment will be made for flat top structures.

Alternate eccentric cone sections or flat top sections with offset openings shall be used in areas where drainage structures are in close proximity to existing underground utilities, as shown on the plans or as directed by the Engineer. No additional payment will be made for eccentric cones or flat top structures with offset openings.

Frames shall be set using clay brick (3 courses allowed for) in a full mortar bed. Cement brick will not be allowed.

Concrete collars for new structures shall be High Early Strength cement concrete. The Contractor shall submit a mix design for High Early Strength concrete to the Engineer for approval. The dimensions of the concrete collars shall be as shown on MassDOT Construction Standard Drawing E 202.9.0. Concrete collars shall be incidental to the item of work to which they pertain.

The concrete collars shall be placed up to a height that is to the bottom of the surface course, thereby allowing for the placement of the minimum of 3 inch of Hot Mix Asphalt above the collar.

Manhole – 5 Foot Diameter shall be constructed as shown in MassDOT Standard Drawing E 202.4.0 with the exception that the inside diameter shall be five feet.

Manhole – 6 Foot Diameter shall be constructed as shown in MassDOT Standard Drawing E 202.4.0 with the exception that the inside diameter shall be six feet.

Diversion Manhole shall be constructed as shown in MassDOT Standard Drawing E 202.4.0 with except as modified on the detail provided in the construction drawings.

Water Quality Inlet shall be constructed as shown on the detail provided in the construction drawings and in accordance with applicable Sub-sections of Subsection 201 of the Standard Specifications.

Gutter Inlet – Special shall be constructed as shown on the detail provided in the construction drawings and in accordance with applicable Sub-sections of Subsection 201 of the Standard Specifications.

Where drainage structures are proposed to be built on existing drainage lines, precast doghouse bases may be substituted for conventional precast bases and shall be constructed in accordance with the detail in the plans. No separate or additional payment shall be provided for doghouse bases.

Catch basins, manholes, and gutter inlets shall be placed on 6” crushed stone (M2.01.1) foundation as directed by the Engineer.

Connections to existing pipe shall be included in the cost of the catch basins or manholes. If existing pipe is to be abandoned, end of existing pipe shall be plugged as specified in Section 200.

BASIS OF PAYMENT

Payment for work under these Items shall be at the respective contract unit price, per each which price shall be full compensation for labor, materials, equipment, tools, sawcut, excavation, asphalt patch, and other incidentals necessary to satisfactorily complete the work.

The crushed stone foundation shall be paid for under Item 156. Masonry plugs shall be paid for under Item 227.4.

<u>ITEM 220.6</u>	<u>SANITARY STRUCTURE REBUILT</u>	<u>FOOT</u>
<u>ITEM 220.7</u>	<u>SANITARY STRUCTURE ADJUSTED</u>	<u>EACH</u>
<u>ITEM 220.8</u>	<u>SANITARY STRUCTURE REMODELED</u>	<u>EACH</u>

Work under these Items shall conform to the relevant provisions of Section 200 and shall be applicable to all types of municipal structures, including sanitary structures, where existing castings are to remain.

Clay brick shall be used in setting frames. The use of cement concrete brick will not be allowed. Castings shall be set to line and grade and provided with a concrete collar. Collars shall be constructed of 4,000 psi or high early strength (H.E.S.) as directed by the Engineer. No additional compensation for concrete collars shall be allowed. Concrete collars shall be brought to a height that will allow placement of minimum 3 inch the specified pavement wearing surface over the collar. Concrete collars shall be tacked coated with RS-1 Asphaltic Emulsion prior to the placement of pavement.

All dirt and debris caused by the Contractor shall be cleaned by the Contractor at his own expense.

BASIS OF PAYMENT

Payment for work under Item 220.7 and 220.8 shall be made at the contract unit price for EACH respective item specified above and shall include saw cuts, concrete collar, setting/resetting the frame and cover to line and grade and all labor, tools, materials and equipment required to complete the work for each structure adjusted or remodeled.

Structures specified to be rebuilt on the plans shall be measured per vertical foot exclusive of casting and paid under Item 220.6 for Sanitary Structure.

Replacement of sewer manhole frame and cover shall be paid under Item 221.

<u>ITEM 221.</u>	<u>FRAME AND COVER</u>	<u>EACH</u>
<u>ITEM 222.1</u>	<u>FRAME AND GRATE - MASSDOT CASCADE TYPE</u>	<u>EACH</u>

The work done under this Item shall conform to the relevant provisions of Section 201 and be for all manholes and catch basins.

All frames and Grate (covers) shall meet MassDOT standards, except where existing castings are to be retained. Cascade type catch basin grates shall be used. Drain manhole covers shall have the word DRAIN and sewer manhole covers shall have the word SEWER with the year cast into the cover. Frames shall be Type B per MassDOT construction standard detail E202.7.0. Frames shall be set using clay brick. Cement concrete brick will not be allowed.

METHOD OF MEASUREMENT

Item 221 and Item 222.1 will be measured per EACH Frame and Grate (or Cover) furnished and delivered to the site.

BASIS OF PAYMENT

Payment under these Items shall include furnishing and installing frame, grate or covers including any transportation on site to the location of installation, any adjustments to new castings required to meet finished grade, clay brick, concrete collars and all miscellaneous labor, materials or equipment to complete the installation.

<u>ITEM 271.1</u>	<u>DRAINAGE PIPE REMOVED AND DISCARDED</u>	<u>FOOT</u>
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This work under this Item shall conform to the relevant provisions of Subsection 270 of the Standard Specifications and the following.

The work to be done under this item shall include all labor, materials and equipment necessary to remove and discard the existing pipes. The work shall consist of the removal of drain pipe (regardless of size) where noted on the plans and as directed by the Engineer. Where existing pipe is located within the same trench as new pipe, the removal and discarding of the existing pipe shall be considered incidental to the installation of the new pipe. The work includes all excavation, shoring, and bracing. A trench shall be excavated and the pipe cut and removed. The remaining open pipe ends shall be plugged watertight. All materials excavated from the trench, when deemed suitable for reuse by the Engineer, shall be placed in 6 inch loose lift depths and compacted to not less than 95 percent of the maximum dry density of the material. If additional material is needed to backfill the trench it shall meet the requirements for Gravel Borrow. All unused and unsuitable material shall be disposed of off-site.

METHOD OF MEASUREMENT

Pipe removed and discarded, except for pipe located in the same trench as new pipe, will be measured in place by the foot of pipe removed and discarded off the project.

BASIS OF PAYMENT

Item 271.1 Drainage Pipe Removed and Discarded, will be paid at the contract unit price per Foot, which price shall be full compensation for all labor, materials, equipment, excavation, sawcutting, removal of pipes, disposal of unsuitable material, and incidentals required to complete the work.

If in situ material is unsatisfactory for backfill, as determined by the Engineer, payment will be made separately for backfill under Item 151. Gravel Borrow.

Masonry plug will be paid under Item 227.4

<u>ITEM 347.1</u>	<u>1 INCH COPPER TUBING TYPE K</u>	<u>FOOT</u>
<u>ITEM 347.2</u>	<u>2 INCH COPPER TUBING TYPE K</u>	<u>FOOT</u>

The work under these items shall conform to the, relevant provisions of Section 301 of the Standard Specifications, details shown on the plans, and the following:

The work includes all necessary and incidental work required for furnishing and installing new water service and appurtenances.

The Contractor shall notify the Town of Billerica Public Works Department seven business days prior to commencing work on these items.

Service to abutting properties shall not interrupt for more than two hours. The abutters shall be informed of the service cutoff 48 hours in advance. The method of installation of the new pipe shall be approved by the Engineer and the Town of Billerica, Department of Public Works.

Copper tubing shall be new Type K annealed copper tubing meeting the requirement of Federal Specification WW-T 7996, conforming to ASTM specifications B-75, B-88, B-68 as they apply to Type K copper tubing and meeting the requirement of AWWA C800.

SUBMITTALS

Immediately, upon receipt of the Notice to Proceed, submit catalog cuts, shop drawings and a list of material to be furnished by the pipe manufacturer intended to be utilized on this project. Also, include information on the local representative for each manufacturer if product is sold through a distributor.

METHOD OF MEASUREMENT AND BASIS OF PAYMENT

Items 347.01 and 347.02 will be measured and paid at the Contract unit price per foot, complete in place, which price shall include all labor, material, tools, equipment and incidental costs required for furnishing and installing new water service pipe and appurtenances including fittings and adapters, concrete block, insulation, removing and resetting existing materials in the same or new locations, excavation to the depth required and backfill trench in accordance with these specifications and as shown on the contract plans, and the testing of the modified water line, complete in place.

Any test pits which may be required by the Engineer shall be paid for under Item 141.1 Test Pit for Exploration.

<u>ITEM 371.06</u>	<u>6 INCH COUPLING</u>	<u>EACH</u>
<u>ITEM 371.08</u>	<u>8 INCH COUPLING</u>	<u>EACH</u>

Work under this Item shall conform to the relevant provisions of Section 300 of the Standard Specifications, and the following:

Where flexible connections in the piping are specified or indicated on the drawings, they shall be obtained by the use of restrained joint solid sleeve-type couplings, split couplings, or mechanical-joint pipe and/or fittings as herein specified.

To ensure correct fitting of pipe and couplings, all sleeve-type couplings and accessories shall be furnished by the supplier of the pipe and shall be of a pressure rating at least equal to that of the pipeline in which they are to be installed.

Solid sleeve pipe couplings shall be metal, with center sleeve, gaskets, end rings, and bolt fasteners. They shall be specifically manufactured for the purpose of the intended use, reducing, insulating and/or transition, and shall be approved for use by the Engineer. Requirements shall include:

- | | |
|-------------------------|------------------------------------------------------------|
| Standard: | AWWA C219. |
| Center-Sleeve Material: | Ductile iron. |
| Gasket Material: | Nitrile or otherwise noted. |
| Pressure Rating: | Equal to piping to be joined, minimum. |
| Ends: | Ends of same size and compatible with piping to be joined. |
| Metal Component Finish: | Corrosion-resistant coating or material. |

All couplings shall be furnished with the pipe stop removed.

All couplings shall be provided with gaskets of a composition suitable for exposure to the liquid within the pipe.

All gaskets provided with metallic tips for electrical continuity through joints.

SLEEVE-TYPE COUPLINGS

Prior to the installation of sleeve-type couplings, the pipe ends shall be cleaned thoroughly for a distance of 8 inches. Soapy water may be used as a gasket lubricant.

A follower and gasket, in that order, shall be slipped over each pipe to a distance of about 6 inches from the end, and the middle ring shall be placed on the already laid pipe end until it is properly centered over the joint. The other pipe end shall be inserted into the middle ring and brought to proper position in relation to the pipe already laid. The gaskets and followers shall then be pressed evenly and firmly into the middle ring flares.

After the bolts have been inserted and all nuts have been made up finger tight, diametrically opposite nuts shall be progressively and uniformly tightened all around the joint, preferably by use of a torque wrench of the appropriate size and torque for the bolts.

The correct torque as indicated by a torque wrench shall not exceed the values recommended by the manufacture.

After assembly and inspection and before being backfilled, all exterior surfaces of buried sleeve-type couplings, including the middle and follower rings, bolts, and nuts, shall be thoroughly coated with an approved heavy-bodied bituminous mastic. Care shall be taken and appropriate devices used to ensure that the undersides, as well as the more readily accessible parts, are well coated.

METHOD OF MEASUREMENT AND BASIS OF PAYMENT

These items shall be measured and paid at the respective Contact unit price per Each, which price shall include all labor, tools, material, equipment, excavation, backfill, socket pipe clamps, tierods and bridles and incidental costs required to complete the work.

<u>ITEM 376.1</u>	<u>HYDRANT - EXCLUDING COST OF HYDRANT</u>	<u>EACH</u>
<u>ITEM 376.3</u>	<u>HYDRANT - REMOVED AND STACKED</u>	<u>EACH</u>

All work shall be done in accordance with MassHighway Standard Specifications, and standard details supplemented by American Waterworks Association Standard Specifications. All new hydrants and gates shall be provided by the Town of Billerica to install at new location as shown on the plans. The hydrants will be picked up at the Billerica DPW yard and the Contractor shall coordinate with DPW for the schedule.

STA 27+10 LT existing hydrant need to be replaced of existing 8-inch service line as shown on the plan.

BASIS OF PAYMENT AND METHOD OF MEASUREMENT

Unit price bid shall include installation of hydrant at new location at the Contract Unit Prices bid per Each. Payment under this Item shall include all excavation, sawcutting, shoring, bracing, bedding, gravel borrow backfill, pressure testing, chlorination, flushing, sampling, analysis. Payment is inclusive of installing the hydrant and new gate complete in place and in working order.

Removed and stacked old hydrant shall be paid under Item 376.3 at the Contract Unit Prices bed per Each which price shall be considered full compensation for all labor, equipment, materials, and incidentals necessary to complete the work to the satisfaction of the Engineer.

All new hydrant including installation at other locations shall be paid under Item 376.

<u>ITEM 381.1</u>	<u>SERVICE BOX REMOVED AND RESET</u>	<u>EACH</u>
<u>ITEM 381.2</u>	<u>SERVICE BOX REMOVED AND STACKED</u>	<u>EACH</u>
<u>ITEM 381.3</u>	<u>SERVICE BOX ADJUSTED</u>	<u>EACH</u>

Work under these items shall conform to the relevant provisions of Subsection 301 of the Standard Specifications and the following:

Under these Items the Contractor shall adjust to grade service box. Service box in driveways shall have collars. Service box in sidewalk areas are not required to have a collar.

Service box located in the roadway shall be removed and reset to behind proposed curb line. Existing curb stop in the roadway shall remain in place in the open position. New curb stop and copper tubing shall be installed between the retained curb stop to the new curb stop behind the proposed curb line.

Any service box damaged due to the Contractor's operations, will be replaced by the Contractor at his own expense.

METHOD OF MEASUREMENT

Items 381.1 and 381.3 will be measured by the unit each, complete in place.

BASIS OF PAYMENT

Items 381.1 and 381.3 will be paid at the contract unit bid price per each, which price shall be considered full compensation for all labor, equipment, materials, and incidentals necessary to complete the work to the satisfaction of the Engineer.

New Curb Stop will be paid for under Item 384.

New copper tubing will be paid for under the respective copper tubing item of work.

<u>ITEM 390.01</u>	<u>IRRIGATION SYSTEM REMOVED AND RESET</u>	<u>FOOT</u>
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All work shall be done in accordance with the relevant Subsections of the MassDOT Highway Division Standard Specifications.

Where a sprinkler system is encountered during the construction, the piping system and sprinkler heads shall be removed and reset at new locations or modified as directed by the Engineer. The exact locations will be determined by the Engineer in the field to the satisfaction of the owner.

Possible location of Sprinkler System:
 STA 43+00 RT (Town Hall Lawn)
 354 Boston Road
 Heritage Road (varies properties)

Existing sprinkler system impacted due to the construction as identify on the plan or encountered during construction operations shall be carefully removed and reset on the property as directed by the Engineer. The work also includes disconnecting existing system with coordination with owner.

All sprinkler heads and pipes etc. shall be removed carefully. The Contractor will be held responsible for any damage done during the removal and resetting of these items and shall replace or repair the damaged item as directed by the Engineer at his own expense.

Sprinkler heads and the pipes shall be relocated to new locations or eliminated as determined by the Engineer. All necessary piping shall be provided and installed by the Contractor.

The operation of the sprinkler system shall be guaranteed by the Contractor for a period of one month from the date of completion of work.

METHOD OF MEASUREMENT AND BASIS OF PAYMENT

Item 390.01 will be measured in place by the Foot of irrigation tubing removed and reset in its final position.

Item 390.01 will be paid at the contract unit bid price per Foot, which Contract unit price shall include all work necessary or incidental for complete in place relocated sprinkler irrigation tubing, sprinkler heads, testing and incidentals required to complete the work.

HIGH EARLY STRENGTH CEMENT

ITEM 431.1

CONCRETE BASE COURSE

CUBIC YARD

The work under this Item shall conform to the relevant provisions of Section 430 of the Standard Specifications and the following:

The Contractor shall use High-Early-Strength Cement concrete Base course for roadway widening less than 4', patches, cradles and/or caps for designated drainage and utility lines, as determined at the time of construction and as directed by the Engineer. The Contractor's attention is drawn to the fact that high early strength concrete may be placed in various thicknesses as directed by the Engineer.

Compensation for this Item shall be at the Contract Unit Price bid per Cubic Yard for uses not otherwise included for payment under other items of this contact. Payment under this Item shall include all form work, labor, materials, equipment and protection as required to complete the installation of High-Early-Strength Cement Concrete.

ITEM 485.01

COBBLESTONE PAVEMENT

SQUARE YARD

The work under this Item shall conform to the relevant provisions of Section 485 and the following:

The work shall consist of furnishing and installing cobblestone pavers on a mortar bed on a concrete base course in accordance with these Special Provisions, as shown on the Plans and as directed by the Engineer.

SUBMITTALS

At least 30 days prior to ordering, the Contractor shall submit to the Engineer, representative samples, certifications, manufacturer's literature and certified test results for materials as specified below. No materials shall be ordered or delivered until the required submittals have been reviewed and approved. Delivered materials shall closely match the approved samples.

Material Samples:

- A. Submit three representative samples of cobbles to be utilized.
- B. Mortar color sample.

Constructed Samples:

Granite cobblestone pavers sample panel: Construct a four (4) foot wide by six (6) foot long sample panel of granite cobblestone pavers on a concrete base with mortar setting bed and mortar joints. Sample panel is to be approved prior to final installation. The sample may be constructed as the initial 6 foot section in the roadway.

The sample, if rejected, shall be rebuilt as necessary to gain approval prior to beginning placement of granite cobble pavers. The sample upon approval shall be maintained as the standard of minimal quality for approval of all proposed cobblestone pavers pavement work required for the project. Protect accepted mock-ups from damage until completion and acceptance of the work. The contractor shall include in his bid price removal of the sample panel from the site following acceptance, unless otherwise directed by the Engineer.

DELIVERY, HANDLING, STORAGE

Store all cobblestone paver units on raised platforms. Storage piles or stacks shall be located to avoid and be protected from heavy or unnecessary traffic. Materials shall be stored under an approved roof or covered with waterproof tarpaulins at all times, except when laborers are working and using the materials.

MATERIALS

Cobblestone Pavers

The stone provided shall match samples of cut stone materials submitted, approved and on file with the Engineer for range of color and consistency of texture. Granite shall comply with requirements of the National Building Granite Quarries Association (NBGQA) for tolerances, color, and finish qualities, unless amended herein.

To the greatest possible extent, provide continuous blocks of stone to allow for fabrication of continuous matching units. Mark matched units to provide continuous sequence installation.

Certification of Specified Physical Characteristics of Stone:

- A. All stone materials shall have characteristics and physical requirements as defined by ASTM C119 and C615, and possesses physical characteristics as specified under C615, in accordance with the following ASTM test references.
 - 1. Abrasion resistance of stone subject to foot traffic: ASTM C241
 - 2. Abrasion of natural building stone: ASTM C97
 - 3. Compressive strength of natural building stone: ASTM C170
 - 4. Modulus of rupture of natural building stone: ASTM C99

B. Certificates shall be furnished by the Contractor, which have been obtained from the stone supplier, attesting that the specified stone meets the required physical characteristics. Certification shall be based on independent testing laboratory tests made within the last ten (10) years. Submit six (6) copies.

C. Stone material:

1. Shall be first quality granite, hard and durable, of a uniform or similar color, grain, size and texture, free from seams, cracks and show no evidence of any rust or iron particles. Test samples shall conform to the requirements of ASTM C615.
2. All granite shall conform to the following minimum requirements:
 - a. Abrasion: 70.0 Ha
 - b. Absorption: 0.4% (average)
 - c. Compressive strength: 19,000 psi (average)
 - d. Modulus of rupture: 1,500 psi (average)
3. Granite shall be gray granite provided from a single quarry source.
4. Granite shall have a thickness of approximately three (3) inches as shown on the Plans. Cobbles shall be approximately eight (8) inches long by four (4) inches wide.
5. All six (6) sides of the cobbles shall be split face with a maximum finish tolerance of one (1) inch.
6. Cobbles shall be selected so that they may be laid out with one-half (1/2) inch to three-quarter (3/4) inch joints.

Mortar Setting Bed

Cement mortar shall meet requirements of Subsection M4.02.15. Color shall be “natural” to match color of cobblestone.

Cement Concrete for Base Course

Cast-in-place concrete base course shall conform to the requirements in Section 485, except final finishing and brooming is not necessary for the cobblestoned area as this is a base course. Minimum twenty-eight (28) day compressive strength shall be 4,000 psi, aggregate size shall be a maximum of three-quarter (3/4) inch conforming to the requirements of Section 901. Concrete shall be air-entrained 6 percent minimum +/- 1 percent, with a three (3) inch to four (4) inch slump. Depths shall be as noted on the Plans.

Welded Wire Mesh (WWM) reinforcement shall conform to the applicable requirements of ASTM A 185. Mesh reinforcement shall be furnished in flat sheets. Mesh reinforcement in rolls will not be permitted. Provide six (6) inches by six (6) inches W2.9 by W2.9 WWM for six (6) inch thick concrete pavement.

CONSTRUCTION METHODS

Concrete

Concrete placement, testing, reinforcing and protection and formwork shall be as specified in Section 701 and as directed in these Special Provisions. No spray or curing compounds shall be

used in construction of concrete base course for cobblestones. Concrete covering over wire mesh shall be as indicated on the Plans and as specified herein.

Mesh reinforcement shall be held firmly in place against vertical or transverse movement.

All forms shall be smooth, free from warp, or sufficient strength to resist deflection and of a depth to conform to the thickness of the proposed base course. All forms shall be joined neatly and tightly, shall be set true to line and grade, well staked and braced, and shall have uniform bearing throughout their length. All forms and stakes shall be removed before placing HMA.

Concrete base shall be placed in one course, to full depth, as detailed on the Plans.

Adequate protection shall be provided whenever temperatures of forty degrees (40°) Fahrenheit or lower occur during placing of concrete, and during the early curing period. The minimum temperature of fresh concrete after placing, and for the first three (3) days, shall be maintained above fifty-five degrees (55°) Fahrenheit. In addition to the above requirements, an additional three (3) days of protection from freezing shall be maintained.

Expansion joints shall be placed twenty (20) feet on center and/or as indicated on the Plans. Follow the manufacturer's application recommendations for joint filler and sealer. Expansion joints shall be one-half (1/2) inch wide. Joint alignment shall be straight and true.

At the cobblestoned area, after floating the concrete off to the desired elevation; apply a pattern to the surface that shall provide a roughened texture to the concrete without affecting the finish grade.

Prior to setting the pavers, the surface shall be wetted or otherwise kept moist throughout a minimum six (6) day curing period through the use of polyethylene film, wetted burlap, or by a spray applied curing compound. The concrete surface shall be protected from all traffic or other disturbance during the curing period. The Contractor shall perform any cleaning necessary to the cement concrete base to provide a clean base surface, free from oil, grease, other impurities, or loose or friable particles. The Contractor shall not begin installation of pavers until the Engineer has accepted finish grade of pavement base.

Mortar Setting Bed

- A. Lay cobble pavers in a full mortar bed at the proper level, in the pattern indicated on the Plans. Mortar joints shall be one-half (1/2) inch to three-quarter (3/4) inch in width.
- B. Fill joints to a full depth with mortar, using a small tool to assure a full joint. Do not smear grout on adjoining surfaces.
- C. Cure joints for at least seven (7) days after installing by covering with curing paper or other non-staining material as approved.

Item 485.01, Cobblestone Pavement, will be measured and paid for at the contract unit price per square yard, complete-in-place including cobblestone pavers, concrete base, mortar setting bed, sawcutting, and all labor, equipment, tools, and incidentals necessary to complete the item to the satisfaction of the Engineer.

ITEM 504.3
ITEM 509.3

GRANITE CURB TYPE VA4 - SLOPED EDGE
GRANITE CURB TRANSITION CURB - SLOPED

FOOT
FOOT

Work under these Items shall conform to the relevant provisions of Section 500, supplemented and amended as follows:

Granite curbing shall conform to Section M9.04 of the Standard Specifications and as shown on construction detail drawing.

Sloped Granite Curb shall have a beveled, mountable edge as shown on the drawings and shall be used in straight curb applications and curved radii of 10 feet or greater. Granite pieces shall have sawn ends, top, bottom and chamfer and shall have split face front and back. Granite pieces shall be between 4 and 10 foot lengths.

Granite transition curb shall be used between granite curb type VA-4 and sloped edge at the median. Typical length of the transition curb shall be 6 feet.

The curb shall be set at the line and grade required as shown on the plans.

Payment for these items shall be at the Contract Unit Prices bid per Foot for furnishing and installing sloped granite curb and transition curb, complete in place including sawcutting, excavation, concrete support, compacted gravel borrow bedding and backfill.

ITEM 697.1

SILT SACK

EACH

Work under this item shall conform to the relevant provisions of Subsections 227 and 670 of the Standard Specifications and the following:

The work under this item includes the furnishing, installation, maintenance and removal of a reusable fabric sack to be installed in drainage structures for the protection of wetlands and other resource areas and the prevention of silt and sediment from the construction site from entering the storm water collection system. Devices shall be ACF Environmental (800)-448-3636; Reed & Graham, Inc. Geosynthetics (888)-381-0800; The BMP Store (800)-644-9223; or approved equal.

CONSTRUCTION

Silt sacks shall be installed in retained existing and proposed catch basins and gutter inlets within the project limits and as directed by the Engineer.

The silt sack shall be as manufactured to fit the opening of the drainage structure under regular flow conditions, and shall be mounted under the grate. The insert shall be secured from the surface such that the grate can be removed without the insert discharging into the structure. The filter material shall be installed and maintained in accordance with the manufacturer's written literature and as directed by the Engineer.

Silt sacks shall remain in place until the placement of the pavement overlay or top course and the graded areas have become permanently stabilized by vegetative growth. All materials used for the filter fabric will become the property of the Contractor and shall be removed from the site.

The Contractor shall inspect the condition of silt sacks after each rainstorm and during major rain events. Silt sacks shall be cleaned periodically to remove and dispose of accumulated debris as required at no additional cost. Silt sacks, which become damaged during construction operations, shall be repaired or replaced immediately at no additional cost to the Department.

When emptying the silt sack, the contractor shall take all due care to prevent sediment from entering the structure. Any silt or other debris found in the drainage system at the end of construction shall be removed at the Contractor's expense.

All curb openings shall be blocked to prevent stormwater from bypassing the device.

All silt, sediment, and debris accumulated in silt sacks shall be handled and disposed of as specified in Section 227 of the Standard Specifications. Under no condition shall silt and sediment from the insert be deposited on site and used in construction.

COMPENSATION

Silt sacks will be measured and paid at the Contract unit price per each, complete in place, which price shall include all labor, materials, equipment and incidental costs required to complete the work. No separate payment will be made for removal and disposal of the sediment from the insert, but all costs in connection therewith shall be included in the Contract unit price bid.

GEOTEXTILE FABRIC

ITEM 698.4 FOR PERMANENT EROSION CONTROL SQUARE YARD

All work shall be done in conformance with the applicable sections of the Standard Specifications.

Geotextile Fabric for Permanent Erosion Control shall conform to requirements of AASHTO M 288 and shall be listed on MassDOT's Qualified Construction Materials List. Geotextile for Permanent Erosion Control shall be used under stone for pipe ends and modified rock fill, including two feet of overlapping width and if it need to be pinned down shall be included under this item.

BASIS OF PAYMENT

Compensation shall be at the contract unit price bid per square yard and shall include the fabric, all labor, tools, materials, and any necessary incidental items to provide complete in place installation. No additional payment for overlapping of fabric.

<u>ITEM 701.</u>	<u>CEMENT CONCRETE SIDEWALK</u>	<u>SQUARE YARD</u>
<u>ITEM 701.1</u>	<u>CEMENT CONCRETE SIDEWALK AT DRIVEWAYS</u>	<u>SQUARE YARD</u>
<u>ITEM 701.2</u>	<u>CEMENT CONCRETE PEDESTRIAN CURB RAMP</u>	<u>SQUARE YARD</u>

Work under this item shall conform to the relevant provisions of Section 701 of the Standard & Supplemental Specifications and the following:

The work include installation of cement concrete sidewalks, shared use path (SUP), cement concrete sidewalk panels for support of brick bands and brick median areas, pedestrain curb ramp (WCR), as well as sidewalks though driveway and driveway aprons.

All work shall conform to the latest edition of the MassDOT and ADA Standards. The Contractor is hereby notified that they are ultimately responsible for constructing all project elements in strict compliance with the current AAB/ADA rules, regulations and standards.

The AAB Rules and Regulations specify maximum slopes and minimum dimensions required for construction acceptance. There is no tolerance allowed for slopes greater than the maximum slope nor for dimensions less than the minimum dimensions.

Sidewalks shall be constructed in accordance with requirements of the Standard Specifications, including placement of alternating sections, 30 feet in length and provided with expansion joints. Expansion filler shall also be used at pours against buildings, walls or other hard fixed objects. Contractor is responsible for securing areas with curing concrete, and shall supply barricades or watchmen as necessary to prevent defacement of concrete surfaces.

Concrete sealer (M 9.15.0) shall be applied to the cured sidewalk surface. Sealer to be on the MassDOT Qualified Products list.

Detectible waning panels shall be installed as shown on the Plans and as detailed in MassDOT Construction Standards details E 107.6.5, dated October 2017. The tile shall conform to Americans with Disabilities Act (ADA) requirements and color shall be brick red.

Payment under this Item shall include temporary removal of obstructions (such as fences) for the purposes of forming and pouring sidewalks that are not specifically paid for under another item.

Payment shall be Contract Unit Prices bid per Square Yard of cement concrete sidewalk with concrete sealer, panels under brick, and driveways, complete in place, to the satisfaction of the Engineer, including but not limited to, protection and finishing. The work shall also include the provision of weep holes in the concrete base below brick pavers, as depicted on the plans.

ITEM 706.01 BRICK PAVERS FOR SIDEWALK AND MEDIAN SQUARE YARD

The work to be done under this Item shall be in conformance with the relevant provisions of Section 700, the plans and the following:

Brick shall be laid with a tight 1/16" joint and placed on a cement concrete base paid to under Item 701, Cement Concrete Sidewalk. All materials shall be delivered, store, and handled to preclude damage of any nature. Manufactured materials shall be delivered and stored in their original containers, plainly marked with product and manufacturer's name.

Brick Pavers:

Shall be true pavers, 2 1/4 inch by 4 inch by 8 inch straight edge, extruded, (wire cut) and shall be Weather Class SX, Type I, Application PX. Paver shall conform to ASTM C 902. Brick shall have an average comprehensive strength not less than 8,000 psi (average of 5 bricks) and average water

absorption of no more than 8% (24 hour submersion at room temperature). The radius of rupture shall be not less than 1,000 pounds per square inch.

Bricks shall be manufactured by Belden Brick Company, Reading, PA, Glen-Gery, Wyomissing, PA, Pine Hall Brick Co., Winston-Salem, NC or approved equal. Color range shall be Regimental Full Range by Belden Brick Company or approved equal.

Material Samples:

The Contractor will be required to submit six samples of brick to the Engineer for approval before ordering. The samples shall demonstrate the final full range of surface color, finish, and shape that will be provided throughout the project. All samples shall be full size.

Reports:

Test reports and certificates shall be submitted for each material and paving element and shall include particle size and range, classification, traffic type, size and tolerance application.

Sample Panels:

Well in advance of placing brick pavers, three (3) sample panels showing three different blends of the brick paver using a plywood base shall be constructed at the site, as directed by the Engineer for the Engineer's approval of material, workmanship, range of color, bond and texture of surface. Sufficient time shall be given to the Engineer and the Town to view and approve the materials, method of laying, and workmanship. The materials and method shall be satisfactory to the Engineer who shall be the sole judge of its acceptability. Sample panels shall be approximately 3' wide by 4' long and shall remain on site at all times until otherwise directed by the Engineer.

Contractor is cautioned that the visual effect and appearance of the surface is an extremely important project element and that its installation must conform to the details and intent of the drawings and specifications. Paving must be installed by a contractor or subcontractor with five years' experience on projects of a similar size and character. The Contractor will be required to submit the name of the subcontractor he intends to employ and verification of experience, capability, and facilities to the Engineer for approval.

The Contractor shall place cement concrete base per Item 701 with a thickness of 4 inches.

Jointing Sand:

1. Sand conforming to the requirements of ASTM C 33, Specification for Concrete Aggregate shall be swept into joints before vibration. Course particles not falling into joints shall be swept away.
2. After vibration, place a finer jointing sand to penetrate to the bottom of the joints.

Setting Bed:

Sand for bedding shall be fine, clean, naturally occurring material with angular and subangular shaped particles, with a maximum size of 3/16 inch concrete sand conforming to the requirements of ASTM C 33, Specification for Concrete Aggregate. Sand rich in silica-based minerals is desirable. Manufactured limestone shall not be used.

The Contractor shall place the sand setting bed and compact the bed to a finished thickness of 1 inch. Compaction shall be by a mechanical vibrator resulting in a compaction of ninety-five percent (95%) of maximum density. Once compacted, the top 1/4 inch shall be loosened with a hand rake.

Core drill (2" diameter) concrete slab at low point/s at a maximum of five (5) feet on center as shown on the drawings or as directed by Engineer. Fill core holes with peastone or an equally free draining material. Cover core holes with Marifi 100X Drainage Fabric or equal material.

Placing Bricks:

Contractor shall verify curbing is acceptable and true to line and grade prior to beginning installing bricks. **Actual width of the brick band shall be verified before pouring concrete base so that the bricks neatly fill the width provided.**

Place brick paver and tap lightly to a true surface. Leveling of paver should be done as the setting operation proceeds so that it is not necessary to disturb the pavers set earlier. Each paver shall be adjusted to obtain a uniform 1/16 inch joint. The Contractor shall sweep jointing sand over surface to fill joints completely.

Pavers shall be carefully placed by hand in straight courses, maintaining accurate alignment, consistent jointing, and a uniform top surface. Newly laid pavers shall be protected with plywood panels on which workers can stand and advance protective panels, as work progresses, but maintain protection in areas subject to continued movement of materials and equipment to avoid creating depressions or disrupting alignment of pavers.

Payment for this Item shall be made at the Contract Unit Price bid per Square Yard, which price shall constitute full compensation for furnishing and installing all materials including brick pavers, stone fines, peastone, drainage fabric, polymeric sand, and all other materials, labor, equipment tools, appurtenances, and incidentals necessary to satisfactorily finish the this work, complete and accepted by the Engineer.

Concrete base shall be paid under 701, Cement Concrete Sidewalk.

ITEM 705.1

FLAGSTONE WALK REMOVED AND RESET

SQUARE YARD

ITEM 706.1

BRICK WALK REMOVED AND RELAID

SQUARE YARD

Work under this item shall be done in accordance with relevant provisions of Subsection 701 of the Standard Specifications, supplemented as follows:

Walkways to be regraded shall have their existing stones, bricks or pavers, removed and cleaned of the jointing material. Any stone, brick or pavers broken or damaged during this work shall be replaced by the Contractor to match existing in color, texture and thickness. The extent of the removal shall be determined by the Engineer. The walkway shall match the proposed back of sidewalk grades, driveways shall match existing driveway grades, and shall be sloped smoothly and evenly without dips or distinct breaks when relaid.

The existing bedding shall be cleaned of all debris and properly prepared for the addition of more bedding as required for the regrading. The bedding shall match existing.

All walks to be removed and relaid shall conform to AAB and ADA rules and regulations.

METHOD OF MEASUREMENT AND BASIS OF PAYMENT

Walks removed and relaid will be measured by the square yard complete and in place.

Walks removed and relaid shall be paid at the contract unit price per square yard, as measured complete in place. The price paid shall be full compensation for replacing broken brick or pavers, disposal or stacking of excess brick, removing, cleaning and relaying them, for furnishing and placing the bedding and jointing materials including the concrete base, necessary excavation, sawcutting, and all other materials, labor and equipment required to make the work complete.

Concrete base thickness shall be similar to existing and shall be paid under Item 901.

ITEM 707.01

RESIN BOUND PAVEMENT

SQUARE FOOT

This Item of work shall consist of installing resin bound pavement at existing trees and newly planted trees at the locations shown on the plans and as specified herein. System shall be permeable, polyurethane, UV stable, flexible, and have a hand troweled surface.

QUALIFICATIONS

Resin-bonded decorative stone qualifications:

- Installer's Field Supervision: Installer to maintain an experienced full-time supervisor on Project site when work is in progress.
- Qualification of Foreman or Crew Leader: All work shall be supervised by a foreman or crew leader who is an experienced installer of resin-bonded stone path systems.
- Polyurethane to be manufactured with quality controls to ensure the uniform quality of the product.

SUBMITTALS

Submit resin product labels/data sheets and a copy of manufacturer installation guidelines and requirements.

Submit three (3) color samples of decorative aggregate for review. Colors shall be a range of grays and browns.

Submit four (4), minimum 6-inch by 6-inch, samples of each decorative stone with resin product applied to illustrate color, texture and extremes of color range. Label each sample indicating the decorative stone vendor name, stone name, and size; and resin manufacturer and color.

Contractor shall provide mockup of permeable resin bound pavement system components. Construct one tree pit panel sized 8 feet long by 4 feet wide which includes all layers of construction. Mockup shall serve as a basis for quality for the Project, to approve visual aspects, to determine correct application rate to provide proper coverage yet maintain permeability, and to accept or reject workmanship. No additional permeable resin bound pavement work shall begin until panel is approved. Mockup may remain as part of the Work. If mockup is not approved by

the Engineer, remove and provide additional mockups as required to meet the Engineer's approval. Once approved, the mockup shall be the standard from which the work will be judged by the Engineer.

MATERIALS

Base for the decorative aggregate shall be 3/4 inch crushed stone, clean and free of fines.

Decorative stone aggregate shall be clean, washed irregularly shaped, round-edged, glacier-worn pebbles; 3/8-inch average size; range 1/4-inch minimum to 1/2-inch maximum. Color range shall be as selected from the manufacturer's samples.

METHOD OF CONSTRUCTION

Once the tree is installed, place a geo-textile filter fabric over the soil. This fabric must be water permeable and designed to prevent fine dirt particles from migrating into the 3/4 inch stone.

Install 4-inches of 3/4 inch crushed stone should be applied on top of the geo-textile filter fabric to a depth of 2 inches below the desired finished grade. Crushed stone shall be compacted to achieve a level and even finish.

Install a metal protective tree ring at a 9 inch radius to the tree flush with the desired finished grade.

Mix aggregate, base and binder per manufacturer's instructions. Hand spread decorative stone and resin mixture. Compact with hand trowel and smooth out any irregularities.

The top of the root-ball of the newly planted tree should be at a minimum of 4 inches to 6 inches below the desired finished grade of the permeable resin bound pavement.

Recommended temperature of application should be between 40°F and 85°F. Do not mix or apply product during wet weather.

Apply binder resin at the application rate necessary to provide proper coverage yet maintain permeability. After application and while binder is still wet, carefully remove errant stones or level and trowel any minor irregularities in the finish surface. Cordon off treated area to protect it from people and animals. Allow 24 hours to cure. Clean and sweep adjacent surfaces.

METHOD OF MEASUREMENT AND BASIS OF PAYMENT

Resin bound pavement shall be paid for at the Contract Unit Price per Square Foot installed including fine grading, base aggregate, decorative aggregate in polyurethane and loose, tree ring, labor, materials, and equipment required for the satisfactory completion of the work.

ITEM 707.31**TREE GRATE (36" x 72")****EACH**

This Item of work shall consist of furnishing and installing Tree Grates and Frames and all necessary fittings and materials, at the locations shown on the plans and as specified herein or as directed by the Engineer.

Tree Grate shall be 36 x 72 inch rectangular, with a starburst design as manufactured by Ironsmith, Inc., Palm Desert, CA , Neenah Foundry, Urban Accessories, or approved equal. Tree grate shall be cast gray iron measuring and shall have 3/8" maximum slot openings. Tree opening shall be 16 inches. Tree grate finish shall be "black dip".

The Contractor shall provide matching steel angle frames as produced by the same manufacturer as the grate and shall be powder coated black and fabricated specifically for the portions adjacent to the concrete sidewalk the Brick Pavers and the granite curb.

The Contractor shall submit product data, for the approval of the Engineer, describing Tree Grate dimensions and layout, mounting steel angle frames, accessories, finish, handling, warranty and installation procedures.

Install tree grates where shown on the plans, flush and leveled with surrounding paved surfaces. Frame must not slope in more than one (1) direction. Use spreaders or stakes to keep frame from distortion as needed. Install frames per drawings and manufacturer's recommendations. Grind pads on underside of tree grate to prevent rocking.

Coordinate installation of tree grate with tree planting. Clean frame and grate. Remove any construction debris etc. from tree pit.

This Item shall be paid for at the Contract Unit Prices bid per Each, which price shall constitute full compensation for all labor, excavation, disposal of excess material, gravel borrow, materials including grates, steel angle frames and anchor bolts of the appropriate size and all other incidentals required to finish the work, complete and accepted by the Engineer.

Tree staples for use in planting trees in tree grate at curb shall be 36" or 42" Tree Staple stabilizer, dependent on tree size, as provided by Tree Staple, Inc. or approved equal. Install according to planting detail and per manufacturer's instructions without any additional cost.

ITEM 740. ENGINEERS FIELD OFFICE AND EQUIPMENT (TYPE A)**MONTH**

Work under this item shall conform to the relevant provisions of Subsection 740 and the following:

Three computer systems, printer system, and a digital camera meeting the requirements set forth below including installation, maintenance, power, paper, disks, and other supplies shall be provided at the Resident Engineer's Office:

All equipment shall be UL approved and Energy Star compliant.

The Computer System shall meet the following minimum criteria or better:

Processor:	Intel, 3.5 GHz
System Memory (RAM):	8GB
Hard Drive:	500GB
Optical Drive:	DVD-RW/DVD+RW/CD-RW/CD+RW
Graphics Card:	4GB
Card Reader:	6-in-1 Card Reader, 2 total USB 3.0, audio
Network Adapter:	10/100 Mbit/s
USB Ports:	6 USB 3.0 ports
Keyboard:	Generic
Mouse:	Optical mouse with scroll, MS-Mouse compliant
OS:	Windows Professional with all security updates
Web Browser:	Latest Internet Explorer with all security updates
Applications:	Latest MS Office Professional with all security updates Latest Adobe Acrobat Professional with all security updates Latest Autodesk AutoCAD LT
Monitor:	24" LED with built-in speakers, 1920 x 1200 max resolution
Flash drives:	2 - 32GB USB 3.0
Internet access:	High Speed (min. 24 mbps) internet access with wireless router.

Multifunction Printer System shall meet the following minimum criteria or better:

Color laser printer, fax, scanner, email and copier all in one with the following minimum capabilities:

- Estimated volume 8,000 pages per month
- LCD touch panel display
- 50 page reversing automatic document feeder (RADF)
- Reduction/enlargement capability
- Ability to copy and print 11" x 17" paper size
- email and network pc connectivity
- Microsoft and Apple compatibility
- ability to overwrite latent images on hard drive
- 600 x 600 dpi capability
- 30 pages per minute print speed (color),
- 4 Paper Trays Standard (not including the bypass tray)
- Automatic duplexing
- Finisher with staple functions
- Standard Ethernet. Print Controller
- Scan documents to PDF, PC and USB
- ability to print with authenticated access protection

The Contractor shall supply a maintenance contract for next day service, and all supplies (toner, staples, paper) necessary to meet estimated monthly usage.

A Digital Camera shall meet the following minimum criteria or better:

Resolution:	12 Megapixel
Optical Zoom:	5x
Internal Memory Included:	Yes
Memory:	8 GB SD Card
Screen:	3 inch Clear Photo LCD
Min Operating Temperature:	14°F
Max Depth of Water Resistant:	30feet
Height of Shock Resistant:	5 feet
Battery Power:	2 rechargeable batteries and a battery charger
Carrying Case:	Rain-proof with shoulder strap

The Engineer's Field Office and the equipment included herein including the computer systems, printer and camera shall remain the property of the Contractor at the completion of the project. Disks, flash drives, and card readers with cards shall become the property of the Department.

Compensation for this work will be made at the contract unit price per month which price includes full compensation for all services and equipment, and incidentals necessary to provide equipment, maintenance, insurance as specified and as directed by the Engineer.

ITEM 751.
ITEM 765.

LOAM BORROW
SEEDING

CUBIC YARD
SQUARE YARD

The work under these Items shall conform to the relevant provisions of Section 751, 765, 767, 770 and as supplemented below. Work includes the placement of approved loam borrow, lime, fertilizer, and seed to restore all disturbed grassed areas as authorized by the Engineer.

Loam Borrow shall meet with Material Specifications M1.07.0. Loam Borrow shall pass a 3/8" screen and laid in a minimum depth of 6" after compacted and shall be free of grass and other unsuitable materials. The placement of new loam borrow shall be as follows.

In new areas or areas of significant disturbance, loam borrow shall be placed with a minimum depth of 6 inches after compaction. In existing grass areas to remain, or where there is minimal disturbance to the surface, depressions shall be filled, and a top dressing of loam borrow shall be applied to a general depth of 1 inch after compaction. Prior to the application of the top dressing, the Contractor shall be required to mechanically aerate these areas by a means acceptable to the Engineer. Loam Borrow shall be used to fill depressions and shape the surface to provide for proper flow of drainage, as well as enhance the general appearance of these grassed areas. Areas adjacent to curbs and other such hard surfaces shall be pre-worked and tapered down 1 to 2 inches so as to allow the top dressing to end up flush with the hard surface.

Lime shall meet M6.01.0. Lime shall be applied at a rate of 75 to 100 lbs. per 1,000 square feet prior to seeding.

Fertilizer shall meet M6.02.0 and the applicable provisions of State and Federal laws and be furnished in containers plainly marked with the chemical analysis of the product. Fertilizer for general planting shall be slow release and shall be commercial grade 10-10-10, or sufficient to meet

the recommendations for soil amendment. At least 40% of the nitrogen content shall be slow release, phosphorus shall be available phosphoric acid, and potassium shall be water-soluble potash. Seed shall conform to the requirements of M6.03.0 Long Term Seed Mixes for Lawns and Slopes-Lawn Areas:

<u>Grass Type</u>	<u>Proportion</u>	<u>Germination Minimum</u>	<u>Purity Minimum</u>
<u>Lawn Grass Areas</u>			
Creeping Red and/or Chewings Fescue	55%	85%	95%
Kentucky Blue	30%	85%	90%
Perennial Rye	5%	90%	98%
Redtop	5%	85%	92%
Dutch White Clover	5%	85%	96%

The hydroseed mixture shall be applied at a rate sufficient to promote lush rapid growth of grass. Fertilizer in the hydro-seed mixture shall be applied at the rate of 30 lbs. per 1,000 square feet and seed in the hydro-seed mixture shall be applied at a rate of at least 120 lbs. per acre or 4 lbs. per 1,000 square feet.

The Contractor shall be responsible for watering the hydro seeded areas daily for a minimum of two weeks or until the grass has become established. The Town will provide water via a hydrant connection.

Payment under Item 751 shall be the Contract Unit Price bid per Cubic Yard, based on a 4 inch depth, which price shall be full compensation for preparing surfaces; fine grading and compaction the sub base, furnishing, placing, raking, shaping and compacting new loam borrow; and furnishing and applying lime.

Payment under Item 765 shall be the Contract Unit Price bid per Square Yard, which price shall be full compensation preparing the loam surface, furnishing and applying hydro-seed, inclusive of fertilizer, as well as the maintenance of hydro-seeded areas as noted above.

Unless otherwise approved by the Engineer, surfaces disturbed outside the Limits of Work line shown for the Contractor's convenience, shall be restored as specified herein, at the Contractor's own expense.

ITEM 756. NPDES STORM WATER POLLUTION PREVENTION PLAN LUMP SUM

This Item addresses the preparation and implementation of a Storm Water Pollution Prevention Plan required by the National Pollutant Discharge Elimination System (NPDES) and applicable Construction General Permit (CGP) issued by the U.S. Environmental Protection Agency (EPA).

Pursuant to the Federal Clean Water Act, construction activities which disturb one acre or more are required to apply to the EPA for coverage under the NPDES General Permit for Storm Water Discharges from Construction Activities. On February 16, 2012 (77 FR 12286), EPA issued the final NPDES Construction General Permit (CGP) for construction activity. The Contractor shall be fully responsible for compliance with the CGP. Should a fine or penalty be assessed against it,

or MassDOT, as a result of a local, state, or federal enforcement action due to non-compliance with the CGP, the Contractor shall take full responsibility.

The NPDES CGP requires the submission of a Notice of Intent (NOI) to the EPA prior to the start of construction (defined as any activity which disturbs land, including clearing and grubbing). There is a fourteen (14) day review period commencing from the date on which EPA enters the Notice into their database. The Contractor is advised that, based on the review of the NOI, EPA may require additional information, including but not limited to, the submission of the Storm Water Pollution Prevention Plan (SWPPP) for review. Work may not commence on the project until final authorization has been granted by EPA. Any additional time required by EPA for review of submittals will not constitute a basis for claim of delay.

In addition, if the project discharges to an Outstanding Resource Water, vernal pool, or is within a coastal ACEC as identified by the Massachusetts Department of Environmental Protection (DEP), a separate notification to DEP is required. DEP may also require submission of the Storm Water Pollution Prevention Plan for review and approval. Filing fees associated with the notification to DEP and, if required, the SWPPP filing to DEP shall be paid by the Contractor.

The CGP also requires the preparation and implementation of a SWPPP in accordance with the afore-mentioned statutes and regulations. The Plan will include the CGP conditions and detailed descriptions of controls of erosion and sedimentation to be implemented during construction. It is the responsibility of the Contractor to prepare the SWPPP to meet the requirements of the most recently issued CGP. The Contractor shall submit the Plan to the Engineer for approval at least four (4) weeks prior to any site activities. It is the responsibility of the Contractor to comply with the CGP conditions and the conditions of any state Wetlands Protection Act Order, Water Quality Certification, Corps of Engineers Section 404 Permit and other environmental permits applicable to the project and to include in the SWPPP the methods and means necessary to comply with applicable conditions of said permits (reference to Part 9.1.1 of the 2012 CGP).

It is the responsibility of the Contractor to complete the SWPPP in accordance with the EPA CGP, provide all information required, and obtain any and all certifications as required by the CGP. Any amendments to the SWPPP required by site conditions, schedule changes, revised work, construction methodologies, and the like are the responsibility of the Contractor. Amendments will require the approval of the Engineer prior to implementation.

Included in the CGP conditions is the requirement for inspection of all erosion controls and site conditions on a weekly basis as well as after each incidence of rainfall exceeding 0.25 inches in twenty-four hours. For multi-day storms, EPA requires that an inspection must be performed during or after the first day of the event and after the end of the event. The CGP requires that inspections be performed by a qualified individual. MassDOT requires proof of completion of a 4 hour minimum sedimentation and erosion control training class current to the latest CGP. This individual can be, but not limited to, someone that is either a certified inspector, certified professional, or certified storm water inspector. The documentation shall be included as an appendix in the SWPPP. The Engineer must approve the contractor's inspector. This individual shall be on-site during construction to perform these inspections. In addition, if the Engineer determines at any time that the inspector's performance is inadequate, the Contractor shall provide an alternate inspector. Written weekly inspection forms, storm event inspection forms, and Monthly Summary Reports must be completed and provided to the Engineer. Monthly Summary Reports must include a summary of construction activities undertaken during the reporting period,

general site conditions, erosion control maintenance and corrective actions taken, the anticipated schedule of construction activities for the next reporting period, any SWPPP amendments, and representative photographs.

The Contractor is responsible for preparation of the Plan, all SWPPP certifications, inspections, reports and any and all corrective actions necessary to comply with the provisions of the CGP. Work associated with performance of inspections is not included under this Item. The Standard Specifications require adequate erosion control for the duration of the Contract. All Control measures must be properly selected, installed, and maintained in accordance with manufacturer specifications and good engineering practices. If periodic inspections or other information indicates a control has been used inappropriately or is no longer adequate, it is the responsibility of the Contractor to replace or modify the control for site conditions at no additional cost to the Department. Contractor must maintain all control measures and other protective measures in effective operating condition and shall consider replacement of erosion controls for each construction season.

This Item addresses acceptable completion of the SWPPP, any revisions/amendments required during construction, and preparation of monthly reports. In addition, any erosion controls beyond those specified in bid items elsewhere in this contract which are selected by the Contractor to facilitate and/or address the Contractor's schedule, methods and prosecution of the work shall be considered incidental to this item.

The Contractor is advised The CGP provides specific requirements for temporary and final stabilization. This shall be incorporated into the project schedule. The permit defines specific deadline requirements for Initial Stabilization ("immediately", i.e., no later than the end of the next work day following the day when earth-disturbing activities have temporarily or permanently ceased) and for Complete Stabilization Activities (no later than 14 calendar days after the initiation of stabilization). Stabilization criteria for vegetative and non-vegetative measures are provided in the CGP.

The CGP requires the submission of a Notice of Termination (NOT) from all operators when final stabilization has been achieved, as well as removal and proper disposal of all construction materials, waste and waste handling devices, removal of all equipment and construction vehicles, removal of all temporary stormwater controls, etc. . Approval of final stabilization by the Engineer and confirmation of submission of the NOT will be required prior to submission of the Resident Engineer's Final Estimate. The permittee is required to use EPA's electronic NOI system or "eNOI system" to prepare and submit NOT. The electronic NOT form can be found at <https://www.epa.gov/npdes/stormwater-discharges-construction-activities#ereporting> . If you are given approval by the EPA Regional Office to use a paper NOT, you must complete the form in Appendix K of the 2017 CGP.

COMPENSATION

Payment for all work under this Item shall be made at the contract unit price, lump sum, which shall include all work detailed above, including Plan preparation, required revisions, revisions/addenda during construction, monthly reports and filing fees.

Payment of fifty (50) % of the contract price shall be made upon acceptance of the Stormwater Pollution Prevention plan. Payment of forty (40) % of the contract price shall be made in equal

installments for implementation of the Stormwater Pollution Prevention plan. Payment of the final ten (10) % of the contract price shall be paid upon satisfactory submissions of a Notice of termination (NOT) when final stabilization has been achieved.

ITEM 761.11**STRUCTURAL SOIL****CUBIC YARD**

This Item of work shall consist of testing backfills and installing structural soil at new tree plantings at the locations shown on the plans and as specified herein.

SUBMITTALS

Submit the following samples and submittals for approval in conformance with the requirements of this Section.

All testing and analysis shall be at the expense of the Contractor.

1. Base Loam for use in manufacturing Structural Soil, Sand for use in manufacturing Structural Soil and the final, manufactured Structural Soil shall be sampled and tested in accordance with the following:

The Contractor shall provide a one cubic foot representative sample from each proposed source of Base Loam, Sand, and organic amendment for testing, analysis, and approval. Additionally, the Contractor shall provide one cubic foot representative samples of

Structural Soil delivered to the site and stockpiled for use. Samples from on-site stockpiles of these three soil materials shall be taken as directed by the Engineer and packaged in the presence of the Engineer.

The Contractor shall deliver all samples to testing laboratories and shall have the testing report sent directly to the Engineer. Tests for gradation, organics, soil chemistry and pH shall be performed by a soil testing agency approved by the Engineer and Department. Test reports shall include the following tests and recommendations.

- a. Sieve analysis shall be performed and compared to the USDA Soil Classification System. Sieve analysis shall be by combined hydrometer and wet sieving using sodium hexametaphosphate as a dispersant in compliance with ASTM D 422 after destruction of organic matter by ignition. The silt and clay content shall be determined by a hydrometer test of soil passing the #200 sieve.
- b. Percent of organics shall be determined by the loss on ignition of oven-dried samples. Test Samples shall be oven-dried to a constant weight at a temperature of 230 degrees F, plus or minus 9 degrees.
- c. Chemical analysis shall be undertaken for Nitrate Nitrogen, Ammonium Nitrogen, Phosphorus, Potassium, Calcium, extractable Aluminum, Soluble Salts, and acidity (pH) and buffer (pH). Nutrient levels shall be measured in parts per million (PPM). A Conductance Meter shall be used to measure Soluble Salt levels in soils: water extracts.

- d. Soil analysis tests shall show recommendations for soil additives to correct soils deficiencies as necessary, and for additives necessary to accomplish particular planting objectives noted.
 - e. All tests shall be performed in accordance with the current standards of the Association of Official Analytical Chemists.
2. Limestone: Submit supplier's certification to the Engineer certifying that the limestone being supplied conforms to these Specifications.
 3. Fertilizer: Submit product literature of planting fertilizer and 6 certificates showing composition and analysis. Submit the purchasing receipt showing the total quantity purchased for the project prior to installation.
 4. If biosolid compost is used as an organic component of the proposed planting soil mixture, the amount of organic material used shall not exceed agronomic rates for nitrogen and phosphorus for trees and shrubs, turf or ornamental perennials. Provide certificates of agronomic rates from vendor for organic matter used in loam borrow manufacturing process. Provide name of manufacturer of compost, telephone number of contact person at the manufacturer, the specific site of the manufacturing of the compost.
 5. Sand: Submit sieve test results and a ten pound sample.
 6. Submit the Landscape Contractor's qualifications showing past experience with installation of Structural Soils by outlining projects of similar quality, schedule requirements and construction detailing over the last 5 years. Qualifications shall include the names of all similar projects, year completed, location, description of the scope of work including the types and quantities of planting mix installed and the name, address and telephone number of the Department or the Engineer.

Delivery, Handling, and Storage

1. Do not deliver or place soils in frozen, wet, or muddy conditions. Do not deliver or place materials in an excessively moist condition.
2. Protect soils and mixes from absorbing excess water and from erosion at all times. Do not store materials unprotected from large rainfall events. Do not allow excess water to enter site prior to compaction. If water is introduced into the material after grading, allow material to drain to near optimum compaction moisture content.

Examination of Conditions

1. All areas to receive Structural Soil shall be inspected by the Contractor before starting work and all defects such as incorrect grading, compaction and inadequate drainage etc. shall be reported to the Engineer prior to beginning this work.
2. The Contractor shall be responsible for judging the full extent of work requirements involved, including but not limited to the potential need for temporary storage and staging of soils, including moving soil stock piles at the site to accommodate scheduling of other work and the need to protect installed soils from compaction, erosion and contamination.

MATERIALS

Structural soil shall be a blend of four parts by volume of coarse sand, one part by volume planting soil (loam borrow), and one part by volume leaf compost. The blending of components into a uniform mixture shall be approved by the Engineer and shall be done prior to placement.

Base Loam:

1. Base Loam as required for the work shall be free of subsoil, large stones, earth clods, sticks, stumps, clay lumps, roots or other objectionable, extraneous matter or debris. Base Loam shall also be free of quack-grass rhizomes, Agropyron Repens, and the nut-like tubers of nutgrass, Cyperus Esculentus, and all other primary noxious weeds. Base Loam shall not be delivered or used for planting while in a frozen or muddy condition. Base Loam for mixing shall conform to the following grain size distribution for material passing the #10 sieve:

U.S. Sieve Size Number	Minimum	Maximum
10	100	--
18	87	100
35	65	92
60	45	80
140	26	46
270	16	32
0.002mm	2	5

2. The ratio of the particle size for 80% passing (D80) to the particle size for 30% passing (D30) shall be 5 or less. (D80/D30 < 5).
3. Maximum size shall be one inch largest dimension. The maximum retained on the #10 sieve shall be 20% by weight of the total sample.
4. Tests shall be by combined hydrometer and wet sieving in compliance with ASTM D422 after destruction of organic matter by ignition.
5. The organic content shall be between 3.5 and 6.0 percent.

Sand:

1. Sand for Sand-Based Structural Soil or for amending loam shall be uniformly graded medium to coarse sand consisting of clean, inert, rounded grains of quartz or other durable rock free from loam or clay, surface coatings and deleterious materials with the following gradation.

U.S. Sieve Size Number	Minimum	Percent Passing Maximum
10	100	--
18	60	80
35	25	45
60	8	20
140	0	8
270	0	3
0.002mm	0	0.5

2. Maximum size shall be one inch largest dimension. The maximum retained on the #10 sieve shall be 10% by weight of the total sample.

3. The ratio of the particle size for 70% passing (D70) to the particle size for 20% passing (D30) shall be 3.0 or less. (D70/D20 <3.0)
4. Tests shall be by combined hydrometer and wet sieving in compliance with ASTM D422 after destruction of organic matter by ignition.

Organic Amendment Materials (Compost):

Compost for amending planting media shall be a stable, humus-like material produced from the aerobic decomposition of organic residues. The residues, if biosolids, shall consist of compost meeting the required criteria as listed herein this Section or approved equal. The compost shall be a dark brown to black color and be capable of supporting plant growth with appropriate management practices in conjunction with addition of fertilizer and other amendments as applicable, with no visible free water or dust, with no unpleasant odor, and meeting the following criteria as reported by the producer.

- a. The ratio of carbon to nitrogen shall be in the range of 10:1 to 25:1.
- b. Stability shall be assessed by either a CO₂ evolution test, a re-heating test, or the Solvita procedure. Protocols for each are specified by the coalition of Northeastern Governors Source Reduction Task Force (CONEG) in their 1966 report, "Model Procurement Specifications for Source Separated Compost." and the Solvita manual (version 3.5). For the CO₂ test, the compost respiration shall be no more than 6 mg CO₂-C/gBVS day. For re-heating using the Dewar self-heating test, the maximum heat rise shall be no greater than 48 degrees F above room temperature (68 to 77 degrees F). For the Solvita test, the compost must achieve a maturity index of 6 or more. Stability tests shall be conducted by Woods End Research Laboratory, Mt. Vernon, Maine.
- c. Pathogens/Metals/Vector Attraction reduction shall meet 40 CFR Part 503 rule, Table 3, page 9392, Vol. 58 No. 32, and Commonwealth of Massachusetts 310 CMR 32.00 (for applications to soils with human activity).
- d. Organic Content shall be at least 40 percent (dry weight). One hundred percent of the material shall pass a 3/8-inch (or smaller) screen. Debris such as metal, glass, plastic, wood (other than residual chips), asphalt or masonry shall not be visible and shall not exceed one percent dry weight. Organic content shall be determined by weight loss on ignition for particles passing a number 10 sieve according to procedures performed by a soil testing agency recommended by the Ohio State University Extension Program and approved by the Landscape Architect and Department. A 3 cubic inch sub-sample of the screened and mixed compost is ground to pass the number 60 sieve. 0.07 to 0.10 ounces of ground sample, dried to a constant weight at 221 degrees F is placed into a muffle furnace. The temperature is slowly raised (41 degrees F/minute) to 842 degrees F and maintained for three hours. The sample is removed to an oven to equilibrate at 224F and the weight is taken. Organic matter is calculated as loss on ignition.
- e. PH: The pH shall be between 5.5 to 8.0 as determined from a 1:1 soil-distilled water suspension using a glass electrode pH meter American Society of Agronomy Methods of Soil Analysis, Part 2, 1986.

- f. Salinity: Electrical conductivity of a one to two soil to water ratio extract shall not exceed 2.0 mmohs/cm (dS/m).
- g. The compost shall be screened to 3/8 inch maximum particle size and shall contain not more than 3 percent material finer than the 200 Sieve as determined by hydrometer test on ashed material.
- h. Nutrient content shall be determined by the University of Massachusetts Soil Testing Laboratory or equivalent laboratory and utilized to evaluate soil required amendments for the mixed soils. Chemical analysis shall be undertaken for Nitrate Nitrogen, Ammonium Nitrogen, Phosphorus, Potassium, Calcium, Aluminum, Magnesium, Iron, Manganese, Lead, Soluble Salts, Cation Exchange Capacity, soil reaction (pH), and

Soil Additives:

1. Acidulant for adjustment of Structural Soil and Planting Pit Medium pH shall be commercial grade flours of sulphur, ferrous sulfate, or aluminum sulfate that are unadulterated. Acidulants shall be delivered in unopened containers with the name of the manufacturer, material, analysis and net weight appearing on each container.
2. Ground limestone for adjustment of Structural Soil pH shall contain not less than 85 percent of total carbonates and shall be ground to such fineness that 40 percent will pass through 100 mesh sieve and 95 percent will pass through a 20 mesh sieve.

Planting Fertilizer:

1. Commercial fertilizer for use in Structural Soil shall be a product complying with the State and United States fertilizer laws. Deliver fertilizer to the site in the original unopened containers, which shall bear the manufacturer's certificate of compliance covering analysis, which shall be furnished to the Engineer. Fertilizer shall be free of nitrogen with percentages of weight for phosphorus and potassium as recommended by soil testing and analysis. Phosphorus and potassium shall be added to the top 18 inches of the Structural Soil in 6-inch lifts as the Structural Soil is placed. Rototill fertilizer into each successive 6-inch lift. Structural Soil shall be sampled and tested after application of fertilizer to verify that amended Structural Soil meets the requirements of the soil test analysis recommendations. Submit soil test results to the Engineer for review and approval.

CONSTRUCTION METHODS

Sub-surface Conditions:

1. Notify the Engineer of subsurface conditions, which will affect the Contractor's ability to complete the work.
2. Locate and confirm the location of all underground utility lines and structures prior to the start of any excavation.
3. The contractor shall exercise extreme care and caution when excavating around existing utilities and shall repair any underground utilities or foundations damaged by the Contractor during the progress of this work. The cost of all repairs shall be at the Contractor's expense.

Site Preparation:

1. Do not proceed with the installation of the Structural Soil material until all walls, curb footings and utility work in the area has been installed. For site elements dependent on Structural Soil for foundation support, postpone installation until immediately after the installation of Structural Soil.
2. Excavate and compact the proposed subgrade to depths, slopes and widths as shown on the Contract

Documents. Maintain all required angles of repose of the adjacent materials as shown on the Contract Documents. Do not over excavate compacted subgrades of adjacent pavement or structures.

3. Confirm that the subgrade is at the proper elevation and compacted as required. Subgrade elevations shall slope parallel to the finished grade and or toward the subsurface drain lines as shown on the Contract Documents.

Clear the excavation of all construction debris, trash, rubble and any foreign material. In the event that fuels, oils, concrete washout silts or other material harmful to plants has been spilled into the subgrade material, excavate the soil sufficiently to remove the harmful material. Fill any over excavation with approved fill and compact to the required subgrade compaction.

5. Protect adjacent walls, walks and utilities from damage or staining by the soil. Use plywood and or plastic sheeting as directed to cover existing concrete, metal and masonry work and other items as directed during the progress of the work.
6. Clean up all trash and any soil or dirt spilled on any paved surface at the end of each working day. Any damage to the paving caused by the soils installation contractor shall be repaired by the General Contractor at the General Contractor’s expense.
7. Maintain all silt and sediment control devices required by applicable regulations. Provide adequate methods to assure that trucks and other equipment do not track soil from the site onto adjacent property and the public right of way.

Planting Media Mix Design:

1. Mix Design: Sand-Based Structural Soil

- a. The Sand-Based Structural Soil shall consist of a blend of five parts by volume of Sand, one part by volume of Base-Loam and two parts by volume of Organic Amendment. Blending of the components shall be carried out with earth moving equipment prior to placement. The components shall be blended to create a uniform mixture as determined by the Engineer. The final mix shall conform to the following gradation requirements for material passing a Number 10 sieve.

- b. The Structural Soil design mix shall meet the following criteria:

U.S. Sieve Size No.	Percent Passing Min.	Percent Passing Max.
10	100	-
18	68	90
35	38	63
60	18	39
140	9	18
270	4	9
.002 mm	1	2

- c. Maximum size shall be one inch largest dimension. The maximum retained on the #10 sieve shall be 15% by weight of the total sample.
- d. The ratio of the particle size for 70% passing (D70) to the particle size for 20% passing (D20) shall be 3.5 or less. (D70/D20 <3.5)

- e. Tests shall be by combined hydrometer and wet sieving in compliance with ASTM D422 after destruction of organic matter by ignition.

Placement of Sand-Based Structural Soil:

1. Contractor shall obtain Engineer's written approval of previously completed work of rough grading of subsoil prior to commencing loam borrow or Structural Soil placement work.
2. Immediately prior to dumping and spreading the Structural Soil, the subgrade shall be cleaned of all debris or rubbish. Such material shall be removed from the site. After subgrade levels have been reached, and immediately prior to placing Sand-Based Structural Soil the entire subgrade area shall be thorough compacted, then loosened to a minimum depth of four inches utilizing the teeth on the bucket of a backhoe or by deep raking.
3. After loosening, Sand-Based Structural Soil shall be spread in lifts not greater than eight inches and compacted with a minimum of two passes of vibratory compaction equipment to a density between 90 and 94 percent Standard Proctor Maximum Dry Density in accordance with compaction standards of ASTM D1557 Method D. During the compaction process, all depressions caused by settlement or compaction shall be filled with additional Structural Soil and the surface shall be regraded and rolled until presenting a smooth and even finish corresponding to the required grades. Sand-Based Structural Soil shall be placed to a depth of two feet within the areas shown on the Drawings.
 - a. Phase the installation of the Structural Soil such that wheeled equipment does not have to travel over already installed soil. If it is determined by the Engineer that equipment must travel over already installed Structural Soil, provide one- inch thick steel plate ballast over the length and width of travel to cover Structural Soil and protect it from compaction.

Clean-Up:

1. Upon completion of the Structural Soil installation operations, clean areas within the contract limits. Remove all excess fills, soils and mix stockpiles and legally dispose of all waste materials, trash and debris. Remove all tools and equipment and provide a clean, clear site. Sweep, do not wash, all paving and other exposed surfaces of dirt and mud until the paving has been installed over the Structural Soil materials. Do no washing until finished material covering Structural Soil is in place.

METHOD OF MEASUREMENT AND BASIS OF PAYMENT:

The work of this Item shall be measured and paid for at the Contract Unit Price per Cubic Yard, which payment shall constitute full compensation for furnishing and installing structural soil including, testing, amending, excavation, placing, spreading, comacting and fine grading and including all labor, equipment tools, appurtenances, and incidentals necessary to satisfactorily complete this Item of work, in place and accepted.

ITEM 765.553**WETLAND/BASIN MIX – RIPARIAN****SQUARE YARD**

The work under this item shall conform to the relevant provisions of Section 765 of the Standard Specifications and the following:

The work shall consist of planting and establishing a stand of grass in the areas shown on the plans or as required by the Engineer. For the purposes of these specifications, the term “grass” shall apply to all the forbs, grasses, sedges, and rushes included in the materials.

All seeding shall be done by a company having a minimum of five years of experience with native grass establishment. Prior to beginning work, the seeding Contractor shall furnish proof of qualifications to the Engineer for approval. Proof of qualifications includes, if requested, providing documentation (photos and contacts) to demonstrate knowledge and expertise with native seeding and proof of having completed successful native seeding projects.

Seeding shall be done within 48 hours of placement of loam and final grading. Mulch for seed shall be Compost Topdressing or hydromulch as specified below and shall be incidental to this item.

SEEDING SEASON

Seeding seasons shall be April 1 through May 15 and October 1 through December 1 for dormant seeding. *Seeding that occurs outside of these periods, shall be increased by 50%.*

MATERIALS**Seed****Samples and Submittals**

- 1) **Certificate of Materials.** 60 days prior to ordering, the Contractor shall submit to the Engineer the manufacturer or supplier’s notarized Certificate of Materials. This document shall not be used as proof of purchase, proof of material delivered, or proof of material seeded, but simply to verify supplier availability of seed listed on the date certified. The species listed shall match those specified on the plans or herein, however, cultivars may vary due to availability. Substantial substitutions or changes in the mix from that specified on the plans or herein shall be approved by MassDOT Landscape Design Section.
- 2) **Seed Tag Certification.** All seed lots have a seed analysis tag as required by State and Federal law. The contractor shall submit seed tags for each bag of seed used on the project site or ensure that each tag is photo documented by the Engineer. Number of tags shall match number of bags sent by the supplier to meet rate of Pure Live Seed specified on the plans. Tag must include: kind and variety of seed; lot number; origin of seed; net weight; % purity; germination; dormant seed; germination test date; inert matter; weed, noxious and other crop seed; and name and address of company responsible for the analysis. Seeding may be considered unacceptable for payment if no tags are submitted.
- 3) **Certificate of Compliance.** Prior to payment, contractor shall submit a bill of lading or a signed, dated and notarized Certificate of Compliance from the Supplier that serves as proof of purchase. This document shall include kind and variety of seed, lot number, net weight shipped,

date of sale, invoice number under which seed was purchased, and name and address of Supplier or Manufacturer. All information must be included on the notarized form, including lot number and net weight shipped for specified job. This information shall match Seed Tag Certification and quantity of seed applied on the job. Seeding may be considered unacceptable for payment if information is incomplete.

- 4) Seed Sample. Contractor may be asked, prior to seeding, to submit a seed sample for testing.

Quantities specified are Pure Live Seed (PLS). Greater quantities of ordered seed may be required to achieve actual specified seeding rates. Pure Live Seed is defined as the fraction of pure seed species within the mix that, by standard seed testing practices, will germinate. This is determined by multiplying the percent of seed purity by the percent of seed germination.

Seed mix shall be a custom blend as shown on the plans or shall be as specified below. Seed cultivars shall be those that are as regional to New England or the local ecotype as possible.

Any species substitutions shall be with a species having similar characteristics and native to New England. Substantial changes in the mix shall be approved by MassDOT Landscape Design Section.

Seed Mix and Rates

Item 765.553 Wetland/Basin Mix - Riparian

<u>Botanical Name</u>	<u>Common Name</u>	<u>% PLS</u> <u>By</u> <u>Weight</u>
Grass		
Sorghastrum nutans NY Eco	Indiangrass NY Ecotype	14.00%
Schizachyrium scoparium	Little Blue Stem	14.00%
Elymus riparius	Riverbank Wild Rye	10.00%
Elymus virginicus	Virginia Wild Rye	10.00%
Panicum clandestinum 'Tioga'	Deer Tongue 'Tioga'	9.00%
Andropogon gerardii NY Eco	Big Bluestem NY Eco	8.00%
Carex vulpinoidea	Fox Sedge	7.00%
Panicum virgatum	Switchgrass	3.00%
Juncus effusus	Soft Rush	2.00%
Agrostis perennans	Upland Bentgrass	2.00%
Scirpus atrovirens	Green Bulrush	1.00%
		<u>80.00%</u>
Herb/Forb		
Chamaecrista fasciculata	Partridge Pea	3.00%
Verbena hastata	Blue Vervain	3.00%
Asclepias incarnata	Swamp Milkweed	3.00%
Heliopsis helianthoides	Ox-Eye Sunflower	2.00%
Eupatorium perfoliatum	Boneset	2.00%
Aster umbellatus	Flat Topped White Aster	1.00%
Aster prenanthoides	Zig Zag Aster	1.00%
Aster puniceus	Aster – Swamp	1.00%
Aster novae-angliae	New England Aster	1.00%
Eupatorium maculatum	Joe-pye Weed	1.00%
Monarda fistulosa	Wild Bergamot	1.00%
Vernonia noveboracensis	New York Ironweed	1.00%
		<u>20.00%</u>
		100.00%

Seeding Rate:

Species ecotype shall be as native to New England region as possible. Apply this mix at 20 lbs PLS/acre.

Fertilizer

No fertilizers shall be applied.

Water

Water, including hose and all other watering equipment required for the work, shall be furnished by the Contractor to the site at no additional cost. Water shall be suitable for irrigation and free from ingredients harmful to plant life. All plants injured or work damaged due to the lack of water or the use of too much water shall be the Contractor's responsibility to correct.

Mulch

Mulch for seeding and topdressing shall be incidental to this item. Mulch shall be:

- Compost Topdressing meeting the material and submittal requirements of Item 751.72, Compost Topdressing and as specified below under Seeding and Mulching.
OR
- Hydromulch per the manufacturer's recommendation. Mulch for hydroseeding shall be wood fiber only.

Photo Documentation

Contractor shall submit photo documentation to the Engineer and Landscape Design Section. Each photo shall be date stamped. Photos shall be submitted after the following stages of construction:

- Soil preparation
- Seed and hydromulch/compost topdressing
- Germination
- Grass establishment after one full growing season (growing season is June-September)

CONSTRUCTION

Surface Preparation

Soil preparation and seeding shall occur only when the bed is in a friable condition, not muddy or hard. Bare soils shall be raked to remove large stiff clods, lumps, brush, roots, stumps, litter and other foreign matter. Ruts and depressions shall be filled with additional loam or compost and the soil shall be re-graded to a smooth and even finish corresponding to the required grades.

When seeding over existing or compacted soil, surface will be prepared by raking or tracking to a depth of 2 inches prior to seeding and prior to Compost Topdressing (when applicable).

Surface preparation shall be compensated for under Item 751. Loam Borrow.

Surface preparation shall be approved by the Engineer prior to seeding.

Seeding over Various Substrates

Loam: Seeding shall occur within 48 hours of site preparation to prevent loss of topsoil. Seeding shall be hydroseeding or broadcast as specified below.

Compost Topdressing: Compost Topdressing shall be applied as specified under that item. Seed should be broadcast at the same time as compost application to ensure a thin cover of compost over

seed. *When seeding is done after application of Compost Topsoil the rate shall be increased by 50% and area shall be hydromulched.*

Compost Mulch over Modified Rock: Compost Mulch shall be applied as specified under that item and shall be such that only the voids in the rock are filled so that seed has an organic substrate for germination. Seed shall be broadcast after compost application. No hydromulch is required.

Seeding Methods

No seeding or surface preparation work shall be done if soils are muddy or dry and compacted.

Broadcast Seeding: Seed shall be broadcast spread using a cyclone or whirlwind seeder or hand broadcast. Small or light-seeded species such as bluestem may be mixed with approved filler (e.g., sawdust, rice, kitty litter, or clean damp sand) to achieve an even distribution. Broadcast seeding shall be undertaken in two separate passes at ninety degrees to each other. One-half the seeding rate shall be applied in each direction.

To ensure seed to soil contact with broadcasting of seed, seed shall be tracked or rolled with a weighted roller.

All broadcast seeding shall be followed by hydromulching unless seeding is done as part of Compost Topdressing and as specified above.

Hydroseeding shall include hydromulch.

Hydromulching shall be per the Standard Specifications and per the manufacturer's directions.

After seeding and mulching, water seeded areas to moisten soil to a depth of at least 2 inches.

Seed and Grass Care

During Germination: Contractor shall care for seeded areas as determined necessary by the Engineer and the MassDOT Landscape Architect. Care may include irrigation and weed control as necessary for germination.

During Establishment: Following germination of seeded species, the contractor shall maintain the stand of grasses to ensure healthy growth. Work shall include mowing or weed whacking for weed control, irrigation if necessary, and monitoring for invasive plants.

Watering shall provide uniform coverage without eroding soil or grassed surfaces. Treatment of invasive plants shall be per the direction of MassDOT Landscape Architect.

The Contractor shall provide all labor, equipment, materials, and water required for establishment. Contractor shall water all seeded areas as necessary to a depth of 2 inches or greater.

Over-seeding

If there are areas of bare ground greater than 2-3 feet in diameter, these areas shall be over-seeded with the specified mix. Over-seeding application rates and methods shall be the same as those listed above. After seeding, areas shall be mulched with straw mulch or ¼ - ½ inch Compost Topsoil and watered with a fine mist to moisten soil to a depth of at least 2 inches.

Areas that are invaded by weeds shall be mowed as low as possible and over-seeded as directed. Soil that is compacted shall be raked or roughened prior to over-seeding. Following over-seeding, soil shall be lightly tamped to ensure seed to soil contact.

Over-seeding and mulch for over-seeding shall be incidental to this item.

ESTABLISHMENT

Native upland grasses and forbs will not look like turf grass. Many of the native grasses are bunch type grasses and will not form a uniform growth or have a sod-type appearance. However, seeded area shall show general uniform growth of the seeded species throughout the area. Areas with significant gaps of bare soil, generally greater than 2-3 feet in diameter, will require over-seeding.

A well-established stand of grasses at the end of one full growing season (June-September), as determined by the Engineer and the MassDOT Landscape Architect, will be required for acceptance. At least 80-90 percent of the grass established shall be the seeded species and any invasive or aggressive weeds (mugwort, ragweed, or knapweed) shall have been cut or otherwise managed.

METHOD OF MEASUREMENT AND BASIS OF PAYMENT

Item 765.553 will be measured for payment by the square yard after one full growing season (June-September) has elapsed between seed application and inspection and upon approval of establishment by the Engineer and the MassDOT Landscape Architect.

Item 765.553 will be paid for at the Contract unit price per Square Yard upon receipt of required submittals as specified above and upon approval of established stand of grass as specified above.

This price shall include seeding, rolling to ensure seed-to-soil contact, care during germination and establishment, irrigation, mulching, over-seeding, labor, materials, equipment, photo documentation, and all incidental costs required to complete the work. Site preparation, including raking, tilling, removal of debris and stones, and other work to the prepare site for seeding shall be compensated for under Item 751, Loam Borrow.

ITEM 767.121**SEDIMENT CONTROL BARRIER****FOOT**

The work under this item shall conform to the relevant provisions of Subsections 670, 751 and 767 of the Standard Specifications and shall include the furnishing and placement of a sediment control barrier. Sediment control barrier shall be installed prior to disturbing upslope soil.

The purpose of the sediment control barrier is to slow runoff velocity and filter suspended sediments from storm water flow. Sediment barrier may be used to contain stockpile sediments, to break slope length, and to slow or prevent upgradient water or water off road surfaces from flowing into a work zone. Contractor shall be responsible for ensuring that barriers fulfill the intent of adequately controlling siltation and runoff.

Twelve-inch diameter (after installation) compost filter tubes with biodegradable natural fabric (i.e., cotton, jute, burlap) are intended to be the primary sedimentation control barrier.

For small areas of disturbance with minimal slope and slope length, the Engineer may approve the following sediment control methods:

- 9-inch compost filter tubes
- Straw bales which shall be trenched

No straw wattles may be used. Additional compost filter tubes (adding depth or height) shall be used at specific locations of concentrated flow such as at gully points, steep slopes, or identified failure points in the sediment capture line.

When required by permits, additional sediment barrier shall be stored on-site for emergency use and replacement for the duration of the contract.

Where shown on the plans or when required by permits, silt fence shall be used in addition to compost filter tubes and straw bales and shall be incidental to the item.

Sediment control barriers shall be installed in the approximate location as shown on the plans and as required so that no excavated or disturbed soil can enter mitigation areas or adjacent wetlands or waterways. Barriers shall be in place prior to excavation work. No work shall take place outside the barriers.

MATERIALS AND CONSTRUCTION

Prior to initial placement of barriers, the Contractor and the Engineer shall review locations specified on the plans and adjust placement to ensure that the placement will provide maximum effectiveness.

Barriers shall be staked, trenched, and/or wedged as specified herein and according to the Manufacturer's instructions. Barriers shall be securely in contact with existing soil such that there is no flow beneath the barrier.

Compost Filter Tube

Compost material inside the filter tube shall meet M1.06.0, except for the following: no peat, manure or bio-solids shall be used; no kiln-dried wood or construction debris shall be allowed; material shall pass through a 2-inch sieve; and the C:N ratio shall be disregarded.

Outer tube fabric shall be made of 100% biodegradable materials (i.e., cotton, hemp or jute) and shall have a knitted mesh with openings that allow for sufficient water flow and effective sediment capture.

Tubes shall be tamped, but not trenched, to ensure good contact with soil. When reinforcement is necessary, tubes shall be stacked as shown on the detail plans.

Straw Bales

Straw bales shall be used if shown on the plans or when specified by Orders of Condition or other permit requirements.

Bales should be placed in a single row, lengthwise on the contour, with ends of adjacent bales tightly abutting one another. All bales should be either wire-bound or string-tied. Straw bales should be installed so that bindings are oriented around the sides (rather than along the tops and bottoms) of the bales in order to prevent deterioration of the bindings.

The barrier should be entrenched and backfilled. A trench should be excavated the width of a bale and the length of the proposed barrier to a minimum depth of 4 inches. The trench must be deep enough to remove all grass and other material which might allow underflow. After the bales are staked and chinked (filled by wedging), the excavated soil should be backfilled against the barrier. Backfill soil should conform to the ground level on the downhill side and should be built up to 4 inches against the uphill side of the barrier.

Each bale should be securely anchored by at least 2 stakes or re-bars driven through the bale. The first stake in each bale should be driven toward the previously laid bale to force the bales together. Stakes or re-bars should be driven deep enough into the ground to securely anchor the bales. For safety reasons, stakes should not extend above the bales but should be driven in flush with the top of the bale.

The gaps between the bales should be chinked (filled by wedging) with straw to prevent water from escaping between the bales. Loose straw scattered over the area immediately uphill from a straw bale barrier tends to increase barrier efficiency. Wedging must be done carefully in order not to separate the bales.

When used in a swale, the barrier should be extended to such a length that the bottoms of the end bales are higher in elevation than the top of the lowest middle bale to assure that sediment-laden runoff will flow either through or over the barrier but not around it.

Silt Fence

Materials and Installation shall be per Section 670.40 and 670.60 of the Standard Specifications and the following:

Silt fence shall only be used if shown on the plans or when specified by Orders of Condition or other permit requirements.

When used with compost filter tubes, the tube shall be placed on a minimum of 8 inches of folded fabric on the upslope side of the fence. Fabric does not need to be trenched.

When used with straw bales, an 8-inch deep and 4-inch wide trench or V-trench shall be dug on the upslope side of the fence line. One foot of fabric shall be placed in the bottom of the trench followed by backfilling with compacted earth or gravel. Stakes shall be on the down slope side of the trench and shall be spaced such that the fence remains vertical and effective.

Width of fabric shall be sufficient to provide a 36-inch high barrier after fabric is folded or trenched. Sagging fabric will require additional staking or other anchoring.

MAINTENANCE

Maintenance of the sediment control barrier shall be per Section 670.60 of the Standard Specifications or per the Stormwater Pollution Prevention Plan (SWPPP), whichever is more restrictive.

The contractor shall inspect the sediment barrier in accordance with relevant permits. At a minimum, barriers shall be inspected at least once every 7 calendar days and after a rain event resulting in 0.25 inches or more of rainfall. Contractor shall be responsible for ensuring that an effective barrier is in place and working effectively for all phases of the Contract.

Barriers that decompose such that they no longer provide the function required shall be repaired or replaced as directed. If the resulting berm of compost within the fabric tube is sufficiently intact and continues to provide effective water and sediment control, barrier does not necessarily require replacement.

DISMANTLING & REMOVING

Barriers shall be dismantled and/or removed, as required, when construction work is complete and upslope areas have been permanently stabilized and after receiving permission to do so from the Engineer.

Regardless of site context, nonbiodegradable material and components of the sediment barriers, including photo-biodegradable fabric, plastic netting, nylon twine, and silt fence, shall be removed and disposed off-site by the Contractor.

For naturalized areas, biodegradable, natural fabric and material may be left in place to decompose on-site. In urban, residential, or other locations where aesthetics is a concern, the following shall apply:

- Compost filter tube fabric shall be cut and removed, and compost shall be raked to blend evenly (as would be done with a soil amendment or mulch). No more than a 2-inch depth shall be left on soil substrate.
- Straw bales shall be removed and disposed off-site by the Contractor. Areas of trenching shall be raked smooth and disturbed soils stabilized with a seed mix matching adjacent seeding or existing grasses (i.e., lawn or native grass mix).
- Silt fence, stakes, and other debris shall be removed and disposed off-site. Site shall be restored to a neat and clean condition.

METHOD OF MEASUREMENT AND BASIS OF PAYMENT

Item 767.121 will be measured and paid for at the contract unit price per foot of sediment control barrier which price shall include all labor, equipment, materials, maintenance, dismantling, removal, restoration of soil, and all incidental costs required to complete the work.

Silt fence, when used in conjunction with compost filter tubes or straw bales, will be incidental to this item.

Additional barrier, such as double or triple stacking of compost filter tubes, will be paid for per foot of tube installed.

Barriers that have been driven over or otherwise damaged by construction activities shall be repaired or replaced as directed by the Engineer at the Contractor's expense.

<u>ITEM 775.148</u>	<u>LINDEN - LITTLE LEAF – ‘GREENSPIRE’ 2-2.5 INCH CALIPER</u>	<u>EACH</u>
<u>ITEM 776.045</u>	<u>MAPLE – HEDGE – ‘STREETSIDE’ 2-2.5 INCH CALIPER</u>	<u>EACH</u>
<u>ITEM 776.543</u>	<u>MAPLE - RED - 'OCTOBER GLORY' 2-2.5 INCH CALIPER</u>	<u>EACH</u>
<u>ITEM 777.673</u>	<u>SWEETGUM 2-2.5 INCH CALIPER</u>	<u>EACH</u>
<u>ITEM 778.389</u>	<u>CHERRY – SARGENTII ‘PINK FLAIR’ 2-2.5 INCH CALIPER</u>	<u>EACH</u>
<u>ITEM 778.468</u>	<u>CRABAPPLE – ‘SPRING SNOW’ 2-2.5 INCH CALIPER</u>	<u>EACH</u>
<u>ITEM 783.467</u>	<u>TUPELO 2-2.5 INCH CALIPER</u>	<u>EACH</u>
<u>ITEM 783.649</u>	<u>ZELKOVA – ‘CITY SPRITE’ 2-.25 INCH CALIPER</u>	<u>EACH</u>

The work under these items shall conform to the applicable requirements of Section 771, PLANTING TREES, SHRUBS AND GROUND COVER, of the latest edition of the Standard Special Provisions.

GENERAL

Plant locations shown on the plans are schematic. Prior to ordering plants, the Landscape Architect shall be contacted to review plant locations.

Final plant locations shall be approved by the Landscape Architect prior to planting. Plants not shown on the plans shall be field located by the Landscape Architect.

WATERING

Watering during the one-year warranty period shall be with equipment that meets the following requirements:

Irrigation shall be sufficient to provide one inch of water per week during the growing season. The volume of water shall be equivalent to approximately 625 gallons of water per 1000 square feet of planted area. Water for both trees and shrubs in plantings beds shall be applied to root balls and to surrounding soil such that all soil in the planting bed is moistened.

Watering

Watering shall be per the Supplement Standard Specification dated June 15, 2012:

All plants shall be watered during planting and all plants shall be watered at least twice each week during weeks where the average daily temperature exceeds 55 degrees (F) and when precipitation is less than 1 inch, as determined by local National Weather Service data. Watering shall be sufficient to provide moist soil to a depth of 6 inches, as determined by the Engineer. If soil is sufficiently moist, as determined by the Engineer, the required watering may be reduced.

Trees will require a minimum of 10 gallons of water each, and shrubs a minimum of 5 gallons per plant per watering.

Trees or shrubs planted after October 15 shall be thoroughly watered at the time of planting, after which subsequent watering will not be required until following season. The Contractor shall maintain a watering log for all plants installed on the project, indicating dates of watering and weather events. Log shall be submitted for final payment.

Log shall be per the form provided by MassDOT and shall be submitted to the Engineer, with a copy forwarded to the Town.

Weeding

All planting beds shall be kept free of weeds and neatly maintained throughout the one-year warranty period.

<u>ITEM 801.22</u>	<u>2 INCH ELECTRICAL CONDUIT – TYPE NM (DOUBLE)</u>	<u>FOOT</u>
<u>ITEM 801.32</u>	<u>3 INCH ELECTRICAL CONDUIT – TYPE NM (DOUBLE)</u>	<u>FOOT</u>
<u>ITEM 801.42</u>	<u>4 INCH ELECTRICAL CONDUIT – TYPE NM (DOUBLE)</u>	<u>FOOT</u>
	1 INCH ELECTRICAL	
<u>ITEM 804.1</u>	<u>CONDUIT TYPE NM – PLASTIC (UL)</u>	<u>FOOT</u>
	2 INCH ELECTRICAL	
<u>ITEM 804.2</u>	<u>CONDUIT TYPE NM – PLASTIC (UL)</u>	<u>FOOT</u>
	3 INCH ELECTRICAL	
<u>ITEM 804.3</u>	<u>CONDUIT TYPE NM – PLASTIC (UL)</u>	<u>FOOT</u>
	4 INCH ELECTRICAL	
<u>ITEM 804.4</u>	<u>CONDUIT TYPE NM – PLASTIC (UL)</u>	<u>FOOT</u>
	3 INCH ELECTRICAL CONDUIT TYPE NM	
<u>ITEM 810.3</u>	<u>-PLASTIC- (UL) CONCRETE ENCASED</u>	<u>FOOT</u>
	3 INCH ELECTRICAL CONDUIT TYPE NM-	
<u>ITEM 810.32</u>	<u>-PLASTIC- (UL) (DOUBLE) CONCRETE ENCASED</u>	<u>FOOT</u>
	4 INCH ELECTRICAL CONDUIT TYPE NM-	
<u>ITEM 810.42</u>	<u>-PLASTIC- (UL) (DOUBLE) CONCRETE ENCASED</u>	<u>FOOT</u>

Work under these Items shall conform to the relevant provisions of Subsection 801 of the Standard Specifications and the following:

Conduit, whether shown on the plans or additional lengths placed as directed by the Engineer, may be increased or decreased by the Engineer depending upon actual conditions encountered, as provided for in Section 4.06 of the Standard Specifications.

Conduits are for the Street Lighting System, GFCI Outlet system, Traffic Signal Systems as well as to subsequently, in some cases, be used by the various Utility Companies to relocate their respective aerial facilities underground.

All conduit material shall be Schedule 80 Polyvinyl Chloride (PVC) and must meet or exceed the requirements of NEMA specifications TC-2, TC-8 and ASTM F512 (NEMA TC-6), all latest revisions.

Conduit fittings shall be joined by means of solvent cement meeting the requirements of ASTM D 2564.

The Contractor shall make efforts to install parallel conduits in the same trench. However, in the case of multiple conduits/utilities in a trench, a 12" clear width shall be provided between communication conduit and electric conduit. All road crossings shall be perpendicular to the centerlines of the road.

Conduits shall be mounted on interlocking spacers (3000 SI). Spacers shall not exceed eight foot intervals and shall be placed at each coupling. Where noted or specified, electrical conduit shall be encased in concrete, as detailed on the plans. Conduit joints shall be staggered to provide at least 12" longitudinal separation between joints between any two adjacent conduits. Conduit must be located at least 30" below final grade to the top of the duct bank/encasement.

Tracer tapes, as shown on the plan details (Caution Electric Line Buried Below), shall be installed in the trench 12 inches minimum above and directly over the conduit. No additional payment will be made for furnishing and installing tracer tape. A polyester pulling tape, 2500 lb test w/footage shall be installed in each conduit and all ends shall be plugged until ready to pull cable.

National Grid, Verizon and Comcast personnel must inspect respective duct lines before they are encased in concrete (minimum of 3000 psi). No direct traffic load is allowed on road crossings for 12 hours after backfilling.

When there is an interval of 4 or more hours between placing of adjacent concrete and the duct bank, #4 reinforcement bars shall be installed across the construction joint. All conduits must be placed in a dry trench. Dewatering may be necessary to install conduit and conduit encasement. No additional payment will be made for dewatering, but shall be incidental to the unit price of these Items.

A minimum separation between communications and electrical conduit shall be 12". Minimum vertical separation between water, gas and sewer lines shall be 12" of concrete encasement, whenever the electrical conduits intersect with these utilities at right angles. A minimum separation of 24" shall be maintained between parallel placement of these utilities and electrical conduits.

The depth of conduit may need to be deeper than the typical excavation depth to avoid conflicts with these existing utilities. The work under these Items shall include these field adjustments.

All conduits shall be rodded with a mandrell no less than a quarter inch smaller than the inside diameter of the conduit.

The work shall consist of furnishing and installing a number of risers on a utility pole to connect underground conduit system also riser at the buildings as shown on the plans. At the riser, the conduit shall terminate in bend not less than 12 inches above finished grade and having a radius of not less than 36 inches. Sweeps for Communication, Telephone and Cable shall be Schedule 80 PVC.

All Electrical Conduit in pavement areas shall be concrete encased as detailed on the plans.

Conduit in Grass or in Planted Areas

Where new conduits are installed in grass and planted areas, no separate payment shall be made for the excavation, sand bedding, gravel backfill, including necessary compaction, or incidental materials, but all costs in connection therewith shall be included in the contract unit price for these Items.

Conduit under Sidewalk, Median or Driveways

Where conduit is installed in a sidewalk, paved median or asphalt driveway areas, no separate payment shall be made for the saw-cutting, excavation, and sand bedding, gravel backfill, including necessary compaction, or incidental materials, but all costs in connection therewith shall be included in the contract unit price for these Items. Payment for cement concrete or asphalt pavement shall be paid under the respective item.

Conduit Crossing Roadways

Trenches in existing bituminous concrete pavements not subject to full depth reconstruction shall be sawcut to an 18 inch width. The existing pavements shall be sawcut through their full depth and the pavement removed.

After conduit installation, the trench shall be backfilled with controlled density-fill (CDF). CDF shall be Type 1E or 2E as directed, confirming to the requirements of Section M4.08.0 of the Standard Specifications. The finished grade of the CDF shall be below existing pavement surface as shown on the construction details.

Where conduit crosses roadways, no separate payment shall be made for the saw-cutting of pavement, excavation, sand bedding, or incidental materials, but all costs in connection therewith shall be included in the contract unit price for these Items.

METHOD OF MEASUREMENT AND BASIS OF PAYMENT

Payment under these Items will be at the respective Contract Unit Price bid per Foot for furnishing and installing utility approved conduit of the appropriate size and type, which price shall be full compensation for all necessary or incidental work including saw-cutting, excavation including increased depths to pass under other utilities and/or enter structures, pull wires, tracer tape, sand bedding, amping, spacers, conduit caps, dewatering, forming and providing concrete encasement in case of those items so identified, gravel borrow backfill and compaction complete in place. Required conduit sweeps at buildings, and at riser poles shall be considered incidental to these Items.

Galvanized Sweeps riser at Pole shall be paid for under Electric Service Riser items, where required.

Temporary payment for surface restoration to match existing surface, where required and authorized in advance by the Engineer shall be paid under Item 472, Temporary Asphalt Paving.

Controlled density fill backfill shall be considered incidental to the various types of items for conduit.

Permanent HMA patch in mill and overlay area to match the existing surface, where required shall be paid under Item 451.

<u>ITEM 811.91</u>	<u>HANDHOLE TYPE A (STREET LIGHTING)</u>	<u>EACH</u>
<u>ITEM 811.94</u>	<u>ELECTRICAL HANDHOLE TYPE C</u>	<u>EACH</u>

The work to be done under these Items shall consist of furnishing and installing electrical handholes for the Street Lighting System at the location shown on the plans, including grounding rod and ground conductor, as specified herein.

All work performed shall be in accordance with Section 820, Highway Lighting, of the Standard Specifications, and as specified herein and in the Appendix.

Type A and Type C Handholes (17" x 30" x 24"), shall be of precast concrete box with heavy duty metal (gray iron) frame and cover.

Covers shall be heavy duty and have the word “ LIGHTING” for street light and “CATV” for Comcast handhole cast into the cover. The color of the cover shall match the color of surface surrounding the cover as approved by the Engineer.

Payment under these Items shall be at the Contract Unit Prices bid per Each, which prices shall be full compensation for furnishing and installing handhole with cover, and performing all necessary or incidental work including saw-cutting, excavation, bedding, gravel borrow, backfilling and compaction ground rods, complete in place as detailed on the plans.

ITEM 811.95**ELECTRIC HANDHOLE TYPE D****EACH****ITEM 811.96****ELECTRIC HANDHOLE TYPE E****EACH**

The work under these Items shall conform to the relevant provisions of Section 801 of the Standard Specifications and the following:

The work shall consist of furnishing and installing handholes for the use of involved utility companies. In all cases, handholes must meet the requirements of the respective utility company. Additional requirements are provided by the utility companies are located in Appendix C.

The cover and the handhole shall be capable of carrying vehicle load in accordance with NESC, Section 32, Article 323.A1 and the latest Massachusetts DPU Safety code. The minimum loading shall be capable of 20,000 lb.

The handhole sizes and uses shall be used as follows:

TYPE D 24” x 36” X 24” Verizon, Fire Alarm

TYPE E 17” x 30” X 17” National Grid

Type “E” Handholes shall apply to National Grid facilities, be the sizes listed above and be as shown referenced pages in the Appendix. They shall meet the requirements of National Grid, Bulletin No. 759B and as manufactured by Highline. Covers for Type E handholes shall be heavy duty and have the word “ELECTRIC” cast into the cover. The handhole color shall be grey.

Type “ D” Handholes shall apply to Verizon, Fire Alarm, or Raytheon facilities, be a precast Concrete (stackable) type, and be the size listed above.

Type D shall shall be of precast concrete box with heavy duty metal (gray iron) frame and cover. and have the word “VERIZON” cast into the cover.

All covers shall be furnished with: skid resistant surface; provisions for lifting during removal; four 1/2” pentahead self-centering stainless steel bolts complete with washers and “floating” nut assembly, and an interlock mechanism. Bolt heads shall be recessed in metal cup embedded in cover assembly. Covers shall fit to box such that no objects can be pushed into the box from the outside.

BASIS OF PAYMENT

Work under these Items shall be at the Contract Unit Price bid per Each per type, which price shall include the furnishing and installing of handhole complete with covers. The quantity of handholes may be increased or decreased by the Engineer depending upon actual conditions encountered, as provided for in the Standard Specifications. No separate payment shall be made for excavation, sawcutting, bedding, gravel borrow backfill and compaction, ground rods (for National Grid) or other incidental materials to complete the installation.

The Contractor shall bore predrill knockouts as required for proper conduit size at each location.

<u>ITEM 813.811</u>	<u>ELECTRIC SERVICE RISER – STA 26+23 LT</u>	<u>EACH</u>
<u>ITEM 813.812</u>	<u>ELECTRIC SERVICE RISER – STA 26+85 LT</u>	<u>EACH</u>
<u>ITEM 813.813</u>	<u>ELECTRIC SERVICE RISER – STA 27+50 RT</u>	<u>EACH</u>
<u>ITEM 813.814</u>	<u>ELECTRIC SERVICE RISER – STA 29+20 LT</u>	<u>EACH</u>
<u>ITEM 813.815</u>	<u>ELECTRIC SERVICE RISER – STA 31+50 LT</u>	<u>EACH</u>
<u>ITEM 813.816</u>	<u>ELECTRIC SERVICE RISER – STA 31+55 RT</u>	<u>EACH</u>
<u>ITEM 813.817</u>	<u>ELECTRIC SERVICE RISER – STA 33+45 LT</u>	<u>EACH</u>
<u>ITEM 813.818</u>	<u>ELECTRIC SERVICE RISER – STA 36+75 LT</u>	<u>EACH</u>
<u>ITEM 813.819</u>	<u>ELECTRIC SERVICE RISER – STA 39+85 LT</u>	<u>EACH</u>
<u>ITEM 813.820</u>	<u>ELECTRIC SERVICE RISER – STA 43+52 LT</u>	<u>EACH</u>
<u>ITEM 813.821</u>	<u>ELECTRIC SERVICE RISER – STA 44+45 LT</u>	<u>EACH</u>
<u>ITEM 813.822</u>	<u>ELECTRIC SERVICE RISER – STA 46+60 LT</u>	<u>EACH</u>
<u>ITEM 813.823</u>	<u>ELECTRIC SERVICE RISER – STA 47+70 LT</u>	<u>EACH</u>
<u>ITEM 813.824</u>	<u>ELECTRIC SERVICE RISER – STA 48+00 RT</u>	<u>EACH</u>
<u>ITEM 813.825</u>	<u>ELECTRIC SERVICE RISER – STA 48+80 LT</u>	<u>EACH</u>
<u>ITEM 813.826</u>	<u>ELECTRIC SERVICE RISER – STA 50+75 RT</u>	<u>EACH</u>
<u>ITEM 813.827</u>	<u>ELECTRIC SERVICE RISER – STA 51+90 RT</u>	<u>EACH</u>
<u>ITEM 813.828</u>	<u>ELECTRIC SERVICE RISER – STA 4+50 LT</u>	<u>EACH</u>
<u>ITEM 813.829</u>	<u>ELECTRIC SERVICE RISER – STA 70+70 LT</u>	<u>EACH</u>

The work shall conform to the relevant provisions of Section 813 and the following:

The work under this Item shall consist of moving and relocating the existing underground utility services from utility poles.

Boston Road (Non-Participating Items)

- Utility Pole # 134 at STA 26+23 LT (R&R UP By Others) (1-3" Riser)
- Utility Pole # 135/10 at STA 26+85 LT (R&R UP By Others) (2-3" Riser)
- Utility Pole # 10-135 at STA 27+50 RT (Exist UP) (2-3" Riser)
- Utility Pole # 137 at STA 29+20 LT (R&R UP By Others) (2-3" Riser)
- Utility Pole # 139 at STA 31+50 LT (R&R UP By Others) (1-3" Riser)
- Utility Pole # 19X at STA 31+55 RT (R&R UP By Others) (1-3" Riser)
- Utility Pole # 141 at STA 33+45 LT (R&R UP By Others) (1-3" Riser)
- Utility Pole # 145 at STA 36+75 LT (R&R UP By Others) (2-4" Riser)
- Utility Pole # 148 at STA 39+85 LT (R&R UP By Others) (2-4" Riser)
- Utility Pole # 152 at STA 43+52 LT (R&R UP By Others) (1-3" Riser)
- Utility Pole # 153-1 at STA 44+45 LT (R&R UP By Others) (1-3" Riser)

Utility Pole # 155-1 at STA 46+60 LT (R&R UP By Others) (1-3" Riser)
Utility Pole # NEW at STA 47+70 LT (NEW UP By Others) (1-3" Riser)
Utility Pole # 156/1 at STA 48+00 LT (Exist UP) (1-3" Riser)
Utility Pole # NEW at STA 48+80 LT (NEW UP By Others) (1-3" Riser)

Heritage Road (Participating Items)

Utility Pole # 1 at STA 50+75 RT (R&R UP By Others) (2-3" Riser)
Utility Pole # 2 at STA 51+90 RT (R&R UP By Others) (2-3" Riser)

Lasallete Road (Non-Participating Items)

Utility Pole # NEW at STA 4+50 LT (NEW UP By Others) (2-4" Riser)

Good Street (Non-Participating Items)

Utility Pole # NEW at STA 70+70 LT (NEW UP By Others) (2-4" Riser)

New utility poles will be installed "By Others". The underground conduit shall be extended by the Contractor to where the new utility poles are installed. New conduit risers and wiring shall be installed and connected to the newly relocated utility poles and power lines. The utility company will connect the risers to the power lines and not the MassDOT contractor.

Sweeps for the National Grid primary shall be galvanized steel.

Mechanical protection with rigid metal conduit shall be provided for the cable at least 10' – 2" above finished grade and a grounding connector installed at the top of the conduit by the Contractor. Spare conduits shall be capped at the top of the bend at ground level. The riser location shall be on a quarter of the pole away from traffic flow, and on the side of the pole away from telephone cable. The involved Utility Companies shall pre-approve riser locations.

The 90 degree rigid steel bends and caps for the spare conduits shall be included as part of the active conduit riser. No separate payment shall be made for excavation, 90 degree rigid steel bends and caps for conduits or other incidental materials, and all costs in connection therewith.

PVC conduit for other utilities risers shall be paid under respective conduit items.

The work shall include all excavation and backfill, compaction, concrete encasement and materials or any other requirements set by the respective utility company, local codes and guidelines.

The work associated with disconnecting power and reconnecting power services to the buildings should be performed overnight between midnight and 5:00 AM or at a time convenient to the property owners or tenants occupying the building. The actual time of day or evening for the disconnecting and reconnecting will be agreed upon between the Engineer, Power Company and the property owner/tenant during construction.

BASIS OF PAYMENT

Payment for Electrical Service Riser will be at the respective Contract Unit Price bid Each regardless of number of risers per pole and shall be full compensation for the furnishing of all labor, materials, tools and equipment associated with the work complete in place.

The work associated with the removal of utility poles, transfer of wiring to the new utility poles, and supplying and installing the new utility poles, new wiring and new riser shall be the responsibility of the respective utility companies and shall not be paid for under this Item.

<u>ITEM 815.1</u>	<u>TRAFFIC CONTROL SIGNAL LOCATION NO. 1</u>	<u>LUMP SUM</u>
<u>ITEM 815.11</u>	<u>TRAFFIC CONTROL SIGNAL LOCATION NO. 1</u>	<u>LUMP SUM</u>
<u>ITEM 815.2</u>	<u>TRAFFIC CONTROL SIGNAL LOCATION NO. 2</u>	<u>LUMP SUM</u>
<u>ITEM 815.3</u>	<u>TRAFFIC CONTROL SIGNAL LOCATION NO. 3</u>	<u>LUMP SUM</u>

Work under this item shall be performed according to the provisions of Section 800 supplemented by the following:

The work consists of furnishing and installing traffic control signal equipment complete and ready for operation, as shown on the plans, for the following loactions:

- Location 1: Boston Road (Route 3A) at Good Street.
- Location 2: Boston Road (Route 3A) Sta. 15+84±
- Location 3: Boston Road (Route 3A) Sta. 26+50±

Included in the work is the furnishing and installing of traffic control signal equipment, including controller, cabinet and foundation with concrete pad, battery backup system, vehicle and pedestrian housings, backplates, accessible pedestrian push buttons with signs and saddles, red, amber, and green LED signals, posts and bases, mast arms, signal post foundations, saw cuts, service connections, wire and cables, pull boxes, Ethernet networking equipment, equipment grounding and bonding, electrical connections, service connections, wireless contact closure transceiver and antenna, emergency preemption pushbutton panels and providing all incidental materials necessary for operating and controlling the traffic control signals, as shown on the plans and specified.

National Grid will furnish connection and power at the location shown on the Contract Drawings. National Grid will connect and disconnect power as required. No work shall be done in manholes or on power poles without a representative of National Grid being present. The Contractor will be responsible for coordinating the National Grid work.

It shall also be the Contractor’s responsibility to pay all charges to National Grid for performing this work. No direct reimbursement will be made under this payment to the Contractor for payments made to National Grid, it being understood that full compensation for any payment made by the Contractor to the utility company will be included in the contract unit prices bid.

A list of required major traffic signal system items is included on the plans. All equipment installed shall be listed on MassDOT’s “Qualified Traffic Control Equipment List”.

The Contractor shall deliver to the Engineer a certificate of compliance with the manufacturer for all materials purchased from the manufacturer.

The Contractor shall request written approval from the Engineer before the placement of any concrete for foundations of mast arms, signal posts and cabinets.

The top of the concrete base for the control cabinet shall be 18 inches above grade. The top of all other foundations not in sidewalk or paved areas shall be a minimum of 2 inches above grade. The top of mast arm foundations in sidewalk areas shall be located flush with finish grade.

Flashing Operation

Changes from automatic flashing to stop-and-go operation and from stop-and-go to automatic flashing operation shall occur as set forth in Sections 4D.28 through 4D.31 of the MUTCD.

Local Traffic Signal Controllers and Cabinets

The controller, malfunction management unit, detector amplifiers, bus interface units, and all other ancillary traffic signal control components included in the traffic control cabinet shall comply with the National Electrical Manufacturers Association (NEMA) Standard No. TS 2.

Traffic Controller Assemblies

The controllers and cabinet assemblies shall be supplied in an 8-phase, TS 2 Type 1 configuration.

Controller cabinet foundations shall not obstruct a sidewalk or crosswalk so that passage by physically-challenged persons is impaired. Anchor bolts shall be internal to the cabinet.

TS 2 Type 1 Controllers and Cabinet Assemblies: Controllers shall conform to Subsection 3, Controller Units of NEMA No. TS 2, Traffic Controller Assemblies. Controllers shall utilize an input/output interface conforming to Subsection 3.3.1 of the NEMA TS 2 Standard for all input/output functions with the backpanel terminals and facilities, the malfunction management unit, detector rack assemblies, and auxiliary devices.

The TS 2 Type 1 cabinet shall meet the requirements of Configuration 3 as defined in Table 5.3.1-1, "Type 2 Configurations" of the NEMA TS 2 Standard. The cabinet shall be fabricated of sheet aluminum to Size 6 dimensions as specified in Table 7.3-1 of the NEMA TS 2 Standards. The cabinet shall have a brushed aluminum finish.

The cabinet shall also be wired with a normally closed switch connected to a user defined input to the controller for remote monitoring of the control cabinets' door open status.

The following requirements are applicable to each signalized location and are designed for effective use of a laptop computer in conjunction with traffic signal controllers. These requirements are also designed to permit all engineers, electricians and technicians (including those who are disabled but ambulatory) to work in the cabinet in a safe, effective and comfortable manner. To this extent, the following meets applicable ADA requirements.

1. Adjust the control cabinet height by use of a cabinet extender, adjust the placement of cabinet shelves, adjust the height of the cabinet foundation or provide any combination of these three items so that the top of the LCD or other visual display window of both the local controller and the master controller is no more than 48" above finished grade in front of the cabinet. The top of the cabinet door opening shall be at least 5'8" above finished grade. Any technical provision, plan detail, standard specification or standard drawing to

the contrary shall not apply to the extent that it may conflict with this viewing height requirement.

2. Furnish and install one slide-out/slide-in shelf or swing-out/swing-in shelf appropriate for the size and load of a laptop computer. This moveable shelf shall support the bottom of the laptop computer at a height between 3'-4" and 3'-8" above finished grade in front of the cabinet.
3. Furnish and install a paved pad in front of the control cabinet. This pad shall be of cement concrete, built in accordance with the sidewalk specification applicable to this project, approximately level, approximately 1" above the surrounding unpaved surface, or at even grade with the adjacent surface if paved. This pad shall abut the front of the cabinet, project at least 1' to each side of the cabinet and at least 3' in front. No pad is required if the front of the cabinet immediately abuts an existing or proposed paved sidewalk or other paved surface.
4. Both the firmware and software version in each timer unit shall be the same throughout the project, and shall be the latest version available on the market. In addition, the contractor shall promptly furnish to the owner and install all upgraded versions of both firmware and software through the last day of the inspection period, guarantee period or warranty period, whichever date is later.
5. The contractor shall furnish one cable with each new timer unit to connect a controller timing mechanism to a laptop computer. This cable shall have a termination at one end to match the controller. It shall have a termination on the other end to match the type of serial port found on laptop computers, usually DB9. This cable shall be wired to provide serial RS232C communication between the controller and the computer.
6. Payment for the work described above shall be deemed to be incidental to and included in the prices bid for various items of traffic signal work, and no additional payment shall be made for the work described above.

Controllers

The local traffic controller shall be capable of being operated in the full-actuated mode, in the free mode, and as semi-actuated in the coordinated mode. The controllers shall be keyboard entry, menu-driven unit mounted in eight-phase cabinets. The controller units shall meet all applicable requirements of the (N.E.M.A.) Standard Publication No. TS-2, Type 1, the Department's 1988 Standard Specifications and include the following as minimum requirements for the "Keyboard Entry Controller Unit."

- a. The Keyboard Entry Controller Unit must be type-tested and approved by the Department.
- b. The controller shall have hard-wire interconnect capability and internal time base coordination logic. The coordination control shall have the capabilities to operate as described under Sub-section 815.41 of the Standard Specifications.
- c. The controller shall have a data transfer/printer port for data transfer to another controller, printer, or laptop PC computer. A port shall be provided for uploading or downloading controller operating parameters from a laptop PC computer.
- d. The controller shall have a security code function.

- e. The controller unit shall have internal fire preemption control capabilities.
- f. The phase or phases selected for "call to non actuated" (C.N.A.) modes shall be determined as needed by keyboard entries.

The Contractor's attention is directed to Table 2, Required Signal Light Switching Assemblies, Section 815.41 of the Standard Specifications. The Contractor shall furnish the appropriate type and number of load switches and place unutilized load switches in the control cabinet for future use. Load relays shall be easily replaced using a screwdriver. Component relays requiring soldering are not acceptable.

In addition to the convenience outlet as described under Subsection 815.41, a lamp with an on/off switch shall be installed in the controller cabinet.

Bus Interface Units

The Bus Interface Unit (BIU) shall comply with Section 8 of the NEMA TS 2 Standard. The BIU shall be fully interchangeable with any other manufacturer's unit and interchangeable in a NEMA TS 2 Type 1 cabinet assembly.

The BIU shall perform the interface function between Port 1 at the controller unit, the malfunction management unit, loop detector rack assembly, and the backpanel terminal and facilities.

As a minimum, two LED indicators shall be provided on the BIU front panel. One indicator shall serve a dual use; as a power on indication and as a diagnostic indicator for proper operation of the device. The second indicator shall serve as a transmit indicator illuminating each time data is transmitted.

NOTE WELL: The contractor shall supply one additional spare BIU in each controller cabinet.

TS2 Cabinet Power Supply

A separate power supply shall be supplied and installed in each of the TS 2 cabinets. The unit shall be AC line powered and provide regulated DC power, unregulated AC power, a line frequency reference for the bus interface units, load switches, and other auxiliary cabinet equipment, as required. As a minimum, the power supply shall meet all requirements of Section 5.3.5 of the NEMA TS 2 Standard.

The power supply shall be either shelf mounted or wall mounted utilizing key hole slots for ease of replacement or installed as part of the rack assembly.

The unit shall contain four LED indicators on the front panel to indicate the four outputs; + 12 VDC +/- 1 VDC @ 2.0 amps, + 24 VDC +/- 2 VDC @ 2.0 amps, 12 VAC @ 250 milliamps, and 60 Hz line frequency reference. A test point terminal shall also be located on the units front panel for + 24VDC and logic ground testing.

Malfunction Management Unit

The malfunction management unit (MMU) shall comply with Section 4 of the NEMA TS 2 standard. The MMU shall be capable of operating as either a Type 16 with 16 channels (8 vehicle, 4 pedestrian, 4 overlap) or a Type 12 with 12 channels (8 vehicle, 4 overlap). The MMU's supplied shall be configured to operate as Type 16 units. The MMU shall be capable of supporting flashing yellow arrow operation.

The MMU's in either the Type 16 or Type 12 configuration shall be capable of operating in a NEMA TS 2 Type 1 cabinet or a NEMA TS 1 cabinet without loss of functionality.

Load Switches

Load switches shall comply with Subsection 6.2 of the NEMA TS 2 Standard. All load switches shall utilize optically isolated encapsulated modular solid-state relays. Discrete components on circuit boards are not acceptable.

Load switch indicator lights shall be LED-type and wired on the input side of the device.

Note: The controller cabinet assembly shall be initially supplied with a full complement of load switches to accommodate each available position of the backpanel.

Flasher

Flashers shall comply with Subsection 6.3 of the NEMA TS 2 Standard and be equipped with two output indicator lights which will show flashing power out to the cabinet assembly.

Flash Transfer Relays

Flash transfer relays shall comply with Subsection 6.4 of the NEMA TS 2 Standard.

The field electrical loading for flash operation shall be wired through the transfer relays such that the load on the 2-circuit flasher is as balanced as possible within the limitations of the signal phasing.

Note: The controller cabinet assembly shall be initially supplied with a full complement of flash transfer relays to accommodate each available position of the backpanel.

Testing of Grounding System

The Contractor shall perform testing of the equipment grounding system in the presence of the Engineer in accordance with the Standard Specifications. A ground rod shall be installed in each controller cabinet.

Video Detection System

The system shall also provide full motion video output showing zones highlighted during detection for fine-tuning. All hardware and software within the traffic signal cabinet shall be NEMA TS-2 compliant.

At the location shown on the plans, the Contractor shall supply and install a Video Detection System. A 9-inch (minimum) video monitor shall be provided for each of the locations for video detection diagnostic purposes. The major components of the Video Detection System are further described as follows:

- A. Prior to installation of the Video Detection System a detailed site survey shall be conducted by a factory trained and certified representative. The site survey shall ensure that the design of the camera, camera location, camera optics, and video/data interconnect is appropriate for the application.
- B. The supplier of the Video Detection System shall supervise the installation and testing of the Video Detection System and computer software. A factory certified representative from the supplier shall be on site during installation.
- C. The Video Detection System shall provide one National Television Standards Committee (NTSC) color composite video output.
- D. The Video Detection System shall provide a minimum of 20 detection zones. The system shall provide flexible, user configurable detection zone placement at any orientation within the field of view of the Video Detection System Camera. It shall be possible to overlap detection zones. It shall be possible to configure the Video Detection System to provide detection signals to the traffic signal controller which are comprised of Boolean combinations of detection zones.
- E. The Video Detection System shall provide failsafe operation whereby it places continuous vehicle calls to the traffic signal controller on all detection zones in the event it senses unacceptable video from the Video Detection System Camera.
- F. The Video Detection System shall include a configuring device and/or a Windows based computer software that provides for configuring the Video Detection System, viewing real time video, and updating the flash memory of the Video Detection System with updated application software.
- G. The Video Detection System shall provide count and presence detection performance with at least 96% accuracy under normal (day and night) conditions.
- H. The Video Detection System shall utilize FLASH memory to store the resident application software.
- I. The Video Detection System shall be comprised of a Video Detection System Camera, Video Detection System Cable, and Video Detection System Hardware.
- J. Video Detection System Cameras
 - 1) The Video Detection System Camera shall operate without degradation over a temperature range of -34 to 60 degrees Celsius at a relative humidity of 10% to 90% condensing.
 - 2) The Video Detection System Cameras shall be housed in a water resistant, dust proof NEMA-4 housing. The housing shall include a rear connector for connection of the Video Detection System Cable. The housing shall be field rotatable to allow for proper alignment between the camera and the traveled road surface.

- 3) The Video Detection System Cameras shall have a heater to prevent the formation of ice and condensation in cold weather and allow the camera to operate correctly while exposed to precipitation and direct sunlight.
- 4) The Video Detection System Cameras shall have a sunshield to protect the lens from direct sunlight and direct precipitation exposure.
- 5) The Video Detection System Cameras shall provide useable video and resolvable features in the video image when those features have luminance levels as low as 0.1 lux at night, and as high as 10,000 lux during the day. The Video Detection System Camera shall contain an automatic gain control (AGC) to provide a satisfactory image over the full range of light levels.

K. Video Detection System Cable

- 1) The Video Detection System Cable shall interconnect the Video Detection System Camera with the Video Detection System Hardware in the traffic signal control cabinet.
- 2) The Video Detection System Cable shall meet the design requirements of the Video Detection System Camera manufacturer, and shall be designed and manufactured specifically for the Video Detection System Camera supplied.
- 3) The Video Detection System Cable shall be capable of withstanding the rigors of outdoor environments, including all combinations of precipitation, heat and cold from -34 to 74 degrees Celsius, and direct exposure to sunlight without exhibiting any signs of deterioration over time.
- 4) The Video Detection System Cable shall be installed with a suitable drip loop to prevent the entrance of water into the housing.

L. Video Detection System Hardware

- 1) The Video Detection System Hardware shall operate without degradation over a temperature range of -34 to 74 degrees Celsius at a relative humidity of 10% to 90% condensing.
- 2) The Video Detection System Hardware shall include interface device(s) which shall be installed in the traffic control cabinet.
- 3) The interface device(s) shall be used to terminate the traffic controller cabinet end of the Video Detection System Cable.
 - a) The interface device(s) shall contain transient suppression devices for all signals transported on the Video Detection System Cable, including but not limited to video, data, and power.
 - The surge protector shall be electrically connected to the cabinet ground rod.
 - Surge protectors should have peak surge current protection of at least 10K amperes with a response time of less than 5 nanoseconds. The protector complies when a lab report from an independent test laboratory stating the product passes this specification is submitted with the shop drawings.
 - Units should be pre-approved or unconditionally warrantied for at least 10 years and certified to comply with the product's published specifications by an independent laboratory.
 - b) The interface device(s) shall contain a switch or shut-off mechanism that shall allow the user to turn off AC service to all components of the Video Detection System.

- c) The interface device(s) shall contain a connector for interfacing to a configuring device and/or a Windows based computer in the field for the purpose of configuring the Video Detection System, viewing real time video, and for updating the flash memory of the Video Detection System with updated application software.
- 4) The Video Detection System Hardware shall include all necessary cables for interconnection to the traffic signal controller, AC power service, a modem for transport of NTSC video to the traffic operations center, and a configuring device and/or a Windows based computer in the field.

Software

All computer system, controller, conflict monitor, and amplifier software shall be supplied with the latest available revision. Any software upgrades released by the manufacturer shall be supplied at no charge to the owner for a period of five years after acceptance of the work.

Data Base Programming

Each programmable local hardware component (controller, malfunction management unit, and detector amplifier) shall be initially programmed by the Contractor based on information contained on the plans. Three (3) sets of hard copy programming per device shall be supplied and stored in each controller cabinet.

Labels

All time settings, switches, harnesses, relays, terminals, and fuses shall be clearly and permanently labeled.

Surge Suppression for Traffic Signal Equipment

Wherever electronic traffic signal equipment is located (cabinets, cameras, etc.), each input & output should be surge protected except traffic signal outputs. Signal outputs from load switches do not need surge suppression since the load switches act as surge suppressors.

The surge protector must be electrically connected to the nearest grounded metal structure or nearest ground rod.

Surge protection for power service shall conform to the current NEMA TS-2 standard except surge capacity shall be 80 kA. The product complies when a lab report from an independent test laboratory stating the product passes the current NEMA TS-2(5.4.2.4) specification (with the additional surge capacity of 80 kA) is submitted with the shop drawings.

Surge protection for all video, loop, pedestrian button, and pre-emption connections should have peak surge current protection of at least 10K amperes with a response time of less than 5 nanoseconds. The product complies when a lab report from an independent test laboratory stating the product passes this specification is submitted with the shop drawings.

Units should be unconditionally warranted for at least 10 years.

Equipment Finish and Color

All traffic signal equipment, including, but not limited to, signal posts, bases, signal heads, visors (outside), mast arms, doors, pushbutton saddles, controller cabinet, service meter socket boxes, hardware, strapping, and rigid mounting brackets for signals and signs, shall be the color **Gloss Black**. This includes the metal strapping used to secure equipment to the mast arm and shaft. The inside of visors shall also be **Flat Black**. The interior of controller cabinets shall be the color white. The Contractor shall submit to the Engineer, Design Engineer (BETA Group), and Town of Billerica for approval, four (4) paint chips and sample finishes on steel of the intended color prior to any work being done under this heading. **See Ornamental specifications for Mast Arm Assemblies and Signal Posts at this location.**

Signal heads, doors, visors, mounting brackets, and hardware supplied direct from the manufacturer in the color stipulated above may be acceptable provided it meets or exceeds the finish process for the material indicated below:

1. Steel Equipment

Galvanizing

All bolts, screws, nuts, rods, and washers shall be galvanized in accordance with AASHTO M232 and the Standard Specifications. The hardened machine screws may be electroplate galvanized. Stainless steel studs, bolts, screws, nuts, straps, and washers shall not be galvanized. Galvanized hardware need not be painted; however, the ends of bolts, nuts, and washers shall be painted in the field according to section "Touch-up and Repairs." Immediately prior to galvanizing, the steel shall be immersed in a bath of zinc ammonium chloride. The dry kettle galvanizing process shall be used.

All steel components, other than above, shall be galvanized after fabrication in accordance with AASHTO M111. The galvanizing bath shall contain nickel (0.05% to 0.09% by weight) in accordance with Subsection 960.61 of the Standard Specifications.

Galvanized members requiring shop assembly shall be welded and drilled prior to galvanizing.

Coating over Galvanized Steel

Prior to painting, the applicator shall ensure that all components are smooth and without sharp protrusions that would present an injury hazard to pedestrians. Also, the fabricator shall ensure that all welds shall be thoroughly cleaned in accordance with good practice and according to AWD D1.5 and ASTM A123-89a and shall have a suitable surface to accept the galvanizing.

In preparation for the two coat painting system, the surface shall be blast cleaned in accordance with the requirements of SSPC-SP-7 "Brush-Off Blast Cleaning" or other method producing equivalent results and uniform profile, to achieve a 1.0 to 1.5 mils anchor profile as indicated by a Keane Tator Profile Comparator or similar device. The creation of the anchor profile shall be performed prior to the formation of "white rust" on the galvanized surface. Following blast cleaning, the zinc coating thickness shall be measured to verify that the coating thickness is in accordance with AASHTO M111.

A two coat painting system shall be applied by the Galvanizer in his own facility within twelve hours of galvanizing the steel components. If the two coat painting system cannot be applied by the Galvanizer within twelve hours of galvanizing, the Galvanizer shall bake the steel components at 375 degrees for two hours prior to SSPC-SP-7 "Brush-Off Blast Cleaning".

The prime coat material shall be a polyamide epoxy applied to minimum dry film thickness of 4.0 to 6.0 mils and force cured as given below for the finish coat.

The finish coat material shall be a two component, catalyzed aliphatic urethane applied by airless spray to a minimum dry film thickness of 4.0 mils.

The color shall be **Gloss Black**, as specified above. The fabricator shall submit to the Engineer for approval, paint chips of the intended color prior to any work being done under this heading.

All finish coat material shall be applied under conditions within the following tolerances:

- A. Air Temperature: 10°C min., 32°C max.
- B. Surface Temperature: 10°C min., 38°C max.
- C. Surface temperature must be at least 5°F above the dew point.

The finish coat shall be cured in a booth capable of maintaining 65°C for 2-4 hours.

Touch-up and Repairs

Should any damage occur to the galvanized coating during shipping or handling at the job site, the Contractor shall repair and touch-up any damaged areas to the satisfaction of the Engineer and the following:

Touch-up of galvanizing before the finish coat is applied shall be accomplished by applying galvanizing repair paint in accordance with Section M7.04.11. The dry film thickness of the applied repair paint shall not be less than 4.0 mils. Applications shall be in accordance with the manufacturer's instructions.

Field touch-up procedures shall conform to the recommendations of the Galvanizer. Touch-up of the finish coat shall be by applying a coating of a two-part urethane, as supplied by the Galvanizer, to achieve a dry film thickness of at least 4.0 mils. Prior to the application of the paint, remove all damaged coatings down to a solidly adhered coating and apply galvanizing repair paint as primer. Allow the primer to dry for at least 4 hours prior to top coating.

The Contractor shall also use the touch-up paint material and procedures to paint the galvanized hardware used in field erection that has not been finish coated previously.

2. Aluminum Equipment

All aluminum equipment called for shall have a powder coat finish **Gloss Black** in color. The coating shall be a polyester-TGIC (triglycidyl isocyanurat) resin system conforming to the following:

Quality	Test	Limits
Abrasion	Taber abraser CS-10, 1000 gram load, 1000 cycles, ASTM D4060	100 mg. maximum weight loss
Adhesion	ASTM D 3359 Initial 1000 hours	5A 5A
Gloss	ASTM D 523 15°C - 600 hours 15°C - 1000 hours	82% retention 90% retention (washed)
Hardness	ASTM D 3363	2H - No Gouge
Impact	ASTM D 2794 Direct	Pass 6.59 Nm
Salt Spray Resistance	ASTM B 177 ASTM D 1654 1000 hours unscribed 400 hours scribed	Table 2-10 Table 1-10
Weather Resistance	ASTM G 23, 1000 hours, 18 min. waterspray, 102 min. light	No film failure
Color	Gloss Black	
Identify	Infrared fingerprint	Match
Flexibility	180° bend; 13mm dia., mandrel within 10 seconds	No breaks, flaking or cracks. Tested with a Q-panel with 2 mils or less of coating
Humidity	ASTM D 2247, 1000 hours	No blister or film failure
Thickness		4 mils± 1 mils
Mar Resistance		Good

A Certificate of Compliance of the powder coating system is required for the Engineer's approval.

Mast Arm Structures

Mast arm structures at Location 1 and Location 3 shall be ornamental traffic mast arm signal poles, as detailed on the plans. Poles shall be the "Hancock" style as manufactured by Spring City Electrical Mfg. Co. or equivalent products by Millerbernd Mfg. Co. They shall match the ornamental street lights being provided under this Contract. The Ornamental Signal Post shall be suitable for supporting one or more signal mast arms as specified. No welding will be allowed at the site at the time of erection. All signal heads and signs on the mast arms shall be fixed mounted. Shoe type bases shall be used. Mast arm shafts shall be fitted with black cap and gold ball finneal for structures at Locations 1 and 3.

Mast arm structures at Location 2 shall be galvanized steel and shall conform to the provisions of M8.18.1. Mast arm structures shall be fabricated by the suppliers approved by MassDOT. Mast arm structures shall be monolever type. All signal heads and signs on the mast arms shall be fixed mounted. Shoe type bases shall be used.

Design shall be in accordance with AASHTO, "Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals." 6th edition with interims for a wind speed of 110 mph. AASHTO breakaway requirements shall not apply. Shop drawings and wind load

calculations shall be submitted and stamped by a professional engineer registered in the Commonwealth of Massachusetts.

Fabrication

The Fabricator shall be certified to AISC Fabricator Certified Quality Program. Proof of this certification will be required to ensure that the fabricator has the personnel, organization, experience, procedures, knowledge, equipment, capability and commitment to fabricate quality traffic pole structures.

Welding

All welding shall be in accordance with the American Welding Society (AWS) D1.1 Structural Welding Code. Tackers and welders shall be qualified in accordance with the code. Tube longitudinal seam welds shall be free of cracks and excessive undercut, performed with automatic processes, and shall be visually inspected. Longitudinal welds suspected to contain defects shall be particle inspected. All circumferential butt-welded tube splices are to be non-destructively tested.

Material Certifications

All structural steel materials are manufactured in the United States of America, and comply with the American Society for Testing and Materials (ASTM) specifications. Mill certifications are supplied as proof of compliance with the specifications.

Calculations

Calculations and detailed drawings shall be prepared and stamped by a professional engineer, registered in the Commonwealth of Massachusetts and shall demonstrate compliance with the AASHTO specifications. They shall include stress analysis on the mast arm, luminaire arm, pole, base plate, and anchor bolts. Maximum loads and stresses shall be determined for the most critical wind direction.

Pole Shaft

The pole shall be fabricated from coil or plate conforming to the requirements of Section M8.18.1 of the Standard Specifications. The pole shall be round in cross-section and has a constant linear taper of 0.14 in/ft and have 16 evenly spaced sharp vertical flutes. The shaft shall be one piece and contain no circumferential welded splices, and shall be a single ply (no laminated tubes). The pole shaft diameter and steel gauge shall be as required to satisfy AASHTO Standards. Each pole shall be provided with an end cap secured in place with set screws.

Signal Mast Arm

The mast arm shall be a “mounting plate” style with an uptilt as detailed in the contract documents and shall conform to the requirements of Section M8.18.1 of the Standard Specifications. The arm shall be round in cross-section and have a constant linear taper of 0.14 in/ft. All mast arms shall be manufactured and shipped in one piece with no circumferential welded splices and shall be of a single ply (no laminated tubes). Each arm is provided with a cast end cap secured in place with set screws.

Base Plate

Base plates shall conform to the requirements of Section M8.18.1 of the Standard Specifications. Plates shall be integrally welded to the tubes with a telescopic joint or a full penetration weld joint with a backing ring.

Anchor Bolts

Anchor bolts shall conform to the requirements of Section M8.01.5 of the Standard Specifications.

Decorative Cast Aluminum Base

The decorative base assembly shall be cast of 356 aluminum alloy and be a two-piece, vertically split design with a base diameter of 36 inches. The overall height of the base shall be 51 inches. The base castings shall be split vertically in half and bolted together forming a smooth and straight match between the halves. All hardware used to secure the vertically split base castings shall be stainless steel and sized so to provide proper securing strength. There shall be a cast aluminum access door in the middle section casting which shall be positioned opposite the hand hole located in the structural steel shaft.

Finish

The mast arm assemblies shall be finished as described for the decorative light pole, Item 823.93 included in these specifications.

Experience / Warranties

The pole manufacturer shall have been in the business of manufacturing traffic signal post products for the municipal street lighting market for a minimum of ten (10) years. The manufacturer(s) of the steel pole shaft assembly and cast aluminum base shall warrant that they will repair and replace product that fails due to structural defect or faulty workmanship within 5 years from date of shipment. Paint systems shall be warranted for a period of five years against peeling, cracking or excessive fading.

Traffic Signal Posts and Bases

All traffic signal posts at Location 1 shall be non-ornamental galvanized steel, painted gloss black, with the exception of 8-foot traffic signal posts which shall be ornamental, painted gloss black.

All traffic signal posts at Location 2 shall be non-ornamental galvanized steel, painted gloss black. Bases for posts shall be of the octagonal pedestal type, painted gloss black.

All traffic signal posts at Location 3 shall be ornamental, painted gloss black.

Ornamental Posts and Bases

Ornamental poles shall be the "Hancock" style as manufactured by Spring City Electrical Mfg. Co. or equivalent products by Millerbernd Mfg. Co. and King Luminaire. They shall match the Ornamental Street Lights being provided under this Contract. The Ornamental Signal Post shall be suitable for attaching and supporting one or more signals as specified. No welding will be allowed at the site at the time of erection.

Design shall be in accordance with AASHTO, "Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals." 2001 edition with interims for a wind speed of 110 mph with 3 second gust. Shop drawings and calculations shall be submitted, stamped by a professional engineer registered in the Commonwealth of Massachusetts. Pole manufacturer(s) shall submit written certifications and affidavits to qualify that all cast iron and steel materials, processes and associated labor related to the manufacture and supply of the light poles are in compliance with the "Buy America" provisions, as addressed in the contract specifications.

Fabricator

The Fabricator shall be certified to AISC Fabricator Certified Quality Program. Proof of this certification will be required to ensure that the fabricator has the personnel, organization, experience, procedures, knowledge, equipment, capability and commitment to fabricate quality traffic pole structures.

Welding

All welding shall be in accordance with the American Welding Society (AWS) D1.1 Structural Welding Code. Tackers and welders shall be qualified in accordance with the code. Tube longitudinal seam welds shall be free of cracks and excessive undercut, performed with automatic processes, and are to be visually inspected. Longitudinal welds suspected to contain defects shall be magnetic particle inspected. All circumferential butt-welded tube splices shall be non-destructively tested.

Material Certifications

All structural steel materials are to be manufactured in the United States of America, and comply with the American Society for Testing and Materials (ASTM) specifications. Mill certifications shall be supplied by the manufacture as proof of compliance with the specifications.

Each pole shall include the following major components:

1. Ornamental Base Section – The base shall be cast of ductile iron per ASTM A 536-84 and shall be of heavy wall construction with a minimum wall thickness of ½ inch. The base shall be a one piece “slip over” design and shall measure 24 inches in height with a diameter of 16 inches where it mounts to the foundation. A wiring access opening with cast ductile iron cover shall be located in the fluted portion of the base, opposite the hand hole in the steel shaft.
2. Fluted Pole Shaft – The steel pole shaft and base plate shall conform to the requirements of Section M8.18.1 of the Standard Specifications. The shaft shall be of monotube fabrication with a single longitudinal T.I.G. weld in accordance to AWG D1.1 standards. The pole shaft wall thickness shall be a minimum of 0.109 inches and satisfy the structural requirements of AASHTO as stated above. The shaft base diameter shall be 5.6 inches minimum, and shall taper down by a uniform .14 inches per foot. The base plate shall be attached by complete circumferential welds on both the inside and outside of the shaft. The shaft shall be dry formed over a mandrel into a cross section with sixteen (16) equally spaced straight, sharp and uniform flutes. Flutes shall taper out to a full round shaft section approximately one inch above the top of the base to insure a tight fit where the shaft enters the decorative base collar.
3. Pole Tenon Assembly – A tenon assembly consisting of a 4 inch diameter by 4 inch long stainless steel pipe for the Type LP1 poles. All tenons shall be welded to the top of the steel pole shaft. A decorative cast iron finishing ring shall be supplied with each pole shaft, designed to slip over the tenon and shoulder onto the top of the pole shaft.
4. Anchor Bolts – Shall conform to the requirements of Section M8.01.5 of the Standard Specifications. . The manufacturer shall note the anchor bolts yield strength on the shop drawings and structural calculations.

Finish

The signal posts and bases shall be finished as described for the decorative light pole, Item 823.93 included in these specifications.

Experience / Warranties

The pole manufacturer shall have been in the business of manufacturing traffic signal post products for the municipal street lighting market for a minimum of ten (10) years.

The manufacturer of the stainless steel pole shaft assembly shall warrant that they will repair and replace product that fails due to structural defect or faulty workmanship within 25 years from date of shipment. The manufacturer of the cast ductile iron pole base assembly be free from defects in material and workmanship under normal use and operation for 25 years. The definition of "normal use" includes damage resulting from motor vehicles traveling at posted speed limits colliding with the lamp post base. Paint systems shall be warranted for a period of five years against peeling, cracking or excessive fading.

Mast Arm Foundations

Mast arm foundations shall be a concrete cored foundation as shown on the Standard Drawings for Overhead Signal Structures and Foundations. The design of the foundation is detailed on the Traffic Signal Plans. Subsurface mast arm borings have been provided in the Appendix D for all designed foundations. Attention is brought to the foundation for Mast Arm 8 (MA-8) at Sta. 40+10.3, 32.8' RT which shall require coring into existing ledge until final foundation depth is obtained. This coring shall be considered incidental to lump sum of Item 815.1 and no additional compensation shall be provided.

The lower portions of all foundations shall be placed directly against undisturbed earth. No forms or reinforcing for foundations shall be set nor shall concrete be placed until the excavation has been inspected by the Engineer and his approval to proceed has been given.

The top of all foundations in sidewalk areas shall be located flush with finish grade. The top of each mast arm foundation shall not be exposed in the sidewalk.

Pedestrian Signal Heads

All pedestrian signal heads shall be mounted so that there is a minimum of 24 inches between any part of the housing or visor and the outer face of the curb. All pedestrian signal heads shall be aluminum, painted black.

Pedestrian signals shall be an approved single section 16 inch Light Emitting Diode (LED) type pedestrian signal head capable of displaying international symbols ("Hand/Person Walking" indications) as per the MUTCD with a countdown display.

Backplates

Backplates shall be aluminum non-louvered with a 5 inch border width and a 3 inch yellow retroreflective border. Only backplates that are listed in the latest MassDOT "Qualified Traffic Control Equipment List" will be used on this project.

Vehicle Signal Heads

All proposed vehicle signal heads shall be aluminum and painted flat black. When, in judgment of the Engineer, the visibility of existing or proposed signal faces will be obstructed by trees and other vegetation, the contractor shall clear the obstructions for proper sight distance. Any clearing necessary shall be done within the State, County, or Town layout, as directed by the Engineer.

LED Vehicle and Pedestrian Signal Modules

All signal and pedestrian displays shall be equipped with LED signal modules. All red, amber, green, and pedestrian signal housings with the exception of optically programmed and fiber optic housings and shall conform to the following where applicable:

- ITE's Vehicle Traffic Control Signal Heads – Light Emitting Diode (LED) Arrow Traffic Signal Supplement, Dated July 1, 2007
- ITE's Vehicle Traffic Control Signal Heads – Light Emitting Diode (LED) Circular Signal Supplement, Dated June 27, 2005.
- ITE's Pedestrian and Countdown Signal Modules Compliant to PTCSI - Part 2 Light Emitting Diode (LED), Dated, February 2011
- On the MassDOT Traffic Signal Approved Equipment List

For an LED module to be installed on this project, the LED module shall have approval from the MassDOT Traffic Control Products Approved Equipment Committee and be included on the Traffic Control Products List prior to the date of this proposal

To prevent the LED module warranty from being voided, the connecting leads on the module shall not be cut. The original LED module leads shall be connected to the signal head terminal block as continuous wire without splices.

The LED signal module will be replaced or repaired by the manufacturer if it exhibits one of the following:

- A failure due to workmanship or material defects within the first 60 months of field operation.
- A greater than 40 percent light output degradation or a fall below the minimum intensity levels (as defined by the latest ITE performance specifications) within the first 36 months of field operation

Pedestrian Pushbutton with Sign and Saddle

Pedestrian pushbutton controls shall be raised from or flush with their housings and shall be a minimum of 2 inches in the smallest direction. The force required to activate the controls shall be no greater than 5 pounds.

Pedestrian pushbuttons shall be an accessible pedestrian type in accordance with Section 4E.09 of the 2009 MUTCD and shall include a red LED confirmation light, locator tone, vibrotactile pushbutton, audible message capability and an instructional panel. Pushbuttons shall be located according to the plans and in conformance with Fig 4E-4 of the 2009 MUTCD, with arrow pointed parallel to the crosswalk being controlled. If two crosswalks, oriented in different directions, end at or near the same location, the positioning of pedestrian pushbuttons and/or legends on the

pedestrian pushbutton signs shall clearly indicate which crosswalk signal is actuated by each pedestrian pushbutton. Pushbuttons shall be separated by a minimum 10 foot distance per MUTCD Fig 4E-3.

Mounting height shall be approximately 42 inches above the finish grade, but not more than 48 inches, in accordance with section 4E.08 of the MUTCD.

Wiring and Service Connections

Traffic signal cable shall be of Type 2, #14 AWG stranded, 10-conductor minimum meeting the requirements of IMSA Specification 20-1, except for mast arm and /or span wire traffic signal cable, which shall be Type 2, #14 AWG stranded, 5-conductor minimum meeting the requirements of IMSA Specification 19-1. All systems shall have a minimum of one (1) 10-conductor cable for each vehicle phase, overlap phase, and pedestrian phase for controller outputs to field wiring required by the timing and sequence plan. A minimum of a five (5) spare conductors shall be provided in the base of each signal post and mast arm. Openings, where cables enter the base of a cabinet, shall be sealed with an approved elastic sealing compound. The open ends of conduits entering or leaving mast arms, posts, and pull boxes shall also be sealed with the approved elastic sealing compound.

The work for service connections shall consist of furnishing and installing all materials and equipment to deliver power to the traffic signals and related electrical systems.

Optical Emergency Preemption System

The work consists of furnishing and installing optical traffic signal preemption systems ready for operation, as described herein and shown on the plans. Included in the work is the furnishing and installing of traffic signal preemption unit and related equipment, optical detection equipment and all necessary connections to the traffic signal controller. The emergency preemption system equipment shall be included in the latest version of the MassDOT Qualified Traffic Control Equipment List and shall be compatible with the Town of Billerica's emergency preemption system.

The emergency preemption system shall consist of a data-encoded phase selector to be installed within the existing control cabinet. This unit will serve to validate, identify, classify, and record the signal from the optical detectors located on support structures at the intersection. Upon receiving a valid signal from the detector, the phase selector shall generate a preempt call to the controller initiating a preemption operation as shown on the plans.

The phase selector shall be a rack-mounted plug-in two channel, dual priority device. Programming the phase selector shall be via a PC-based computer utilizing unit specific software. One copy of software on a disk shall be supplied and licensed to the Town as part of this contract. A hard copy of final programming data shall be left in the control cabinet. The Contractor shall supply a complete set of interface cables for phase selector to laptop connection.

Emergency vehicles equipped with optical energy emitters transmit optical energy impulses to optical detectors mounted at the intersection. When optical energy impulses are received at the intersection, control of the signals shall transfer from the local controller to show a selected display shown on the plans to assist the vehicle through the intersection without conflict. After the vehicle

has passed through the intersection, control of the signals shall then return to the local controller which shall restore the appropriate timings that were in effect prior to preemption.

1. **General Operation and Description of Work**

The following description of work specifies the responsibilities involved in the installation of optical preemption equipment.

The Contractor is required to supply material and labor (required or shown) for the complete installation of optical preemption equipment at the specified location in this project. Intersection preemption equipment required includes optical detectors, phase selectors, card rack, preemption indicator lights, cable, interfacing of preemption equipment to the local controller, making electrical connections, and all required incidentals.

The following are the operational requirements of the optical preemption system:

- Operating sequence, as specified, shall be initiated when detector receives optical energy of the required repetition rate from an emitter.
- Detector shall transform the optical energy signals into electrical signals and transmit the electrical signal to the phase selector for processing.
- Phase selector shall cause the local controller to show a selected display identical to one of the color interval displays normally available in the controller which will assist the emergency vehicles through the intersection without conflict.
- Phase selector shall allow the controller to release from hold and resume normal operation after optical energy signals are lost provided the desired green display has already been obtained.

Detector cable for optical preemption equipment shall meet specifications of the system manufacturer.

2. **Installation**

The preemption equipment manufacturer shall be responsible for preemption system design and documentation.

Preemption System Design and documentation shall include the following:

- Provide the installing agency with locations for detector installation. Suggested detector locations are shown on the plans and may be changed to improve the operation. Notice shall be given to the Engineer prior to any change.
- Provide the controller manufacturer, Engineer, and owner with electrical diagrams.

The installer shall install the equipment consistent with the preemption equipment manufacturer's recommended installation procedures and electrical diagrams in a neat and workmanlike manner.

The preemption equipment manufacturer shall be responsible for operational checkout of the specified preemption functions prior to final acceptance and approval by MassDOT.

Operating checkout includes the following:

- Verifying that the preemption system is properly installed as per the preemption manufacturer's recommendations and the electrical diagrams as provided by the preemption equipment manufacturer.
- Verifying that the priority system timing and range are properly set. Preemption equipment warranties are put into effect.
- Instructing the vehicle drivers or their representative(s) in the operation of the preemption system.

3. **Warranty**

All components of the preemption system specified herein shall be warranted by the manufacturer to be free of defects in materials and workmanship for a period of two years from the date of delivery or one year from the date of installation, whichever occurs first.

The Contractor shall repair or replace, free of charge to the Town of Billerica or MassDOT, any part that fails in any manner during the warranty period, and 12 (twelve) months after final acceptance of the project by the Owner.

Preemption Indicator Light

A preemption indicator light shall be provided and mounted as shown on the plans. It shall be located in a position where it may be visible from all preemption approaches to each intersection. The light shall be weather tight and consist of a clear (white) strobe which shall be illuminated whenever the controller is in the emergency preemption phase. The indicator light shall meet ITE, NEMA, IMSA, and MassDOT standards.

Pushbutton Fire Preemption

The plans call for pushbutton fire preemption panels in three locations at the Billerica Fire headquarters on Good Street: two in the main vehicle bay, and one in the ambulance bay.

For each panel, two pushbutton actuators shall be installed in a NEMA enclosure, as shown on the plans. One pushbutton shall be red; the other pushbutton shall be black. Both pushbuttons shall be the "mushroom" type. The red pushbutton shall be labeled "*Start*" and call Phase 4 at the intersection. The black pushbutton shall be labeled "*Terminate*" and provide early termination of Phase 4. When called, Phase 4 shall be assigned the highest priority preemption mode and shall override all other modes of operation (normal and other preemptions).

The words "*Start*" and "*Terminate*" shall be permanently engraved into separate metal plates. The background of the engraved letters shall be the color red for "*Start*" and black for "*Terminate*." The plates shall be permanently attached to the NEMA enclosure above each respective pushbutton. The words "*FIRE PREEMPTION*" shall also be permanently engraved into a single metal plate and attached to the NEMA enclosure. The background of the engraved letters shall be the color red.

Three pilot lights shall be furnished and installed in the preemption panel to indicate what interval Phase 4 is in during the preemption mode. The top pilot light shall be red, the middle pilot light amber, and the bottom pilot light green. All pilot light bulbs shall be high intensity. Bulbs shall be

easily replaced without the need for special tools. Three (3) spare pilot light bulbs shall be provided prior to final acceptance of the project. The red pilot light shall be illuminated when the intersection is in normal operation (i.e., out of Phase 2).

The operation of each pushbutton and pilot light shall be as follows:

Red Pushbutton - Activation of the red pushbutton shall call Phase 4 into operation and suspend normal controller operation at the intersection, provided the minimum green has been serviced for the active normal phase(s). The red pilot light shall blank out and the amber pilot light shall illuminate, confirming yellow and red clearance periods at both intersections. At the completion of the clearance periods, the controllers shall proceed to Phase 4 and begin timing the maximum green. The amber pilot light shall blank out and the green pilot light shall illuminate, confirming the signal is in Phase 4 green. At the end of the Phase 4 maximum green period, the controllers shall proceed to the clearance period. The green pilot light shall blank out and the amber pilot light shall illuminate. The controller shall return to normal operation, the amber pilot light shall blank out, and the red pilot light shall illuminate.

Black Pushbutton - Activation of the black pushbutton shall immediately terminate Phase 4 maximum green, provided the minimum green for Phase 4 has been served. The controllers shall then begin yellow and red clearance periods, terminate the green pilot light, and illuminate the amber pilot light, confirming the yellow clearance period for Phase 4 has begun. At the completion of the clearance periods, the controllers shall proceed to normal operation and illuminate the red pilot light, confirming the preemption mode is out of operation. The purpose of the black button is to allow early termination of the Phase 4 timing at the fire station prior to reaching the maximum green time setting. Phase 4 shall always service the minimum time setting before returning to normal operation.

The Contractor shall furnish and install the pushbutton preemption panel in the fire station and ambulance bay at locations as directed by Billerica Fire Department personnel. The Contractor shall also furnish and install all wiring and conduit, from the controller cabinets to the pushbutton preemption panel via wireless contact closure transceiver and antenna, and make all necessary electrical connections to provide a fully operational pushbutton preemption system.

Wireless Contact Closure Transceivers and Antennas

The wireless contact closure transceiver shall provide bi-directional wireless I/O capabilities for point-to-point, point-to-multipoint, and multipoint-to-point applications. The unit shall operate in the 900 MHz and/or 2.4 GHz license free frequency band and shall utilize spread spectrum modulation with frequency hopping. The unit shall provide 8 channels of input and 8 channels of output. The unit shall be capable of operating in the following modes: Base, Repeater, Remote, and Remote/Repeater. The unit shall employ cyclic redundancy checking error detection and be capable of retransmitting data when an error occurs. The unit shall be capable of operating with three timing modes: low-latency, normal, and long-distance. The unit shall have front panel indicators for power, input, output and link.

The wireless contact closure transceiver shall be a shelf or wall mount unit and shall operate at 12 or 24 VDC.

NOTE: The contractor shall propose the antenna type and location so as to provide the most reliable operation. The contractor shall submit, as shop drawings, cut sheets for the proposed equipment and 20-scale sketches depicting the location of each proposed antenna.

Managed Fiber/Ethernet Switch

The Contractor shall furnish and install a Fiber/Ethernet switch in the traffic signal control cabinet for future connection to Town-owned fiber optic cable. The module shall support the Ethernet data IEEE 802.3 protocol using Auto-negotiating and Auto-MDI/MDI-X features. The module shall feature eight 10/100TX RJ-45 ports and three 100/1000FX SFP ports. The module shall require no in-field electrical or optical adjustments or in-line attenuators to ease installation. The module shall provide power, link speed, and fiber port status indicating LED's for monitoring proper system operation. The module shall have redundant power supply connections to minimize single point failure. The module shall provide a serial connection for local management of the device as well as a web-based configuration and management interface hosted on the device. The module shall have a lifetime warranty to reduce system life cycle cost in an event of a module failure. The switch shall be installed in the cabinet as shown on the plans and or as directed by the Engineer.

The Fiber/Ethernet switch shall be of rugged design and suitable for reliable operation when mounted in the configuration as specified.

The Fiber/Ethernet switch shall include all software required for monitoring and updating the Fiber/Ethernet switch.

The Fiber/Ethernet switch shall support the following IEEE Networking Standards:

1. IEEE 802.3 10Base-T Ethernet
2. IEEE 802.3u 100Base-TX Fast Ethernet
3. IEEE 802.3ab 1000Base-TX
4. IEEE 802.3z Gigabit Ethernet Fiber
5. IEEE 802.3x Flow Control and Back-pressure
6. IEEE 802.1p class of service
7. IEEE 802.1Q VLAN and GVRP
8. IEEE 802.1D-2004 Rapid Spanning Tree Protocol (RSTP)
9. IEEE802.3ad LACP
10. IEEE802.1X Port based Network Access Control

The switch shall provide the following switch performance:

1. Switch Technology: Store and Forward Technology with 32Gbps Switch Fabric.
2. System Throughput: 14,880pps for 10M Ethernet; 148,800pps for 100M Fast Ethernet; 1,488,100 for Gigabit Ethernet
3. Transfer Packet Size: 64 bytes to 1522 bytes (with VLAN Tag)
4. MAC Address: 8K MAC
5. Packet Buffer: 1Mbits
6. Relay Alarm: Dry Relay output with 1A@24V ability

The Contractor shall supply, install, and test all Ethernet cables required to make all connections in the cabinet.

The Fiber/Ethernet switch shall be an Ethernet layer 2 device.

The Fiber/Ethernet switch shall have a switching method of store and forward.

The Fiber/Ethernet switch shall support the following protocols:

- RTP/ID
- TCP/IP with full multicast support
- DNS
- DHCP

The Fiber/Ethernet switch shall support the following network management protocols:

- SNMP V2c
- RMON for Ethernet agent
- Telnet/TFTP

The Fiber/Ethernet switch shall have an operating temperature range of -40 degrees to +74 degrees C.

The Fiber/Ethernet switch shall have a power usage of +12VDC to +24 VDC at 1 amp.

This shall be provided by a plug-in type AC adapter supplied with the unit.

The Fiber/Ethernet switch shall include all accessories required for complete operation of the unit, including Ethernet cables, fiber optic patch cables, power adapters, and mounting hardware, as a minimum.

The Contractor shall supply all necessary cables and power supply to ensure a working installation.

Battery Backup System

The system shall monitor 120VAC input from the electric utility source and automatically switch to/from a system consisting of batteries and electronics mounted in a single enclosure mounted on the side of the proposed traffic signal controller cabinet. The typical traffic controller will be NEMA TS2 with LED field displays for vehicles and pedestrians. Traffic system components to be powered will also include video monitoring camera system, emergency preemption and communication electronics.

Wiring of appropriate size shall be provided to/from the traffic controller. The battery backup system shall not be wired to street lighting circuits. A maintenance bypass switch shall be included to allow operation of the traffic signal system while repairs are made to the battery backup system. The battery backup system shall regulate the voltage provided to the traffic signal control cabinet.

The battery backup systems shall be designed and constructed to provide a minimum of four (4) hours of continuous power at 77 degrees F.

The battery backup system equipment shall be plug connected and shelf mounted.

The battery backup system shall have external control and communications capabilities via Ethernet interface.

The battery backup system shall have a manual generator transfer switch and receptacle to provide emergency portable generator power to the traffic controller during extended power outages.

The battery backup system shall be designed to operate over a temperature range from -30F to +165F and shall include a surge suppressor wired to the input from utility power.

Wiring diagrams and manuals shall be supplied for all equipment installed as part of the Battery Backup System. Documentation shall involve instructions for set up and troubleshooting of all components in the Battery Backup System.

The battery backup system shall be warranted by its supplier for two (2) years from the date of delivery.

Fine Tuning, Testing and Adjustment Period

After the Contractor has finished installing the controller and all other associated signal equipment to operate as specified in the contract documents, the fine tuning, adjusting and testing period shall begin. During this period, the Contractor, under the direction of the Engineer, will make necessary adjustments and tests to insure safe and efficient operation of the equipment. This completion date has taken this testing period into consideration. No request for final acceptance will be considered until successful completion of the testing period.

Guarantee After Final Acceptance

The Contractor shall diagnose (trouble-shoot) the system and, at his own expenses replace any part of the traffic signal control equipment found to be defective in workmanship, material or manner of functioning within six months from date of final acceptance of all the installations under this Contract. This requirement does not affect the one-year warranty period on equipment specified in Subsection 815.20 of the Standard Specifications.

Upon the date of acceptance of the project by MassDOT, the Contractor shall turn over all guarantees and warranties to MassDOT, where applicable.

Record Traffic Signal Layout Plans

It is the responsibility of the Contractor to provide electronic Record traffic signal layout plans indicating all changes made during construction. The plans shall indicate the location of traffic signal equipment retained, removed and reset, and installed, including detectors, signal posts, mast arms and/or strain poles, pedestrian and vehicular signal heads, controller cabinets, conduit, pull boxes and service connections. The plans shall also indicate the final field timing and sequence, major items list, power-pole number, and meter number. Electronic Record plans shall be provided in accordance with MassDOT signal inventory standards, including electronic picture files, one for each approach to the signal.

Miscellaneous Requirements

The actuated controller shall have capability to preempt to a preselected phase by external command. Because this is often overlooked, the Contractor's attention is drawn to the requirements of Subsection 813.60C, Splicing, relative to four optional methods of splicing in signal bases, Subsection 813.40C, Ground Electrodes, relative to Requirement 1 - Connection to a Water Piping System, and Subsection 813.61, Equipment Grounding.

All anchor bolts and bolts for holding hand hole and access covers shall be greased at the time of installation.

All proposed conduit shall be 3 inch Type NM, plastic conduit unless otherwise specified. 3 inch conduit shall be paid for under Item 804.3 and shall not be included in the lump sum bid price for Item 815.

The Contractor shall make all necessary arrangements with the electric company for the service connections or for any main power cut off when necessary, and bear all charges incurred thereby.

Basis of Payment

The lump sum price bid for Item 815. shall constitute full compensation for all labor, materials, and equipment necessary or incidental to the installation of a complete intersection traffic control signal system functioning as specified and as shown, including excavation and backfill, traffic signal post foundations, service connections and all charges therefore, except for the 3 inch electrical conduit, Type NM Plastic (UL), which will be paid for under Item 804.3. Pull boxes will be paid for under Item 811.31. Fiber/Ethernet switch shall be paid as a non-participating item under Item 815.11.

ITEM 823.60

HIGHWAY LIGHTING LOAD CENTER

LUMP SUM

The work to be done under this Item shall include, but not be limited to, the installation of all electrical wiring and cabling for the entire load center system, meter sockets, electrical metering, control cabinet, distribution panels, circuit breakers, GFI receptacles (where specified), foundations, appropriate grounding all in accordance with the applicable provisions of Sections 813 and 820 of the Standard Specifications. This Item shall also include conduit, cabling and related fees to provide an underground service connection to the National Grid.

The Contractor shall obtain all necessary permits and licenses, file necessary plans, and pay all fees for permits and inspections. Permit fees are the responsibility of the Contractor as part of his bid.

SUBMITTALS

List of materials and equipment requiring shop drawings shall include:

1. Rigid Conduit
2. Panelboards, Time Clock
3. Service Cabinets and Equipment

4. Meter Sockets
5. Disconnect Switch
6. Circuit Breakers
7. Wiring Devices and Receptacles

MATERIALS

Materials and products furnished shall be designed for the intended use, shall meet all requirements of the latest edition of the National Electric Code (NEC), and all local codes.

Materials shall be manufactured in accordance with the standards indicated in this Section, and typical industry standards and codes for the products specified. Materials and equipment shall be Underwriter's Laboratory (UL) listed.

The materials used shall be new, unused, and of the best quality for the intended use. All equipment shall have the manufacturer's name, address, model or type designation, serial number and all applicable ratings clearly marked thereon in a location which can be readily observed after installation. The required information should be marked on durable nameplates that are permanently fastened to the equipment.

Electrical equipment shall at all times during construction be adequately protected against mechanical injury or damage by water. Electrical equipment shall not be stored outside exposed to the elements. If any equipment or apparatus is damaged, such damage shall be repaired at no additional cost, or replaced at no additional cost as directed by the Engineer.

Wire & Cable

Unless otherwise noted, conductors for power, lighting, and grounding *above grade* shall be No. 12 through No. 6 AWG, NEC type THWN/THHN, meeting the requirements of UL 83. Conductors for power and lighting shall be no smaller than No. 12 AWG.

All conductors shall be annealed copper, 98% conductivity, Class B stranded, except conductors used for power and lighting circuits No. 10 AWG and smaller which may be solid. All conductors should be rated for 600 volts or less, with a thermal rating of 90° C.

The outside covering of all wiring for power, lighting, grounding, and control uses shall be color coded to identify polarity as follows:

<u>Phase</u>	<u>Color</u>
A or 1	Black
B or 2	Red
C or 3	Blue
Neutral	White
Equipment Ground	Green

Raceways (Conduit)

Rigid Metallic Conduit: UL6 and ANSI C80.1.

Flexible Metallic Conduit: UL1. Liquid tight flexible metal conduit shall be used in wet locations.

Minimum size of conduit shall be 3/4". Unless indicated on Drawings, conduit sizes can be sized in accordance with National Electric Code (NEC). Conduit bends shall not have kinks or flats, and shall not be less than standard radii.

Rigid Galvanized Steel (RGS) conduit shall be used for all power, control signal, and instrumentation wiring, except where noted. Conduit shall be fully threaded at both ends and each length shall be furnished with one threaded coupling.

Conduits shall be made electrically continuous at coupling and connections to boxes and cabinets by means of joining fasteners or copper bond wires. Conduit shall be connected to grounded structural steel or the ground network. After assembly all conduit locknuts, all EMT coupling fittings, and all bond wire screws shall be set up tight before installation of wiring. Insulated metallic bushings shall be used on all conduits entering panel cabinets, handholes, and wiring gutters, except on branch lighting circuits.

Expansion fittings shall be provided on all conduits as required by the latest National Electrical Code, and as required by local and state codes. This includes, but is not limited to, vertical conduit risers coming from below-grade.

Boxes

Outlet and Switch Boxes: NEMA OS 1.

Pull Boxes, Junction Boxes, and Equipment Enclosures: NEMA ICS 6.

Handholes, junction boxes, and equipment enclosures shall be of NEMA Type 1 construction for indoor use, and NEMA Type 3R construction for outdoor or wet location use, unless otherwise noted.

Box sizes shall not be less than that required by the Massachusetts Electrical Code.

Wiring Devices

Wiring Devices: NEMA WD 1mm. They shall be specification grade, 20 ampere, ivory with Type 302 stainless steel plates. Ground fault current interrupter (GFCI) devices shall be provided where specified and/or required by applicable codes.

Panelboards

Panelboards: NEMA PB1, and UL 67. They shall be door-in-door construction with copper bus. Circuit breakers shall be molded case, thermal magnetic, bolt-on type rated as noted, and rated to match panelboard voltage and interrupting rating (22kA minimum). Circuit breakers should be capable of accepting up to #4 AWG wiring.

Panelboard to be 100A, 1-phase, 120/240V with circuit breaker minimum quantities as shown on Contract Drawings. Provide 200A/2Pole main circuit breaker in panel, and sufficient breakers for lighting circuits and receptacle in cabinet.

Meter Sockets

Meter Sockets: UL 414, UL 486B, and ANSI C12.7.

Outdoor meter sockets are to be NEMA 3R, and have vandal-proof covers to protect utility kWh meters (if specified). Unless otherwise noted, meter sockets shall be ringless, with lever bypass, tin plated connections, and have provision for a fifth terminal on single-phase applications.

Meter Socket shall be either heavy duty or medium duty, 100 ampere, ringless, 5 terminal, with approximate dimensions of 19”H x 13”W x 5”D. (Milbank U9319-XL, Eaton, Square-D or Brooks Manufacturing or approved equal). Socket to meet local utility requirements.

Load Center Cabinets

Provide outdoor NEMA 3R Highway Lighting Control Center Cabinet. Contractor to size cabinet to coordinate with sizes of panelboard and equipment to be installed within cabinets. Dimensions shown are typical and are for reference only. Cabinet to include all equipment shown or implied and all equipment shall be installed inside of cabinet without physical conflicts and per NEC. Cabinet to be sized for all necessary conduits, whether active, spare or future as listed on panelboard schedules.

Cabinets to be manufactured from 14 gauge minimum stainless steel with 12 gauge steel panel, mounted inside. Cabinets to have integral keyed locking mechanism, keyed alike, with provision for pad-lock. Cabinets shall be ventilated type and **factory painted black powder-coat**. Cabinets to have door hold-open latches. .

Provide outdoor-rated 100A meter socket mounted on the side of the cabinet to meet local utility requirements. Meter socket to be 100A, 120/240V, 10kA minimum AIC, NEMA 3R.

Provide the following internal components:

- Duplex GFCI receptacle, white, 20A, with stainless steel cover
- SPST switch, rated 120V, 20A for internal light switch
- Cabinet light
- 120V, 75W incandescent light fixture in ceramic socket inside of cabinet
- On/Off/Auto selector switch, rated 120V, 10A in NEMA 1 enclosure (2 total)
- Time Clock, 120V, SPST, 20A in NEMA 1 enclosure, with 365day 24/7 astronomical digital time. (for GFI’s)
- Lighting contactor, 6-pole, 30A, 240V rated, with 120V AC 10A minimum coil (2 total)
- Photocontrol, 120V, mounted through internal viewing window or drilled hole.
- Thermostat, 120V line voltage control, with 500W, 120V strip heater mounted inside of cabinet.
- Thermostat, 120V line voltage control with 100CFM exhaust fan mounted in cabinet.
- Louver in door with air filter.

Load Center Cabinet to be installed on new concrete foundation 18 inches above finish grade as shown and as directed. Contractor responsible for coordinating foundation dimensions to be 6-inches wider than cabinet. Furnish and install a paved pad in front of the control cabinet. This pad shall be of cement concrete, built in accordance with the sidewalk specification applicable to this

project, approximately level, approximately 1" above the surrounding unpaved surface, or at even grade with the adjacent surface if paved.

EXECUTION:

This section covers the requirements for installation of materials, proper workmanship, testing, cleaning, grounding, and work methods to be followed by the Contractor. This Section also includes specific instructions and to be used in conjunction with the contract Drawings. Any discrepancies noted between the specification, Drawings, and actual installation shall be reported immediately. Failure on the part of the Contractor to report discrepancies immediately will be considered negligent.

Work will be coordinated such that systems can be properly located, and conflicts and delays are avoided.

Materials and Workmanship

The Contractor's work shall be executed in workmanlike manner and shall present neat, rectilinear and mechanical appearance when completed. Material and equipment shall be new and installed according to manufacturer's recommended best practice so that complete installation shall operate safely and efficiently.

Testing, Inspection And Cleaning

The Contractor will test wiring and connections for continuity and grounds before fixtures are connected; demonstrate insulation resistance by megger test as required at not less than 500 volts. Insulation resistance between conductors and grounds for secondary distribution systems shall meet National Electrical Code (NEC) requirements.

Grounding

The Contractor shall ensure bond and ground equipment and systems connected under this Section are in accordance with standards of the NEC and other applicable regulations and codes.

The Conduit system shall be electrically continuous throughout, grounded at service entrance. Equipment frames, enclosures, boxes, etc. shall be grounded by use of green-jacketed (or bare copper) ground, sized as per Table 250-95 of the NEC.

Green bonding jumper shall be installed in flexible conduits.

Copper fittings for ground connections shall conform to the requirements of ASTM B 30. All bolts, u-bolts, cap screws, nuts, and lock washers for copper fitting shall be of approved corrosion-resisting material.

Ground Rods shall be 5/8" diameter and 10' in length, solid copper as required by applicable codes (NEC, NESC). Bonding connections to ground rods shall be permanent, welded or crimped, with copper connectors. All wire used for grounding shall be no smaller than #4 Awg copper, stranded conductor.

Contractor to provide two (2) 5/8" x 10'-0" copper ground rods, to be installed around the base of the new metering cabinets. Grounding to be installed per installation detail.

Electrical Service Conduit Installation

Conduit sweeps at metering cabinet shall be rigid galvanized steel (RGS), 24" minimum radius (as required by Utility). Provide 3-conductor, #1/0AWG 600V service cable with ground to utility transformer for new 100A service to metering cabinet.

Load Center Cabinet Installation

Contractor to provide new outdoor NEMA 3R stainless steel Highway Lighting Control Center Cabinet (factory painted color: black), with 100 amp, 5 terminal, meter socket mounted on the side of meter cabinet as indicated on the Drawings. Contractor to coordinate the incoming underground 100-amp service from the utility to the new Highway Lighting Control Center Cabinet. **Cabinet must be painted black by manufacturer**, as field painting is not acceptable.

Contractor to provide a 12-inch layer of 3/4" crushed stone (M2.01.4) under the foundation for drainage.

The street lighting cabinets will require temporary service connection if new undergrounding service connection location as shown on the plan is not ready. Temporary power shall consist of a 3" NM Schedule 80 conduit to the closest adjacent existing wooden utility pole with available electrical secondary cables. Contractor shall provide secondary cabling for 100A, single phase, 120/240V three-wire service from utility pole riser to consist of 3W#1/0AWG with #4AWG ground, type XHHW-2 600V power cable. Contractor shall install steel 3" riser pole conduit per local utility requirements. Contractor shall feed meter socket on Electrical Cabinet, while providing provision for future underground service connection from new infrastructure as shown on Contract Drawings. Contractor shall provide all materials and labor and installation for a complete functional electrical service without any additional compensation.

COMPENSATION:

Payment made under this Item shall be at the Contract Unit Price bid per each, which sum shall include all labor, materials, concrete foundation, equipment required to furnish, install and test, complete in place and operational, the load center as specified herein. This price shall include associated electrical components, temporary service connection, miscellaneous hardware, service connection and 3 inch rigid steel conduit required for the service connection. It shall also include furnishing and installing all wiring (Wire type 7 #6-12) and related connections, splices and hardware, ground rods, and incidental labor and equipment to complete and make operation the entire related lighting and outlet system. Payment shall include the provision of pole risers for services connections and the provision of 3' x 4' Concrete pad as detailed on the plans.

No additional compensation will be made to National Grid fees or charges. Contractor shall be responsible for all charges and fees assessed by National Grid.

ITEM 823.72 LIGHT POST REMOVED AND RESET EACH

All work shall be done in accordance with the relevant provisions of the Standard Specifications.

The Contractor shall notify the owner before starting any work. The work shall include disconnecting the wiring, removing the light post, providing and installing new conduit, new cable (splices will not be acceptable), making all connections as required and resetting the light post on new foundation. The size of the new foundation shall be the same as the existing foundation.

Payment for Item 823.72 shall include all work necessary for removing and resetting the light post, foundation, wiring, complete in place including all necessary or incidental materials and labor.

ITEM 823.73 COBRA HEAD LIGHT REMOVED AND RESET EACH

Work under this item shall be done in accordance with to the relevant sections of Standard Specifications Section 820 and the following:

Contractor shall remove and reset cobra head light from relocated utility poles. Contractor shall coordinate with the utility company prior to relocation.

METHOD OF MEASUREMENT AND BASIS OF PAYMENT

Payment for work under this Item shall be at the contract unit price, per each which price shall be full compensation for labor, materials, equipment, tools, and other incidentals necessary to satisfactorily complete the work.

ITEM 823.82 FLAG POLE REMOVED AND RESET LUMP SUM

Work under these Items shall conform to the relevant provisions of Section 800, supplemented and amended as follows:

This work shall consist of removal and resetting of existing tapered aluminum flagpole including, temporary storage, disassembling and reassembling, backfilling, excavation, disposal of old foundation and excess material, installation of concrete footing and providing necessary fittings, hardware, and flag, as shown on the plans or as directed by the Engineer.

Contractor shall supply manufacturer data sheets for the flagpole and shop drawing showing the foundation design for the flagpole based on height and flag size.

Install flagpole where shown on the plans in accordance original manufacturer's written instructions approved shop drawings and these specifications. Flagpole shall be true and plumb with the cleat located in the prevailing wind direction. Maximum variation from true vertical shall be within one inch of true vertical, measured at top of pole, in 3 directions.

Payment shall be at the Contract Unit Prices bid per Lump Sum for removing and resetting flagpole, removing existing concrete foundation, all excavation, installing new foundation, base plate, lighting protection, wedges, shims, providing new halyard, cleat, finial, snap hooks etc. as needed, complete in place including sawcutting, excavation, concrete support, compacted gravel borrow bedding and backfill.

<u>ITEM 823.93</u>	ORNAMENTAL STREET LIGHT (TYPE A) <u>120 W LED (SINGLE)</u>	<u>EACH</u>
<u>ITEM 823.94</u>	ORNAMENTAL STREET LIGHT (TYPE A2) <u>120 W LED (TWIN)</u>	<u>EACH</u>
<u>ITEM 823.95</u>	ORNAMENTAL STREET LIGHT (TYPE B) <u>85 W LED (SINGLE)</u>	<u>EACH</u>

The work under these Items shall include all labor, materials and equipment necessary to furnish and install Streetlights complete and ready for operation, in accordance with the applicable provisions of Section 813 and 820 of the Standard Specifications and the following. See Contract Drawings for the locations of each type of street light.

The work shall include, but not be limited to, the installation of Ornamental light poles, light fixtures, bulbs, ballasts, receptacles and appropriate grounding. Contractor shall provide all labor, materials, equipment, tools, supplies and transportation involved in the installation of the electrical equipment as specified.

All work under these and other electrical systems shall conform to the requirements of the local power utility and the National Electric Code.

SUBMITTALS:

Submittals for lighting equipment shall include photometric data. Shop drawings and reports shall employ terminology, classifications, and methods prescribed by the IES Lighting Handbook, as applicable, for the lighting systems specified. Manufacturer's data shall be submitted for the following:

- Luminaires, including lamps, ballast.
- Lamp sockets and Lampholders
- Independent Testing Laboratory Photometric Data
- Lighting standards and mounting Brackets.

Shop drawings shall be submitted for the following:

- Luminaire type: fabrication and assembly drawings and paint finish process
- Lighting standards: including base details, dimensions, wind loading, EPA ratings , pole deflection and other applicable information.
- Wind load calculations verifying conformance to AASHTO publication "Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals", 2009 addition. Calculations and shop drawings shall be stamped by Professional Engineer Registered in the Commonwealth of Massachusetts
- Light Pole Foundation

MATERIALS:

Materials and products furnished shall be designed for the intended use, shall meet all requirements of the latest edition of the National Electric Code (NEC), and all local codes.

Materials shall be manufactured in accordance with the standards indicated in this Section and typical industry standards and codes for the products specified.

The materials used shall be new, unused, and of the best quality for intended use. All equipment shall have the manufacturer's name, address, model, or type designations, serial number and all applicable ratings clearly marked thereon in a location which can be readily observed after installation. The required information should be marked on durable nameplates that are permanently fastened to equipment.

Electrical equipment shall at all times during construction be adequately protected against mechanical injury or damage by water. Electrical equipment (excluding light poles) shall not be stored outside exposed to the elements. If any equipment or apparatus is damaged, such damage shall be repaired at no additional cost, or replaced at no additional cost as directed by the Engineer.

Foundations

Cylindrical foundations for ornamental light poles shall be as specified on the drawings and as required by the pole manufacturer. Foundations shall be made of minimum 5,000 psi concrete (at 28 days) and have steel reinforcement meeting ASTM A-615, grade 60. Foundations shall have a minimum of two (2) 2" PVC conduits for lighting circuits, 180 degrees apart. Foundations to be installed flush with finished grade in sidewalk areas and 3" above finished grade in grass areas. Anchor bolts to be as required by pole manufacturer.

Anchor bolts to be $\frac{3}{4}$ " diameter by 30" long "j-hook" type galvanized steel (4 per foundation).

Wire & Cable

Wire and Cable to be provided under Item 823.60 Highway Lighting Load Center. See Item 823.60 for specifications.

Ornamental Street Lights (Type A & B)

This section pertains to furnishing and installing ornamental lights complete with pole shaft, decorative cast base, and luminaire as detailed herein.

Light Pole Assembly: The light pole assemblies shall be as manufactured by Spring City Electrical Mfg. Co., Catalog No. AARQTN-2S-CU, as detailed on the plans or equivalent products by King Luminaire or Streetlighting Equipment Corp. The poles shall have nominal lengths as shown on the plans.

Light Poles -The light poles shall be constructed to support the design load of luminaires, cross arms and all associated appurtenances including banner at a wind speed of 130 mph with 3 second gust. Structural calculations and shop drawings verifying conformance to AASHTO publication "Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals", 2009 addition shall be provided. AASHTO breakaway requirements shall not apply. Shop drawings and calculations shall be submitted, stamped by a professional engineer registered in the Commonwealth of Massachusetts. Pole manufacturer(s) shall submit written certifications and affidavits to qualify that all cast iron and steel materials, processes and associated labor related to the manufacture and supply

of the light poles are in compliance with the “Buy America” provisions included in the contract specifications for iron and steel products. Each pole shall include the following major components:

Ornamental Base Component - The base shall be cast of ductile iron per ASTM A 536-84 and shall be of heavy wall construction with a minimum wall thickness of ½ inch. The base shall be a two piece “clam shell” design and shall measure 51 inches in height with a diameter of 16 inches where it mounts to the foundation. The base shall weight 330 pounds +/- 5%. A wiring access opening with cast ductile iron cover shall be located in the fluted portion of the base, opposite the hand hole in the steel shaft.

Fluted Pole Shaft – The steel pole shaft shall meet all the requirements of ASTM A240 Grade A with an after fabrication minimum yield strength of 50,000 psi. The shaft shall be of monotube fabrication with a single longitudinal T.I.G. weld in accordance to AWG D1.1 standards. The pole shaft wall thickness shall be a minimum of 0.109 inches and satisfy the structural requirements of AASHTO as stated above. The shaft base diameter shall be 5.6 inches and shall taper down by a uniform .14 inches per foot. The shaft shall include a ¾ inch thick base plate made of 304L stainless steel plate and attached by complete circumferential welds on both the inside and outside of the shaft. The base plate shall be designed to accept four (4) ¾ inch diameter anchor bolts on an 11 inch bolt circle. The shaft shall be dry formed over a mandrel into a cross section with sixteen (16) equally spaced straight, sharp and uniform flutes. Flutes shall taper out to a full round shaft section approximately one inch above the top of the base to insure a tight fit where the shaft enters the base collar. Pole shaft lengths shall be manufactured to provide the luminaire mounting heights shown for each light pole type as detailed in the contract documents.

Pole Tenon Assembly - A tenon assembly shall consist of a 4 inch diameter by 4 inches long stainless steel pipe for Type A2 light poles to accommodate the twin cross arm tenon. A 3” diameter by 3” tall tenon assembly shall be provided for Types A and C light poles to accommodate the luminaire slipfitter. All tenons shall be welded to the top of the steel pole shaft. A decorative finishing ring shall be integrally welded to each pole shaft, designed to support and level the installed luminaire.

Anchor Bolts – A set of four (4) ¾ inch diameter by 30 inch long, fully hot dipped galvanized anchor bolts shall be furnished with each lighting pole type. The manufacturer shall note the anchor bolts yield strength on the shop drawings and structural calculations.

Power Outlet -All poles shall be furnished with a 15 amp GFCI receptacle and weatherproof while in use cover for field installation by contractor. The cover shall be metallic, low profile type and be painted to match pole shaft assembly

Banner Arms – A set of (2) “clamp-on” style banner arms designed to mount one 18 inch wide x 36 inch long banners shall be supplied with each Type A and B light poles. **Banners will be furnished and installed by the Town of Billerica and are not part of this contract.** The banner clamps shall be sized to fit to the pole shaft section for both upper and lower locations. Each clamp assembly shall include (2) ½ inch diameter stainless steel hex head machine bolt fasteners and locking hardware and allow no more than a ½ inch gap between the matching clamp surfaces when assembled to the pole shaft. The upper banner arm clamp shall also include a flag holder, fabricated from a section of steel tubing,

angle cut and welded to the “street side” of the clamp mechanism as detailed on the contract drawings. The banner arms shall be made from 1 ¼ inch schedule 40 steel pipe. One end of the pipe shall be equipped with a ¼ - 20 set screw used as a means to attach a removable cast aluminum ball finial.

Flower Basket Brackets - A “clamp-on” style bracket arms designed to support a flower basket shall be supplied with each Type A and B light pole. Flower baskets and supporting hardware will be furnished and installed by the Town of Billerica and are not part of this contract. The bracket clamps shall be sized to fit to the pole shaft section at the intended attachment locations. Each clamp assembly shall include (2) ½ inch diameter stainless steel hex head machine bolt fasteners and locking hardware and allow no more than a ½ inch gap between the matching clamp surfaces when assembled to the pole shaft. The bracket arms shall be made from 1 inch schedule 40 aluminum pipe and include a decorative cast truss scroll. One end of the pipe shall be equipped with a ¼ - 20 set screw used as a means to attach a removable cast aluminum ball finial.

Twin Cross Arm Bracket - The cross arm shall be provided for each Type A Twin light pole, The crossarm shall be constructed of ANSI 356 Per ASTM B26-95Alloy cast aluminum and 6061 aluminum pipe and shall be of the same style as detailed in the contract documents. The cross arm shall be designed to slip fit onto the specified pole tenon and attach by means of tightening two tiers of four (4) 3/8 inch diameter stainless steel set screws. The cross arm shall support two (2) luminaires as specified and provide the required luminaire mounting height of 17.5 feet with a horizontal luminaire spacing of 42 inches.

Luminaires – **Luminaires** shall be as manufactured by Spring City Electrical Mfg. Co: Types A & B Catalog No. ALMYRK-LE120/EV1/X2-40-CR3-YSDP-CMS-FBR-CU and Type C Catalog No. ALMYRK-LE040/EV1/X2-40-CR3-YSDP-CMS-FBR-CU or equivalent products by King Luminaire or Streetlighting Equipment Corp. Luminaires shall meet the following:

The luminaires shall be designed to securely mount to the specified light pole and cross arm tenon assemblies by means of a slip fitter component. Luminaire housings shall be of cast aluminum ANSI 356 per ASTM B26-95. The luminaire shall be hexagonal in shape and assembled by welding the fitter to the decorative cage assembly. The roof shall be mechanically fastened to the assembly. The decorative roof casting, shall use the COOLCAST Technology. The decorative roof casting, shall utilize the COOLCAST Technology and must provide a minimum of 250 square inches of casting to outside air. The overall luminaire dimensions shall be 39-7/8 inches tall by 20-1/2 inches in width.

The luminaire shall not have any openings or holes, except for the tenon application The luminaire shall contain completely pre-wired integral driver and optical assembly,. The luminaire shall be labeled internally and externally in accordance with ANSI C136.15. The luminaire shall be UL/cUL listed for wet locations per UL 1598.

Electrical System - Each Type A (Single or Twin) 120 watt luminaire to be furnished with (1) internally mounted 150-watt drivers for operation at 120, 208, 240, 277 volt. The drivers shall produce a constant current at 350 mA. The system wattage shall not exceed 122 system watts. The LED light engine shall consist of (108) Cree XTE 1-watt LED’s. The driver

assembly shall be removed and installed using (3) stainless steel fasteners. The electrical system shall be protected by a minimum of a 10kV surge suppressor.

Each Type B 80 watt luminaire to be furnished with (1) internally mounted 85-watt drivers for operation at 120, 208, 240, 277 volt. The drivers shall produce a constant current at 350 mA.

The LED light engine shall consist of (36) Cree XTE 1-watt LED's. The driver assembly shall be removed and installed using (3) stainless steel fasteners. The electrical system shall be protected by a minimum of a 10kV surge suppressor.

Copper wiring shall be used in the compartment. Harness and wiring insulation shall be THWN rated for 105°C and 600 volts.

The luminaires shall be internally labeled in accordance with ANSI C136.22 and shall include manufacturer's name and catalog number, month and year of manufacture, line input voltage, frequency if other than 60 hertz, ballast/driver type.

Optical System - The luminaire shall use high output, high brightness XTE LED's manufacture by Cree. The LEDs shall be mounted on printed aluminum circuit boards with a thermal interface material to maximize heat transfer to the heat sink surface. The junction temperature shall remain under 75 degrees Celsius assuming a 25 degree ambient temperature.

The LED circuit board shall utilize a conformal coating to protect the electrical system. The LED life rating data shall be determined in accordance with Illuminating Engineering Society of North America (IESNA) Lumen Maintenance (LM)-80-08.

The LED Light engine shall produce a 4000K-color temperature per ANSI C78.337-2011, and maintain a junction temperature below 70 degree Celsius to ensure lumen maintenance of 90% at no less than 50,000 hours. TM-21 results shall be provided at the engineer's request. The color rendering index shall be greater than 70.

The optical section of the luminaire shall consist of (8) seeded acrylic panels. The lens material shall be molded from virgin, high impact clear seeded acrylic. The acrylic panels will enclose (2) 54-cavity injection molded CROSSFIRE Optical System utilizing free form refractive optics.

The distribution of the luminaire shall be Type III per ANSI/IESNA RP-8-00, with the LED light engines mounted on the vertical cast pads in the roof. The CROSSFIRE Optics shall be positioned so the maximum vertical angle is 70 degrees. The maximum horizontal angles shall be at 70 degrees to ensure proper roadway illumination. The photometric results must be performed to LM-79 requirements by a DOE recognized and approved testing facility. The minimum efficacy shall be 80 lumens/watt. The 80-120-watt Luminaire Classification System (LCS) shall be B3-U3-G3. The Coefficient of Utilization shall be 64.7% Street Side and less than 35.3% House side.

An opaque white polycarbonate hurricane chimney ornament shall be located in the lower lens area of the luminaire for aesthetic effect only.

Anchor Bolts – A set of four (4) ¾ inch diameter by 30 inch long, fully hot dipped galvanized anchor bolts shall be furnished with each lighting pole type. . The manufacturer shall note the anchor bolts yield strength on the shop drawings. Type D Spring City Catalog # DBDHNC-16-3.67

Finish – Pole Shaft, Base, Cross Arm & Banner Arm Assemblies

Surface Preparation – Surfaces to be coated shall be cleaned properly to remove oil, grease or foreign contamination. All exterior surfaces shall be blast cleaned to Steel Structures Painting council Surface preparation Specification No.10 (SSPC-SP-10). By-products from the blasting process shall be “blown off” with dry, compressed air. Coating shall proceed within 8 hours of blasting. Should rust form on the surface prior to coating, the entire surface shall be re-blasted.

Primer Coating – A zinc rich base primer coat shall be applied to all accessible interior and exterior surfaces of the pole base and shaft to a minimum dry film thickness (DFT) of 3 mils.

Exterior Coating - All exterior surfaces of the cast iron base and shaft shall be top coated with a gloss black, polyaspartic aliphatic polyurea paint to an average dry film thickness (DFT) of 2.5 – 3.0 mils. Coatings shall be applied by electrostatic spray equipment without runs, sags, thin spots, pinholes or unacceptable marks. Special attention shall be given to ensure that edges, corners, crevices, welds and fasteners receive a film thickness equivalent to that of the adjacent coated surfaces.

All components exterior surfaces shall receive a factory applied TGIC polyester urethane powder coating. The finishing system shall protect cast iron aluminum alloy from salt and chemical corrosion. The finish shall be non-textured, with a gloss percentage to match the light pole shaft. The color shall be high gloss black.

Surface Preparation – All exterior surfaces shall be brush blast cleaned to SSPC-SP6.

Coating – Average Dry Film Thickness (DFT) of 4.0 mils. The coating electronically applied and cured in a gas fired convection oven. The thermosetting powder resin shall provide adhesion that meets 5A or 5B the classifications of ASTM D3359.

Experience / Warranties

The light pole and luminaire manufacturer shall have been in the business of manufacturing outdoor lighting products for the municipal street lighting market for a minimum of ten (10) years. The stainless steel pole shaft assembly shall be warranted by the manufacturer to repair and replace product that fails due to corrosion, structural defect or faulty workmanship within 25 years from date of shipment. The cast ductile iron pole base shall be warranted by the manufacturer that their castings will be free from defects in material and workmanship under normal use and operation for 25 years. Twin ornamental cross arm bracket shall be warranted against defects in material and workmanship under normal use for a period of 10 years.

The luminaire shall be free from defects in material and workmanship for ten years. The warranty shall provide for the replacement or repair of the luminaire, including light source, drivers, surge protection and other integral components.

EXECUTION:

This section covers the requirements for installation of materials, proper workmanship, testing, cleaning, grounding, and work methods to be followed by the Contractor. This Section also includes specific instructions and to be used in conjunction with the Contract Drawings. Any discrepancies noted between the Specification, Drawings, and actual installation shall be reported immediately to the Engineer. Failure on the part of the Contractor to report discrepancies immediately will be considered negligent.

Work will be coordinated such that systems can be properly located, and conflicts and delays are avoided. Contractor shall consider commencement of work acceptance of existing conditions.

Materials & Workmanship

Work shall be executed in workmanlike manner and shall present neat, rectilinear and mechanical appearance when completed. Material and equipment shall be new and installed according to manufacturer's recommended best practice so that complete installation shall operate safely and efficiently.

Installation of Precast Light Pole Foundations

Contractor shall remove and existing sidewalk materials, curbing and other masonry to be replaced after light pole foundation is replaced. Existing soil shall be excavated out and disposed of, taking care to not damage surrounding structures, electrical conduits and other utilities. Contractor to barricade areas disturbed until fully repaired unless directed otherwise.

New precast light pole foundation shall be installed in locations as shown. New 2" PVC electrical conduit connections should be attached to new light pole foundation, to maintain continuity of conduit system. New light pole foundation shall be installed level and plumb with existing conditions and at appropriate height above finished grade.

Grounding

Grounding of all Ornamental light poles and fixtures shall be in accordance Section 250 of the latest edition of the National Electrical Code. Equipment bonding conductor shall be installed from branch feeder circuit into adjacent electric handhole and into light pole base. Bonding conductor to be permanently attached to metal light pole per grounding stud provided by manufacturer or field installed if not provided. Bonding conductor to be bonding to metal handhole cover, if present. Provide #10AWG copper binding conductor vertically up length of pole shaft along with power conductors and bond to fixture ground stud and GFCI receptacle (if provided). Test all bonding conductors to be continuous back to source. Perform ground resistance test at each pole location. Should ground resistance be less than 25 ohms, contractor shall provide additional ground rod electrode at pole foundation, in accordance with NEC requirements and re-test to determine if resistance is below 25 ohms. Report all instances where ground resistance is above 25 ohms. All grounding conductors to be provided with either green outer jacket or green marking tape.

Testing, Inspection & Cleaning

Test wiring and connections for continuity and grounds before fixtures are connected; demonstrate insulation resistance by megger test as required at not less than 500 volts. Insulation resistance between conductors and grounds for secondary distribution systems shall meet National Electrical Code (NEC) requirements.

Test lighting fixtures with specified lamps in place for 100 hours. Replace lamps that fail within 1 year after acceptance.

COMPENSATION:

Payment under these Items will be at the Contract Unit Prices per Each type, which price shall constitute full compensation for furnishing, installing and integrating ornamental lights into the roadway and sidewalk system. The work shall include, but not be limited to, furnishing and installing new luminaires, posts and bases, flag pole holder, flower basket brackets, banner arms, internal wiring, testing, assembly, outdoor receptacles with GFI colored black, concrete foundation including excavation and backfill, cable and wire, conduit (not otherwise provided under other items in the contract) and all labor and miscellaneous materials.

No separate payment shall be made for wiring, splices, fusing, grounding and connections installed within the luminaire, but all costs in connection therewith shall be included in the Contract unit price bid.

Conduit and Handholes shall be paid for their respective Items.

ITEM 824. **DUPLEX RECEPTACLE (TREE LIGHT)** **EACH**

The work to be done under this Item shall consist of furnishing and installing 20-amp weather resistant duplex receptacles on rigid conduit at the location shown on the plans, as specified herein. These are noted as GFCI Outlet at tree location in sidewalk on the Lighting Plans.

All work performed shall be in accordance with Section 820, Highway Lighting, of the Standard Specifications, and as specified herein and in the Appendix.

Weather resistant GFCI receptacle shall meet NEMA 3R for wet locations, single gang box (approximately 2.8" wide x 4.5" high, and 2.7" deep) 20-amp, 125V and be enclosed in a weatherproof (weathertight) box with gasketed in-use cover and a hinge for access. Color shall be Ivory.

Material for rigid conduit shall be 1" galvanized (sweep and riser) that meets ANSI C80.1.

Install receptacles so that the bottom of the receptacle is 12 and 16 inches above finish grade.

Payment under this Item shall be at the Contract Unit Prices bid per Each, which prices shall be full compensation for furnishing and installing GFCI receptacle, weather-proof box, and rigid conduit and performing all necessary or incidental work including excavation, bedding, gravel borrow, backfilling and compaction, complete in place as detailed on the plans.

Payment for 1 inch PVC conduit for cable to lighting handhole will be paid under Item 804.1.

RECTANGULAR RAPID
ITEM 824.211 FLASHING BEACON (AC POWER), LOCATION 1 LUMP SUM

All work under this item shall be in accordance with Section 800 of the Standard Specifications, the Plans, and the following:

DESCRIPTION

The work shall include furnishing and installing an AC-powered, pedestrian actuated, rectangular rapid flashing beacon (RRFB) systems at the location shown in the plans. RRFBs are intended to provide supplemental warning to approaching vehicles of the potential for pedestrians to be crossing in an adjacent crosswalk.

Locations of the RRFB are to be as follows:

- Location 1: Heritage Road Sta. 59+16

MATERIALS

RRFB system at Location 1: Heritage Road Sta. 59+16 shall, at a minimum, consist of the following items, which shall be included in the lump sum bid:

- (2) 15' traffic signal posts, pedestals and foundations;
- (2) APS pushbutton systems;
- (4) dual rectangular yellow LED beacons in NEMA enclosures;
- (2) 9"x12" R10-25 (PUSH BUTTON TO TURN ON WARNING LIGHTS) signs;
- (4) 30"x30" W11-15 (Pedestrian/Bicycle Warning) signs;
- (2) 24"x12" W16-7pR and (2) 24"x12" W16-7pL (Diagonal Downward Arrow) signs;
- (2) NEMA Type 3R or higher enclosures to house:
 - Electrical components, including wiring and solid-state circuit boards;
 - On-board user interface;
 - Frequency hopping spread spectrum (or other alternate FCC approved) wireless activation unit with a minimum 150' range; and
- All mounting and supporting hardware and wiring necessary to complete a working system.
- Underground service connection to listed utility pole.

RRFB controller and LED beacons, APS pushbutton systems, and traffic signal posts and pedestals shall be listed on the Qualified Traffic Control Equipment List. Pedestals shall be cast iron.

The light intensity of the LED beacons during daytime conditions shall meet the minimum specifications for Class 1 yellow peak luminous intensity in the Society of Automotive Engineers (SAE) Standard J595 (Directional Flashing Optical Warning Devices for Authorized Emergency, Maintenance, and Service Vehicles) dated January, 2005. An automatic signal dimming device shall be included to reduce the brilliance of the LED beacons during nighttime conditions.

A pilot light shall be integrated into the housing of the dual rectangular yellow LED beacons, facing pedestrians in the crosswalk, to provide confirmation that the RRFB is in operation.

All signs shall be MUTCD-compliant. R10-25 signs shall have a black border and legend on a white background. W11-15, W16-7PR, and W16-7PL signs shall have a black border and legend on a fluorescent yellow background. All sign sheeting materials shall be per Subsection 828.41.

R10-25 signs may be integrated into the APS pushbutton system as a single unit or mounted separately on Type A aluminum.

W11-15, W16-7PR, and W16-7PL signs shall be Type A aluminum per Subsection 828.42.

Any proprietary software required for the programming and/or operation of the system shall be included at no additional cost.

EQUIPMENT FINISH AND COLOR

All traffic signal equipment, including, but not limited to, signal posts, bases, pushbutton saddles, hardware, strapping, and rigid mounting brackets for signals and signs, shall be the color **Gloss Black**. (See Item 815. for finish and color specifications)

POSTS AND BASES

All 15-foot traffic signal posts shall be galvanized steel, non-ornamental, painted gloss black. Bases for non-ornamental posts shall be of the octagonal pedestal type, painted gloss black.

FUNCTIONAL REQUIREMENTS

The RRFB system shall remain dark until pedestrian actuation.

Upon actuation, all LED beacons shall activate and flash in a rapidly flashing sequence. Each sequence shall last 800 milliseconds and there shall be 75 sequences per minute. The sequence shall be the same for each pair of LED beacons in an enclosure and shall be as follows:

1. The RRFB indication on the left-hand side shall be illuminated for approximately 50 milliseconds.
2. Both RRFB indications shall be dark for approximately 50 milliseconds.
3. The RRFB indication on the right-hand side shall be illuminated for approximately 50 milliseconds.
4. Both RRFB indications shall be dark for approximately 50 milliseconds.
5. The RRFB indication on the left-hand side shall be illuminated for approximately 50 milliseconds.
6. Both RRFB indications shall be dark for approximately 50 milliseconds.
7. The RRFB indication on the right-hand side shall be illuminated for approximately 50 milliseconds.
8. Both RRFB indications shall be dark for approximately 50 milliseconds.
9. Both RRFB indications shall be illuminated for approximately 50 milliseconds.
10. Both RRFB indications shall be dark for approximately 50 milliseconds.
11. Both RRFB indications shall be illuminated for approximately 50 milliseconds.
12. Both RRFB indications shall be dark for approximately 250 milliseconds.

The flash rate of each individual RRFB indication, as applied over the full flashing sequence, shall not be between 5 and 30 flashes per second.

All RRFBs within the system shall commence and cease operation simultaneously.

The length of the flashing cycle upon actuation and the minimum allowable time between actuations shall be per the plans. These settings shall be user-programmable through the on-board user interface. No-fee wireless (Wi-Fi, Bluetooth®, etc.) may be used as an alternative programming method.

Each APS pushbutton shall have a tactile arrow and locator tone. The tactile arrow shall be oriented to point in the direction of the crosswalk. The locator tone shall have a duration of 0.15 seconds or less and shall repeat at 1-second intervals. The locator tone shall be set 2 to 5 dBA above ambient sound, shall automatically adjust intensity, but cap at a maximum volume of 100 dBA. The tone shall be audible whenever the LED modules are not active.

Upon activation of the LED modules, a speech message shall state, “Yellow lights are flashing.” This message shall be stated twice. No vibrotactile or percussive indications shall be used.

If a pushbutton is pressed before the minimum time between actuation intervals is met, a speech message shall state, “Wait,” and the locator tone shall resume until the LED modules activate.

CONSTRUCTION METHODS

No work shall commence until the shop drawings are approved.

Layout and design of the RRFB system shall conform to the plans.

Conduit installations shall be per Subsection 801.60.

Pull box installations shall be per Subsection 801.61.

Foundation installations shall be per Subsection 801.62. The top of the foundation shall be ¼” to 1” proud of the sidewalk and chamfered at 45 degrees. Gaps between the sidewalk and foundation shall be no larger than ¼” and grouted with preformed joint filler.

Equipment grounding shall be per Subsections 813.61 and 813.62.

Service connection shall be per Subsection 813.63. Contractor shall be required to pay all costs associated with the utility connection until final acceptance of the system. Upon acceptance, the contractor shall notify the Town of Billerica in writing with the account number and meter number in order to transfer payment of the account.

The Contractor shall diagnose and replace any part of the pedestrian activated warning system that is found to be defective in workmanship, material, or manner of functioning within six months of final acceptance by the Engineer. This requirement does not supersede the one-year warranty period on materials specified in Subsection 815.20.

COMPENSATION

The RRFB systems shall be paid for at the contract unit price per Lump Sum. This shall include all labor, materials, equipment, service connections, and incidental costs required to complete the work.

Conduit, pull boxes, and equipment grounding shall be paid for separately under their respective pay items.

	FLASHING WARNING BEACON	
<u>ITEM 824.511</u>	<u>REMOVED AND STACKED – LOCATION 1</u>	<u>LUMP SUM</u>
	FLASHING WARNING BEACON	
<u>ITEM 824.512</u>	<u>REMOVED AND STACKED – LOCATION 2</u>	<u>LUMP SUM</u>

The work under these item shall conform to the relevant provisions of Section 800 of the Standard Specifications and the following:

This item of work shall include but not necessarily be limited to: removing, transporting and stacked the existing School Zone overhead and post-mounted flashing beacons along Boston Road at Sta. 41+03 and at Sta. 46+55, as directed by the Engineer, also including the removal and disposal of supports and associated electrical systems; disconnecting the beacon power source (performed by National Grid), and repairing any damage to wood poles to remain. Old cable should be removed and properly disposed of by the Contractor. The Contractor shall carefully remove, transport and stack all material that, in the opinion of the Engineer, is salvageable. The material shall be stacked on site and the Contractor shall coordinate with the Town to schedule pick-up time and location.

If the Engineer determines that any part of the stacked material is unsuitable for reuse, or if the Town of Billerica decides to abandon part or all of such materials, said materials shall become the property of the Contractor, and he shall dispose of them away from the site. Compensation for the removal and disposal of unsuitable or abandoned shall be included under this Item.

METHOD OF MEASUREMENT AND BASIS OF PAYMENT

Item 824.511 and Item 824.512 will be measured and paid for at the contract unit price of Lump Sum. This cost shall include all labor, material, equipment and incidental costs required to complete the work at each location.

<u>ITEM 825.01</u>	<u>SERVICE CONVERSION #337 BOSTON ROAD</u>	<u>LUMP SUM</u>
<u>ITEM 825.02</u>	<u>SERVICE CONVERSION #349 BOSTON ROAD</u>	<u>LUMP SUM</u>
<u>ITEM 825.03</u>	<u>SERVICE CONVERSION #367 BOSTON ROAD</u>	<u>LUMP SUM</u>
<u>ITEM 825.04</u>	<u>SERVICE CONVERSION #371 BOSTON ROAD</u>	<u>LUMP SUM</u>
<u>ITEM 825.05</u>	<u>SERVICE CONVERSION #373 BOSTON ROAD</u>	<u>LUMP SUM</u>
<u>ITEM 825.06</u>	<u>SERVICE CONVERSION #377 BOSTON ROAD</u>	<u>LUMP SUM</u>

The work under these Items shall include all labor, materials, and equipment necessary to convert overhead services connections for Electric to 6 properties located along Boston Road between

Heritage Road and Danforth Village. **Replacement of overhead service for Verizon and Comcast will be done by their respective companies.** The work shall be in accordance with the applicable provisions of the Standard Specifications, and the following.

The work of these Items are to perform and complete the changeover of overhead service connections for properties at the addresses listed. The Contractor installed utility company approved conduits and handholes from utility poles located on the along Boston Road to the ownership lines of properties located on Boston Road. The work of these Items includes furnishing and installing all materials, equipment and labor necessary to make service connections from previously installed handholes to the involved properties, as detailed herein.

Once the service rework has been completed on the property side of the handholes, the Contractor shall arrange for the utility companies to schedule and install wiring and complete the change over of service.

A general outline of the work at each property follows:

Boston Road Address	Underground Utility Connection	General Description of Work
#337	Electric (Telephone & Cable Overhead)	Connect to existing undergrounding service at property line with secondary service from NGRID
#349	Electric, Telephone, Cable	Connect to existing undergrounding service at property line with secondary service from NGRID
#367	Electric, Telephone, Cable	Convert NGID electrical service. Mount boxes and conduit, Remove existing exterior lines on building wall that are no longer needed.
#371	Electric, Telephone, Cable	Convert electrical service. Mount boxes and conduit, Remove existing exterior lines on building wall that are no longer needed.
#373	Electric, Telephone, Cable	Convert electrical service. Mount boxes and conduit, Remove existing exterior lines on building wall that are no longer needed.
#377	Electric, Telephone, Cable	Connect to existing undergrounding service at property line with secondary service from NGRID

The Contractor shall perform the work at each property, as detailed herein and as shown on the electrical detail drawings.

The Contractor shall furnish/install conduits, wiring, splice boxes and devices associated with the modification of the existing overhead electrical power, s for an underground installation, as are indicated on the drawings and herein specified.

The Contractor shall furnish/install hot dipped galvanized steel channels and hardware as necessary for mounting of all equipment. In addition, all outside mounted electrical equipment and

hardware shall be hot dipped galvanized. All electrical outdoor enclosures and wiring shall meet the NEMA 3R construction and installation requirements.

The Contractor shall be required to obtain permits from the Town's Building Department for each property and pay all fees for these permits. He shall be required to arrange for inspections, as required by the Building Department, complete the work in accordance with the local requirements and meet with the approval of the Town Electrical Inspector.

All work shall conform to the requirements of National Grid, Verizon, Comcast and the National Electrical Code. Other references are as follows:

- UL: Underwriters Laboratories, Inc., 33 Pfingsten Road, Northbrook, IL
- NEMA: National Electrical Manufacturers Association, 2101 L Street, Northwest, Washington, DC
- FM: Factory Mutual Engineering Corporation, Factory Mutual System, 1151 Boston/Providence Turnpike, Norwood, MA

PRODUCTS

Acceptable Manufacturers of Miscellaneous Equipment:

1. General Electric Company
2. Cutler/Hammer Company
3. Square D Company
4. Or approved acceptable equivalent.

Acceptable Manufacturers of Steel Channel:

1. Unistrut Corp., Wayne, MI
2. Power-Strut Division, Van Huffer Tube Corp., Warren, OH
3. T.J. Cope, Div. of Cyprus Mines Corp., Collegetown, PA
4. Or approved acceptable equivalent.

Electrical Wireway: Galvanized steel, hinged, NEMA 3R electrical service wireway. as indicated on the electrical drawings. The wireway shall be sized as required by the NEC based on the conduits size and configuration (i.e. Straight pull, Angle pull, U Pull, etc.). The wireway shall have interior insulated connectors for the electrical splices.

Insulated Multi-cable Conductor: Electrical connector blocks shall be molded with high-dielectric insulation which is abrasion/chemical resistant, UV and cold temperature rated. Connector blocks shall be supplied with removable access plugs over the hex screws and mounting holes at each end of the connector for a direct mounting inside the wireway. Acceptable manufacturers are:

1. Polaris Electrical Connectors.
2. Raychem / TE Connectivity

Conduit and Wiring: The Contractor's work includes coordination with the "Existing" service handholes and service entrance equipment at each property. All conduit and wire must meet or exceed all applicable NEC, NEMA, UL, ASTM and ANSI applicable technical standards C. Conduit and wire shall be as follows:

1. Rigid steel conduit: hot dipped galvanized with threaded couplings (ANSI Std C80.1) and schedule 40 PVC raceways.
2. Flexible metal conduit: hot dipped galvanized flexible inner jacket and watertight synthetic outer jacket (UL Std 360) including flexible PVC raceways.
3. Power wire: copper conductors with type "THHN/THWN" insulation (600 Volts rated).

EXECUTION

Contractor shall install conduit and wiring and make all necessary electrical connections between all external equipment and devices, meters, disconnects, splitter boxes, etc., are indicated. Conduit and wire shall be installed as follows:

1. All outside exposed wiring at the buildings and utility poles shall be rigid galvanized raceways. Use PVC-80 concealed duct bank raceways between the utility handholes and the buildings (completed under current contract).
2. All interior exposed wiring in the buildings shall be galvanized electric metallic tubing if necessary.
3. All wires shall be color coded by voltage and use.
4. All wires shall be installed without any intermediate splices.
5. All wiring shall be installed in strict accordance with the manufacturer's recommendations.

All power wiring shall be field 1000 volt megger tested by Contractor. Also, the driven ground rods shall be field tested in order to verify low grounding impedance. All field testing shall be submitted with a certification letter and field testing forms by the Contractor to the Engineer.

The Contractor shall provide all required technical field assistance during the start-up and field acceptance testing including verifying the operation of the telephone and CABLE TV services.

The work associated with disconnecting power and reconnecting power services to the buildings should be performed overnight between midnight and 5:00 AM or at a time convenient to the property owners or tenants occupying the building. The actual time of day or evening for the disconnecting and reconnecting will be agreed upon in advance between the Engineer, Power Company and the property owner/tenant during construction without any additional compensation.

COMPENSATION

Payment under these Items shall be at the Contract Lump Sums bid for each property, which sums shall constitute full compensation for furnishing and installing all labor, materials and equipment to convert the identified overhead service connections at each respective property to underground, as detailed in the plans and as specified herein. In general, the work shall extend from the existing

handholes (already recently installed for this purpose and located at the property line) to the location of the overhead connection at the buildings. The work shall include the removal of unneeded overhead lines and related appurtenances mounted on building wall once the utility companies have completed the service changeover. Damage caused by the Contractor to the building will be corrected by the Contractor at his expense. The utility companies will remove the abandoned aerial lines from the properties to the pole.

Utility company customary fees for the changeover will be borne by the Town, including the removal of aerial lines from the properties to the poles. However, payment under these Items shall include the Contractor's notification of and coordination with the Utility Companies and the barring of premium charges to minimize service impacts to the properties by the changeovers. The Contractor shall be responsible for obtain local permits and approval of the work and shall bare the cost of local permit fees.

ITEM 840.001 SUPPORT FOR OVERHEAD REGULATORY SIGNS LUMP SUM

Work under this item shall be performed according to the provisions of Section 800 supplemented by the following:

Included in the work is the furnishing and installing of mast arms, foundations, sign hangers and attachments, and all incidental work necessary to provide a support structure for overhead regulatory signs as shown on the plans.

Mast Arm Structures

Mast arm structure shall be galvanized steel and shall conform to the provisions of M8.18.1. Mast arm structure shall be fabricated by the suppliers approved by MassDOT. Mast arm structures shall be monolever type. All signs on the mast arm shall be fixed mounted. Shoe type bases shall be used.

Shop drawings and calculations shall be submitted for the mast arm structure. All shop drawings and calculations shall be stamped by a Professional Engineer registered in Massachusetts. Acceptance of mast arm poles will be contingent upon review and approval of shop drawings for all mast arm poles.

Mast Arm Foundations

Mast arm foundation shall be a concrete cored foundation as shown on the Standard Drawings for Overhead Signal Structures and Foundations. The design of the foundation is detailed on the Traffic Signal Plans. Subsurface mast arm borings have been provided in the Appendix D for all designed foundations.

The lower portions of all foundations shall be placed directly against undisturbed earth. No forms or reinforcing for foundations shall be set nor shall concrete be placed until the excavation has been inspected by the Engineer and his approval to proceed has been given.

The top of all foundations in sidewalk areas shall be located flush with finish grade. The top of each mast arm foundation shall not be exposed in the sidewalk.

Mast Arm Sign Hanger Brackets

Sign hanger brackets for mast arms shall be used in all locations where a sign is to be mounted to the mast arm. Mast arm sign hanger brackets shall consist of a mast arm clamp assembly cast from 356-T6 aluminum alloy or equivalent, vertical support tube extruded from 6063 aluminum or equivalent, stainless steel bands, clamp screw, hardware, and all miscellaneous materials necessary to fix mount the sign to the mast arm.

The sign hanger bracket shall be universally adjustable capable of making horizontal, vertical, and 360 degree rotational adjustments so that any sign mounted on a mast arm can be adjusted to provide proper alignment and sight perpendicular to the flow of traffic.

Vertical support tubes shall be of sufficient length to allow mounting of the sign to within 3 inches of the top and bottom of the sign.

Overhead mounted signs shall provide a minimum vertical clearance of 17 feet to the sign over the entire width of the pavement and shoulders.

Equipment Finish And Color

All traffic signal equipment, including, but not limited to hardware, strapping, and rigid mounting brackets for signals and signs, shall be the color **Gloss Black**. (See Item 815. for finish and color specifications)

Basis of Payment

The lump sum price bid for Item 840.001, Support for Overhead Regulatory Signs, shall constitute full compensation for all labor, materials, and equipment necessary or incidental to the installation of a complete support structure as specified and as shown, including excavation and backfill, mast arm structure and foundation. Signs to be mounted on the structure shall be paid for under Item 832.

<u>ITEM 852.11</u>	<u>TEMPORARY PEDESTRIAN BARRICADE</u>	<u>FOOT</u>
<u>ITEM 852.12</u>	<u>TEMPORARY PEDESTRIAN CURB RAMP</u>	<u>EACH</u>

DESCRIPTION

Work under these items consist of furnishing, deploying, maintaining in proper operating conditions, and removing temporary pedestrian barricades and temporary pedestrian ramps as part of a Temporary Pedestrian Access Route (TPAR) in order to guide pedestrians around a fully- or partially-closed sidewalk. These devices are intended to prevent pedestrians from entering the work area and to prevent pedestrians from inadvertently entering the vehicle travel lane by providing visual and physical separation between each space.

MATERIALS

The Temporary Pedestrian Barricade shall have a continuous bottom rail or edge no more than two (2) inches above the ground and eight (8) inches in height (minimum) to accommodate cane users,

have a smooth and continuous hand railing along the top edge no less than 32 inches above the ground and not obstruct or project into the pedestrian path of travel. Barricade walls shall be nearly vertical and generally within the same plane.

If exposed to traffic, Temporary Pedestrian Barricades shall be crashworthy.

The Temporary Pedestrian Curb Ramp shall provide a 48 inch minimum width, with a firm, stable, and non-slip surface. Protective edging with a two (2) inch minimum height shall be installed when the curb ramp or landing platform has a vertical drop of six (6) inches or greater.

The Temporary Pedestrian Curb Ramp walkway and landing area surface shall be of a solid, continuous, contrasting color abutting up to the existing sidewalk.

If a Temporary Pedestrian Curb Ramp leads to a crosswalk, a detectable warning pad must be used at the base of the ramp; if it leads to a protected path that does not conflict with vehicular traffic then a detectable pad shall not be used.

CONSTRUCTION METHODS

The Temporary Pedestrian Barricade shall be placed in an area that will provide pedestrians with a TPAR on a smooth, continuous hard surface for its entirety. The geometry and alignment of the facility shall meet the applicable requirements of the “Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities” and the Massachusetts Architectural Access Board.

The recommended width of the TPAR is 60 inches, but if constraints exist a minimum clear width of 48 inches shall be provided along its entirety. If a 60 inch width cannot be accommodated in full, a 60 inch by 60 inch passing space shall be provided every 200 feet or less along the TPAR. Turning areas shall be 60 inches by 60 inches minimum.

Lateral joints between any surfaces shall not exceed 0.5 inches. Lateral edges may be vertical up to 0.25 inches high and shall be beveled at 1V:2H between 0.25 inches and 0.5 inches.

The TPAR shall be kept clear of debris, snow, and ice and the Temporary Pedestrian Barricades and Temporary Pedestrian Curb Ramps shall not obstruct drainage.

Removal and/or resetting of Temporary Pedestrian Barricades and Temporary Pedestrian Curb Ramps shall be considered incidental.

COMPENSATION

Payment for Temporary Pedestrian Barricades will be made at the contract price per foot installed in place, including all incidental items. This price shall include the cost of furnishing, installing, resetting, removal, and maintaining in good working condition.

Payment for Temporary Pedestrian Curb Ramps will be made at the contract price per each unit installed in place, including all incidental items. This price shall include the cost of furnishing, installing, resetting, removal, and maintaining in good working condition.

**REFLECTORIZED DRUMS WITH SEQUENTIAL
FLASHING WARNING LIGHTS**

ITEM 859.1 **DAY**

The work under this Item shall conform the relevant provisions of Subsection 850 of the Standard Specifications and the following:

Work under this item consists of furnishing, installing, maintaining in proper operating conditions, and removing reflectorized drums, and any necessary ballast, equipped with sequential flashing warning lights.

MATERIALS

Reflectorized drums shall be listed on the MassDOT Qualified Traffic Control Equipment List. Reflective sheeting on drums shall meet or exceed ASTM D4956 Type VIII. All drums shall be maintained in a satisfactory manner including the removal of oils, dirt, and debris that may cause reduced retroreflectivity.

The Contractor shall use one of the following sequential flashing warning light systems unless otherwise approved by the Engineer:

1. Empco-Lite LWCSO.
2. pi-Lit® Sequential Barricade-Style Lamp; or
3. Unipart Dorman SynchroGUIDE.

Sequential flashing warning lights shall be secured to reflectorized drums per the light manufacturer's specifications.

CONSTRUCTION METHODS

The first ten (10) drums in any merging or shifting taper as designated in the Temporary Traffic Control Plan shall be equipped with sequential flashing warning lights. These lights shall be operating, at a minimum, between dusk and dawn when the taper is deployed.

The successive flashing of the sequential warning lights shall occur from the upstream end of the merging or shifting taper to the downstream end of the taper in order to identify the desired vehicle path. Each warning light in the sequence shall be flashed at a rate of not less than 55, nor more than 75 times per minute.

Warning lights shall be powered off when drums are not deployed in a taper.

METHOD OF MEASUREMENT

A group of ten (10) reflectorized drums with sequential flashing warning lights is considered one (1) unit and will be measured by the day. Each period of up to 24 hours during which this unit is in use will be measured as one day regardless of the number of times that the drums are positioned, repositioned, removed, or returned to service.

BASIS OF PAYMENT

Reflectorized Drums with Sequential Flashing Warning Lights will be paid for at the contract unit price per day, which shall include full compensation for furnishing, positioning, repositioning, and removing the group of ten (10) drums as directed by the Engineer.

PREFORMED PAVEMENT MARKINGS, WET REFLECTIVE **ITEM 867.706 (6 INCH YELLOW LINE WITH BLACK CONTRAST) FOOT**

The work to be done under these items shall conform to the relevant provisions of Section 860 of the Standard Specifications and the following:

Work shall consist of the furnishing and installation of preformed wet reflective pavement markings.

Materials

Preformed Marking Lines are composed of performed thermoplastics, tape, or other materials premixed with pigments, glass spheres or other reflective materials, and other additives to control color, retroreflectivity, and skid resistance.

All pavement marking colors shall conform to the MUTCD standards, including the Daytime Color Specification Limits for Retroreflective Pavement Marking Material found in 23 CFR 655, Subpart F.

Post-installation, the surfaces of all preformed markings shall provide a minimum skid resistance value of 35 British Pendulum Number (BPN) when tested in accordance with ASTM E303, with exception to crosswalks, stop lines, and markings that delineate bicycle facilities, which shall provide a minimum of 55 BPN.

Preformed pavement markings shall be certified by the manufacturer, including verification from an independent laboratory, as capable of meeting the following minimum initial retroreflectivity levels:

Test Method	Yellow Markings
Observation Angle	1.05°
Entrance Angle	88.8°
ASTM E1710 (Dry)	300 mcd/lux/m ²
ASTM E2177 (Wet Recovery)	250 mcd/lux/m ²
ASTM E2832 (Wet Continuous)	200 mcd/lux/m ²

The black contrast shall be non-reflective and 2 inches wide on each side, adding a total of 4 inches of nominal width to the line.

The leading edge(s) of all preformed markings shall be tapered to minimize risk of plow damage.

The Contractor shall provide a Certificate of Compliance verifying the product supplied will meet the color, friction, and retroreflectivity requirements prior to installation.

CONSTRUCTION METHODS

The Contractor shall supply Shop Drawings to the Engineer for approval a minimum of 30 days in advance of installation. Shop Drawings shall include the product manufacturer's instructions, material safety data sheets (MSDS) for all components including any primers and sealers, and all tools, equipment, and procedures to be used for the installation. No work shall commence until the Shop Drawings have been approved.

Lines shall not be placed adjacent to each other to increase line width unless lines greater than 12 inches wide are required and the manufacturer's specifications allow it.

All existing pavement markings that are to remain, castings, curbs, and rumble strips within the vicinity of the Preformed Markings shall be protected by the Contractor. Existing pavement markings damaged during the installation shall be removed and replaced by the Contractor at no additional cost.

The Contractor shall follow all installation instructions from the manufacturer, including allowable ranges of temperature and humidity for installation, unless otherwise approved by the Engineer.

Upon completion of installation, a sealer shall be applied if recommended by the manufacturer. The sealer shall be installed per the manufacturer's specification. The application of a sealer shall be considered incidental to the cost of the item.

The Contractor shall maintain protection of the Preformed Markings installation from vehicle, bicycle and foot traffic throughout the minimum cure time recommended by the manufacturer.

METHOD OF MEASUREMENT AND BASIS OF PAYMENT

Item 867.706 will be measured per FOOT, complete in place, as specified under Subsection 860.80.

Item 867.706 will be paid for at the respective contract unit price per FOOT. The contract prices shall include all material, labor, and equipment required or incidental to the satisfactory completion of the work.

	<u>6 INCH DURABLE RECESSED WET</u>	
<u>ITEM 868.106</u>	<u>REFLECTIVE WHITE LINE (THERMOPLASTIC)</u>	<u>FOOT</u>
	<u>12 INCH DURABLE RECESSED WET</u>	
<u>ITEM 868.112</u>	<u>REFLECTIVE WHITE LINE (THERMOPLASTIC)</u>	<u>FOOT</u>
	<u>6 INCH DURABLE RECESSED WET</u>	
<u>ITEM 869.106</u>	<u>REFLECTIVE YELLOW LINE (THERMOPLASTIC)</u>	<u>FOOT</u>
	<u>12 INCH DURABLE RECESSED WET</u>	
<u>ITEM 869.112</u>	<u>REFLECTIVE YELLOW LINE (THERMOPLASTIC)</u>	<u>FOOT</u>

The work to be done under these items shall conform to the relevant provisions of Section 860 of the Standard Specifications and the following:

Work shall consist of grooving a slot in the pavement surface and the furnishing and installation of liquid thermoplastic wet reflective pavement markings, liquid two-part polyurea wet reflective pavement markings, liquid two-part epoxy wet reflective pavement markings, and preformed wet reflective pavement markings. As work incidental to these items, the Contractor or pavement marking Material Supplier(s) shall measure the performance of the pavement markings upon installation, six months following installation, and one year following installation.

Construction Methods for Installation of Groove

Contractor shall refer to 3MTM Information Folder 5.18 Grooving Applications and the following:

Prior to cutting out the grooves for all recessed lines, the Contractor shall use a chalk line or other suitable method to layout the proposed pavement markings on the surface course so that the Engineer can inspect the locations. Once the Engineer has inspected and approved the proposed striping layout, the grooves for the proposed pavement markings may be cut. No pavement grooving shall be done without the prior approval of the Engineer.

Groove position shall be a minimum of 4 inches from the edge of the pavement marking to any longitudinal pavement joints. The groove shall not be installed on bridge joints, at drainage structures, or in other areas identified by the Engineer. The groove shall not be installed continuously for intermittent pavement markings, but only where markings are to be applied.

The use of gang stacked diamond cutting blades to grind a smooth square slot is required for producing all grooves. The spacers between blade cuts shall be such that there will be less than a 10 mil rise in the finished groove between the blades. The acceptability of the surface texture will be determined by the Engineer and/or Material Supplier's Technical Representative.

The diamond grinder shall have an articulating head so that the slots are installed correctly on grades and super elevated sections.

Grooves that are ground deeper or wider than the specified allowable limits shall be repaired according to the Department's approved repair procedure at no additional cost to the Department. Grooves that are ground too shallow or narrow shall be reground to the specification limits at no additional cost to the Department. Slots that are ground out of alignment shall be cut out and patched using an approved method and approved materials.

The Contractor shall grind the groove to the correct depth, width, and length as specified and in proper alignment. Grooves shall be 1 inch \pm ¼ inch wider than the pavement marking material. Groove depth shall be per the Material Supplier's specification for liquid thermoplastic application, 80 mils \pm 5 mils for polyurea or epoxy liquid pavement markings application, and 150 mils \pm 5 mils for preformed material application, unless otherwise approved by the Engineer. Depth shall be consistent across the full width of the groove. Depth plates shall be provided by the Contractor to the Engineer to assure that desired groove depth is achieved.

Grooves shall be clean, dry and free of laitance, oil, dirt, grease, paint or other foreign contaminants. Shrouds and a vacuum apparatus shall be included as part of the grinder to remove larger pieces of pavement that are ground out. If water is used to clean the groove or the grooving process takes place during rainfall, a minimum of 24 hours of dry time is required prior to the placement of pavement markings.

A Technical Representative from the Material Supplier(s) shall be present for the first grooving operation shift to provide quality assurance/quality control.

After the depth, width, length, and surface condition has been approved by the Engineer, an air lance shall be used to remove fine particles from the groove. Air compressors shall initially be blown out away from the application area to prevent compressor condensation build-up from entering the groove. The Contractor shall prevent traffic from traversing the grooves and re-clean grooves, as necessary, prior to application of pavement markings at no additional cost to the Department.

All grooves must be given final approval by the Engineer prior to the placement of pavement marking material.

Construction Methods for Installation of Liquid Pavement Markings

Application of liquid pavement markings and reflective elements shall be per the Material Supplier(s)'s specifications in order to meet the minimum initial retroreflectance levels described herein.

The minimum uniform wet thickness for all applied polyurea and epoxy applications shall be 20 mils, unless otherwise approved by the Engineer.

The uniform wet thickness of applied thermoplastic pavement markings shall be 120 mils \pm 5 mils.

A Technical Representative from the Material Supplier shall be present for the first liquid pavement marking installation shift for each liquid binder type to provide quality assurance/quality control.

Construction Methods for Installation of Preformed Pavement Markings

Application of the preformed pavement markings shall conform to Section III Application Guidelines of 3MTM Information Folder 5.18 Grooving Applications, unless otherwise instructed by the Engineer.

A primer application shall be applied prior to the installation of all preformed pavement markings per the Manufacturer's Specification. This work shall be considered incidental to the cost of the item.

A Technical Representative from the Material Supplier shall be present for the first preformed pavement marking installation shift to provide quality assurance/quality control.

Materials

For thermoplastic applications, the Contractor shall use one of the following products, or approved equivalent:

1. 3M™ All Weather Thermoplastic;
2. Ennis-Flint Pavemark®;
3. Franklin Paint™ 22% Melt Down Thermoplastic; or
4. Swarco SWARCOTHERM.

For polyurea applications, the Contractor shall use one of the following products, or approved equivalent:

1. 3MTM Liquid Pavement Marking Series 5000;
2. Ennis-Flint HPS®-5; or
3. Epoplex GLOMARC® 90.

For epoxy applications, the Contractor shall use one of the following products, or approved equivalent:

1. Ennis-Flint HPS®-4;
2. Epoplex GLOMARC® 60; or
3. Swarco 1180 Series.

3MTM Stamark™ All Weather Contrast Tape 380AW-5, or approved equivalent, shall be used on all Portland Concrete Cement surfaces in place of liquid pavement markings.

Material certifications shall be provided to the Engineer prior to installation.

Pavement Marking Retroreflectivity Performance

Incidental to the cost of these items, the Contractor or Material Supplier shall perform retroreflectance readings and provide the results to the Department. The measurement and sampling procedures contained in ASTM D7585 (Standard Practice for Evaluating Retroreflective Pavement Markings Using Portable Hand-Operated Instruments) using the Referee Evaluation Protocol found in section 6.4 shall be followed. The following tests shall be performed during the measurement and sampling process:

1. ASTM E1710 (Standard Test Method for Measurement of Retroreflective Pavement Marking Materials with CEN-Prescribed Geometry Using a Portable Retroreflectometer);

2. ASTM E2177 (Standard Test Method for Measuring the Coefficient of Retroreflected Luminance (RL) of Pavement Markings in a Standard Condition of Wetness); and
3. ASTM E2832 (Standard Test Method for Measuring the Coefficient of Retroreflected Luminance of Pavement Markings in a Standard Condition of Continuous Wetting (RL-2)).

All measuring equipment shall be properly calibrated prior to the implementation of any temporary traffic controls that are required.

Retroreflectance readings shall be taken at the following three times:

1. Initial (between 7 and 30 days from date of application);
2. 6 Month (182 days, \pm 14 days from initial application); and
3. 1 Year (365 days, \pm 14 days from initial application).

The cost of temporary traffic control setups for the Initial readings shall be considered incidental to the cost of item. The Department will provide temporary traffic control setups for the 6 Month and 1 Year readings at no cost to the Contractor or Material Supplier.

The average Initial retroreflectance readings shall exceed the following minimum values for all pavement marking materials installed under these items:

	White Markings	Yellow Markings
Observation Angle	1.05°	1.05°
Entrance Angle	88.8°	88.8°
ASTM E1710 (Dry)	475 mcd/lux/m ²	375 mcd/lux/m ²
ASTM E2177 (Wet Recovery)	475 mcd/lux/m ²	375 mcd/lux/m ²
ASTM E2832 (Wet Continuous)	150 mcd/lux/m ²	125 mcd/lux/m ²

Pavement markings with measured average initial retroreflectance readings that do not meet the specified minimum values using the procedures outlined in subsection 6.4.5 of ASTM D7585 shall be removed by an approved method and reapplied at no cost to the Department, unless otherwise approved by the Engineer.

Readings taken at the 6 Month and 1 Year intervals are for MassDOT Highway Division informational purposes only. Average readings that fall below the specified minimum values will not require additional testing or pavement marking removal and reinstallation.

Retroreflectance readings shall be summarized and include the following information: date & time of reading, highway location (including direction) of each test, material type tested, ASTM test method, pavement marking color, date of initial material application, air and pavement temperature during application, initial material application thickness, depth of groove, and any other pertinent information. Results for all readings shall be provided within 10 business days of testing to the Engineer, with a second copy sent to:

State Traffic Engineer
Attention: Pavement Marking Retroreflectivity Testing
10 Park Plaza, Room 7210
Boston, MA 02116

Payment

Payment for work under these items will be made at the contract price per foot for lines completely installed in place, including all incidental items. Applied lines are to be paid for on the actual length of lines applied. This price shall include the cost of furnishing and maintaining in good working condition of all traffic management devices.

ITEM 874.45 MISCELLANEOUS SIGNS REMOVED AND RESET EACH

The work under this item shall conform to the relevant provision of Subsections 828 and 840 of the Standard Specifications and the following:

The work shall include removing and resetting existing informational, guide, and directional sign panels on ground-mounted supports at the current or new locations as indicated on the plans. The work will also include the restoration to original condition, of any natural features disturbed in any way or manner by the operation.

MATERIALS

Materials for signs removed and reset shall be the existing signs and supports. If in the opinion of the Engineer, the existing sign panel or sign support is unsuitable for reuse, a new sign panel or sign support of a size and composition equal to the existing sign panel shall be furnished, as directed by the Engineer.

The hardware used to attach the sign panel to the new or existing sign support shall be the existing bolts, brackets or clamps, or new and equal quality equipment furnished by the Contractor, as directed by the Engineer.

CONSTRUCTION METHODS

Sign panels to be removed and reset shall be cleaned before being remounted on new or existing sign supports.

Work shall include the dismantling, removal, transporting, storing and resetting of existing traffic signs at the locations shown on the plans. The Contractor shall completely remove the sign and post and reset said sign and post at the new location. If existing sign and/or post are not suitable for reuse as determined by the Engineer, the contractor shall provide new sign and/or post under items 832. and/or 847.1 respectively. New attachment hardware shall be furnished as necessary to replace any missing or unusable existing hardware.

Existing sign and/or post damaged or lost by the Contractor's operations shall be replaced in-kind by the Contractor at no additional compensation

The Contractor shall backfill with compacted gravel all holes resulting from the removal of the existing signs and their foundations and restore the area to match existing conditions of adjacent areas.

METHOD OF MEASUREMENT

Miscellaneous signs removed and reset will be measured for payment by the unit each sign and post reset in its final position, complete in place.

BASIS OF PAYMENT

Miscellaneous signs removed and reset will be paid for at the Contract unit price per each, which price shall include all labor, materials, equipment and incidental costs required to complete the work, including dismantling, excavating and removing, loading, transporting, and resetting of the signs and their supports; gravel backfill; and concrete foundations where required..

Replacement of sign panels and supports that have been determined to be unsuitable for reuse shall be paid for under the appropriate contract bid items. No payment shall be made for any sign panels or sign supports that have been damaged by the Contractor's operation.

ITEM 874.51 MISCELLANEOUS SIGNS REMOVED AND DISCARDED EACH

Work under this item includes the dismantling, removal, transportation and discarding of the existing roadside signs shown on the plans and removal and disposal of the sign supports and their foundations.

The existing signs shall not be removed until the new signs and structures replacing them are ready for traffic or until the Engineer shall permit.

If signs are attached to existing light poles, utility poles or traffic poles, only the sign and attached hardware shall be removed and discarded.

The work described above will constitute one lump sum unit.

BASIS OF PAYMENT

Item 874.51 will be paid at the Contract unit price per each, which price shall include all labor, materials, equipment and all incidental costs required for dismantling, loading, transporting, and discarding of the signs as designated above, the excavating and disposal of the existing foundation and supports of the sign, and the supplying and placing of compacted gravel backfill where foundations and posts are removed and restoration of surface.

ITEM 874.7 MISCELLANEOUS SIGNS REMOVED AND STACKED EACH

The work under this item shall conform to the relevant provision of Section 800 of the Standard Specifications and the following:

Work to be completed under this item shall include the dismantling, removal, transporting, resetting, stacking, and disposal of existing roadside traffic signs as indicated on the plans or as directed by the Engineer, including the removal and disposal of existing sign supports and foundations.

The Contractor shall exercise particular care in the dismantling, removal, transporting, and resetting of the existing signs designated on the plans to be reset or stacked. Any sign panel damaged through carelessness or lack of protection by the Contractor shall be replaced at the Contractor's expense.

The existing signs shall not be removed until the new signs and structures replacing them are ready for installation or until the Engineer shall permit.

Existing foundations shall be excavated (including Class "B" Rock) to a depth of at least six inches below grade and the resulting hole shall be backfilled with compacted gravel and the surface restored to match existing conditions of adjacent areas.

Signs to be removed and stacked shall be stacked on site and the Contractor shall coordinate with the Town to schedule pick-up time and location.

COMPENSATION

Payment for removing and stacking signs shall be at the contract price per each under Item 874.7 for all signs removed and stacked within the project, which price shall provide full compensation for dismantling, loading, transporting and stacking of signs; the excavating and disposal of the existing supports and foundations, of the same; the supplying and placing of compacted gravel backfill where foundations and posts are removed; and surface restoration.

No separate payments will be made for any excavation, including Class "B" Rock Excavation, gravel backfill, compaction, and surface restoration. All costs for excavation, backfill, compaction, restoration, and any incidental work shall be included in the bid price.

ITEM 988.01 SEDIMENT FOREBAY PAVING SQUARE FOOT

The work under this item shall conform to the relevant provisions of Sections 501 and 983 of the Standard Specifications and the following:

The purpose of this item is to provide a level protective surface over a compacted gravel borrow foundation to facilitate in maintenance of the pretreatment sedimentation forebay, Heritage Road Sta. 3+30 RT.

The work shall include the construction to the line and grade of a level sedimentation forebay protective bottom surface conforming to the minimum size and dimensions shown on the Contract

Drawings and the following:

Each piece of granite curb or edging shall have a minimum length of eighteen (18) inches, minimum width of four (4) inches and minimum depth of four (4) inches. Granite curb or edging shall be placed in an offset tile pattern with two (2) inch spacing on all sides. Material may either be new or existing curb or edging designated to be discarded as shown on the plans within the Project limits of work.

Reused curbing shall include removal, temporary storage and protection, cutting, removal and disposal of all foreign matter and installation.

Curb layout pattern shall be pre-approved by the Engineer.

METHOD OF MEASUREMENT AND BASIS OF PAYMENT

Measurement for Sediment Forebay Paving will be by the square foot of curbing installed and accepted as specified on the Contract Drawings.

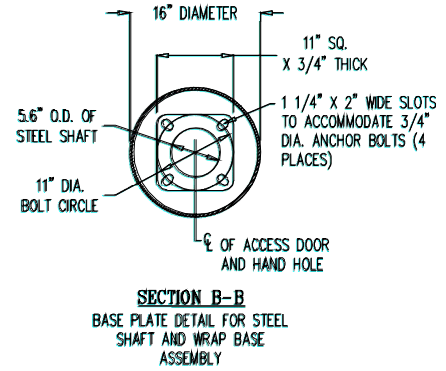
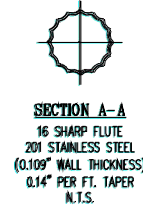
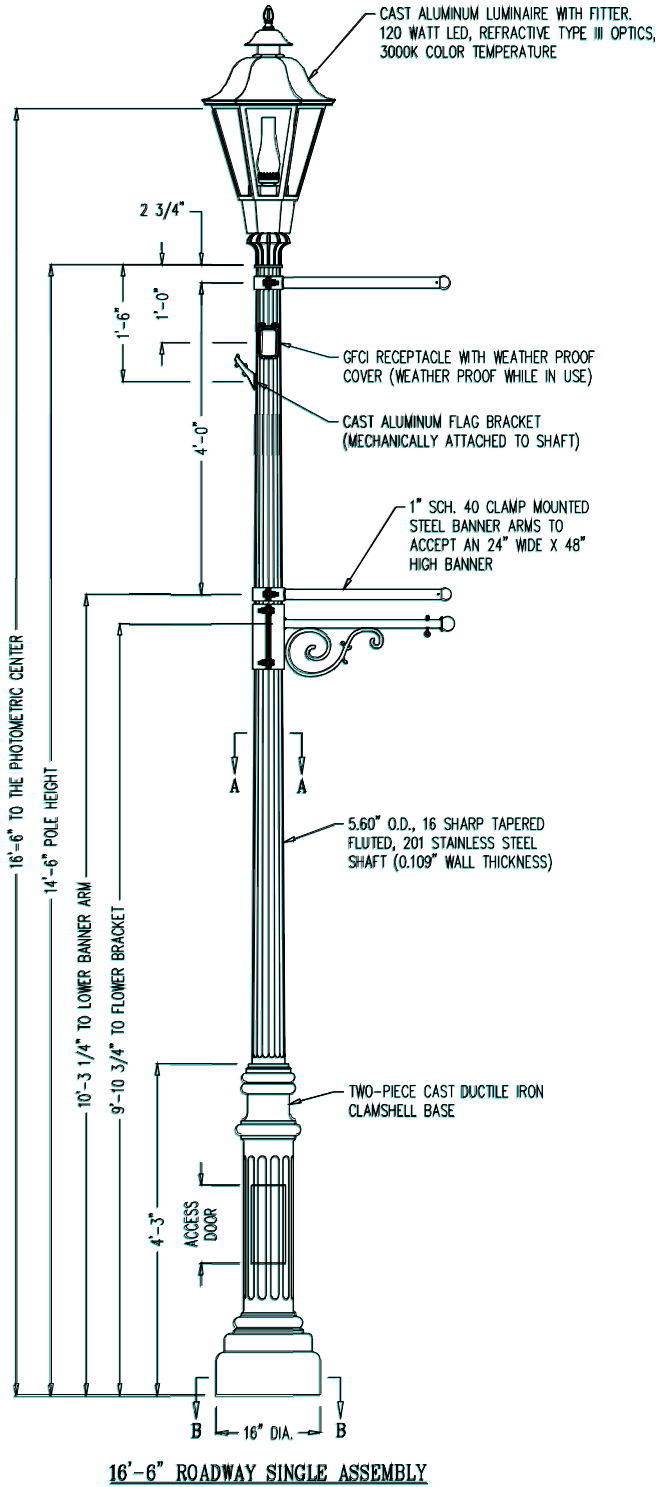
Payment will be by the Contract bid price per square foot and shall include compensation for all labor, equipment and materials necessary to complete the specified work.

Gravel borrow will be paid for separately by the cubic yard under Item 151.

End of Document

APPENDIX A – ORNAMENTAL TRAFFIC & LIGHTING POST DETAILS

120 WATT -TYPE A LIGHT
 85 WATT - TYPE B LIGHT

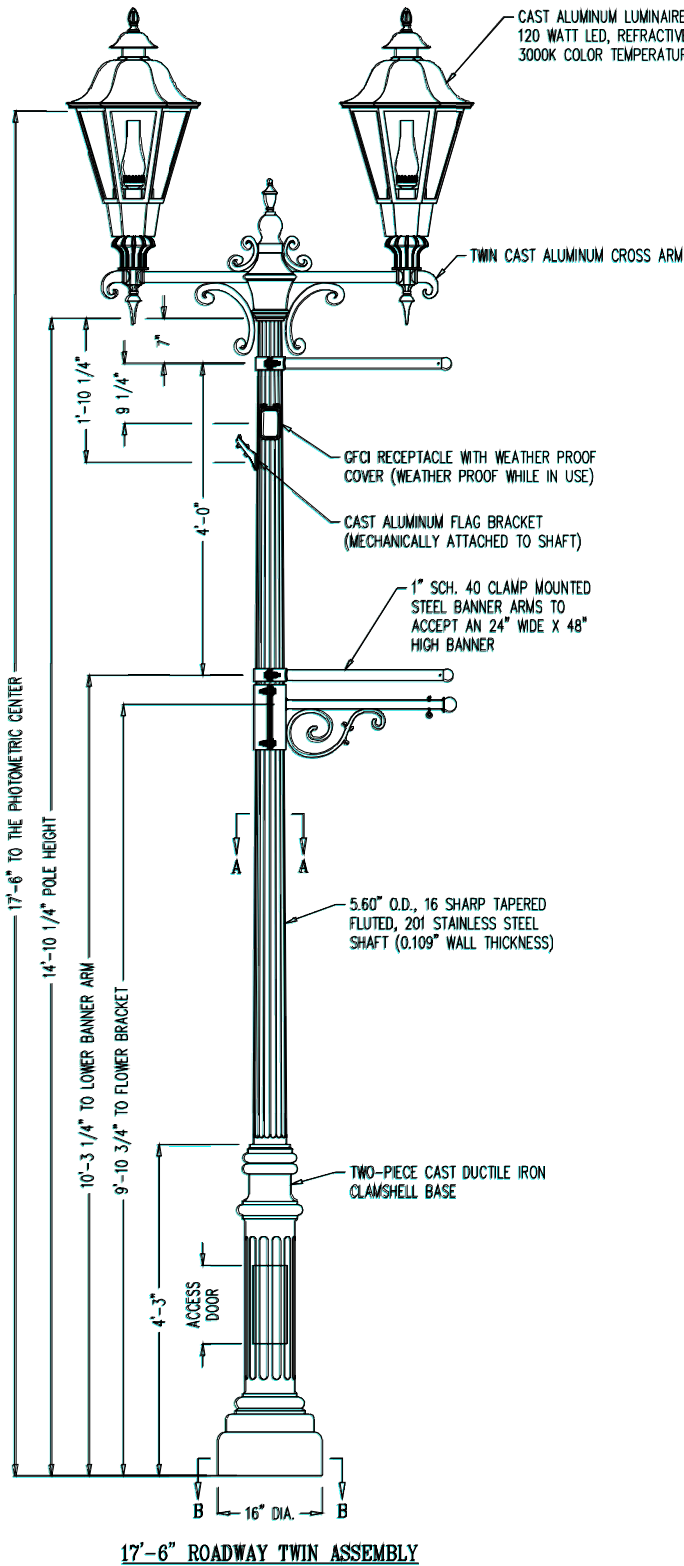


Rehabilitation on Boston Road (Route 3A)
 from Billerica Town Center to Floyd Street

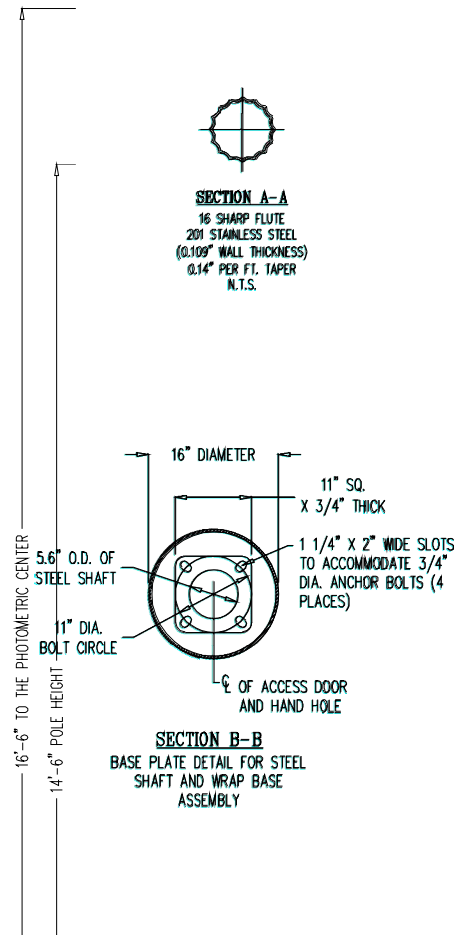
Ornamental Street Light (Single)
 (Item 823.93 & 823.95)

Billerica, MA

Not to Scale



17'-6" ROADWAY TWIN ASSEMBLY

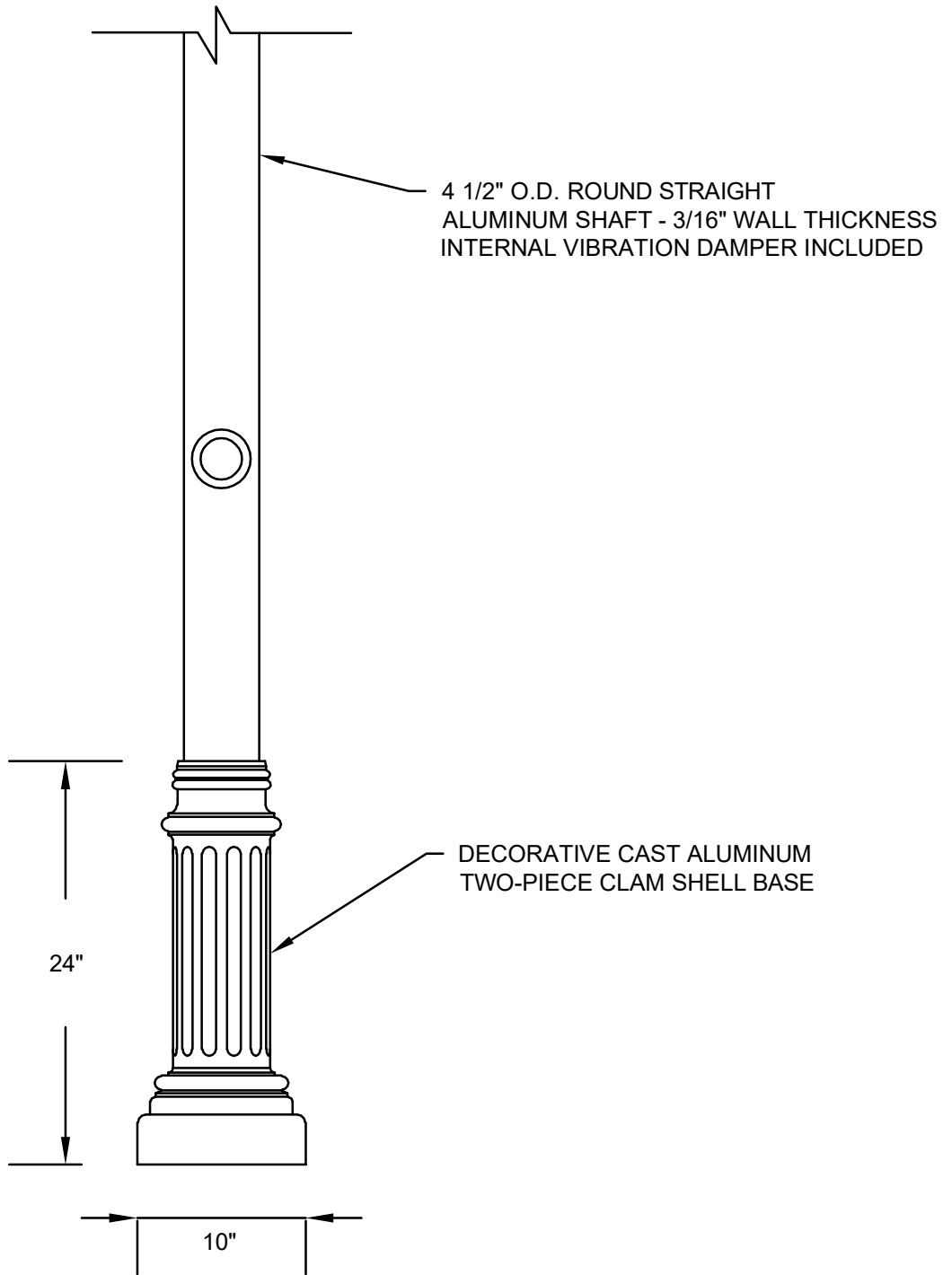


**Rehabilitation on Boston Road (Route 3A)
from Billerica Town Center to Floyd Street**

Billerica, MA

Ornamental Street Light (Twin)
(Item 823.94)

Not to Scale



**Rehabilitation on Boston Road (Route 3A)
from Billerica Town Center to Floyd Street**

Billerica, MA

Ornamental Traffic Signal Post
(Items 815.1 & 815.3)

Not to Scale

APPENDIX B – UTILITY COMPANY REQUIREMENTS

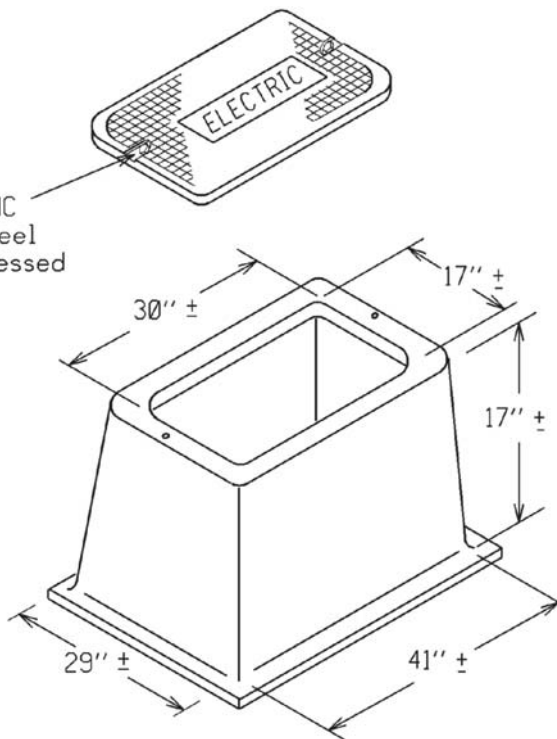
REFERENCE

NATIONAL GRID SPECIFICATIONS FOR ELECTRICAL INSTALLATIONS
(ELECTRIC SYSTEM BULLETIN NO. 759A & NO. 759B)

Std. Item	UR10F
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Two $\frac{3}{8}$ " x $1\frac{1}{2}$ "-16 UNC
captive Stainless Steel
Pentahead bolts recessed
in cover.



New Drawing

TYPE E
ITEM# 811.96

HIGH DENSITY PLASTIC HANDHOLE
LIGHT DUTY RECTANGULAR 17" X 30"

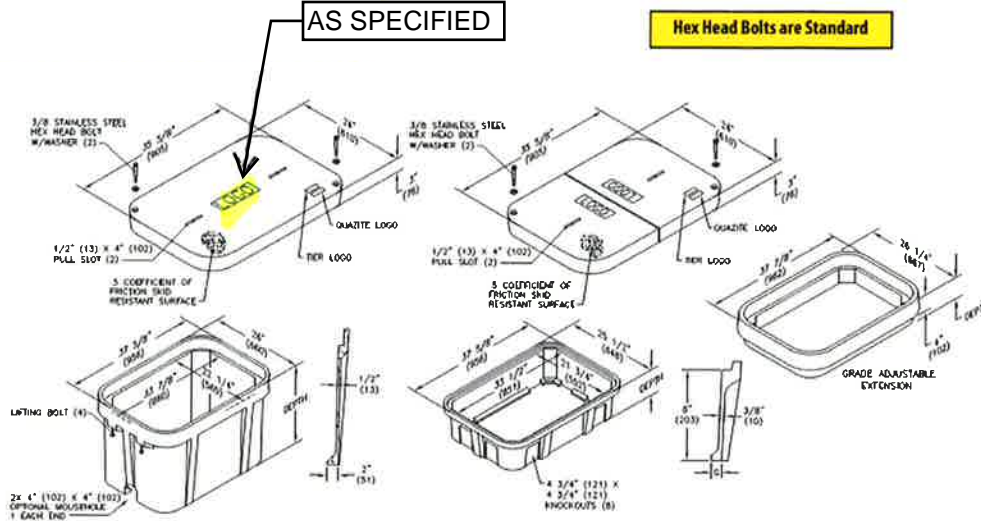
ISSUE	PAGE NUMBER	UNDERGROUND CONSTRUCTION STANDARD	nationalgrid
7/13	33-100		



For sales and support visit:
 hubbellpowersystems.com/contact/

Home > Products > Enclosures > Underground > Straight > 24 x 36

24" x 36" PG Style Polymer Concrete (Stackable) Assembly



Covers

DESCRIPTION	TIER	DESIGN/TEST LOAD#	WEIGHT #	PALLET QTY	PART NO.
W/ 2 Bolts	8	8,000 / 12,000	100	10	PG2436CA00**
2 piece w/2 Bolts	8	8,000 / 12,000	122	10	PG2436CS00**
W/ 2 Bolts	15	15,000 / 22,500	115	10	PG2436HA00**
2 piece w/2 Bolts	15	15,000 / 22,500	122	10	PG2436HS00**
W/ 2 Bolts	22	22,500 / 33,750	122	10	PG2436HH00**
No Bolts	8	8,000 / 12,000	100	10	PG2436WA00**

To order gasketed covers, replace the letter "A" with the letter "G".

Replace ** with a logo code (Click Here)

NOTE: Gasketed covers and bolt grommets must be used with a gasketed box. Gaskets reduce the inflow of fluids but do not make the enclosure water tight.

Boxes (Box depths 24" thru 42" must be used as bottom of any stack)

DESCRIPTION	DEPTH	TIER	DESIGN/TEST LOAD#	WEIGHT #	PALLET QTY	PART NO.
Standard Open Bottom	18"	22	22,500 / 33,750	141	4	PG2436BA18
	24"		22,500 / 33,750	180	3	PG2436BA24
	30"		22,500 / 33,750	196	2	PG2436BA30
	36"		22,500 / 33,750	254	2	PG2436BA36
	42"		22,500 / 33,750	293	1	PG2436BA42
Solid Bottom	18 1/2"	22	22,500 / 33,750	171	4	PG2436DA18
	24 1/2"		22,500 / 33,750	228	3	PG2436DA24
	30 1/2"		22,500 / 33,750	238	2	PG2436DA30
	36 1/2"		22,500 / 33,750	282	2	PG2436DA36
	42 1/2"		22,500 / 33,750	321	1	PG2436DA42

To order boxes with 2 standard mouseholes, replace the letter "A" with the letter "B".

To order gasketed boxes, replace the letter "A" with the letter "G".

NOTE: 24" thru 42" boxes must be used as bottom on any stack.

NOTE: Gasketed covers and bolt grommets must be used with a gasketed box. Gaskets reduce the inflow of fluids but do not make the enclosure water tight.

Bottom Extensions (for use under 12" and 18" boxes only, one per box)

DESCRIPTION	DEPTH	TIER	DESIGN/TEST LOAD#	WEIGHT #	PALLET QTY	PART NO.
Open Bottom	8 3/4"	22	22,500 / 33,750	81	6	PG2436EA08
Solid Bottom	9 1/4"	22	22,500 / 33,750	95	6	PG2436RA08

**TYPE E
 ITEM# 811.95**

APPENDIX C – PAVEMENT CORES & SOIL SAMPLING REPORT



Briggs Engineering & Testing

A DIVISION OF PK ASSOCIATES, INC.

December 9, 2014

BETA Group, Inc.
315 Norwood Park South
Norwood, MA 02062
Att.: Drashan Jhaveri, P.E.

RE: Report – Pavement Cores and Soil Sampling-
Boston Road, Billerica, MA

Dear Mr. Jhaveri,

In accordance with our proposal we have completed the pavement coring and soil sampling at the above referenced project location. Sampling locations were in accordance with your instructions.

The thickness of the bituminous pavement cores is shown in the attached Table 1. Photographs of the cores and test pits and the laboratory test reports for the soil extracted from the test pits are also attached.

If you have any questions concerning the aforementioned proposal, please do not hesitate to contact me at 781-871-6040

Very truly yours,
Briggs Engineering & Testing
A Division of PK Associates, Inc.

Paul M. Skorohod
President



Bituminous Core Thickness Data
Boston Road, Billerica

Core #1	
Top	1.5"
Top	.785"
Dense Top	0.5
Top	0.75
Dense Top	1"
Dense Top	2.75"
Binder	2.75"
Total	10.25"

Core #2	
Dense Top	0.75
Toop	1.25
Top	0.785
Dense Ytop	1.5
Leveling	0.75
Total	10"

Core #3	
Top	1.25
Dense Top	1.125
Top	1
Top	1.375
Base	3.125
Binder	0.5
Dense Top	0.5
Base	0.75
Total	9.625"

Core #4	
Top	1.125"
Top	.75"
Top	.75"
Binder	2"
Top	1"
Dense Top	1.5"
Binder	1.75"
Binder	.785"
Top	.625"
Total	10.25"

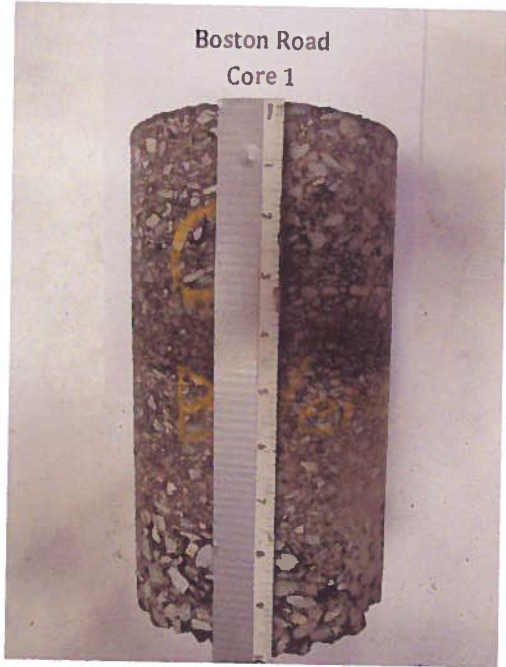
Core #5	
Leveling	.5"
Dense Top	.625"
Binder	2"
Top	1.5"
Dense Top	.785"
Binder	1"
Binder	1.25"
Base	3.25"
Total	11"

Core #6	
Top	3.25"
Top	1.785"
Binder	2.25"
Top	1.5"
Total	8.785"

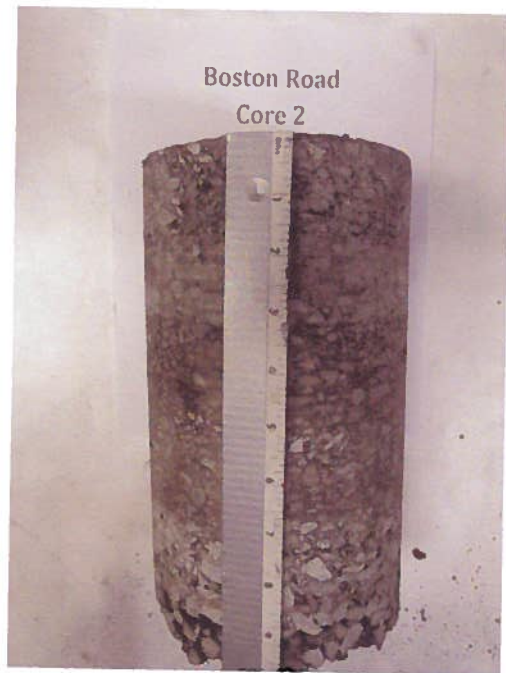
Core #7	
Top	1.125"
Top	1.785"
Top	.75"
Top	1.5"
Top	2.25"
Top	2.375"
Total	9.785"

Core #8	
Dense Top	1.75"
Top	1.75"
Top	3.75"
Total	7.25"

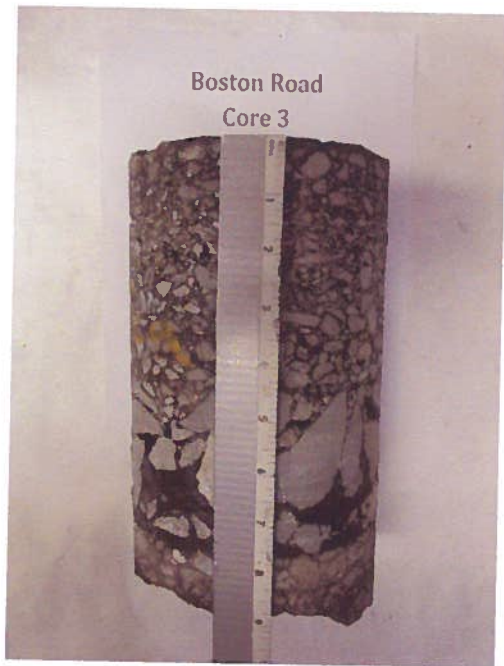
Core #9	
Top	.625"
Binder	1.125"
Base	2"
base	1.75"
Total	5.5"



Boston Road, Core 1



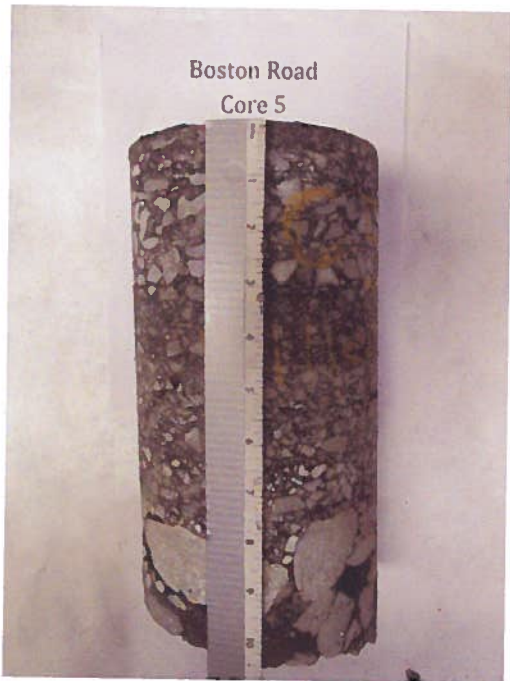
Boston Road, Core 2



Boston Road, Core 3



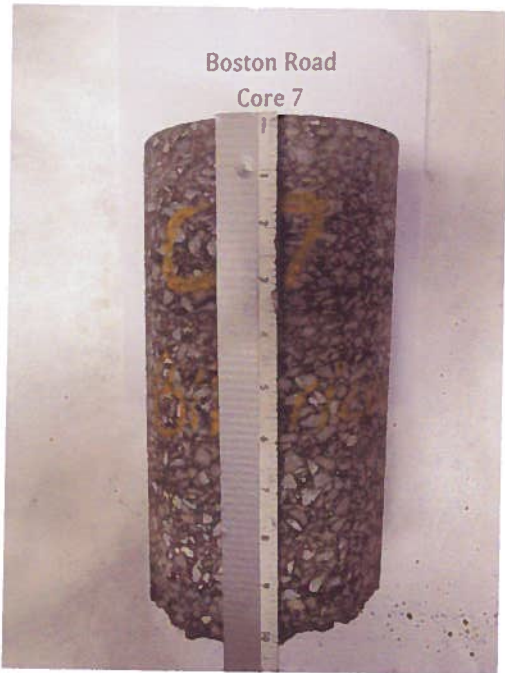
Boston Road, Core 4



Boston Road, Core 5



Boston Road, Core 6



Boston Road, Core 7



Boston Road, Core 8

Boston Road
Core 9



Boston Road, Core 9



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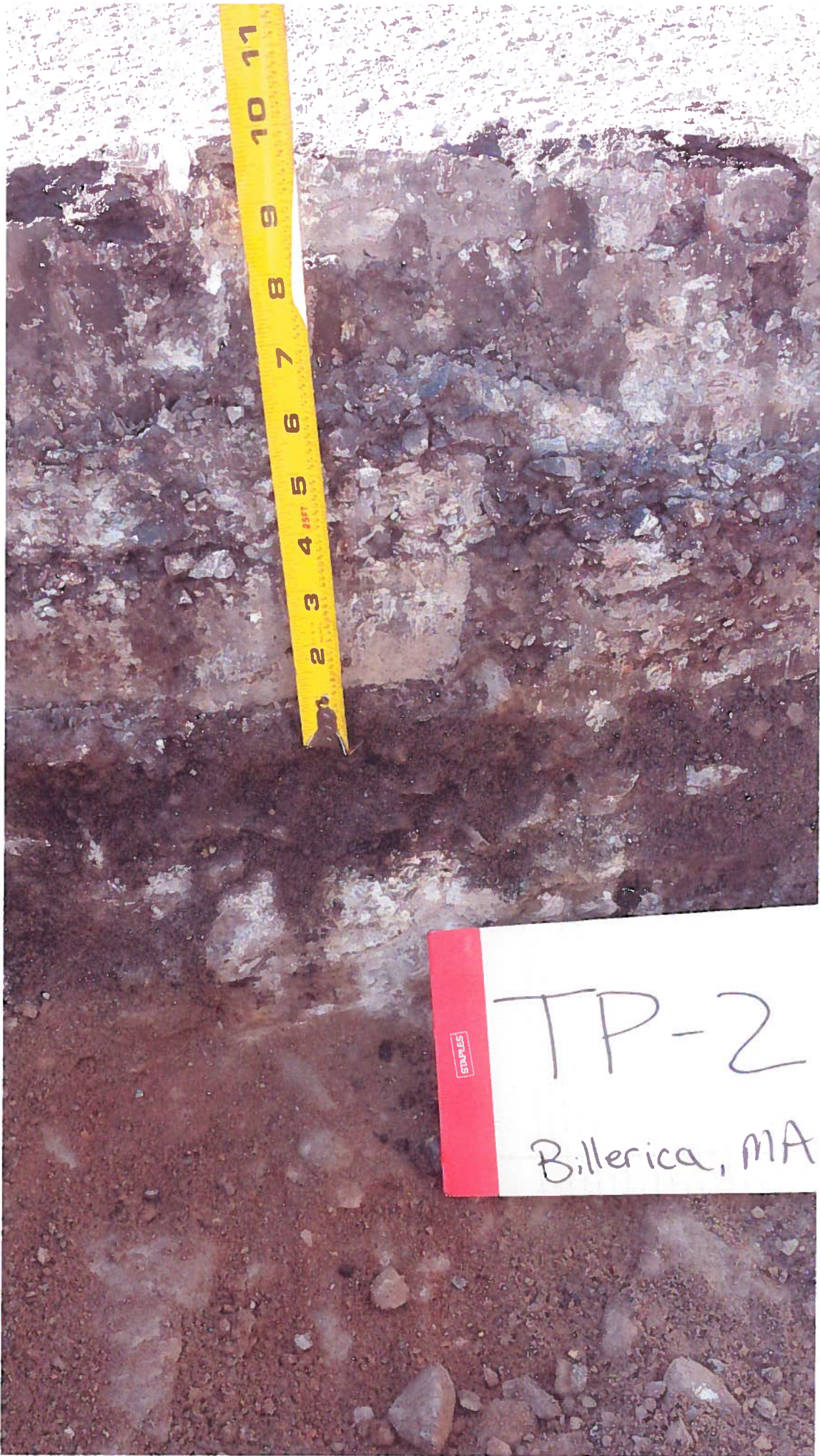
STAPLES

TP-1
Billerica, MA



TP-1
Billerica, MA





TP-2

Billerica, MA



TP-2

Billerica, MA

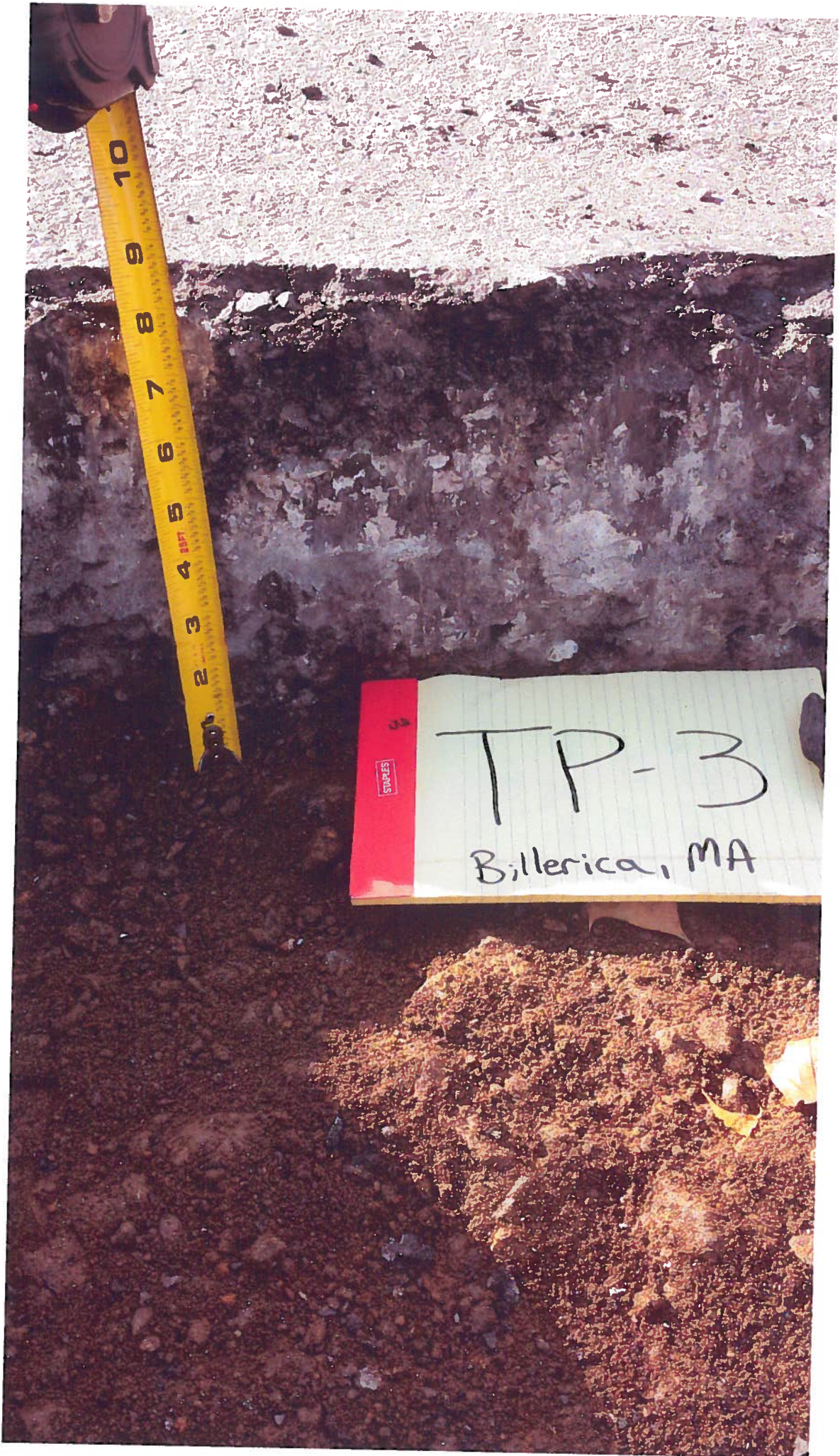


TP-2
Billerica, MA

TP-2
Billerica, MA



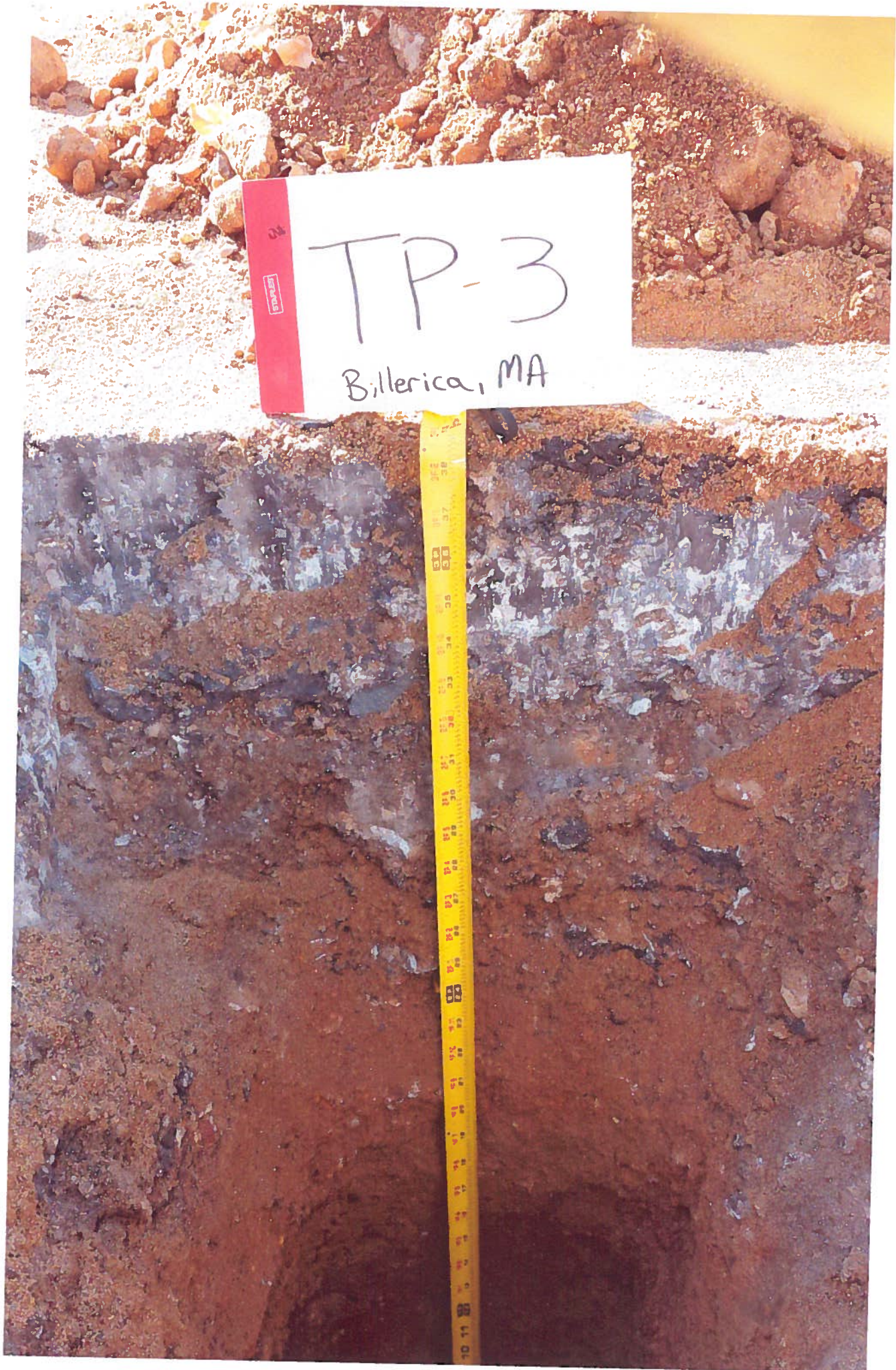
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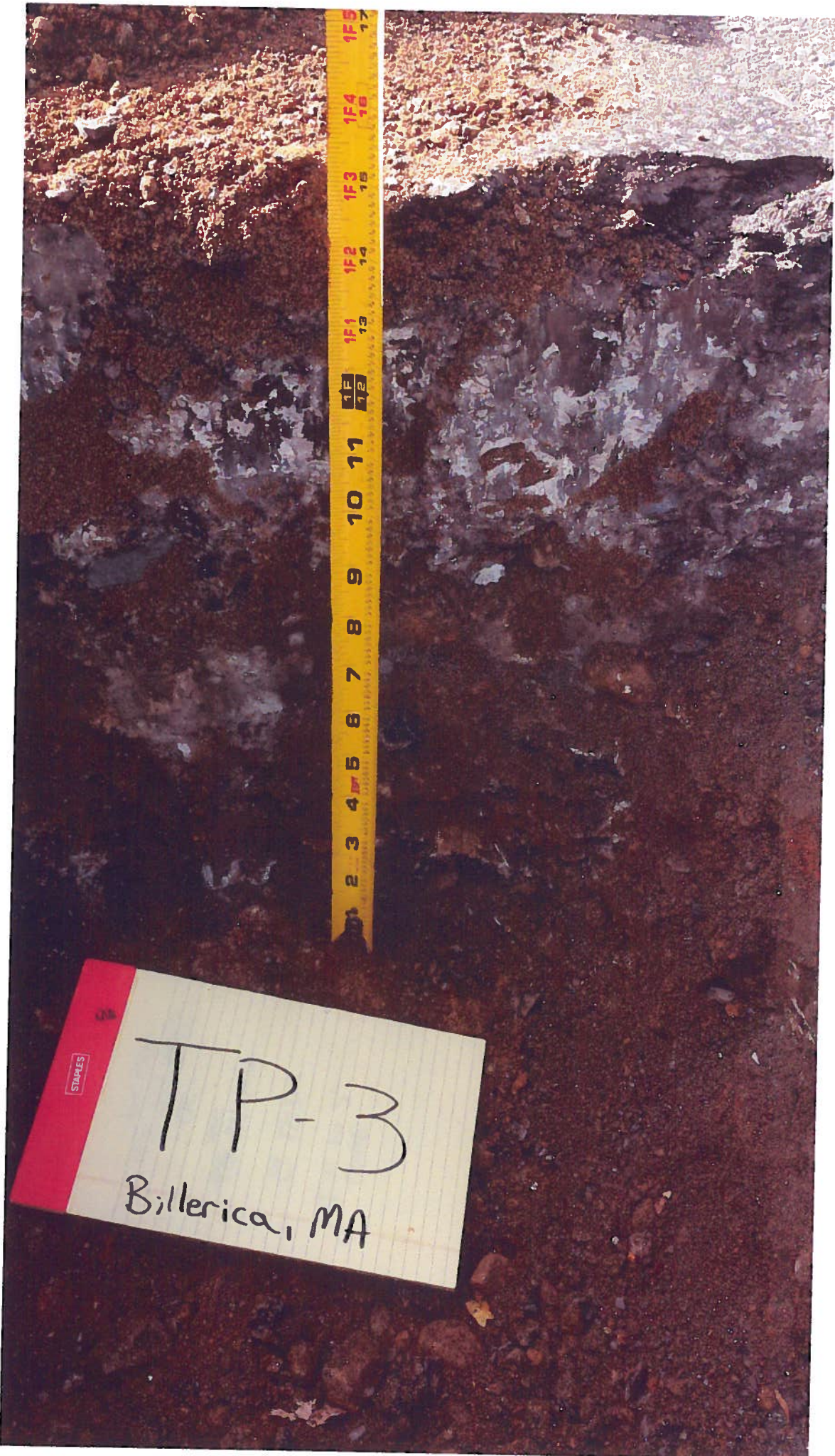


STAPLES
TP-3
Billerica, MA

TP-3

Billerica, MA





STAPLES
TP-3
Billerica, MA



Briggs Engineering & Testing
 A DIVISION OF PK ASSOCIATES, INC.

BETA Group, Inc.
 315 Norwood Park South, 2nd Fl.
 Norwood, MA 02062
 Attn: Mr. Michael P. Worhunsy, P.E.

Report Date: 12/8/14

Project: **Boston Rd/Billerica**
 Briggs #: 27968

Tested: 12/5/14
 Received: 11/18/14

1	<u>Sample No.</u> M-25085	<u>Description</u> Gravelly Sand	<u>Source of Material</u> Base/ TP #1
---	------------------------------	-------------------------------------	------------------------------------------

2. Sieve Analysis {ASTM C 136, and ASTM C 117}

Sieve Size		Results {% Passing by Wt.}	Specifications		
Standard	Alternate		M1.03.0 Gravel Borrow Type C	M1.03.1 Processed Gravel for Subbase	AASHTO M 145
100 mm	4"	100			
75 mm	3"	100			
63 mm	2-1/2"	100		100	
50 mm	2"	100			
37.5 mm	1-1/2"	98	100	70-100	
25 mm	1"	94			
19 mm	3/4"	90 *			
12.5 mm	1/2"	83		50-85	
9.5 mm	3/8"	76	50-85		
4.75 mm	#4	64 *	40-75	30-60	
2.36 mm	#8	50			
2.00 mm	#10	48			
1.18 mm	#16	41			
0.600 mm	#30	31			
0.425 mm	#40	26			
0.300 mm	#50	21	8-28		
0.150 mm	#100	13			
0.075 mm	#200	7.3	0-10	0-10	36 min.

3. Soils Classification {AASHTO M145}

A-1-a

4. The sample tested does conform to Specifications for "Gravel Borrow Type C."

*5. The sample tested does not conform to Specifications for "Processed Gravel for Subbase."

BRIGGS ENGINEERING & TESTING
 A Division of PK Associates, Inc.

Sean Skorohod
 Director of Testing Services
 Construction Technology Division

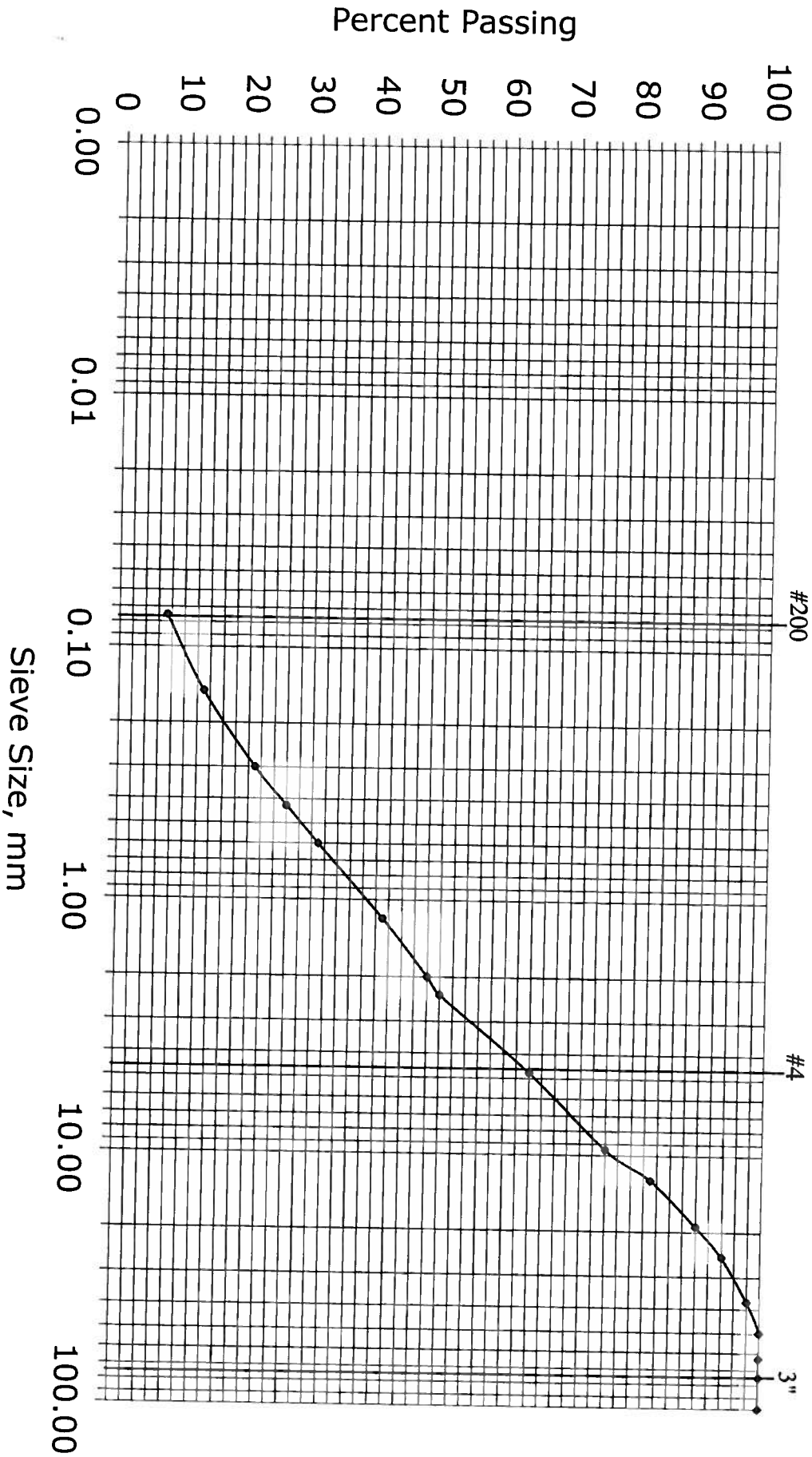
www.briggsengineering.com



Briggs Engineering & Testing
A Division of PK Associates, Inc.

Project:	Boston Rd/Billerica
Date Tested:	12/5/14
Lab Ref. No.:	M-25085

Sieve Analysis





Briggs Engineering & Testing

A DIVISION OF PK ASSOCIATES, INC.

BETA Group, Inc.
 315 Norwood Park South, 2nd Fl.
 Norwood, MA 02062
 Attn: Mr. Michael P. Worhunsky, P.E.

Report Date: 12/8/14

Project: **Boston Rd/Billerica**
 Briggs #: 27968

Tested: 12/8/14
 Received: 11/18/14

1	<u>Sample No.</u>	<u>Description</u>	<u>Source of Material</u>
	M-25086	Gravelly Sand	Base/ TP #2

2. Sieve Analysis {ASTM C 136, and ASTM C 117}

Sieve Size		Results	Specifications		
Standard	Alternate	{% Passing by Wt.}	M1.03.0 Gravel Borrow Type C	M1.03.1 Processed Gravel for Subbase	AASHTO M 145
100 mm	4"	100			
75 mm	3"	100		100	
63 mm	2-1/2"	100			
50 mm	2"	94 *	100	70-100	
37.5 mm	1-1/2"	88			
25 mm	1"	82			
19 mm	3/4"	78		50-85	
12.5 mm	1/2"	71	50-85		
9.5 mm	3/8"	66			
4.75 mm	#4	57	40-75	30-60	
2.36 mm	#8	46			
2.00 mm	#10	44			
1.18 mm	#16	35			
0.600 mm	#30	22			
0.425 mm	#40	17			
0.300 mm	#50	13	8-28		
0.150 mm	#100	8			
0.075 mm	#200	5.3	0-10	0-10	36 min.

3. Soils Classification {AASHTO M145}

A-1-a

*4. The sample tested does not conform to Specifications for "Gravel Borrow Type C."

5. The sample tested does conform to Specifications for "Processed Gravel for Subbase."

BRIGGS ENGINEERING & TESTING

A Division of PK Associates, Inc.

Sean Skorohod
 Director of Testing Services
 Construction Technology Division

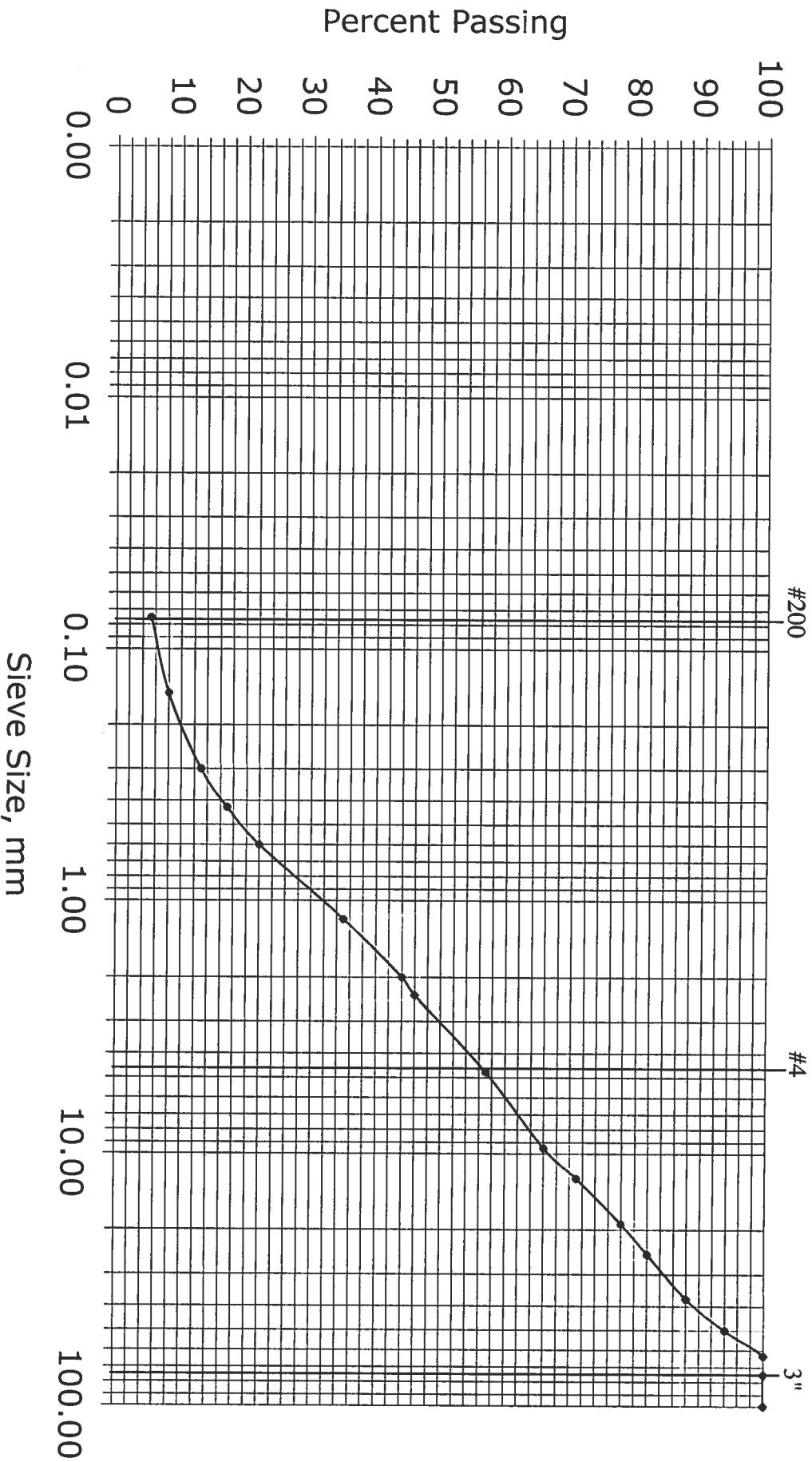
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Briggs Engineering & Testing
A Division of PK Associates, Inc.

Project:	Boston Rd/Billerica
Date Tested:	12/8/14
Lab Ref. No.:	M-25086

Sieve Analysis





Briggs Engineering & Testing

A DIVISION OF PK ASSOCIATES, INC.

BETA Group, Inc.
 315 Norwood Park South, 2nd Fl.
 Norwood, MA 02062
 Attn: Mr. Michael P. Worhunsky, P.E.

Report Date: 12/8/14

Project: **Boston Rd/Billerica**
 Briggs #: 27968

Tested: 12/5/14
 Received: 11/18/14

1	<u>Sample No.</u>	<u>Description</u>	<u>Source of Material</u>
	M-25087	Sandy Gravel	Base/ TP #3

2. Sieve Analysis {ASTM C 136, and ASTM C 117}

Sieve Size		Results	Specifications		
Standard	Alternate	{% Passing by Wt.}	M1.03.0 Gravel Borrow Type C	M1.03.1 Processed Gravel for Subbase	AASHTO M 145
100 mm	4"	100			
75 mm	3"	100		100	
63 mm	2-1/2"	100			
50 mm	2"	100	100	70-100	
37.5 mm	1-1/2"	94			
25 mm	1"	87			
19 mm	3/4"	81		50-85	
12.5 mm	1/2"	71	50-85		
9.5 mm	3/8"	61			
4.75 mm	#4	45	40-75	30-60	
2.36 mm	#8	36			
2.00 mm	#10	34			
1.18 mm	#16	28			
0.600 mm	#30	20			
0.425 mm	#40	17			
0.300 mm	#50	14	8-28		
0.150 mm	#100	8			
0.075 mm	#200	5.0	0-10	0-10	36 min.

3. Soils Classification {AASHTO M145}

A-1-a

4. The sample tested does conform to Specifications for "Gravel Borrow Type C."

5. The sample tested does conform to Specifications for "Processed Gravel for Subbase."

BRIGGS ENGINEERING & TESTING

A Division of PK Associates, Inc.

Sean Skorohod
 Director of Testing Services
 Construction Technology Division

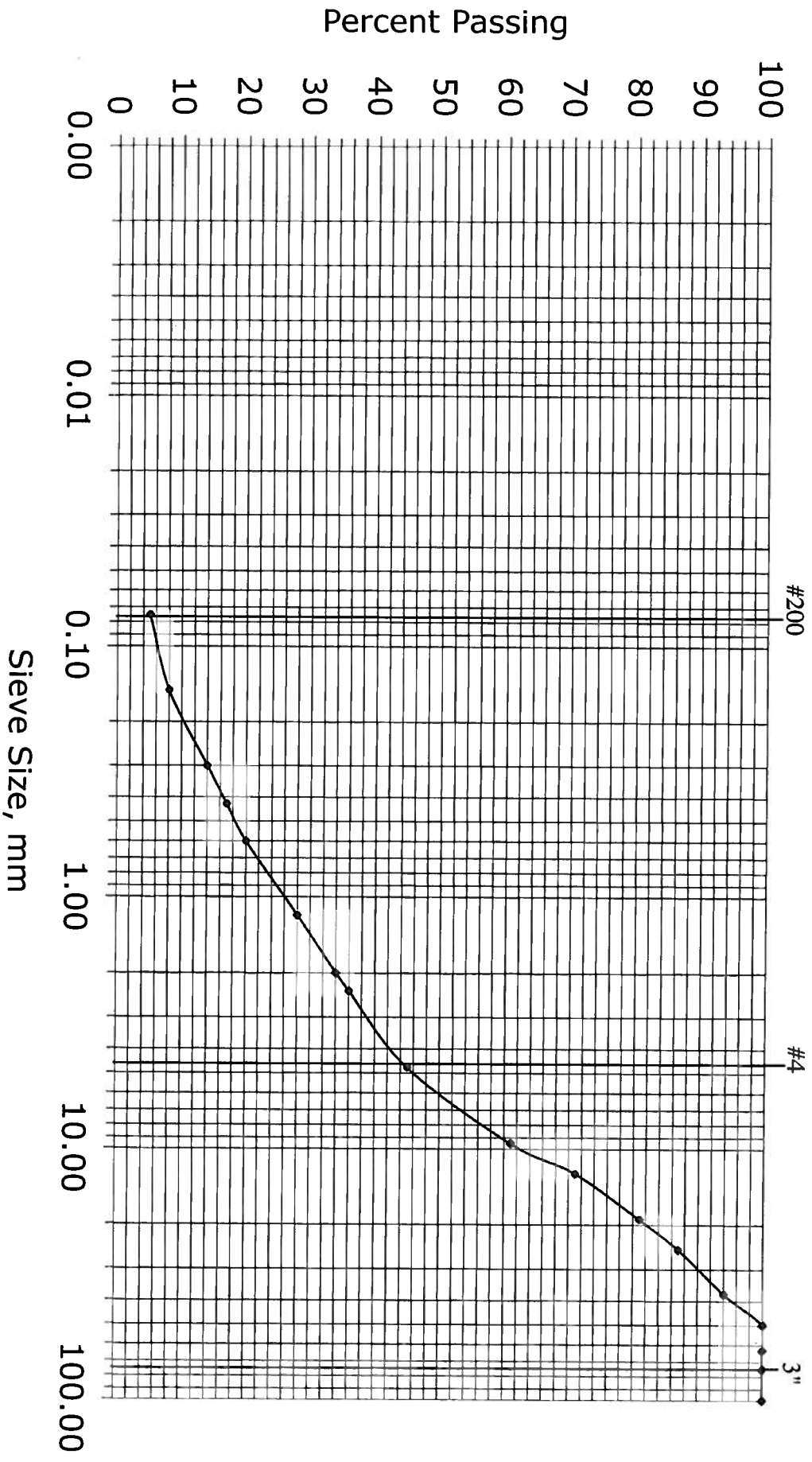
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A Division of PK Associates, Inc.

Project:	Boston Rd/Billerica
Date Tested:	12/5/14
Lab Ref. No.:	M-25087

Sieve Analysis





Briggs Engineering & Testing
A DIVISION OF PK ASSOCIATES, INC.

BETA Group, Inc.
 315 Norwood Park South, 2nd Fl.
 Norwood, MA 02062
 Attn: Mr. Michael P. Worhunsy, P.E.

Report Date: 12/8/14

Project: **Boston Rd/Billerica**
 Briggs #: 27968

Tested: 12/8/14
 Received: 11/18/14

1	<u>Sample No.</u>	<u>Description</u>	<u>Source of Material</u>
	M-25088	Gravelly Sand	Sub-Base/ TP #3

2. Sieve Analysis {ASTM C 136, and ASTM C 117}

Sieve Size		Results	Specifications		
Standard	Alternate	{% Passing by Wt.}	M1.03.0 Gravel Borrow Type C	M1.03.1 Processed Gravel for Subbase	AASHTO M 145
100 mm	4"	100			
75 mm	3"	100		100	
63 mm	2-1/2"	100			
50 mm	2"	98 *	100	70-100	
37.5 mm	1-1/2"	98			
25 mm	1"	92			
19 mm	3/4"	89 *		50-85	
12.5 mm	1/2"	82	50-85		
9.5 mm	3/8"	77			
4.75 mm	#4	67 *	40-75	30-60	
2.36 mm	#8	58			
2.00 mm	#10	56			
1.18 mm	#16	48			
0.600 mm	#30	38			
0.425 mm	#40	32			
0.300 mm	#50	27	8-28		
0.150 mm	#100	18			
0.075 mm	#200	12.3 *	0-10	0-10	36 min.

3. Soils Classification {AASHTO M145}

A-1-b

*4. The sample tested does not conform to Specifications for "Gravel Borrow Type C."

*5. The sample tested does not conform to Specifications for "Processed Gravel for Subbase."

BRIGGS ENGINEERING & TESTING
A Division of PK Associates, Inc.

Sean Skorohod
 Director of Testing Services
 Construction Technology Division

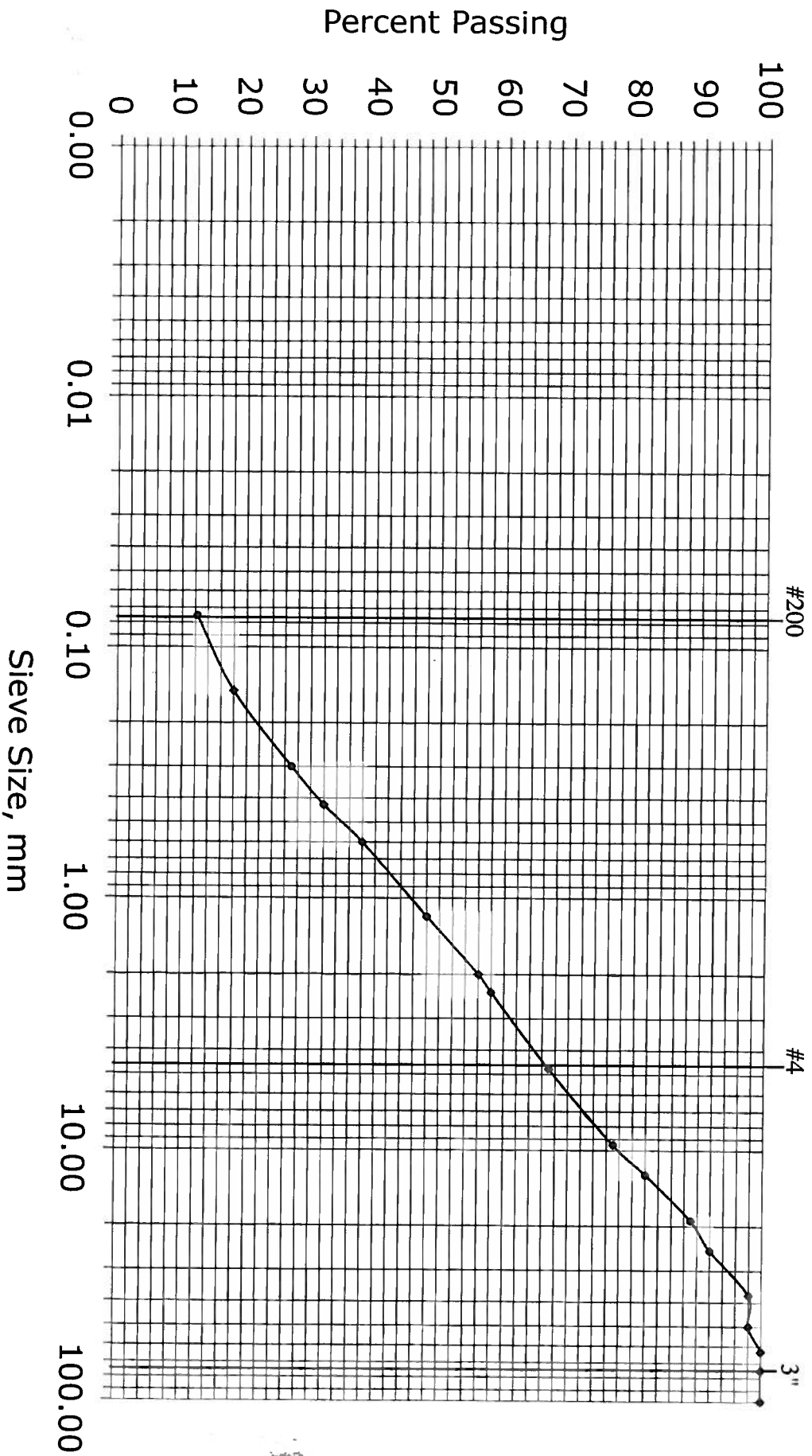
www.briggsengineering.com



Briggs Engineering & Testing
A Division of P.K. Associates, Inc.

Project:	Boston Rd/Billerica
Date Tested:	12/8/14
Lab Ref. No.:	M-25088

Sieve Analysis



APPENDIX D – BORING LOGS

Northern Drill Service, Inc.				Client: BETA Group, Inc.		Boring #
130 East Main Street, Northborough, MA 01532				Project: Boston Rd Mast Arms		B-1
TEL 508-393-6900 FAX 508-393-6901				Location: Boston Rd, Billerica, MA		Page 1 OF 1
File #:				CASING	SAMPLER	CORE BARREL
Date Started: 6/30/2021				TYPE	HW	S/S
Date Completed: 6/30/2021				SIZE	4"	2"
Driller: Justin Raymond				HAMMER		140
Site Rep.:				FALL		30"
				Ground Water level: 5.7'		
SAMPLE					Strata	
No.	Depth	Pen. In.	Rec. In.	Blows/6"	Change	SAMPLE DESCRIPTION
S-1	.5'--2.5'	24"	12"	8-7-5-5		S-1: Medium dense, dark brown silty fine sand some tan coarse sand, trace coarse gravel.
S-2	4'--6'	24"	12"	7-12-16-14		S-2: Medium dense, tan fine sand, little medium to coarse gravel, trace coarse sand.
S-3	9'--11'	24"	17"	10-11-13-16		S-3: Medium dense, tan fine sand, some medium to coarse gravel, trace coarse sand.
S-4	14'--16'	24"	10"	12-21-36-24		S-4: Very dense, gray fine sand, some medium to coarse gravel, some silt, trace coarse sand.
S-5	19'--21'	15"	6"	38-48-100/3"		S-5: Very dense, gray fine sand, some medium gravel, trace coarse sand. Glacial till
S-6	24'--26'	15"	4"	47-51-100/3		S-6: Very dense, gray fine sand, some coarse sand, some medium to coarse gravel.
						Bottom of Exploration = 25.5'

Cohesionless Density Blows/ft: 0-10 Loose 10-30 Medium-Dense 30-50 Dense 50+ Very Dense

Northern Drill Service, Inc.				Client: BETA Group, Inc.		Boring #
130 East Main Street, Northborough, MA 01532				Project: Boston Rd. Mast Arms		B-2
TEL 508-393-6900 FAX 508-393-6901				Location: Boston Rd, Billerica, MA		Page 1 OF 1
File #:				CASING	SAMPLER	CORE BARREL
Date Started: 6/25/2021				TYPE	HW	S/S
Date Completed: 6/25/2021				SIZE	4"	2"
Driller: Justin Raymond				HAMMER		140
Site Rep.:				FALL		30"
				Ground Water level: 4.5'		
SAMPLE					Strata	
No.	Depth	Pen. In.	Rec. In.	Blows/6"	Change	SAMPLE DESCRIPTION
S-1	0-2'	24"	16"	3-2-2-4		S-1: Loose, brown fine to medium sand, trace, medium to coarse gravel.
S-2	4'-6'	24"	14"	16-18-17-15		S-2: Dense, tan fine sand, some medium to coarse gravel, some silt, trace coarse sand.
S-3	9'-11'	24"	6"	11-14-11-9		S-3: Medium Dense, tan fine sand, some medium to large gravel. Little silt, trace coarse sand.
S-4	14'-16'	24"	12"	71-44-22-19		S-4: Very dense, gray coarse sand and medium to coarse gravel, some fine sand, trace silt.
S-5	19'-21'	15"	9"	34-48-100/3"		S-5: Very dense, gray fine to medium sand and medium to coarse gravel, trace fine sand.
S-6	24'-26'	0"	0"	100/0"		20.5'- 1' boulder S-6: Split spoon refusal- no recovery
						Bottom of Exploration = 26'

Cohesionless Density Blows/ft: 0-10 Loose 10-30 Medium-Dense 30-50 Dense 50+ Very Dense

Northern Drill Service, Inc.				Client: BETA Group, Inc.		Boring #
130 East Main Street, Northborough, MA 01532				Project: Boston Rd. Mast Arms		B-3
TEL 508-393-6900 FAX 508-393-6901				Location: Boston Rd, Billerica, MA		Page 1 OF 1
File #:				CASING	SAMPLER	CORE BARREL
Date Started: 6/28/2021				TYPE	HW	S/S
Date Completed: 6/28/2021				SIZE	4"	2"
Driller: Justin Raymond				HAMMER		140
Site Rep.:				FALL		30"
				Ground Water level: 5.5'		
SAMPLE					Strata	
No.	Depth	Pen. In.	Rec. In.	Blows/6"	Change	SAMPLE DESCRIPTION
S-1	0'-2'	24"	6"	6-3-6-7		S-1: Loose, brown medium to coarse sand, some small to medium gravel, trace fine sand.
S-2	4'-6'	24"	3"	35-19-14-18		S-2: Dense, gray/tan coarse sand and medium to coarse gravel. Trace fine sand. Strong petroleum odor.
S-3	9'-11'	24"	12"	14-11-12-13		S-3: Medium dense, gray fine sand, some tan coarse sand, trace silt.
S-4	14'-16'	23"	10"	26-45-66-100/5"		S-4: Very dense, gray fine sand, some coarse sand and coarse gravel, trace coarse sand.
						Bottom of Exploration = 15.5'

Cohesionless Density Blows/ft: 0-10 Loose 10-30 Medium-Dense 30-50 Dense 50+ Very Dense

Northern Drill Service, Inc.				Client: BETA Group, Inc.		Boring #
130 East Main Street, Northborough, MA 01532				Project: Boston Rd Mast Arms		B-4
TEL 508-393-6900 FAX 508-393-6901				Location: Boston Rd, Billerica, MA		Page 1 OF 1
File #:				CASING	SAMPLER	CORE BARREL
Date Started: 6/30/2021				TYPE	HW	S/S
Date Completed: 6/30/2021				SIZE	4"	2"
Driller: Justin Raymond				HAMMER		140
Site Rep.:				FALL		30"
				Ground Water level: 6.2'		
SAMPLE					Strata	
No.	Depth	Pen. In.	Rec. In.	Blows/6"	Change	SAMPLE DESCRIPTION
S-1	0'-2'	24"	20"	5-8-9-8		S-1: Medium dense, brown fine to medium sand, some medium to coarse gravel, trace fine sand.
S-2	4'-6'	24"	12"	3-6-9-13		S-2: Medium dense, grey fine sand, some coarse sand, trace coarse gravel, trace silt.
S-3	9'-11'	24"	18"	9-9-10-9		S-3: Medium dense, gray fine sand, some silt, trace coarse gravel, trace coarse sand.
S-4	14'-16'	5"	2"	100/5"	13'-15'	S-4: Very dense, tan coarse gravel, some fine sand, some silt. 13'-15': 2" boulder
C-1	17'-22'	60"	59"			C-1: RQD=59% Gray Sandstone
C-2	22'-27'	60"	60"			C-2: RQD= 96% Gray Sandstone/ white granite.
						Bottom of Exploration = 27'

Cohesionless Density Blows/ft: 0-10 Loose 10-30 Medium-Dense 30-50 Dense 50+ Very Dense

Northern Drill Service, Inc.				Client: BETA Group, Inc.		Boring #
130 East Main Street, Northborough, MA 01532				Project: Boston Rd. Mast Arms		B-5
TEL 508-393-6900 FAX 508-393-6901				Location: Boston Rd. Billerica, MA		Page 1 OF 1
File #:				CASING	SAMPLER	CORE BARREL
Date Started: 6/28/2021				TYPE	HW	S/S
Date Completed: 6/28/2021				SIZE	4"	2"
Driller: Justin Raymond				HAMMER		140
Site Rep.:				FALL		30"
				Ground Water level: 5.1'		
SAMPLE					Strata	
No.	Depth	Pen. In.	Rec. In.	Blows/6"	Change	SAMPLE DESCRIPTION
S-1	.5'-2.5'	24"	12"	6-8-8-4		S-1: Medium dense, brown fine to medium sand, some medium to coarse gravel.
S-2	4'-6'	3"	0	100/3"		S-2: No recovery. 1.5' boulder 4'-5.5'
S-3	9'-11'	24"	15"	11-12-11-16		S-3: Medium dense, tan fine to medium sand, some coarse gravel, trace silt.
S-4	14'-16'	24"	19"	16-25-24-32		S-4: Dense, gray fine sand, some silt, trace coarse gravel, trace coarse sand.
S-5	19'-21'	3"	2"	100/3"	19'	S-5: Very dense, gray coarse sand, some fine sand, some coarse gravel. weathered rock at 19', advance boring to 24'
S-6	24'-26'	8"	2"	32-100/2"		S-6: Very dense, gray coarse sand and coarse gravel. Trace fine sand. Decomposed rock.
						Bottom of Exploration = 24.5'

Cohesionless Density Blows/ft: 0-10 Loose 10-30 Medium-Dense 30-50 Dense 50+ Very Dense

Northern Drill Service, Inc.				Client: BETA Group, Inc.		Boring #
130 East Main Street, Northborough, MA 01532				Project: Boston Rd. Mast Arms		B-6
TEL 508-393-6900 FAX 508-393-6901				Location: Boston Rd. Billerica, MA		Page 1 OF 1
File #:				CASING	SAMPLER	CORE BARREL
Date Started: 7/1/2021				TYPE	HW	S/S
Date Completed: 7/1/2021				SIZE	4"	2"
Driller: Justin Raymond				HAMMER		140
Site Rep.:				FALL		30"
				Ground Water level: 6.2'		
SAMPLE					Strata	
No.	Depth	Pen. In.	Rec. In.	Blows/6"	Change	SAMPLE DESCRIPTION
S-1	0-2"	24"	7"	3-2-3-4		S-1: Loose, brown fine sand, some coarse sand, trace coarse gravel.
S-2	4'-6'	23"	8"	11-60-100/5"		S-2: Very dense, tan coarse sand and medium to coarse gravel, some fine sand.
S-3	9'-11'	24"	13"	21-19-90-100/3"		S-3: Very Dense, tan fine sand and medium to coarse gravel, some coarse sand, trace silt.
C-1:	12'-17'	60"	55"			C-1: RQD= 62% Gray Sandstone
C-2:	17'-22'	60"	60"			C-2: RQD= 72% Gray Sandstone
						Bottom of Exploration = 22'

Cohesionless Density Blows/ft: 0-10 Loose 10-30 Medium-Dense 30-50 Dense 50+ Very Dense

Northern Drill Service, Inc.				Client: BETA Group, Inc.		Boring #
130 East Main Street, Northborough, MA 01532				Project: Boston Rd. Mast Arms		B-7
TEL 508-393-6900 FAX 508-393-6901				Location: Boston Rd. Billerica, MA		Page 1 OF 1
File #:				CASING	SAMPLER	CORE BARREL
Date Started: 7-1-2021				TYPE	HW	S/S
Date Completed: 7-1-2021				SIZE	4"	2"
Driller: Justin Raymond				HAMMER		140
Site Rep.:				FALL		30"
				Ground Water level: 6.8'		
SAMPLE				Blows/6"	Strata Change	SAMPLE DESCRIPTION
No.	Depth	Pen. In.	Rec. In.			
S-1	0-2'	24"	12"	1-2-1-2		S-1: Loose, brown fine sand, some coarse sand, trace coarse gravel.
S-2	4'-6'	24"	19"	7-9-11-10		S-2: Medium dense, tan fine to medium sand, some medium to coarse gravel, trace coarse sand.
S-3	9'-11'	24"	9"	11-11-15-47	11'	S-3: Medium dense, tan coarse sand and trace fine sand. weathered rock encountered 11'.
C-1	13'-18'	60"	60"			C-1: RQD= 40%
C-2	18'-13'	60"	60"			C-2: RQD=65%
						Bottom of Exploration = 23'

Cohesionless Density Blows/ft: 0-10 Loose 10-30 Medium-Dense 30-50 Dense 50+ Very Dense

Northern Drill Service, Inc.				Client: BETA Group, Inc.		Boring #
130 East Main Street, Northborough, MA 01532				Project: Boston Rd. Mast Arms		B-8
TEL 508-393-6900 FAX 508-393-6901				Location: Boston Rd. Billerica, MA		Page 1 OF 1
File #:				CASING	SAMPLER	CORE BARREL
Date Started: 6/23/2021				TYPE	HW	S/S
Date Completed: 6/23/2021				SIZE	4"	2"
Driller: Justin Raymond				HAMMER		140
Site Rep.:				FALL		30"
				Ground Water level: 7.1'		
SAMPLE					Strata	
No.	Depth	Pen. In.	Rec. In.	Blows/6"	Change	SAMPLE DESCRIPTION
S-1	0-2'	24"	12"	13-4-4-3		S-1: Loose, brown fine to medium sand, some some small coarse gravel.
S-2	4'-6'	24"	18"	4-4-8-30	7'	S-2: M-Dense, tan fine to medium sand, Some coarse gravel, Trace coarse sand Boulder from 7'-10.5'.
S-3	10.5'-12.5'	5"	3"	100/5"		S-3: Very dense, tan fine sand, some silt, trace coarse sand, trace small coarse gravel. Top of rock 11.5'
C-1	13'-18'	60"	56"			C-1: RQD= 23% Light gray granite
C-2	18'-23'	60"	60"			C-2: RQD= 48% Light gray granite
						Bottom of Exploration = 23'

Cohesionless Density Blows/ft: 0-10 Loose 10-30 Medium-Dense 30-50 Dense 50+ Very Dense

Northern Drill Service, Inc.				Client: BETA Group, Inc.		Boring #
130 East Main Street, Northborough, MA 01532				Project: Boston Rd. Mast Arms		B-9
TEL 508-393-6900 FAX 508-393-6901				Location: Boston Rd. Billerica, MA		Page 1 OF 1
File #:				CASING	SAMPLER	CORE BARREL
Date Started: 6/25/2021				TYPE	HW	S/S
Date Completed: 6/25/2021				SIZE	4"	2"
Driller: Justin Raymond				HAMMER		140
Site Rep.:				FALL		30"
				Ground Water level: 5'		
SAMPLE				Blows/6"	Strata Change	SAMPLE DESCRIPTION
No.	Depth	Pen. In.	Rec. In.			
S-1	0-2'	24"	12"	5-5-3-3		S-1: Loose, brown fine sand, some coarse sand, some medium to fine gravel.
S-2	4'-6'	24"	18"	5-7-9-9		S-2: M-dense, tan fine sand, some silt, some medium to coarse gravel, trace coarse sand.
S-3	9'-11'	24"	12"	14-20-17-14		S-3: Dense, gray fine sand, some medium to coarse gravel, trace silt, trace coarse sand.
S-4	14'-16'	24"	9"	10-11-8-10		S-4: M-dense, tan fine to medium sand, some silt, trace coarse gravel.
S-5	19'-21'	0"	0"			S-5: 2' boulder from 19'-21'
S-6	24'-26'	2"	2"	100/2"		S-6: Very dense, gray weathered rock, some coarse sand.
						Bottom of Exploration = 25'

Cohesionless Density Blows/ft: 0-10 Loose 10-30 Medium-Dense 30-50 Dense 50+ Very Dense